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Improving Safety Programs Through Data Governance and Data Business Planning

A Peer Exchange

March 3–4, 2015
Washington, D.C.

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TRANSPORTATION RESEARCH CIRCULAR E-C196

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Standing Committee on Statewide Transportation Data and Information Systems
Standing Committee on Information Systems and Technology
Standing Committee on Geographic Information Science and Applications
Transportation Research Board

Supported by
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James P. Hall
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Preface

State departments of transportation (DOTs) are taking advantage of data from a variety of sources to improve planning, programming, and design of safety improvements. Bringing the right data together in useful forms for decision making requires careful planning, management, and coordination both within DOTs and between DOTs and external partner agencies. Data governance and data business planning are important strategies that state transportation agencies can use to maximize the effectiveness of data-driven decision making for safety and other key agency objectives. Data governance institutionalizes and assigns responsibilities for traditional data management practices focusing on data collection, storage, security, data inventory, analysis, quality control, reporting, and visualization. Data business planning helps agencies to align their data collection and management strategies with their business needs.

The TRB Committees on Statewide Transportation Data and Information Systems, Transportation Information Systems and Technology, and Geographic Information Science and Applications hosted a peer exchange on March 3–4, 2015, in Washington, D.C., to explore effective data governance and data business planning solutions for safety applications. Participants explored both technical and organizational factors and identified priority research needs. Ten state transportation agencies were selected for participation based on their progress toward and interest in data governance and safety data business planning: Alaska, Idaho, Iowa, Louisiana, Maryland, Michigan, Montana, Ohio, Rhode Island, and Washington State.

A total of 15 state agency representatives and 11 individuals from federal agencies, universities, and the private sector participated in the peer exchange. State transportation agency participants represented safety, data management, planning, geographic information systems, information technology, and executive business process areas. A planning group chaired by Jack Stickel of the Alaska Department of Transportation and Public Facilities (DOT&PF) carried out the detailed planning for the peer exchange. This e-circular was prepared by James P. Hall of the University of Illinois at Springfield as a factual summary of the event. The views contained in this e-circular are those of individual peer exchange participants and do not necessarily represent the views of all participants, the planning team, the sponsoring committees, or TRB.

Before the peer exchange, state agency participants completed comprehensive questionnaires on their current practices and concerns in safety data governance, data management, and data integration. For safety program and project decision-making activities, data governance and data integration from multiple data sources are critical.

In general, although agencies identified multiple ongoing data management practices, most states do not have an institutionalized, organizationwide data governance process with defined organizational responsibilities. Several of the states have institutionalized their data governance efforts into a Data Governance Council (Michigan) or a Data Governance Committee (Iowa and Ohio). Washington State is in the process of establishing an Enterprise Information Governance Group.

At the peer exchange, attendees focused on four major themes:

1. The business case for data governance,
2. Essential elements of data governance,
3. Operationalizing data governance at a DOT, and
4. Using data governance to advance data sharing and integration.

Much discussion centered on the importance of data governance in the context of the changing state DOT organization. Transportation agencies are moving rapidly to a culture of information delivery, not just infrastructure, with a greater emphasis on open and transparent data. Executive commitment is important to articulate the importance of data governance across the organization; however, executives also need assistance in making the case.

Other discussion topic areas included: the actual benefits and value of data governance programs, essential data governance roles, strategies for operationalizing data governance in constrained environments, and successful techniques for data coordination and collaboration both across organizational silos and between DOTs and external safety partners.

Participants then developed six research needs statements:

1. Determining Metrics for Successful Data Governance;
2. Peer Exchange on Executive Perspective on Managing Transportation Data and Information as an Asset;
3. Essential Elements of Data Integration to Drive Business Decisions in Transportation Agencies;
4. Data Governance in the Context of Centralized Information Technology;
5. Crash Data Life-Cycle Practices; and
6. The Effect of Location Accuracy on Safety Data Analysis: A Case for Data Governance.

Funding provided by the FHWA Office of Safety to support this event is gratefully acknowledged.

Background, Objectives, and Discussions of the Improving Safety Programs Through Data Governance and Data Business Planning Peer Exchange

JACK STICKEL
Alaska Department of Transportation and Public Facilities

JAMES P. HALL
University of Illinois at Springfield

FRANCES HARRISON
Spy Pond Partners, LLC

This peer exchange was organized by TRB's Committees on Statewide Transportation Data and Information Systems, Transportation Information Systems and Technology, and the Geographic Information Science and Applications. The FHWA Office of Safety funded the peer exchange.

BACKGROUND

The Moving Ahead for Progress in the 21st Century Act (MAP-21) establishes a performance- and outcome-based transportation program for safety, infrastructure condition, congestion reduction, system reliability, freight movement, environment sustainability, and reduced project delivery delays. MAP-21 identifies safety as a national goal area, with strong emphasis on data programs and data systems for collecting, analyzing, and managing safety data. For example, state highway agencies are to submit a geospatially enabled roadway network or base map for all public roads which will result in the All Roads Network of Linear referenced Data (ARNOLD). States also should collect the Model Inventory of Roadway Elements (MIRE) fundamental data elements (FDE) on all public roads as soon as possible. Implementing data governance and data business planning can improve the overall agency's data programs and help meet the MAP-21 requirements by

- Documenting the data processes and goals;
- Aligning data programs with the national and agency strategic goals; and
- Developing a long-range structure for data programs.

Collecting, storing, and maintaining quality safety data is the cornerstone for highway safety data programs' expansion of analysis and evaluation capabilities. Data governance principles can promote collaboration, consistency, and efficiency in safety data collection, acquisition, organization, and dissemination. Data management, data governance, and data business planning are often used interchangeably or as components of one another. *NCHRP Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies* defines

- **Data Management** as "the development, execution, and oversight of architectures, policies, practices, and procedures to manage the information lifecycle needs of an enterprise ….as it pertains to data collection, storage, security, data inventory, analysis, quality control, reporting, and visualization;" and
- **Data Governance** as "the execution and enforcement of authority over the management of data assets and the performance of data functions."

This peer exchange focused on improving state transportation agency highway safety programs to meet the national goals through the effective implementation of data governance and a formal data business planning process.

A good baseline exists for data governance from the information technology (IT) and geographic information system (GIS) fields. States have started developing data business plans and implementing data governance structures to manage their data programs. Noteworthy safety data practices and safety data analysis tools are available on the FHWA website. The challenge now is how to effectively deploy data governance to boost safety data program capabilities within a DOT. Key needs include demonstrating how proper data governance can help improve safety data programs, how these will work in the organization, and how to implement data governance across the agency. Additionally, there is a need to identify current best practices for overcoming existing barriers using data business planning for safety data within a DOT.

The linkage between safety and other DOT data programs is well established. The MIRE FDE provides a recommended listing of roadway inventory and traffic elements critical to safety management. There is a substantive relationship between safety and asset management. Traffic data is integral to many safety tools and programs, e.g., the Highway Safety Improvement Program (HSIP). Weather Responsive Traffic Management (WRTM) integrates traffic and weather data for a safety and mobility evaluation. Implementing a comprehensive data business planning process for all transportation data programs will improve data dissemination and, in the long run, can lead to achievement of the agency's safety improvement objectives.

PEER EXCHANGE OBJECTIVES

The objective of this peer exchange was to bring together the FHWA Office of Safety, AASHTO safety entities, and state DOT representatives from management, safety, statewide data, GIS, and IT to discuss data governance and data business planning solutions that can improve the agency capabilities response to meeting DOT and national safety requirements. Peer participants explored data governance and data business planning solutions for improving safety data and shared best practices on implementing data governance Attendees also explored both technical and organizational factors and identified possible research needs. The peer was held March 3–4, 2015, in Washington, D.C.

Invited state agency participants prepared advance reports highlighting their current practices, successes, and implementation challenges in safety data governance and data business planning. A summary of the state reports was presented at a webinar on February 15, 2015. The FHWA Office of Safety, Alaska DOT&PF, Idaho DOT, and Michigan DOT also presented on this topic at a session at the 94th Annual Meeting of the Transportation Research Board in 2015.

A major product of the peer is this TRB e-circular which outlines possible research initiatives to advance the state of the practice. In addition, a future webinar on the results of the peer exchange is planned for delivery through AASHTO.

PEER EXCHANGE PARTICIPANTS

In 2014, a Peer Exchange Planning Committee was formed to determine the objectives of the peer exchange and to administer pre-peer activities. The Planning Committee consisted of the following members:

Planning Committee

- Jack Stickel, Alaska DOT&PF, *Chair*;
- James Hall, University of Illinois at Springfield;
- Kelly Hardy, AASHTO;
- Frances Harrison, Spy Pond Partners;
- Ray Krammes, FHWA;
- Nancy Lefler, VHB;
- Jim Mitchell, Louisiana Department of Transportation and Development (DOTD);
- Gregory Slater, Maryland DOT, State Highway Administration (SHA);
- Stuart Thompson, FHWA;
- Ida van Schalkwyk, Washington State DOT;
- Ron Vibbert, Michigan DOT; and
- Penelope Weinberger, AASHTO.

TRB Staff

- Thomas M. Palmerlee,
- Bernardo Kleiner, and
- Michael Miller.

The Planning Committee identified and selected 10 state transportation agencies for participation in the peer exchange based on their progress and interest in safety data governance and data business planning. The participating state transportation agencies were

- Alaska DOT&PF,
- Idaho Transportation Department (ITD),
- Iowa DOT,
- Louisiana DOTD,
- Maryland DOT, SHA,
- Michigan DOT,
- Montana DOT,
- Ohio DOT,
- Rhode Island DOT, and

- Washington State DOT.

Individual transportation agency representatives and other participants were selected to provide a wide range of backgrounds and skill sets including agency executives, safety analysts, enterprise data architects, data managers, GIS specialists, safety data leads, asset managers, planners, performance managers, and business analysts. Ultimately, a total of 15 state agency representatives and 11 additional federal, university, and private agency representatives participated in the peer exchange. The following is a listing of the 26 peer exchange participants:

Name	**Organization**
Mike Bousliman	Montana DOT
Nancy Boyd	Washington State DOT
Clint Farr	Alaska DOT&PF
Steve Gent	Iowa DOT
James Hall	University of Illinois at Springfield
Kelly Hardy	AASHTO
Frances Harrison	Spy Pond Partners, LLC
Brent Jennings	ITD
Bernardo Kleiner	TRB
Steve Kut	Rhode Island DOT
Nancy Lefler	VHB
Erin Lesh	Maryland DOT, SHA
James Mitchell	Louisiana DOTD
Michael Miller	TRB
Tom Palmerlee	TRB
Robert Pollack	FHWA
Sean Raymond	Rhode Island DOT
John Selmer	Iowa DOT
Jack Stickel	Alaska DOT&PF
Rob Surber	Michigan DOT
Stuart Thompson	FHWA
Derek Troyer	Ohio DOT
Ida van Schalkwyk	Washington State DOT
Anita Vandervalk	Cambridge Systematics
Ron Vibbert	Michigan DOT
Penelope Weinberger	AASHTO
David Winter	FHWA

STATE TRANSPORTATION AGENCY QUESTIONNAIRES

State agencies completed a questionnaire before the Peer Exchange. The questionnaire explored the agencies' current practices and experiences in data governance, data management, data integration, and roadway and safety data assessments. The questionnaire also queried their current issues and concerns in these areas.

The following lists the questions that were posed to the state transportation agencies. The summary of responses for each state agency and each agency's detailed response is included in the chapter Full Text of State Questionnaire Responses: Peer Exchange Questions in this e-circular.

Questionnaire Instructions and Background Information

Please refer to the Highway Safety Terms document (Appendix B) for definitions of data governance terms, highway safety terms and the NHTSA Traffic Records Program Assessment.

This peer was particularly focused on safety-related data. In addition to crash information, safety data includes data that safety personnel need in order to analyze crashes, identify contributing factors, propose countermeasures, and then evaluate the effectiveness of the countermeasures. At the very least, roadway, traffic volume and crash data are necessary in an integrated environment. Ideally such an integrated dataset would include assets (signs, bridges, culverts, traffic barriers, etc.), facility-related information (transit stops, sidewalks, bicycle lanes, etc.), and maintenance data (winter maintenance–snowplowing activity, and amounts of sand and chemicals used on the roadway). Another component is real-time data. This includes, but is not limited to, Road Weather Information System (atmospheric, pavement, subsurface, camera images), 511 traveler information, and traffic (travel time, congestion). Additional elements are identified in MIRE.

Part A. Data Governance

1. Has there been any formal effort in your agency to identify policy, planning, and research needs for improvements to data for safety programs, and integrating safety into project development? If so, please describe. For the purpose of this question, safety programs refer to activities related to network screening or identification of locations or corridors that would most likely benefit from investment, analysis of contributing factors to crashes at the identified locations, identification and evaluation of countermeasures, economic valuation of alternative countermeasures, and evaluation of implemented safety projects.
2. Are data governance and data business planning activities discussed as part of your agency's involvement with the Traffic Records Coordinating Committee (TRCC)? Explain representation on the committee and subcommittees; and specific activities supporting the data needs for the DOT safety program.
3. Data sources and streams—who in your agency is responsible for collecting and managing:
    a. Roadway data (basic cross-section information that includes lane widths, shoulder widths, and median width);
    b. Crash data from the crash reports for reportable motor vehicle crashes;

c. Traffic volume data [including preparation of the estimated traffic volume information for the Highway Performance Monitoring System (HPMS) and managing short term traffic count data];

d. Asset data (bridge, pavement, signage, and other asset datasets);

e. Maintenance data; and

f. Data related to incidents on major corridors (this may be incident response datasets or data from traffic management centers).

4. State safety program and related activities—who in your agency is responsible for

a. Safety analysis for the state Strategic Highway Safety Plan (SHSP) development and monitoring;

b. Safety analysis for identifying potential locations or corridors for further evaluation or for investment (e.g., network screening);

c. Analysis of contributing factors of crashes at given locations or for corridors;

d. Identification and evaluation of countermeasures (including performing an economic valuation of alternative countermeasures); and

e. Performing predictive analysis as described in the *Highway Safety Manual* (HSM).

5. General data-related questions—who in your agency is responsible for

a. Making decisions about what data to collect in order to support the safety program or integration of safety into project development;

b. Recommending and championing investments in safety data improvements;

c. Developing safety data collection requirements or specifications;

d. Working with individuals or groups that perform safety analysis to understand their data needs and concerns;

e. Monitoring and improving safety data quality; and

f. Ensuring and improving integration across different data sources in order to support the safety program, and integration of safety into project development?

6. Do you have formally defined roles for data governance in your agency? If so, please describe the roles and an organizational chart.

7. Do you have an agencywide data governance body? If so, can you provide more information (such as handouts) to explain how it works?

8. Do you have a data governance body that specifically focuses on data for safety in the DOT? If so, explain how it works.

9. Have your safety data workflows been analyzed and mapped? Please provide an example.

10. Have your data business rules been documented to facilitate safety data processing, quality assurance, interpretation, and use and to ensure continuity with staff turnover?

11. Have common geospatial and linear reference-based systems (LRS) been established for

a. Roadway data (basic cross-section information that includes lane widths, shoulder widths, and median width);

b. Reportable motor vehicle crashes on all public roads in the state;

c. Traffic volume data;

d. Asset data: bridge, pavement, signage, and other asset datasets;

e. Maintenance data; and

f. Incidents on major corridors.

12. Do the systems listed in no. 11 integrate with the LRS mandated for HPMS and for ARNOLD (http://www.fhwa .dot.gov/policyinformation/hpms/arnold.cfm)?

13. Have service level agreements (SLAs) been established for data timeliness, accuracy, completeness, consistency–uniformity, and accessibility been implemented? If so, in what areas?

14. Have the roles, responsibilities, and accountability for data stewards and data owners been codified (e.g., in job positions)? If so, for what areas?

15. What cultural and institutional issues exist that may inhibit implementing a data governance program that would support the safety program, and integration of safety into project development?

Part B. Data Management

This section relates specifically to crash and roadway data.

1. Do you have a process and system for archiving location referencing and historical road inventory data? If so, please describe your process, and how you utilize this archived information. Can the archives be used to accurately locate historical crash information? Are there any problem areas?
2. Are there established procedures to review and inventory available data, e.g., a data registry?
    a. Have the data sets critical to safety data programs been identified and catalogued?
    b. How are the procedures implemented?
    c. Are new data sets evaluated using a structured process or an ad hoc analysis?
3. Are safety-related data collection and management plans, metadata, and standards in place?
    a. Do you maintain a safety data model?
    b. Do you maintain safety data dictionaries?
    c. Do you maintain standard metadata about your safety-related data sets?
    d. Are database business rules established and who establishes them?
    e. Who is responsible for keeping safety-related data models, data dictionaries, and metadata updated?
    f. Have data migration, integration, and archiving business rules been established?
4. Are all reportable crashes (including local) captured in an electronic data system? Are they all spatially referenced?
5. How are network screening business intelligence tools used to automate current manual practices for safety-related decision making? (Examples: HSM, tools, others?)

Part C. Data Governance: Integration

1. Have linkages between roadway, crash, injury surveillance, citation, road weather, health records, and other data systems been established? How well are the linkages working? (Examples: production server linkage, manual integration.)
2. How have crash records been integrated with other agency data in support of programs outside of the crash records and analysis function, e.g., transportation asset management (TAM), performance management, project scoping–preconstruction?
    a. What safety data integration efforts have been most successful?

b. What integration initiatives have been less successful and why?

3. Does your agency make use of design or as-built plans to update road network geometry–GIS? If so, describe your process, and any benefits it has had for improving crash analysis?

4. What data access and visualization techniques are being used to facilitate the application of safety data for decision making for

a. The safety program, and

b. Elements in the project development process? Please provide examples.

Part D. Program Assessment

1. Have there been efforts [e.g., Roadway Safety Data Program (RSDP), Roadway Data Improvement Program (RDIP), traffic records assessment] to evaluate your safety data management practices, e.g., with a capability maturity model or other type of program self-assessment? What value have these efforts provided? Does your agency also conduct its own internal self-assessment? What specific actions have resulted from these assessments to improve data management?

2. What procedures are in place to identify risks, gaps, and overlaps in data collected, managed and used in the DOT safety programming activities and the project development process?

3. Are there processes in place for data users to assess the quality of your safety-related data and communicate this information to data stewards?

4. How do you prioritize DOT safety data needs? Do you perform a risk analysis?

Part E. Closing

1. What would motivate your agency to implement a comprehensive data business planning process for the DOT?

2. What safety-related business process areas would benefit the most?

3. What questions do you have for your peers regarding improving safety programs through data governance and data business planning?

PEER EXCHANGE STRUCTURE AND DISCUSSIONS

Introductory Remarks

Jack Stickel, peer exchange planning team chair and the Alaska DOT&PF Enterprise GIS Manager, welcomed the participants. He thanked them for their efforts in identifying the state of the practice prior to the peer and he encouraged attendees to participate actively in the peer, discussing the successes and challenges they had experienced in data governance and data business planning. He reiterated the anticipated products of the peer exchange which included publication of the e-circular, peer exchange analysis of peer focus areas, and the identification of possible research issues to develop draft statements of possible research needs. Stickel also discussed dissemination approaches of results to state DOTs, including an AASHTO webinar, and approaches to achieving data governance sustainability.

Tom Palmerlee and Bernardo Kleiner discussed the role of TRB in committee facilitation to move research forward focused on the needs of transportation agencies. They thanked the FHWA Office of Safety for providing funding for the peer exchange.

Motivation for the Peer Exchange: FHWA Office of Safety Perspective
Stuart Thompson, FHWA

MAP-21 calls for advancing the capabilities of states for safety data collection, integration, and analysis to support program planning and performance management and continues to support data improvement activities as an eligible HSIP expense. MAP-21 acknowledges the importance of using multiple data sources to understand highway safety problems and to make effective decisions regarding resource allocation for highway safety. To do this, state safety data systems should be sufficient to guide the HSIP and SHSP processes, analyses, and evaluations.

Consistent with the purpose and scope of the HSIP, MAP-21 requires that a state have in place a safety data system to perform safety problem identification and countermeasure analysis. The statute also specifies that a state shall advance the capabilities of the state for data collection, analysis, and integration in a manner that includes all public roads, including non-state–owned public roads and roads on tribal land in the state. Public road means "any road under the jurisdiction of and maintained by a public authority and open to public travel."

FHWA completed a national Roadway Safety Data Program Capabilities Assessment (RSDPCA) and accompanying report on July 31, 2012. The objectives of this project were: assess state's roadway safety data capabilities, identify critical gaps and potential solutions to achieve data goals, and advance the state of practice for data-driven highway safety planning. The assessment focused on four areas in each state:

- Roadway inventory data collection–technical standards;
- Data analysis tools and uses;
- Data management; and
- Data interoperability and expandability.

Results from the RSDPCA provided a snap shot of each state's capabilities in these four categories. Additionally each state was invited to send a representative to one of four regional peer exchanges to further discuss their needs and ways FHWA could assist in improving their safety data capabilities. As documented in the Perspective for the Development of the Roadway Safety Data Program report (http://safety.fhwa.dot.gov/rsdp/perspectives_rpt.aspx), needs related to data management included

A. Developing a reference for states to integrate data from various agencies and move towards a modern relational database with a comprehensive data clearinghouse for centralized and decentralized structures.

B. Providing a reference to include pilots and case studies for state DOT leaders to understand how highly ranked data management states use data governance and data management through a strong IT-driven data governance process or alternative means.

C. Developing a common glossary of terms can assist safety professionals to understand IT terminology and vice versa.

D. Providing a reference for state DOTs to understand the benefits of how to use data management documentation to retain institutional knowledge, practices, organizational structures, etc.

E. Developing a reference for state DOTs that includes talking points and training webinars on data sharing expectations for roadway safety data for the public and between stakeholders.

F. Developing and implementing performance measurement models where systemwide performance is monitored.

G. Conducting model pilots and case studies on data quality management from highly ranked data management states.

Motivation for the Peer Exchange: Office of Highway Policy Information Perspective
David Winter, Director, FHWA Office of Highway Policy Information

FHWA is making progress on improving its own data programs. In December 2012, FHWA formed a Data Governance Advisory Council. One of the goals is to develop a Data Governance Plan. The first volume is done and should be released soon. The next phase is to develop an Enterprise Architecture (EA) Plan. FHWA has determined the current state and they are working on the future vision of the EA with an action plan. FHWA is also working on the metadata component, some of which is required by the Office of Management and Budget for governmentwide open data initiatives such as data.gov. FHWA is also developing a process to build a consolidated data dictionary. A major challenge is consolidating across the data dictionaries of different transportation business process areas.

James Hall then provided a summary of the state reports which is included in the next chapter of this e-circular.

BREAKOUT SESSIONS

Frances Harrison served as the moderator for the peer breakout sessions. The purpose of the breakout sessions was to form groups to review data governance focus areas, identify important points for dissemination, and describe potential research needs and other actions to advance the state of the practice. Based on the state reports, the Peer Planning Committee identified four focus areas for the breakout sessions:

1. Business Case for Data Governance;
2. Essential Elements of Data Governance;
3. Operationalizing Data Governance at a DOT; and
4. Using Data Governance to Advance Data Sharing and Integration.

Prior to the breakout sessions, several state agencies presented their activities and interest on a particular focus area theme to the full group. Peer participants, based on their requested preference, were assigned to specific focus areas. Breakout sessions for Focus Areas A and B were held in the morning and Focus Areas C and D were in the afternoon.

Breakout group facilitators then reported the discussions of the breakout sessions to the full group.

The following summarizes discussions for each of the four breakout sessions.

Focus Area A: Business Case for Data Governance
Nancy Lefler, VHB, Facilitator

Idaho Department of Transportation Perspective
Brent Jennings and Shannon Barnes

Brent Jennings presented on the approach Idaho is employing towards going to the next level of data governance. There are many data sources, however, data access and use is limited by lack of data resource knowledge, data inaccessibility, lack of data understanding, and inability to apply data to decision-making activities. The purpose of data governance is to

- Support the agency's strategic plan;
- Integrate with gateway plans and projects;
- Work efficiently to create systematic analysis;
- Create innovate partnerships;
- Support performance measures; and
- Support data-based investments.

Data governance also helps enable agency business intelligence functions such as business process engineering, data analytics, benchmarking, and reporting. A data warehouse will help ensure relevant data is accessible across the organization but implementation is a difficult task with incremental steps. To get started, it is important to work together to leverage resources for funding and personnel, to understand that managing information as a strategic tool is critical to achieving goals and objectives, and to recognize that business process perspectives are important in moving from design to implementation. For implementation, an effective approach is to start with a few pieces of the puzzle and build upon success.

Rhode Island DOT Perspective
Sean Raymond and Steve Kut

Rhode Island identified the following benefits of data governance programs:

- Increase in staff productivity and labor cost savings;
- Revenue increases;
- Reduction in duplication and redundancy;
- Asset management functional improvements;
- Support for economic and business development initiatives;
- Avoidance of new costs;
- Savings in capital project design;
- Savings in infrastructure maintenance and design; and
- More effective management–allocation of field services.

Negative consequences from ineffective data management are significant costs resulting from ineffective decision making, data redundancy (with risks from conflicting data), and

duplication of effort across the organization. The department hopes to solve the following problems by implementing data governance to

- Eliminate information-sharing barriers;
- Eliminate data silos;
- Improve internal–external reporting;
- Reduce costs throughout the organization;
- Develop business data standards and policies;
- Improve records management; and
- Improve communication between agencies–departments.

Rhode Island DOT completed a Crash Data Improvement Program (CDIP) in 2013 which recommended that crash records be referenced to a centralized LRS with improvements to Rhode Island DOT's online crash analysis and reporting system. The department is in the process of creating the centralized statewide LRS while collecting nearly all MIRE elements for all 6,500 mi of public roads. An RDIP in 2014 recommended the establishment of a Data Governance Committee. Rhode Island has a Local–State Data Integration for Asset Management and Safety Analysis Project in development. Through a web portal, local and regional governments can actively participate in the maintenance of the road network.

Rhode Island DOT also has an Every Day Counts 4D Modeling initiative in progress, which is updating computer aided design (CAD) design standards to interact with GIS system. This effort will also establish processes and workflows to automate data integration and maintenance of business data. The Roads and Highways Road Characteristic Editor provides a web portal that can be configured to provide access to local–regional government.

Business Case for Data Governance: Breakout Session Discussion

The following summarizes the breakout group discussion on Focus Area A: Business Case for Data Governance. Initial questions posed to the participants were:

- What is the actual, demonstrated value or benefits of data governance programs?
- What are the negative consequences of not having a data governance program?
- What are the problems agencies are trying to solve by implementing data governance?
- How should the success or progress of a data governance group be measured?

Discussion first centered on the difficulties in determining the value of effective data governance. The accessibility of quality information to decision makers is a key benefit. Data can support performance measure assessments and justify data-based investments. Data governance value can also result from cost avoidance and risk reduction. Without data governance, the agency cannot perform proper quality checks on the data.

Data value goes beyond return on investment. Given the rise in mobile devices, there is a rapidly increasing public expectation of accessibility to transportation information across modes. As a result, transportation agencies are at risk if this information is not available. Open data can also result in value to stakeholders such as traveling public, business–commerce, and the legislature.

Executive commitment is important to articulate the importance of data governance across the organization. However, executives need assistance in helping to make the case. The term "data governance" can also have a negative connotation. There is a need for a more-positive message of managing data resources as part of knowledge management and with an emphasis on agency value.

Much discussion centered on the changing state DOT organization. Transportation agencies are rapidly moving to a culture of information delivery, not just infrastructure. There is a greater emphasis on open and transparent data. Technology has changed rapidly over the last 10 years but organizational processes have not kept up. Although information requests have grown, information sources often remain silo based with a reluctance to share data. Internal and external data sharing requires metadata information on the source, content, and quality of the data in standardized formats.

Implementation of data governance practices are challenging for a variety of reasons. Each state transportation agency has a unique culture and distinctive characteristics in the way their data systems have evolved. Organizational responsibility for data governance varies across agencies. There is a need for cost-neutral approaches where data governance costs are balanced by increased efficiencies or revenue sources. Value could also arise from incentive budget planning.

There is a need to provide examples of data governance in transportation agencies and to tell stories of effective data governance practices and the resultant use of quality data to improve decisions and processes and to address risks.

Focus Area B: Essential Elements of Data Governance
Kelly Hardy, AASHTO, Facilitator

Alaska DOT&PF Perspective
Jack Stickel

Jack Stickel presented a summary of best practices and strategies for beginning transportation data governance from two TRB papers: Data Business Plans and Governance Programs: Aligning Transportation Data to Agency Strategic Objectives (J. R. Stickel and A. Vandervalk. Presented at 93rd Annual Meeting of the Transportation Research Board, Washington, D.C., 2013) and Transportation Agency Data Governance Programs: Getting Started Toward Sustainability (J. R. Stickel and J. Sullivan. Presented at 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2014). The presentation covered the relationship between data management and governance, and the importance of establishing a vision, goals, and data governance principles. From a safety perspective, key elements are to integrate core data systems to embrace vital safety initiatives.

Steps that should be considered when starting a data governance program are to

- Develop a data governance plan;
- Define critical data elements;
- Form a data governance board and data management teams;
- Establish data governance workflow;
- Register and catalog existing and new data sets;
- Evaluate and score existing and new data sets; and

- Establish data management team review.

The presentation also covered the essential functions that should be included in a data governance program:

- Accountability: assign roles, responsibilities, and accountability.
- Business processes: model workflow and business processes (Unified Modeling Language, use cases, and activity diagrams).
- Communicate and educate: raise the level of awareness on the value of data and data governance principles.
- Data governance strategy: formalize strategies using policies, goals, and principles.
- Document: metadata, business processes, and common definitions to bridge semantic differences.
- IT: involve at each level of the data governance process.
- Priorities: establish priorities through a combination of strategic evaluation and self-assessment.
- Self-Evaluation: use a data program self-assessment to define gaps, assess risks, set priorities, and develop an action plan (NCHRP 08-36, Task 100, and NCHRP 08-92, 2015).
- Strategic plan and goals: align data programs with the agency's strategic goals and link programs to data collection, reporting, and analysis.
- Subject matter experts: identify and assign roles as data stewards or data owners.

Washington State DOT Perspective
Ida van Schalkwyk, John Milton, Leni Oman, Nancy Boyd, and Lynn Peterson

Ida van Schalkwyk's presentation focused on data governance from a data scientist perspective. The data scientist extracts insights and information from data. The data scientist is relatively new to industry and incorporates skills from a variety of positions—programmer, statistician, mathematician, communicator, and knowledge strategist. The focus of a data scientist is on developing business process value.

The Washington State SHSP, Target Zero, has a zero goal for fatal and serious injuries by 2030. To reach this goal, it is important to be able to answer four basic questions in safety as part of Washington State DOT business: where should we focus? What should we focus on? What should we do to maximize our investment? Did it work? In a recent executive order, the Secretary of Transportation directed designers to use quantitative methods and analytical tools to identify alternative designs, analyze the performance of different solutions as part of least-cost planning, and focus on alternatives with the best return on investment based on project need for practical design.

Data integration needs and requirements change along with nature of analysis in planning programming, project development, and operations. With the growing need for systemwide prioritization, and weighing of impacts across multiple goal areas, there is a need for a more sophisticated level of integration across a wider range of data source. As this sophistication increases so too does the need to communicate the results in an understandable and accessible manner. Washington State DOT presented a successful project where data integration facilitated analysis for asset management in a manner that has never been done before. Washington State DOT has 3,100 existing illumination systems with over 60,000 light fixtures. With a substantial

growth in the number of lighting systems over the past 10 years, Washington State DOT had to evaluate what the impact of lighting is on safety performance and where lighting is needed. Using random-parameter crash prediction models, Washington State DOT was able to determine that continuous Interstate lighting had no measureable impact on safety performance. This is now influencing design manual changes, decisions regarding lighting removal, and overall policies regarding lighting as a safety countermeasure.

Washington State DOT determined that data governance must be accomplished from an enterprise perspective rather than from a narrow safety focus. The enterprise perspective is appealing to a data scientist working in safety because answering questions about safety performance requires enterprise systems. Washington State DOT business processes are changing for safety performance measures and tracking implementation. Access to enterprise data is a great opportunity since robust analysis methods and computational power enables the incorporation of integrated analyses.

Washington State DOT has an Executive Order that directs employees to make efficient and strategic use of data and information assets including resources needed to collect, store, mange, retrieve, and analyze data and information. Washington State DOT is in the process of developing an Enterprise Information Governance Group to provide policy direction that enables cost-effective management on ongoing and future data and information needs. Washington State DOT is also investigating the concept of a Chief Data and Analytics Officer whose role to ensure the organization has the data, capabilities and the mindset to champion data analytics.

Washington State DOT developed the following data and information principles (extracted from the Executive Order for the Enterprise Information Governance Group):

1. Data and information are critical to effective business decision making at Washington State DOT and shall be maintained in a manner appropriate to meet business needs.
2. Data and information are strategic, long-term assets owned by Washington State DOT, not by individual business units. They are findable, retrievable, and shared.
3. Data and information shall be collected once, stored once, and used multiple times.
4. Data and information that is not used shall not be collected or stored.
5. Data and information that is used by multiple applications or shared across business units shall be defined and managed from an enterprise perspective and fit for a variety of applications.
6. Data and information investments will consider business priorities, program impacts, and trade-offs.
7. Data and information shall be managed to provide availability, security, and integrity; they shall be both safer from harm and accessible by those who need them.
8. Data and information governance, costs, and stewardship processes will be transparent.

Essential Elements of Data Governance: Breakout Session Discussion

The following summarizes the breakout group discussion on Focus Area B: Essential Elements of data governance. An initial question posed to the participants was to discuss what data governance roles and functions are essential versus “nice to have”?

Essential elements of data governance implementation are to develop a vision and then produce a work plan for implementation. The vision includes the development of goals, data

governance principles, and a plan for implementation. The vision should also identify key stakeholders and address issues of accountability and accessibility. Data should be open unless there is a good reason for restricting access.

The work plan should model business processes for data governance and data distribution. Components should include communication and training. Data governance activities should also be periodically evaluated and assessed.

The following areas were highlighted as possible research needs:

- What are the best practices for state DOT safety data governance (possibly a synthesis)?
- What are the metrics necessary for assessing data governance?
- For implementation, what elements are critical, what are practical–realistic, and what are possible–visionary?
- How does an agency determine its level of implementation of data governance in various aspects, and how does it get to the next level?
- How does an agency increase outreach and education on the safety MIRE data elements?
- After an agency conducts a data self-assessment, what is the next step?

In addition, there was a discussion on how agencies can focus their implementation efforts incrementally to address the fiscal and personnel limitations in agencies?

Focus Area C: Operationalizing Data Governance at a DOT
Nancy Lefler, VHB, Facilitator

Montana DOT Perspective
Mike Bousliman

There is a lack of comprehension of the concept of data governance in transportation agencies. A major benefit of data governance is that it assists decision making processes in the organization. Senior leadership needs to embrace the types of decisions enabled by new technologies and provide the necessary data to decision makers. It is important for agencies to define what problems they are trying to solve and to determine what data they need.

Governance of the Information Technology function is also important to help prioritize IT investment decisions. Lack of investment in IT can lead to significant operational problems. Ongoing research with regard to IT architecture, security, and governance are critical in improving the decision-making processes in transportation agencies. The challenge for organizations is to raise the level of understanding of the value and the importance of data governance.

Michigan DOT Perspective
Ron Vibbert

Ron Vibbert presented the Michigan DOT approach to operationalizing data governance and management. The objective is to build data governance into both business and technical processes so these become part of what we do, instead of an add-on. Michigan DOT employs a

model with three levels: (*a*) data governance, (*b*) data stewardship, and (*c*) data management (see Figure 1). Michigan emphasizes the importance of data governance authority and the scope of this authority must be understood, respected and executed. Governance is a managerial rather than a technical function, although knowledge of the technical aspects is important.

The challenge is how to implement this authority while crossing silos of information for Asset Performance Systems (e.g., safety management, intermodal management, and congestion management) and Asset Management Systems (e.g., pavement, bridge, other asset inventory). A primary success factor is to pick the right people for the right roles. For example, data stewards should know general business and data processes and exercise management for definitions across business areas. Subject matter experts should know the subject area and data management roles. Another important function is information system technologists who support data governance functions with metadata-related tools and with appropriate process to manage change across business areas. This helps to ensure actual organizational buy-in for the data governance process. User training is also important illustrating basic concepts and example activities.

Operationalizing Data Governance at a DOT: Breakout Session Discussion

The following summarizes the breakout group discussion on Focus Area C: Operationalizing Data Governance at a DOT. Initial questions posed to the participants were:

- What are specific strategies for operationalizing data governance functions that fit within the resource-constrained DOT environment?
- What help do DOTs need to implement more effective data governance?

Operationalizing data governance involves data collection, data management, and data distribution. Data collection can be internal or outsourced. Data governance requirements should be established so data collection activities meet the requirements. It is important to have someone in charge, a champion, who can manage the implementation plan.

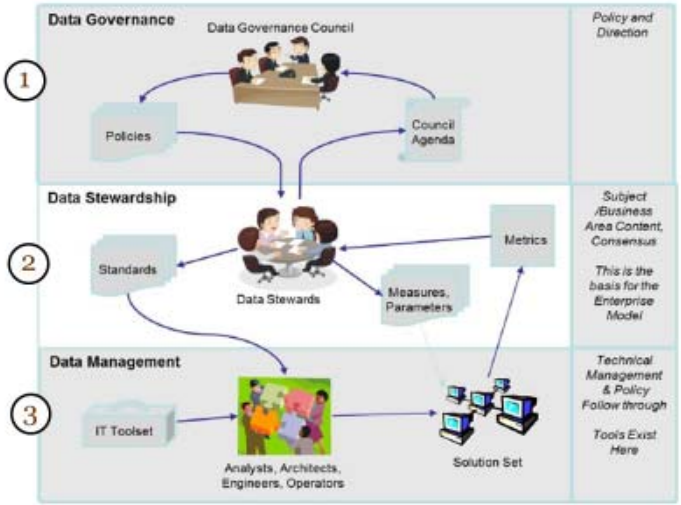


FIGURE 1 Michigan DOT data governance three-tiered model.

Operationalizing also requires a focus on the value of data to gain organizational support. How can data be used to meet the agency's mission, e.g., how can agencies provide value to elected officials? Demonstrating the value may help in moving towards a data centric organization. Data governance implementation may require adjustments of business processes including collaborations with the private sector. Are there options for revenue sharing or generating multi-beneficial relationships?

Possible research needs include the development of organizational models for data governance and position descriptions for data stewardship. Documentation on the state of the practice of data governance would be useful. Are there different implementation methods, e.g., information systems or business process centric? Are there different requirements for internal use and external data dissemination? The AASHTO Standing Committee on Planning Subcommittee and the AASHTO Subcommittee on Information Systems may be useful resources in developing possible research needs in this area.

Focus Area D: Using Data Governance to Advance Data Sharing and Integration
Kelly Hardy, AASHTO, Facilitator

Ohio DOT Perspective
Derek Troyer

Derek Troyer of Ohio DOT presented on how data governance improves sharing and integration. Ohio DOT has operated a GIS crash mapping service since 2008. It provides Internet query capabilities to internal and external users. It has easy to use tools to diagnose observed crash patterns. For roadway data collection sharing, Ohio has a LRS that brought together county engineers, auditors, and E-911 to develop a system to collect data to meet the needs of the state but also to fulfill the uses of local governments. TRCC funding was used for development and 78 out of 88 counties are participating. Annual updates are sent to the state to be incorporated into county mileage reports. Engineering, E-911, and auditors departments are maintaining the data. More recently, Ohio DOT has developed the Transportation Information Mapping System with Phase 1 developed in 2013. It has been widely accepted and additional datasets have been requested. Phase 2 was developed in 2014 and includes information on assets, roadway, project, and safety information.

Maryland SHA Perspective
Erin Lesh and Greg Slater

To advance data sharing and integration, Maryland SHA employs an Enterprise GIS Portal (eGIS) which provides broad access to geospatial information and services in an effort to foster collaboration between business units and promotes the use of GIS to support crucial business functions. eGIS is the foundation and framework to provide executives and the enterprise community with geospatial capabilities for data driven analysis and decision support.

The contents of eGIS are groups of GIS data layers and GIS tools that are aggregated to support common SHA business processes and workflows, often organized around a specific SHA business unit. Users can create custom contents and can merge and share contents. The eGIS system integrates with SHA's Asset Data Warehouse and includes safety-related asset information on lighting, signs, traffic barriers, rumble strips, line striping, and weather sensors.

These data sources can be combined for web-based editing and reporting. eGIS also contains dashboard information for performance related functions.

The emphasis on data sharing and integration has resulted from the new MAP-21, Transportation Asset Management Plan (TAMP), and ARNOLD reporting requirements at the federal level. Maryland SHA has emphasized data coordination and education activities focused on data owners and data awareness. Maryland DOT also has control over roadway design and maintenance activity information which they share for better facilitation with law enforcement, emergency medical services (EMS), first responders, department of motor vehicles (DMV), and metropolitan planning organizations (MPOs).

Using Data Governance to Advance Data Sharing and Integration: Breakout Session Discussion

The following summarizes the breakout group discussion on Focus Area D: Using Data Governance to Advance Data Sharing and Integration. Initial questions posed to the participants were:

- What are successful techniques for truly working across silos in a DOT (and with external partners) to make progress on standardization, integration, and common services that meet the needs of multiple safety related functions?
- What help do DOTs need to advance data sharing and integration?

Some participants identified strong executive leadership and legislative requirements (e.g., MAP-21) as strong motivating factors to advance data sharing and integration. Also, a specific project or initiative can provide a rallying point to implement data integration processes. Examples include implementing safety analysis, crash database redesign, or responding to executive queries, e.g., data on load posted structures. Cost sharing across different business process areas can be valuable. The increasing emphasis on state and local agency collaborations on data collection and dissemination also creates opportunities.

Technology-related elements for promoting data integration and sharing include

- One LRS for all public roads;
- Global positioning system (GPS) standards for the collection of data;
- Developing methods for attaching collected data to the LRS;
- Developing data migration services towards a customer-centric approach; and
- Integrating more-advanced data collection techniques such as LIDAR.

The breakout group identified the following possible research needs:

- Documentation of case studies of successful integration for roadway, traffic, and crash data at a minimum.
- Investigate the level of data accuracy necessary for business processes.
- Investigate the role of data stewards in navigating the balance of data collection standards and the recognition of different data needs for different applications.
- Principles for data integration that are scalable and adaptable for different organizational structures.

- Investigate public data dissemination models while protecting the state from liability issues.
- Develop models to integrate hospital data and other potentially private–secure data for safety-related decisions.

IDENTIFICATION OF POSSIBLE RESEARCH NEEDS

Ida van Schalkwyk, Washington State DOT, Moderator

Breakout Sessions

The peer exchange included another breakout group session on the second day. Ida van Schalkwyk gave instructions to the Breakout Groups to review the previous day's discussion and to identify possible research need topics to improve transportation agency data governance and data business planning activities. A total of 11 research needs areas reported their discussions to the larger group. Both breakout groups presented their research needs themes. After a thorough discussion, the following themes emerged:

- Metrics for data.gov for information and data systems, performance outcomes, tracking progress, return on investment, value, training to use metrics, and connection to maturity model.
- Data governance in state DOTs, state of practice: framework, best practices; coordinate with AASHTO Subcommittee on Information Systems and the safety community
- Chief Executive Officer (CEO) level: executive view–needs and case for data governance, business value, knowledge organization, making the business case.
- Guidebook on essential elements of data governance. Where is the agency now and how does it move to the next steps in achieving what is practical? Includes metadata needs.
- Essential elements of data integration. Examine previous work in light of changing technologies, computer resources, etc. From a state DOT perspective, how can the agency tailor off-the-shelf applications and vendors to successfully integrate? How can vendors cooperate for better integration?
- Identify best practices in integration and analytics. What does it take to implement Safety Analyst in each state?
- How to include external agencies (crashes, roadway data, and traffic) and influence relationships that provide crash and roadway data in the data governance process.
- Synthesis on centralized IT services. What are the success stories? Organization structure and roles and how governance fits in.
- Document the full crash data life-cycle practices to better understand the how to improve crash data performance.
- Design a training curriculum for people to understand how to use and how to value data governance.
- What is the level of accuracy necessary for location (road network and business data) and models (standards, business processes)?

Some participants also reported on their key takeaways from the peer. Immediately after the peer exchange the Peer Planning Committee reviewed the research themes in the context of

ongoing research efforts and selected six research themes for the development of possible Research Needs Statements.

Research Needs Statements

In the days following the peer exchange, the Peer Planning Committee worked with a variety of different state agency participants and developed six research needs statements, as follows:

1. Determining Metrics for Effective Data Governance;
2. Peer Exchange on Executive Perspective on Managing Transportation Data and Information as an Asset;
3. Essential Elements of Data Integration to Drive Business Decisions in Transportation Agencies;
4. Data Governance in the Context of Centralized IT;
5. Crash Data Life-Cycle Practices; and
6. Effect of Location Accuracy on Safety Data Analysis: A Case for Data Governance.

The full description for each of these research needs statements is included in the Research Needs Statements chapter of this e-circular. The intent of the planning committee is to move these research areas forward in conjunction with the research efforts of interested state agencies, TRB committees, FHWA, and AASHTO.

ASSOCIATED ACTIVITIES

At the peer, presentations also were made on current activities that relate to transportation agency data governance.

MIRE Reassessment

Nancy Lefler, VHB

FHWA released MIRE V 1.0 in 2010. MIRE is a recommended guideline of roadway and traffic data elements that states could collect to develop a more robust roadway and traffic data inventory for safety analysis. Since the release of MIRE V 1.0 there have been advances in safety analyses techniques, an increased awareness by both the safety and the data communities of the importance of quality data in safety analysis, and additional federal requirements for related data.

FHWA is conducting an assessment of MIRE V 1.0 and revising MIRE based on the results of the assessment to create MIRE V 2.0. The assessment will compare MIRE to other related FHWA datasets to help create more consistency with MIRE and other FHWA datasets. The assessment will also take into account data requirements for safety tools and resources such as Safety Analyst. This project includes vetting sessions (both in person and online) with MIRE users to obtain their feedback on the recommended revisions to MIRE. The feedback from the vetting sessions will be taken into account when developing MIRE V 2.0. This effort will also look to determine the level of interest for establishing standards for roadway inventory data.

GIS in Transportation Symposium
James Hall and John Selmer

The next AASHTO GIS in Transportation (GIS-T) Symposium is scheduled for April 19–23, 2015, in Des Moines, Iowa. Data governance is a key issue of the 2015 conference and there is a scheduled workshop, roundtable discussion, and presentations on data governance processes and activities. Presentation summaries will be available on the GIS-T conference website after the conference. The intent is that the e-circular of this peer exchange will be available and announced for the conference attendees. The discussions from the peer exchange will also be presented at the midyear meetings of the Standing Committees on Information Systems and Technology and Geographic Information Science and Applications, which will be held at the GIS-T Symposium.

FHWA Safety Data Management Systems and Processes
Anita Vandervalk

The FHWA Office of Safety is conducting a project to assist states in developing, enhancing, managing, maintaining and governing an effective data system. Development of an informational guide will

1. Provide the information necessary for a state to develop and maintain a data business plan that recognizes the current and future informational needs of all business units within the DOT and
2. Identify institutional arrangements needed to support a successful integrated data management system that fully supports safety programs.

The guide will be developed with a safety data perspective to assist safety managers and engineers in understanding agencywide data management and governance processes and their responsibilities within those processes. The guide will also help other key players of state data systems understand safety program needs and what is required for safety data collection, analysis, and management. Key players include but are not limited to executives, information technology personnel, planners, asset managers, financial managers, GIS specialists, and state TRCCs.

This project will build on the results of Chapter 2: Guide for Data Management in NCHRP Report 666 and work done by the FHWA Office of Safety's Roadway Safety Data Program to increase states' ability to collect, analyze, integrate, manage and assess safety data. Products and tasks will include a synthesis of relevant studies, identification of a technical advisory group (TAG), case studies, peer exchange, pilot studies, informational guide, and webinars.

Emphasis areas to include, but not limited to, are as follows:

1. Establishing a Need for Safety Data Management–Governance;
2. Establishing Goals for Safety Data Management;
3. Assessing Current State of Safety Data Program System;
4. Establishing Safety Data Governance Program;
5. Technology for Safety Data Management; and
6. Linking Safety Data to Planning, Performance Measures, and Target Processes.

A TAG comprised of experts in safety data management and data governance has been established to review task work and provide guidance at key points throughout the project (see Table 1).

The following tasks are planned or in progress to support the development of the data management guide for state DOTs.

Literature Review–Synthesis

This task has two components that will result in one final report that includes a literature review and synthesis of state interviews.

1. Review current literature to identify resources and guidance available to state DOTs in each of the emphasis areas recommended for data management in Chapter 2: Data Management Guide of NCHRP Report 666, Volume II. A relevant project under development is NCHRP 8-92: Implementing a Transportation Agency Data Self-Assessment.
2. Conduct interviews with state DOTs to document issues, challenges, and noteworthy practices in safety data management, provide a synthesis of interview findings, and use the findings to select four states to conduct case studies.

Nine states were selected for interviews based on an initial assessment of capability–maturity in the areas of data business planning, assessment of safety data systems, data governance, and data management. Representatives from the planning and IT divisions were also included in the interviews (as available) in addition to staff from the safety offices. The nine state DOTs interviewed during January and February 2015, were Colorado, Kentucky, Michigan, Minnesota, Missouri, New Hampshire, Ohio, Utah, and Washington. The team also reviewed a questionnaire resulting in these other states considered for case studies on noteworthy practices: Alaska, Idaho, Iowa, Montana, and Rhode Island. The three states selected to participate in both are Michigan, Ohio, and Washington.

TABLE 1 Technical Advisory Group

TECHNICAL ADVISORY GROUP	
Name	**Agency**
Stan Burns	Utah DOT
Jack Stickel	Alaska DOT&PF
Greg Slater	Maryland State Highway Administration
Derek Troyer	Ohio DOT
Tim Harmon	New Hampshire DOT
Jim Hubbell	Mid America Regional Council
Shannon Barnes	Idaho DOT
Mike Bousliman	Montana DOT

Prepare Case Studies and Noteworthy Practices

Based on state DOT interview findings and gaps in literature focused around the data management emphasis areas defined in the Literature Review and Synthesis task, four states with noteworthy practices in the gap areas will be selected for case studies. As is always the case with documenting noteworthy practices, some states are more advanced in some areas. It is unusual to find a state that represents "best" practice in all areas. Therefore, utilizing the knowledge and experience of the TAG and the Literature Review and Synthesis Report, the project team will recommend at least four case study subject areas and recommend appropriate states to represent each.

One of the key findings from the focused interviews and surveys was that out of 14 states reviewed in detail, none have formal safety data business plans, six have formal enterprise or office wide data business plans, eight have formal data governance groups and nine have integrated data systems to support safety. Since no state recently surveyed has implemented a stand-alone data business plan for safety, it further justifies the need for development of a guide to help states in this effort. It should be noted that states with existing data business plans however, do typically include a component that addresses their safety data program goals, principles, and performance measures.

The Cambridge Systematics Project Manager participated in this peer exchange. Lessons learned and ideas gathered during the peer exchange will be documented, shared with the project team, and applied in the case study task and development of the data management guide.

Develop Draft and Final Guide

A draft guide will be produced covering development of a Safety Data Business Plan using the steps for data management outlined in NCHRP 666. The draft guide will be delivered in several iterations in both web tool and document formats and a 90-min webinar will be prepared and delivered to present information to potential pilot study agencies.

The project team will select two states to pilot the draft guide and develop state safety Data Business Plans. The states selected will be at a lower stage of maturity when compared to the Case Study states but need to be a higher level of readiness. Criteria for selection will include readiness, willingness to participate, having a strong safety program in place (e.g., using the HSM, predictive methods, and systemic analysis), and the ability to support the contractor and participate in timely reviews.

The final guide will incorporate lessons learned from the pilot studies and will include conflict–resolution documentation, executive summaries, web page content, PowerPoint material, newsletter articles to summarize each case study, and a 90-min webinar to present the final guide to all 50 states.

The project team will provide assistance to states with business plan development, data management, implementation, and maintenance as requested by the FHWA Contracting Officer's Technical Manager or Contracting Officer's Representative.

The next steps to prepare for the development of the guide will be to prepare case studies and noteworthy practices, document (in detail) this peer exchange, and review the official peer summary when it becomes available. The team will continue to coordinate closely with the TAG for the project as well as the participants of the peer exchange to ensure the guide outline will meet their needs. A final draft guide will be completed by the end of 2015 and piloted in two states in 2016.

Summary of State Reports on Safety Data Governance Practices

JAMES P. HALL
University of Illinois at Springfield

The following summarizes the 10 state transportation agency responses to the peer exchange questionnaire in the areas of data governance, data management, and data integration. Questions also covered data program assessment, agency motivations for a comprehensive data business planning process and queries that the state agency representatives had for other state agency participants.

DATA GOVERNANCE

States indicated they have several current formal data governance-related efforts including:

- Long-range transportation plan (LRTP),
- SHSP,
- HSIP,
- TRCC,
- TAMP,
- Safety management system (SMS),
- Crash data management, and
- Asset management data management.

States also rely on their TRCC to assist in safety data governance, typically for integrating crash and roadway data. Several states are active in multiple safety data sharing objectives including the integration of citation and public health data.

Organizationally, the responsibility for roadway and traffic data categories falls into planning, GIS, or asset management areas. Crash data is typically managed in safety, DMV, state police, planning, GIS or asset management offices. Specific asset category data, e.g., guardrails, are scattered by types of assets. The maintenance–operations area is typically responsible for operations data. Corridor incident data is handled by operations or traffic management centers. The categories of data related to safety decisions appears to be expanding including the areas of signage, guardrails, traffic signals, striping, stormwater, green assets, Americans with Disabilities (ADA)–compliant sidewalks, and illumination.

The safety office and planning–programming areas are typically responsible for SHSP development. For safety analysis activities, traffic safety engineers at the central office and the districts are involved in identifying and evaluating countermeasures and performing predictive analysis as described in the HSM.

Planning, safety offices, or user areas generally champion investments in safety data, develop data specifications, monitor data quality, and work with safety analysis groups. Several of the states have institutionalized their data governance efforts into a Data Governance Council

(Michigan) or a Data Governance Committee (Iowa and Ohio). Washington State is in the process of establishing an Enterprise Information Governance Group. Most states do not have a formal data governance effort in their agency but several are working on developing such a group.

Most states do not have an institutional data governance effort focused on safety. Idaho, Iowa, and Maryland do so through their TRCC. Washington State manages safety through its Multimodal Safety Executive Committee (director-level leadership) and its Multimodal Safety Issue Group (engineers and planners). Several states indicated they perform safety data governance through their safety office.

The implementation of data governance practices is mixed. Several states indicated that they had mapped their safety data workflows. Several had documented safety business rules, developed SLAs for data quality or codified responsibilities for data stewards in position descriptions.

States indicated there were multiple institutional issues in formalizing their data governance efforts. A summary of these follows:

- Change in organizational roles–power, culture;
- Obtaining and maintaining executive support;
- Difficulties implementing enterprise systems while addressing data silos;
- State government implementation of centralized IT operations, impacting DOT operations;
- Transportation agency decentralized IT operations, e.g., district IT operations impacting central office IT operations;
- No standard blueprint to implement a data governance process;
- Lack of staffing and knowledge workers;
- Differences in generational familiarity with IT and analytics;
- Difficulties in incorporating enhanced data collection techniques; and
- Expanding data collection categories, data elements, and data types.

DATA MANAGEMENT

This section focuses on the state agency data management practices for crash, roadway, and traffic data. Most states deploy data governance components for roadway and crash datasets including data dictionaries, metadata, and data business rules, but they are not consistently applied. Several states are working on safety data models illustrating data flows. States apply both structured and ad hoc methods in evaluating new sources of data and new datasets. In general, the data owners for crash and for roadway data are responsible for updating safety models and data business rules. In some states, this is the responsibility of the information systems or GIS section. With a focus of enterprise data and data usage, Iowa uniquely houses this responsibility in their Office of Research and Analytics.

Archiving historical roadway inventory information is critical in conducting analyses of the crash histories before and after safety project improvements as well as general network safety analyses. Most states create a year-end roadway inventory file for this roadway archive function. Moreover, Iowa time stamps all roadway data revisions so they can determine the historical roadway characteristics at any point in time.

States apply a variety of network screening business intelligence tools to automate manual practices for safety-related decision making. Four states use AASHTOWare Safety Analyst. Many states apply HSM tools. Some states have also developed their own methods to perform network analysis, specific to the characteristics of the state.

DATA INTEGRATION

Most states indicated that they have an integrated LRS in conjunction with their GIS and they are able to integrate roadway, traffic, and crash data at some level. Most states are able to report all of their public roadways to FHWA's ARNOLD system. However, states are mixed on whether their roadway and crash data are completely integrated, particularly on the local system. States also vary on the integration of operations and congestion data with their roadway and crash systems. Alaska indicated they are close to integrating weather data.

States use a variety of methods in integrating crash records with asset management, performance management, and project scoping activities. Some states distribute information to decision makers through the web, a GIS portal, or both. Crash frequency and severity are often available for asset management decisions. Integration of data for project scoping also occurs at varying levels of integration.

Regarding visualization techniques for safety program development and for safety projects, most states use GIS. Other techniques include Intersection Crash Magic, photo logging, video logging, and heat maps.

In identifying successful data integration efforts, many states cited the ability to integrate roadway, traffic, and crash information. Maryland has integrated crash data with congestion data. Several states mentioned the integration of crash frequency and severity with their TAM system. Washington has linked crash data with illumination and lighting data for network analysis. Montana has linked their Safety Information Management System with their SmartCop system.

States have been less successful in the full implementation and integration of crash data for the *total* public roadway network. The ability to integrate crashes with health records is also a challenge due to personal–private information issues. Other areas of difficulty include project scoping, lack of a fully integrated TAM, and that integration is currently led by individual business units rather than with an enterprise focus. Another item of concern is whether past and successful data integration efforts should be upgraded with more modern methods.

PROGRAM ASSESSMENT

Most states have taken advantage of federal assistance efforts for evaluating safety data management practices, including RSDP, CDIP, RSDP, NHTSA Traffic Records Assessments, and capability maturity assessments. Several states have developed action plans for improvements resulting from these federal assessments. Some states indicated other assessments are also conducted periodically by the highway safety office, the TRCC, or internally as needed.

Regarding processes for data users to assess data quality, many states rely on their traffic safety engineers, HPMS reviewers, the traffic safety office, feedback from state police, and informal feedback from users. However, some states do not have a method to assess data quality.

States deploy a variety of methods to prioritize their safety data needs. Several states perform a risk analysis or a data value assessment process. Several states prioritize through their traffic safety engineers or the traffic safety office. Others rely on MIRE FDE or they address their safety needs as necessary.

AGENCY MOTIVATIONS FOR A COMPREHENSIVE DATA BUSINESS PLANNING PROCESS

Agencies cited a variety of motivations to develop a comprehensive data business planning process. These include the existence of formal Data Governance Councils or Committees, a directive from an agency head, or a formal EA project. Other agency motivations involve improving the TAM–planning process, advancing the spatial delivery of information, demonstrating pilot project results, growing awareness of problems, and opportunities, and increasing resource support.

Safety-related business process areas that would benefit the most from data business planning include spatial analysis–GIS, integration of safety and TAM data, data warehouse creation, access to data, and relationships with law enforcement.

QUESTIONS TO OTHER STATES

The state transportation agencies had multiple questions for their peer states. These are categorized as organizational, data collection, data integration, and technology as follows.

Organizational

- How to establish a data governance council?
- How to implement a data warehouse?
- Examples of safety data governance: policies and management.
- How to articulate business needs for data?
- Describe the difficulties and opportunities in implementation.
- How can safety personnel help to improve asset management practices?

Data Collection

- What are the best practices to collect MIRE FDE?
- What are successful automated data collection techniques?
- How to obtain local agency buy-in for asset–crash data collection?
- How to incorporate as-built and maintenance data?
- How to develop models for baseline roadway data until actual data is collected?
- How to incorporate high usage private roads?
- How to utilize crowdsourced data?

Data Integration

- What are the keys to data integration?
- How to incorporate consistent location referencing for any data collected?
- How to address resistance to the integration of citation and other external data?

Technology

- What are future platforms in establishing data hierarchies for automated roadway data collection?
- How to migrate from mainframe–traditional data collection to more sustainable collection–storage?
- How to advance data analytics and integration?
- What are the different types of web analysis tools?
- Can the SHRP 2 Naturalistic Driving Study data be used to supplement currently unavailable data in the road inventory?

Full Text of State Questionnaire Responses
Peer Exchange Questions

The following are the comprehensive state agency responses to questions submitted prior to the Improving Safety Programs through data governance and Data Business Planning Peer Exchange. State transportation agencies participating in the survey were the Alaska DOT&PF, ITD, Iowa DOT, Louisiana DOTD, Maryland DOT SHA, Michigan DOT, Montana DOT, Ohio DOT, Rhode Island DOT, and Washington State DOT.

QUESTIONNAIRE BACKGROUND INFORMATION

The Terms and Acronyms in Appendix A provide definitions of data governance terms, highway safety terms, and the NHTSA Traffic Records Program Assessment.

This peer is particularly focused on safety-related data. In addition to crash information, safety data includes data that safety personnel need in order to analyze crashes, identify contributing factors, propose countermeasures, and then evaluate the effectiveness of the countermeasures by having, at the very least, roadway, traffic volume, and crash data in an integrated environment. Ideally such an integrated dataset would include assets (signs, bridges, culverts, traffic barriers, etc.), facility-related information (transit stops, sidewalks, bicycle lanes, etc.), and maintenance data (winter maintenance–snowplowing activity, and amounts of sand and chemicals used on the roadway). Another component is real-time data. This includes, but is not limited to, Road Weather Information System (atmospheric, pavement, subsurface, camera images), 511 traveler information, and traffic (travel time, congestion). Additional elements are identified in MIRE.

SECTION A: DATA GOVERNANCE

1. Has there been any formal effort in your agency to identify policy, planning, and research needs for improvements to data for safety programs, and integrating safety into project development? If so, please describe. For the purpose of this question, safety programs refer to activities related to network screening or identification of locations or corridors that would most likely benefit from investment; analysis of contributing factors to crashes at the identified locations; identification and evaluation of countermeasures; economic valuation of alternative countermeasures; and evaluation of implemented safety projects.

Alaska: On the crash data management side, Alaska DOT&PF is formalizing some quality assurance–quality control (QA/QC) into the Version 2 data entry instructions. On the data analysis side, there are four activities for identifying policies, planning, and research needs for safety: the LRTP, the SHSP, the HSIP, and the new Crash Analysis and Reporting System for Highways (CRASH).

The LRTP provides the strategic guidance for addressing safety issues. Although the LRTP does not specifically address data for safety programs, it does require aligning programs with safety policy goals. Alaska's Let's Get Moving 2030 LRTP is currently in the update process. The new

Alaska Long-Range Transportation Policy Plan will address all modes of safety and establish performance goals that address MAP-21 performance measures.

The second activity, the SHSP, is a statewide, comprehensive safety plan that provides a coordinated framework for highway safety on all public roads. The Roadways SHSP emphasis area is relevant to safety data improvement and integration. Most of the Roadways strategies and actions call for improved safety data, network screening, contributing factors, or evaluation of countermeasures. The roadways strategies and actions are shown in Table 2.

The third activity is the more formal HSIP which identifies high crash locations on Alaska roads, evaluates corrective measures, funds the most effective ones, and evaluates the project effectiveness after the projects are completed. The program is described in the HSIP Handbook. HSIP high-crash identification tools are integrated into the spatial database, i.e., named intersections and named segments, and are being integrated into the new CRASH application. The HSIP requirements are also being designed into our new crash analysis and reporting tool software system.

The fourth activity is the new CRASH application. The requirements for the new system incorporate the needs of the LRTP, SHSP, and especially the HSIP program. Alaska DOT&PF expects to start the procurement process for the new software in near future, with a fully operational system anticipated by the end of 2015.

Idaho: Attached is a document that summarizes Idaho's formal effort to create and implement planning and prioritization tools for integrating safety into project development. This effort utilizes a data-driven corridor approach to identify "at risk" locations and a process for the analysis of countermeasures and selection of projects based upon a cost–benefit basis.

Iowa: No.

Louisiana: Although there is currently no enterprise data management system for all safety–roadway data in DOTD, a project is planned to develop an enterprise system. The DOTD IT Enterprise GIS Planning report provides specific recommendations for building an enterprise data system for the DOTD.

Currently, DOTD does not have an integrated statewide enterprise system for conducting roadway and highway safety analysis. This results in multiple databases having duplicate information. DOTD expects to have the ability to add new features and data elements to the system once the new enterprise system is implemented.

Louisiana State University Highway Safety Research Group (HSRG) has worked towards developing a data warehouse for state roads that integrates crashes with roadway information and other safety data. This data warehouse will support DOTD and local agency crash and safety analysis efforts.

A number of local agencies collect their own data (roadway and safety); however, no process exists to integrate these data into a future enterprise system.

Maryland: Yes. Using crash data from the Maryland State Police, the Maryland SHA creates a segment-based severity index using an equation that accounts not only for crash rates, but also congestion. SHA uses the top-ranked safety corridors based on severity index segments the appropriate safety programs needed to address the issue: engineering, enforcement, or education.

TABLE 2 Alaska DOT&PF SHSP Roadways Emphasis Areas

SHSP Roadways Emphasis Area
Strategy 1: Implement education/awareness programs to enhance roadway safety
Action 1.1: Implement programs to increase awareness at intersections
Action 1.2: Implement programs to increase awareness of work zone safety
Action 1.3: Implement programs to increase awareness of head-on crashes
Action 1.4: Implement programs to increase awareness of wildlife crashes
Action 1.5: Utilize 511 and traveler information systems to disseminate roadway safety messages
Strategy 2: Implement engineering programs to enhance roadway safety
Action 2.1: Preserve main roads and build multilane/divided highways for Alaska's future economy
Action 2.2: Plan for safety upgrades early in the project scoping process
Action 2.3: Implement infrastructure projects to address run-off-road crashes
Action 2.4: Implement infrastructure projects to address head-on crashes
Action 2.5: Implement infrastructure projects to address intersection crashes
Action 2.6: Implement appropriate engineering strategies to address high-crash locations involving older drivers and pedestrians
Action 2.7: Implement infrastructure projects to address animal–vehicle collisions
Action 2.8: Implement wildlife management and habitat manipulation techniques to address animal-vehicle collisions
Action 2.9: Install infrastructure for real-time data collection
Strategy 3: Implement improvements to EMS to enhance roadway safety
Action 3.1: Encourage expansion of 911 service miles
Action 3.2: Expand signage and call box coverage area and map coverage area
Strategy 4: Utilize data and electronic information programs to enhance roadway safety
Action 4.1: Improve crash data collection procedures and methods
Action 4.2: Improve crash data analysis and distribution of data to users
Action 4.3: Conduct research on Alaska-specific issues related to roadway collisions
Action 4.4: Utilize real-time data to enhance roadway safety information
Action 4.5: Improve monitoring of other transportation data for highway safety
Strategy 5: Implement HSIP-qualified strategies
Action 5.1: Improve roadway safety through HSIP-qualified activities and projects

To elaborate, SHA creates 3-mi segments on state roads categorized by severity. These segments are then sent to SHA Program Managers in the Office of Planning and Preliminary Engineering who run further analyses to prioritize segments for safety improvements.

On an annual basis, SHA also screens the network for intersections and half-mile segments that have crash rates that are significantly higher than other similar intersections and segments. SHA District Offices study each location and provide recommendations for improvements to enhance safety at each location. This results in a wide range of improvements, from maintenance projects to small geometric improvements to larger capacity or safety enhancements.

Michigan: Since 1997, Michigan DOT has developed and is using a legacy SMS for analysis and countermeasure identification. Also, Michigan DOT has participated, in conjunction with the Department's Local Technical Assistance Program (LTAP) agency, Michigan Technological University, in the modification and further development of the Roadsoft application in order to make these sorts of analysis available to nontrunkline agencies. This includes the distribution of subsets of Michigan's crash data to local agencies. A current project is underway to convert the existing SMS over to a Michigan DOT version of Roadsoft. This conversion will not only update from the legacy system of SMS, it will also allow for more transparent communication with local agencies. For project scoping, language has been included in the Michigan DOT scoping manual for HSM-level analysis that requires more data. There has been no identification of safety specific research needs for data. Research-related activities have been successful for Michigan DOT roadway related research and limited on nonMichigan DOT roadways. Data for the safety related project development process have primarily been centered around nominal approaches such as the AASHTO A Policy on Geometric Design of Highways and Streets. On a biannual cycle, Safety Programs produces either the High-Crash List or Transparency Report utilizing the best available data through the use of Safety Analyst. Research has been concentrated on developing Michigan specific Safety Performance Functions (SPFs) for use with the HSM. In addition, all research on safety improvements requires the development of Crash Modification Factors (CMFs).

Montana: Montana DOT is not aware of an agencywide effort to "identify policy, planning, and research needs for improvements to data for safety programs." For every project beyond a seal and cover, the Montana DOT engineering division completes a safety review of the specific project location in an effort to identify areas within the particular project that may benefit from the implementation of a specific safety countermeasure.

Ohio: No.

Rhode Island: Yes, Rhode Island DOT is in the process of procuring AASHTO Safety Analyst to perform network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and safety effectiveness evaluation based on the HSM methodology. Rhode Island DOT has also recently awarded a contract to collect the majority of MIRE elements on all public roads that will be stored in a data warehouse from which Safety Analyst will extract information. The Rhode Island DOT Traffic Management and Highway Safety section has been working closely with the Rhode Island DOT GIS and Asset Management section on these efforts. This will allow the department to make more informed safety decisions regarding safety programs and subprograms, and integrate safety improvements into various projects in the Rhode Island DOT.

Washington State: There have been several efforts to improve data management. Each of these has resulted in improvements. Each group has been disbanded at the end of a predefined task or changes in agency administration.

- 1997: Washington State DOT Data Council;
- 2002–2005: Coordinating Technologies Process Improvement Team;
- 2005: Statewide Archive (traffic data);

- 2005–2009: Critical Applications Modernization and Integration;
- 2006: Strategic Delivery Plan for Capital Construction Program;
- 2006–2007: Document Management Team;
- 2003–2007: Customer Advisory Group–Technical Advisory Group;
- 2009: Feasibility Studies on Critical Applications Implementation;
- 2011–2012: Task Force on Systems Operations and Infrastructure Data; and
- 2013: A new group called the Enterprise Information Governance Group.

Specifically, as it relates to improvements to safety data, several years ago Washington State DOT performed a risk assessment to guide priorities for a roadside data collection effort to specifically support the safety program and to integrate safety into project development. Roadside data were collected on all state routes except for the Interstate system. This data collection effort is currently on hold.

Several discussions within Washington State DOT are currently underway regarding data needs and how data is collected and integrated at the enterprise level. Further, discussions specifically related to data collection for assets using LIDAR versus field personnel are ongoing.

Washington State DOT has also begun to collect and inventory intersection and ramp data for inclusion in the Safety Analyst software. It is the intent of this data collection to improve network screening. Washington State DOT IT staff are being used, as well as consultant data collection provided through FHWA.

Washington State DOT is developing an implementation plan for safety that is intended to tie performance measures with implemented safety investment towards developing CMFs. Washington State DOT has also used newly collected roadside data to develop random SPFs for use in network screening, systemic safety improvement and planning, operations and design.

(NOTE: Washington State DOT has done a significant amount of work in the area of evaluating and establishing tools and methods to support integration of safety into project development, and will continue to do so.)

2. Are data governance and data business planning activities discussed as part of your agency's involvement with the TRCC? Explain representation on the committee and subcommittees; and specific activities supporting the data needs for the DOT safety program.

Alaska: Data governance and data business planning has not been discussed at the Alaska TRCC in the most recent past. However, the objectives outlined in the TRCC's Alaska Traffic Records Strategic Plan, available on the TRCC website, would encompass data governance and business planning activities. Department representation on TRCC includes the crash data manager and the Fatality Analysis Reporting System (FARS) analyst. The FARS analyst serves as the Alaska TRCC administrator. The primary subcommittee is the Traffic and Criminal Software (TraCS) subcommittee. This entity primarily deals with implementation and administration of TraCS hardware and software around the state, and the collection, storage, dissemination, and use of TraCS-generated data.

Idaho: Data governance and data business planning activities are discussed at the TRCC. As a result of these discussions projects are generated and funded with NHTSA traffic records incentive funds. The TRCC is membership is made up of individuals from:

- Judicial records (Idaho Supreme Court);
- EMS from Idaho Department of Health and Welfare;
- Idaho Vital Statistics;
- Idaho State Police;
- Association of Local Law Enforcement;
- Roadway Engineering (for roadway elements);
- DMV;
- ITD Office of Highway Safety;
- FHWA; and
- NHTSA.

The last Traffic Records Assessment was completed in 2011. Idaho has utilized the resultant recommendations for improvement to create projects to support the safety data needs for the highway safety program.

Projects and specific activities supporting the data needs include

- Creation and implementation of an electronic citation program;
- Feasibility study of a data warehouse;
- Integrating roadway characteristic data with crash data; and
- Update systems performance measures.

Iowa: Yes. The statewide TRCC is chaired by the Governor's Traffic Safety Bureau and attendees include Traffic and Safety, Systems Planning, Motor Vehicle, Research and Analytics, Public Health, Iowa State Patrol, University of Iowa and Iowa State University, EMS, and the Department of Justice (DOJ). Statewide TRCC works to improve data for all purposes. They recently created a centralized website with information on Iowa's six-pack of safety data, i.e., Iowa DOT Traffic Safety Data and Analysis website.

Louisiana: DOTD staff actively participate on the TRCC which includes other state and local agencies.

Maryland: Data governance and data business planning activities are being discussed and created within SHA (for all areas, not just safety) but have not yet been discussed through SHA's involvement with the TRCC. SHA and the other agencies participating in the TRCC provide routine updates on safety data collection and distribution from the viewpoint of the individual agency responsible for the data being discussed.

Michigan: Many of the TRCC's activities are focused on data issues across a wide range of state agencies representing the engineering, legal, medical, and judicial aspects of the crash community. There is a single, statewide crash database that is shared, as needed, among various TRCC participating agencies. Michigan also has a Crash Data Users Group (CDUG) that actively works on data issues. A Data Linkages Team, which reports to the TRCC, is working to connect state level crash, judicial and medical data across state agencies and on a Crash Progress Redesign that will focus on modernizing the crash data processes and the connections to it. Membership of these will be noted in the TRCC report. Recently, Michigan's CDUG completed

an update of the Michigan Crash Report form (UD-10) through input from state agencies. The Data Linkages Team, Crash Progress Redesign, and CDUG have all reported back to TRCC.

Montana: To date, the TRCC has not been involved with data governance and data business planning activities.

Ohio: No data governance has been discussed at the TRCC. The Ohio DOT has received funding to collect highly accurate centerline information for 90% of the state. The department works with local officials to collaborate on what information would be collected beyond the required state attributes. Ohio DOT working on building an enterprise intersection table with TRCC funds to meet all of the MIRE FDE requirements. (http://ogrip.oit.ohio.gov/ProjectsInitiatives/LBRS.aspx)

Rhode Island: Yes, the TRCC has been involved with both the project to collect the MIRE elements and the project that will create the database to store collected data and complete the state's LRS on all public roads. Strategic partners of the TRCC include the following: Office of Highway Safety, Rhode Island DOT, FMCSA, FHWA, Rhode Island DMV, Rhode Island Traffic Tribunal, Rhode Island Department of Health, local–state police, and public–private organizations to improve Rhode Island's traffic records system. NHTSA 408/405C grant funding is being used to develop the database (complete LRS) and collect pavement, right-of-way, and the majority of MIRE elements on all public roads.

Washington State: No. The Director of Multimodal Planning is a member of the TRCC. Membership on subcommittees varies and is not coordinated across Washington State DOT. Washington State DOT does work in subcommittee or related groups of the TRCC to address some of these issues. For instance, Washington State DOT, Washington State Traffic Safety Commission, and Washington State Patrol meet periodically to discuss data related issues needs and coordination. These groups are advisory to business owners, but are relatively effective in creating change. The focus of these groups is data integration of hospital and crash records, and development and quality control for crash records.

3. Data sources–streams. Who in your agency is responsible for collecting and managing:

3*a*. Roadway data: basic cross section information that includes lane widths, shoulder widths, median width.

Alaska: The Transportation GIS (TGIS) Section within the Program Development Division's Transportation Information Group is responsible for the basic roadway data collection program. In addition to the roadway centerlines, roadway attributes, and roadway features, the data collection program also provides digital images, lidar, and the pavement condition information. The TGIS staff manages the data collection life cycle, which includes the roadway inventory, quality assurance, integration with the route–milepoint linear referencing, the department's TAM information system (being developed at this time), and other department data systems. TGIS also manages HPMS spatial reporting requirements.

Idaho: The geometric data is collected by the Division of Engineering Services within ITD. This collection is accomplished utilizing both district (field) and headquarters resources and is obtained both manually and electronically.

Iowa: Research and analytics.

Louisiana: The DOTD has a current contract with a private vendor for the collection of HPMS and MIRE roadway data elements for all public roads in the state (the local roads collection is being conducted under the Local Roads Data Collection Project). This includes a common data collection protocol. The state maintained roads were collected in 2010–2011 and these data are currently being delivered to DOTD. DOTD has established a 3-year schedule for the collection on the local roads. The LTAP at DOTD has expressed interest in advancing the timeline for collection for the top 20 parishes. The current roadway data collection effort is based on standards established by DOTD and their vendor.

DOTD collects nearly all of the FDE on the state-maintained system for each MIRE subsection; segments, intersections, and ramps. Additional MIRE elements being collected include: sidewalks, curb cuts, horizontal curve, signs, guardrails, shoulder information, grade, and cross-slope.

DOTD is collecting the following data elements on local roads: horizontal curvature, grade, cross-slope, speed limit signs, sidewalks, shoulder information, curb cuts, median type, number of lanes, lane widths, intersection location and control type, and video log.

Annual average daily traffic (AADT) data are sporadic and limited for local roads. Exposure data are essential to data driven safety analyses and decisions. Some local agencies are collecting traffic data which are not integrated into the DOTD traffic database. These non-DOTD counts may not follow HPMS guidelines, but do provide valuable information.

DOTD has a research project with the University of Louisiana Lafayette to assess currently available traffic data on the local road network and to develop a process to estimate or predict ADT on the local network.

Maryland: Office of Planning, Data Services Engineering Division.

Michigan: Transportation Planning.

Montana: Data and Statistics Bureau, Planning Division.

Ohio: Division of Planning, Office of Technical Services, Transportation Information Management Section.

Rhode Island: Rhode Island DOT Asset Management and GIS.

Washington State: Transportation Data and GIS Office (TDGO): Roadway Data [The roadway data is captured in the Transportation Information Planning and Support System (TRIPS) data system, also known as the roadway log: http://www.wsdot.wa.gov/mapsdata /roadway/statehighwaylog.htm].

3*b*. Crash data from the crash reports for reportable motor vehicle crashes.

Alaska: The crash data manager and team of two data entry specialists and contractors process crash reports collected from the DMV. Most of the major Law Enforcement Agencies (LEAs) provide reports to DMV electronically. Thus the vast majority of the reports received from the DMV are electronic through either the TraCS or proprietary systems. There is also a smattering of hard copy reports that are sent in from small and rural LEAs.

Idaho: All crash reports generated by law enforcement are required by Idaho Code to be submitted to the ITD Office of Highway Safety within 48 h upon completion of the investigation. All crash reports are submitted electronically from all law enforcement agencies. This results in a central repository for crash reports for all roadways (state and local system) in Idaho. The ITD Office of Highway Safety is also responsible for the management of the crash data and dissemination to all requesting parties.

Iowa: Motor vehicle.

Maryland: Office of Traffic and Safety gets a direct data feed from Maryland State Police.

Michigan: Michigan State Police. Crash reporting is approximately 95% digital and if through the software it does not locate properly, an operator does it manually. That data is housed in a central database and is shared with permissions out to other state and local agencies along with the digital images of the crash reports.

Montana: Information Services Division (ISD) and Traffic Safety Engineering.

Ohio: Division of Planning, Office of Program Management, Highway Safety Section.

Rhode Island: Rhode Island DOT Asset Management, Traffic Research Unit.

Washington State: TDGO: Collision Data. This data is captured in the Collision Location and Analysis System (CLAS) data system: http://www.wsdot.wa.gov/mapsdata/tdgo_home.htm #collision.

3*c*. Traffic volume data (including preparation of the estimated traffic volume information for the HPMS; and managing short-term traffic count data).

Alaska: The department's three regions manage the traffic data collection and estimated volume information. The statewide traffic data manager provides the program oversight and prepares the annual HPMS submittal. Of necessity, the GIS staff is involved in completing the HPMS spatial requirements.

Idaho: ITD is responsible to collect and manage the traffic volume data on the dtate highway system and the local road owner (county, city, or local highway district) is responsible for the local system. Traffic volume data for the state highway system is gathered, for the most part,

electronically with permanent automatic traffic recorders and portable electronic data gathering equipment.

Iowa: Systems Planning.

Maryland: Office of Planning, Data Services Engineering Division.

Michigan: Transportation Planning.

Montana: Data and Statistics Bureau, Planning Division.

Ohio: Division of Planning, Office of Technical Services, Traffic Monitoring Section

Rhode Island: Rhode Island DOT Asset Management–Traffic Research Unit.

Washington State: TDGO. Several different parts of TDGO work with travel data.

3*d*. Asset data: bridge, pavement, signage, and other asset datasets

Alaska: The department's Design and Engineering Services Division (D&ES) has a bridge management system, PONTIS, and a pavement management system. The Program Development Division's TGIS Section maintains a Spatially Integrated Roadway Information System (SIRIS), which is composed of the Roadway Data System (RDS), the traffic data system, and the crash data system. The RDS contains the spatial and LRS foundation and the road centerline–LRS network. Most of the bridge and pavement attribute data are maintained by D&ES; the location referencing is accomplished via the bridge number, LRS, or another common key. The RDS also contains other highway attributes that include roadway designations such as functional classification, government boundaries, mileposts, traffic stations, environmental sites, maintenance categories, speed zones, and significant features along the roadway, e.g., rivers.

Idaho: ITD gathers asset data on the state highway system and local roadway owners gather asset data on the local highway system, with the exception that all bridge inspections are coordinated by ITD.

Iowa: The appropriate office responsible for the specific topic.

Maryland:

- Bridge: Office of Structures;
- Pavement: Office of Materials and Technology;
- Signage: captured by Office of Planning, Data Services Engineering Division;
- Guardrails: captured by Office of Planning, Data Services Engineering Division;
- Storm water: Office of Highway Development, Highway Hydraulics Division;
- Green assets: Office of Environmental Design;
- ADA sidewalks, ramps, bicycle compatibility: Office of Highway Development,
- Innovative Contracting Division and Design Technical Services Division; and

- Signals, accessible pedestrian signals, countdown pedestrian signals: Office of Traffic and Safety, Traffic Engineering Design Division.

Michigan: This is an activity that happens at different times and places within Michigan DOT. As such there is currently no single source. Bridges are inspected annually and the data is updated in the Transportation Management System. Pavement data is collected on a cycle and signing is transitioning to an ERSI system from the Michigan Traffic Sign Inventory System.

Montana: Generally, the office responsible for the specific topic collects the asset data for the item. Some assets, signs as an example, are currently not contained in a centralized database.

Ohio:

- Bridges: Division of Engineering, Office of Structural Engineering, Bridge Management Section;
- Guardrails: Division of Engineering, Office of Roadway Engineering Services;
- Speed zones: Division of Operations, Office of Traffic Engineering;
- Pavement condition: Division of Planning, Office of Technical Services, Transportation Information Management Section; and
- Signal inventory: Division of Operations, Office of Traffic Engineering.

Rhode Island: Rhode Island DOT Asset Management–Traffic Research Unit and GIS.

Washington State: Asset data is collected and managed across several divisions of the agency and is not centrally coordinated.

- Bridges: bridge inventory, bridge clearance, design, and condition performance information is contained in the Bridge Engineering Information System, Washington Bridge Information System, Bridge Load Rating and Structural Analysis, Bridge Repair, and Historic Bridges. Data is managed by the Bridge and Structures Office.
- Pavement: pavement-related data are collected and managed by the Materials Laboratory in the Pavement Division as part of the Washington State Pavement Management System.
- Signage: signage data are collected by the regions into the Traffic Signs Management System (TSMS). TSMS is managed by Headquarters Traffic Operations. Location assignment methods differ across regions.
- ADA accommodations: ADA database (to date only includes where most of the needs are and does not include what Washington State DOT has fixed) is managed by the Development Division.
- Fixed objects in clear zone: the Highway Activity Tracking System (HATS) collects and edits asset data associated with Maintenance Office activities. Data that was collected by the Roadside Feature Inventory Program has been imported into HATS.
- Storm water management features: the Stormwater Information Database is managed by the Development Division.
- Roadway performance description: TRIPS is managed by the GIS and Roadway Data Office.

- The Washington Intelligent Transportation Systems (ITS) is managed by the Traffic Operations Division.
- Other asset datasets: a recent review of asset datasets identified a number of systems but it is recognized that there may be systems that are maintained within an office that staff may not be fully aware.
  - Design drawings: CAD, Records Management;
  - Money: expenditures by fund source and programs—TRAINS, Financial Information Retrieval System;
  - Contracts: Transportation Accounting and Reporting System, Construction Contracts Information System, Contract Administration and Payment System, Primavera Contract Manager, Office of Financial Management Enterprise Content Management System;
  - Data and Software: Data or Terms Search, Application and Data Information System; and
  - Highway Access: Road Access Management Permit System.

Washington State DOT's vision for asset data is a data resource that contains the core content needed to meet the department's business needs, is well integrated with systems housing more detailed information and activities associated with asset data, and is findable by employees and Washington State DOT consultants throughout the organization.

3*e*. Maintenance data

Alaska: The Statewide Maintenance and Operations maintains a Maintenance Management System (MMS). The linkage between RDS and MMS is through a common key, although this process is now outdated. Currently there is a request for proposal out to procure a modern maintenance system that is fully integrated with the spatial data applications and SIRIS–RDS.

Idaho: ITD gathers maintenance data on the state highway system and local roadway owners gather maintenance data on the local highway system. ITD uses a structured maintenance management system with the majority of the input coming from the district (field) offices.

Iowa: Maintenance.

Maryland: The Office of Maintenance collects this data and the Office of Information Technology manages this data.

Michigan: This system is currently under development in the Bureau of Field Services as Performance Base Management System (PBM).

Montana: Maintenance Division staff.

Ohio: Division of Operations, Office of Maintenance Administration.

Rhode Island: Rhode Island DOT Maintenance, Asset Management–GIS.

Washington State: Maintenance data are captured in several different systems. The list below represents commonly known systems:

- HATS: The department is implementing a new data collection system for certain maintenance activities. It is intended to become a tool for managing general work operations activities to the roadway system and assets on the system. Over time more activities will be added (http://hatsprod/maintenance/management/activities/).
- Automatic vehicle location operations: Maintenance Operations System; collects information via maintenance equipment used to clear snow, ice, and perform other actions, primarily during winter operations (http://webprod5.wsdot.loc/Maintenance/Management /WinterOperations/Map.aspx).
- Signal Maintenance Management System (SiMMS): this system tracks major electrical systems, their inventory, and related maintenance activities. It is also used to enter work reports for maintenance jobs, print timesheets, and maintain location records for signals inventory. Location information in the system is for junction boxes rather than individual features in the inventory.
- Culvert maintenance management system: enables the collection, storage and reporting of culvert inspections, cleanings and repairs to meet the requirements of the department.

3*f*. Data related to incidents on major corridors (this may be incident response datasets or data from traffic management centers).

Alaska: The department does not have a traffic management center. Any significant incidents hopefully are reported through the regional maintenance and operations staff (weekdays) or through the Alaska State Trooper Operations Centers (night–weekends) and displayed on the http://511.alaska.gov traveler information site.

Idaho: Incident data (and management of incidents) is gathered by both ITD and local agencies. One statewide traffic (incident) management center is located in Boise for the ITD system and the Ada County Highway District has a small traffic management center for the management of traffic and incidents for the local roads in the Boise metro area.

Iowa: Traffic Operations.

Maryland: Coordinated Highway Action Response Team (CHART).

Michigan: ITS Traffic Operations Centers. These exist in Michigan DOT Grand Rapids and Metro regions, the city of Detroit, and Michigan DOT Central Office in Lansing for the Statewide Transportation Operations Center.

Montana: Traffic Safety Engineering via crash data (this would not be real-time incident management), and Maintenance Division staff.

Montana: Traffic Safety Engineering and Maintenance Division staff.

Ohio: Division of Operation, Office of Traffic Engineering.

Rhode Island: Rhode Island DOT Maintenance, Traffic Management Center (TMC)

Washington State:

- Washington Incident Tracking System: tracks field reports of incident response teams working on major corridors.
- TMC System: captures traffic management related information (closures, construction, incidents) as part of the management of the traffic management centers in the state and the Washington State DOT travel information system.

4. State safety program and related activities. Who in your agency is responsible for:

4*a*. Safety analysis for the SHSP development and monitoring.

Alaska: The Program Development Division is the lead for department's SHSP. The State Crash Manager and the Transportation Data Programs Manager are the SHSP coadministrators. However, there are multiple partners involved in developing the plan. There are three emphasis areas, each with a cochair: driver behavior, roadways, and special users. The cochairs are responsible for monitoring the emphasis area task progress.

Idaho: The ITD Office of Highway Safety is responsible for the analysis of data for the SHSP. This work is performed by research analysts that are part of the Office of Highway Safety staff.

Iowa: Traffic and Safety.

Maryland: Maryland Motor Vehicle Administration's (MVA), Maryland's Highway Safety Office (behavioral information), and SHA's Office of Traffic and Safety (infrastructure and pedestrian information).

The MVA's Highway Safety Office (MHSO) is the agency for responsible for coordinating the SHSP. As part of the coordination of the SHSP, the MHSO works with the University of Maryland, Baltimore's, National Study Center for Trauma and EMS (NSC) which currently houses Maryland's Crash Outcome Data Evaluation System (CODES) program. MHSO and NSC work together to provide data support to all SHSP Emphasis Area Teams (EAT) through a Data Coordination Support Team, which ensures that each EAT has a data coordinator. Staff from the NSC, at least annually, provides an update on crash data (fatalities and serious injuries) to evaluate where Maryland stands in relation to its SHSP goals. (The NSC also supported the MHSO in developing the target setting methodology for the current SHSP as well as the upcoming 5-year SHSP renewal, 2016–2020.) In addition to fatal and serious injury crash data evaluation, the MHSO and the NSC conduct an annual driver survey that measures the knowledge, attitudes, and behaviors of Maryland drivers. The survey was developed using the SHSP framework and results from the survey are used to evaluate the effectiveness of the SHSP emphasis areas.

Michigan: Traffic and Safety.

Montana: Traffic Safety Engineering and Highway Traffic Safety Section.

Ohio: Division of Planning, Office of Program Management, Highway Safety Section.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety

Washington State: The Washington State Traffic Safety Commission (WTSC) (http://www.wtsc.wa.gov/) has lead responsibility for performing the safety analysis for the 2013 State SHSP, Target Zero. However, Washington State DOT and the Washington State Patrol also develop yearly crash reports for use in carrying out and implementing Target Zero. Each entity works as a partner as necessary to achieve the collective goals.

4b. Safety analysis for identifying potential locations or corridors for further evaluation or for investment (aka network screening).

Alaska: Statewide and regional traffic and safety personnel manage the HSIP, develop and implement policies on traffic safety, operation, and traffic control devices. They produce and maintain the *Alaska Traffic Manual*, the *Alaska Sign Design Specifications Manual*, traffic-related standard drawings, and the *Alaska Highway Safety Improvement Program Handbook*.

Idaho: Safety analysis for the Idaho Highway Safety Corridor Analysis program is performed by the District (field) Traffic Safety Engineer with coordination provided by the Office of Highway Safety. This work is only performed on the state highway system.

Iowa: Traffic and Safety.

Maryland: Office of Traffic and Safety, Office of Planning and Preliminary Engineering, Office of Highway Development.

Michigan: Traffic and Safety.

Montana: Traffic Safety Engineering.

Ohio: Division of Planning, Office of Program Management, Highway Safety Section.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: The Capital Program Development and Management Office at headquarters performs and leads network screening for the I2 safety program, using AASHTOWare Safety Analyst. Safety Analyst is available to any office or region within Washington State DOT for network screening. Its current use is limited to mostly the I2 safety program. Multimodal Planning, Traffic Operations, and Development Divisions have responsibility as appropriate for the respective regions they work in. Traffic Operations, Development, Multimodal Planning, and Enterprise Risk and Safety Management Divisions have differing roles in safety analysis as well. Because Washington State DOT does not have a specific safety office, roles are shared in a matrix fashion. (NOTE: The I2 safety program is the capital safety program of WSDOT.)

4*c*. Analysis of contributing factors of crashes at given locations or for corridors.

Alaska: While the statewide and regional traffic and safety staff perform the primary crash analysis, the crash data manger also provides reporting and analysis for contributing factors.

Idaho: Analysis of contributing factors is primarily done by the District (field) Traffic Safety Engineers with support from the Office of Highway Safety. Both behavior and infrastructure contributing factors are evaluated. Road Safety Audits are also employed when warranted.

Iowa: Traffic and Safety.

Maryland: Office of Traffic and Safety, District Traffic Offices.

Michigan: Traffic and Safety, Region and Transportation Service Center Safety Staff.

Montana: Traffic Safety Engineering.

Ohio: Each district has a District Safety Review Team Coordinator that does the primary investigations to present to the Central Office for funding.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: This analysis takes place across multiple offices in the department and across regions as part of the project development process. In some business processes the function is centralized and in others it is not.

4*d*. Identification and evaluation of countermeasures (including performing an economic valuation of alternative countermeasures).

Alaska: The regional Traffic and Safety offices provide traffic engineering support to Planning, Preliminary Design, Design, Construction, and Maintenance staff. They see that regional plans and activities comply with applicable traffic control device standards, and provide expertise on safety countermeasures, traffic signals, street lighting, signs, striping, crashworthy hardware, work zone traffic control, capacity analysis, and railroad crossings.

Idaho: This is performed by the District (field) Traffic Safety Engineers utilizing ITD's Highway Safety Corridor Analysis program.

Iowa: Traffic and Safety.

Maryland: Office of Traffic and Safety, Office of Planning and Preliminary Engineering, Office of Highway Development.

Michigan: Local Agency Programs, Traffic and Safety. Performing predictive analysis as described in the HSM. This is done in the department's Traffic and Safety section.

Montana: Traffic Safety Engineering.

Ohio: Each district has a District Safety Review Team Coordinator that does the project evaluation to present to Central Office for funding.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: These activities take place across multiple offices in the department and across regions as part of the project development process. In some business processes the function is centralized and in others it is not. Washington State DOT also has formed a "gateway committee" that reviews region scoped projects to provide expert advice and direction on countermeasure usage and economic evaluation. A subcommittee, led by Headquarters Traffic Operations, is responsible for developing a "short list" of CMFs available from FHWA's Crash Modification Clearinghouse. The focus of this effort is to determine the most reliable CMFs based on the context and classification of the CMF to provide consistency of application across Washington State DOT Regions.

4*e*. Performing predictive analysis as described in the HSM.

Alaska: Statewide Traffic and Safety staff perform this function.

Idaho: This is performed by the District (field) Traffic Safety Engineers utilizing ITD's Highway Safety Corridor Analysis program.

Iowa: Design at the initial phase of implementation

Maryland: Office of Traffic and Safety, Office of Planning and Preliminary Engineering, Office of Highway Development.

Montana: Traffic Safety Engineering.

Ohio: Each District has a District Safety Review Team Coordinator as well as staff in the Highway Safety Section. The Central Office assists with site analysis techniques and reviews.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: Currently these activities take place across multiple offices in the department and across regions as part of the project development process. The Headquarters Development Division and Traffic Operations usually play an oversight role with the analysis and in some cases perform the analysis for regional offices. Washington State DOT's intent is to build on the skillsets of staff to allow staff across regions and business units to perform this analysis. Washington State DOT has developed an executive policy on the roles and use of the HSM. The Director of Engineering Policy and Innovation, and Enterprise Risk and Safety Management, are working to institutionalize the HSM with the DOT Multimodal Safety Executive Committee.

5. General data-related questions. Who in your agency is responsible for:

Michigan: (General comment) Data collection is spread out within the department. Most of Michigan DOT's data is created as the outgrowth of an existing process, and when that process stops so does further data development. Even though these questions are being asked for safety analysis purposes, Michigan DOT does not have large data collection programs (other than traffic, bridge condition, or pavement condition). So it is not that the department is not collecting data for safety, Michigan DOT does not collect for any one specific program. Data is collected on cycles per specific programs in different areas of Michigan DOT. There are current attempts to create an enterprise-level system for this data to be used alongside one-time collected sets.

5*a*. Making decisions about what data to collect in order to support the safety program or integration of safety into project development?

Alaska: No enterprise governance entity exists that makes the call on what data to collect to support the safety program or integration of safety into project development. However, the Transportation Asset Management Information System (TAMIS) will focus on road inventory needs and will provide a data registry to track the data element life cycle. The data registry is expected to rollout in 2015. There is a concerted effort to incorporate the MIRE FDE into the road inventory program.

The Program Development Division has several data initiatives to support the safety program: SIRIS, Data Value Assessment, and Enterprise Data Collection.

- SIRIS is composed of the RDS, the Traffic System, and the Crash System. RDS is the Alaska DOT&PF's LRS which is based on Alaska DOT&PF's road centerline network. It includes many common roadway inventory features and attributes and currently covers all roads in Alaska with a functional class rating above local. The three separate SIRIS components integrate using a common road centerline–LRS network. Integrating the Traffic and Crash systems with RDS through SIRIS will make it easier to share and receive information from other transportation datasets such as bridge, pavement, and maintenance systems. A spatial data model incorporates the key fields for the traffic and crash system and provides linkage tools for other data sets. This includes the key feature classes, event tables, and jurisdictional boundaries.
- Data Value Assessment. The Transportation Information Group (TIG) developed a data value assessment to determine if a new feature should be added to the RDS. The assessment focused on three aspects: management of the data, use of the data, and impacts on the RDS. The assessment contains 16 questions to help both the requester and TIG to decide if the new future should be added to the RDS. Four fundamental background questions help focus on the request for a new feature:
  - Is there one or more state, federal, or internal management requirements to collect and report this feature?
  - Please explain who is requiring this data feature?
  - Please explain how the management of the data feature will be funded?
  - Please explain how the data feature is going to be used?
- Enterprise Data Collection. One of the shortfalls to past integration efforts has been lack of a common LRS. Many data collection events were one-time projects; bringing the data sets into an enterprise GIS-required significant work. For the first time, key data owners agreed

on a single data collection platform for road centerlines, digital imaging, LIDAR, and pavement condition. This is a great start to expanding to an enterprise data collection strategy. Feature extraction is a key part of the data collection contract. Roadway information, including lanes, signs, and bridges are routinely extracted. Location and attributes of other features can be extracted, either in house or through contractual services.

Idaho: The Office of Highway Safety is the leader in collaboration with the districts, Local Highway Technical Assistance Council, and law enforcement.

Iowa: Traffic and Safety and Motor Vehicle.

Maryland: There are many offices that contribute to data collection decisions for various safety-related activities.

Michigan: Traffic and Safety; however, in the near future this is going to be driven by MAP-21 and MIRE FDE.

Montana: Traffic Safety Engineering, Data and Statistics Bureau, Planning Division, and Information Services Division.

Ohio: It is a joint effort between the two sections of Highway Safety and Transportation Information Management in the division of planning.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: Individual business offices are responsible for data collection decisions, although considerable enterprise-level discussions are ongoing related to this issue. In particular, the Enterprise Information Governance Group has developed a set of guiding principles to inform these decisions on future data collection efforts. The Multimodal Safety Executive Committee (MSEC) may set policy related to these issues and the Multimodal Safety Issue Group (MSIG) may provide technical assistance.

5*b*. Recommending and championing investments in safety data improvements?

Alaska: This is a joint effort involving the work programs with the Transportation Information Group (GIS, traffic crash, highway designations) and traffic and safety staff (regional and statewide). Safety data improvements are also championed by members of the TRCC.

Idaho: The Office of Highway Safety is the leader in championing investments in safety data improvements.

Iowa: Traffic and Safety and Motor Vehicles.

Maryland: TRCC for crash data; various SHA offices for other roadway-specific data.

Michigan: Traffic and Safety.

Montana: Traffic Safety Engineering, Data and Statistics Bureau, Planning Division, and Information Services Division.

Ohio: Division of Planning, Office of Program Management, Highway Safety Section.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety

Washington State: Individual business offices are responsible for such activities. There is currently discussion about forming subject domains to foster collaboration and alignment of data amongst business offices.

5*c*. Developing safety data collection requirements or specifications?

Alaska: This is a joint effort encompassing the work programs with the TIG involving GIS, traffic, crashes, highway designations, and traffic–safety staff (regional and statewide). The roadway inventory program and the SIRIS–RDS data model incorporate the MIRE. The safety data elements follow the same data collection and feature extraction specifications as other road inventory roadway features.

Idaho: The Office of Highway Safety takes the lead role.

Iowa: Traffic and Safety and Motor Vehicles.

Maryland: TRCC for crash data; various SHA offices for other roadway-specific data.

Michigan: Traffic and Safety.

Montana: Traffic Safety Engineering, Data and Statistics Bureau, Planning Division, and Information Services Division.

Ohio: Historically, it is a joint effort between the two sections of Highway Safety and Transportation Information Management in the division of planning. There is a new data governance Committee in the Division of Planning that is trying to be more formal about the format of specific attributes.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: Individual business offices have been typically allowed to set the requirements and specifications. However, as budget concerns have increased, the Enterprise Information Governance Group (EIGG) has developed principles to help guide these decisions. Discussions are ongoing as to the enterprise versus business responsibilities for these decisions.

As it relates to crash data: the TDGO Collision Data Unit develops crash related specifications but only as it relates to the capturing of crash data from the Police Traffic Collision Report. TGDO is represented on the state TRCC where such activities can be initiated if deemed necessary by TGDO's Collision Office.

5*d*. Working with individuals or groups that perform safety analysis to understand their data needs and concerns?

Alaska: The regional and statewide traffic and safety staff perform the HSIP crash analysis. The TIG and specifically the crash data manager, works with the traffic and safety staff to understand their needs and concerns. This was particularly true in building the specifications and requirements for the new crash analysis and reporting system.

Idaho: The Office of Highway Safety takes the lead role.

Iowa: InTrans, LTAP and Traffic and Safety, Research and Analytics.

Maryland: Office of Traffic and Safety, Traffic Development and Support Division.

Michigan: Traffic and Safety.

Montana: Traffic Safety Engineering and Highway Traffic Safety Section.

Ohio: This is mainly the Highway Safety Section unless it is a specific location which is delegated to the districts to coordinate.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety.

Washington State: The MSEC is responsible for providing the policy and direction related to data needs and concerns, the MSIG is responsible for the technical aspects. Washington State DOT works both internally and externally to understand these needs through periodic meetings with partners.

5*e*. Monitoring and improving safety data quality?

Alaska: The regional and statewide traffic and safety staff, through their HSIP crash analysis, will often discover data problems. The TIG and specifically the crash data manager works with the traffic and safety staff to understand data problems and potential solutions.

Idaho: The Office of Highway Safety takes the lead role.

Iowa: Statewide TRCC.

Louisiana: There is a standard process and business rule for adding data to Surface Type Log (STL). Currently there are no automated QA checks taking place within the system. There is also no standard process to provide feedback on data quality once it is entered into the system.

DOTD currently conducts manual sampling of 20% of the roadway attribute data collected on the state system. The long-term plan is to sample at a much lower rate (5%) on the data collected on the local roads. Section 21 does not have easy access to as-built plans for updating roadway attributes.

Maryland: Office of Traffic and Safety, Traffic Development, and Support Division; Office of Planning and Preliminary Engineering; Office of Materials and Technology.

Michigan: Traffic and Safety. This is currently done to meet a specific data need as it is identified along with when required resources are available.

Montana: Traffic Safety Engineering and Highway Traffic Safety Section.

Ohio: Highway Safety Section and the staff at the Ohio Department of Public Service, Traffic Safety Office.

Rhode Island: DOT Traffic Management and Highway Safety and Asset Management–GIS.

Washington State: Data stewards of the individual datasets are responsible for monitoring and improving data quality. Any office may raise a concern related to data quality, and working groups are often designated to coordinate and facilitate data quality discussions between business offices, the individual data stewards, or the user of data utilized in performing the safety analysis. Washington State DOT is working to create a greater level of understanding on data and the use of data for differing levels of analysis. For instance, what might be the level of data quality for a research or design need versus a high-level planning need?

5*f*. Ensuring and improving integration across different data sources in order to support the safety program, and integration of safety into project development?

Alaska: The key to effective integration is having an enterprise LRS and road centerline network. While there is agreement on these principals, there needs to be substantive work accomplished to ensure integration between systems and provide access to the published road network.

Idaho: The Office of Highway Safety takes the lead role.

Iowa: Statewide TRCC

Maryland: Office of Planning and Preliminary Engineering, Data Services Engineering Division.

Michigan: All data can be integrated, technically, as Michigan DOT has implemented a LRS that is virtually used in all of the department's asset databases.

Montana: Traffic Safety Engineering, Highway Traffic Safety Section, and Information Services Division.

Ohio: Ohio DOT's Highway Safety Section and the TRCC.

Rhode Island: Rhode Island DOT Traffic Management and Highway Safety and Asset Management.

Washington State: Individual champions and high level users have typically raised the need for integration of data sets across business units. The EIGG is currently working to raise awareness and to develop policy related to this issue.

6. Do you have formally defined roles for data governance in your agency? If so, please describe the roles and provide an organizational chart.

Alaska: None at this time, but is planned as part of the department's TAMIS data business plan and within the TIG. The TAMIS business plan will lay the framework for business areas that use data systems, as TAMIS will be the only enterprise-wide governance structure.

At the Program Division level, the TIG is assigning roles and responsibilities through a two-tiered governance structure:

- Data Governance Board. Thisb will consist of high-level TIG managers to assist in resolving disagreements, prioritizing staff time, and offering insight from a broader DOT&PF perspective.
- Data Management Team. This team will consist of TIG data managers and a TAM representative that will make data governance decisions and manage the data governance process. Initially, there will be one Data Management Team for all SIRIS components. However, this may grow to more than one team if there ever is a clear separation of actions around groups of data elements.

The key role of the Data Management Team is to

- Evaluate existing and proposed data sets using the Data Value Assessment Form and respond to requesters;
- Develop a data model and data integration plan for each approved data set;
- Implement data management solutions; and
- Develop and operate a catalog of significant data sets.

Idaho: No.

Iowa: Yes, see the answers to question 3a. for the roles.

Louisiana: DOTD does not have a currently have an overall data governance structure. The Data Collection and Management Section (Section 21) of the DOTD has a vision to integrate databases into an enterprise system across all units within DOTD. This vision stemmed from inheriting multiple data assignments from other groups with no additional staffing or resources. Section 21 has assumed the responsibility of identifying relevant DOTD databases and ownership, as well as establishing current and future needs for an enterprise data system. This effort has been supported by findings from the IT Enterprise GIS Planning Report (September 27, 2012). A core group was established to implement the report findings.

Maryland: Maryland SHA does not have agencywide data governance roles established at this time. SHA does have a policy for crash data ownership, maintenance, and dissemination.

Michigan: Michigan has established a Data Governance Council with members from the business and IT communities.

- Michigan DOT members are at the manager (second-line supervisor) level, or are senior staff. IT members are a mix of management, and key data staff.
- The IT people are executing various tasks to further the technical execution of good data management practice.
- Although Michigan DOT does have data stewards identified, these are for the execution of the change management processes being put in place. There is no organizational chart, as yet.

Montana: Montana DOT has a TRCC, part of a NHTSA requirement.

Ohio: This committee was just created and there has been no formal role or organizational chart developed.

Rhode Island: Rhode Island DOT is currently participating in a pilot project for Local–State Data Integration for Asset Management and Safety Analysis. The project will assist DOT and selected local agencies to: develop processes and identify staffing and resources needed to guarantee the ongoing maintenance and utility of the roadway location and MIRE inventory data; and manage data integration and assist DOT in developing processes for integration of the new MIRE data into the LRS database (Esri Roads and Highways) for use in safety analysis. This project is expected to be completed by the end of April 2015.

Washington State: Washington State DOT is currently establishing an EIGG. The roles and responsibilities are being discussed in terms of appropriate levels of governance for differing activities.

7. Do you have an agencywide data governance body? If so, can you provide more information to explain how it works?

Alaska: The department is moving toward an agencywide governance body for the TAMP and the TAMIS. The TAMIS involves multiple agency databases, including SIRIS, RDS, crash data system, and the traffic data system. There have been extensive developments in the TAMP and TAMIS this past year; here are a few key elements:

- TAM Governance Teams:
  - Executive Leadership Team: Alaska DOT&PF Commissioner, three deputy commissioners, and three regional directors. Owns the TAM implementation process, sets the TAM objectives, solves resourcing and support problems, coordinates implementation, and sets technical teams;
  - Steering Committee: director-level participation on guiding the TAMP and TAMIS development and deployment;
  - Communications Team: communicates and markets TAM principles and processes;

– Planning and Programming Team: prioritizes, plans, and programs TAM projects based on performance-based standards;
– Data Integration Team: implements data collection and manages the TAMIS improvement;
– Highway Technical Team: addresses TAM highway matters involving pavement, geotechnical, bridge, and traffic–safety areas;
– State Equipment Fleet–Public Facilities Technical Team: addresses TAM concerns involving state buildings and motor vehicles under DOT&PF management;
– Aviation Technical Team: addresses the two international airports, the international airport system, and public airports;
– Marine Highway Technical Team: addresses the state's marine highway system and the state's ports and harbors.

- Department Policy and Procedure for Data and Information Systems Governance (draft) establishes a structure for developing, approving, and managing standards, procedures and manuals, following the AASHTO data principles, to ensure consistency across the department. Alaska DOT&PF added four additional principles for Alaskan-unique IT and information management situations.
- TAMIS Data System Evaluation evaluated the data and information systems that should be included in the TAMIS, including the Crash Data Entry System, CRASH, SIRIS–RDS, and the Traffic Data System.
- TAMIS Framework defined key integration points and data catalog (business data owner, steward, custodian, and stakeholders) for the TAMIS data systems.
- TAMIS Gap Analysis examined gaps in data systems, hardware–software, and business processes using a capability maturity model to identify issues that prevent the "desired state." The Gap Analysis also examined the linkages between highway safety, road system performance, and asset management. Safety data governance is very much part of the gap analysis.

Iowa: Yes, the following describes the current state of data governance at the Iowa DOT.

Data governance is defined as the execution and enforcement of authority over the management of data assets and the performance of data functions. Data governance defines how an organization coordinates the strategic management of data and information resources. This includes establishing clear roles, responsibilities, and authorities through data governance committees and works structures.

Data governance promotes the understanding of data as a valuable asset to the organization and encourages the understanding and management of data from both a technical and business perspective. It provides an enterprise focus for identifying and controlling the collection, storage, and sharing of data. A data governance framework documents key business programs and data systems, and defines roles and responsibilities for data custodians.

The department's application development teams typically take direction from their data custodians, and the organizational structure makes it difficult to look beyond the needs of those data custodians when creating applications, systems, and data repositories. The most significant issue that emerged from the Enterprise Data Architecture Committee's analysis is that there was no governance body looking out for the needs of the enterprise.

The Enterprise Data Architecture Committee recommended that the Iowa DOT create a formal data committee that is made up of select data custodians, program, and technology

experts. The data committee reports to the Information Processing Steering Committee. The newly formed data committee has developed a vision, mission, and objectives for data availability within the Iowa DOT.

The newly formed data committee has created a data model. The model includes a framework to show the relationship between the IP Steering Committee, Data Governance Committee, and data custodians of the Iowa DOT. This model also includes a clear description of roles and responsibilities of the data committee, data custodians, and the IT division. Finally, the model addresses the process for making decisions related to data system investments at the Iowa DOT.

Louisiana: No.

Maryland: In 2012, SHA created the Data Services Engineering Division (DSED) as a branch of the Office of Planning and Preliminary Engineering. One of the missions of DSED is to identify a strategic approach to data management for both DSED and agencywide. DSED's plan is designed to support overall data management throughout the agency, and to provide a starting point for data governance standards and policies for categories of data such as safety, asset and mobility data. This plan is still under development at this point.

Michigan: Yes.

Montana: Not at this time, working towards a data governance strategy as part of Montana DOT's EA project.

Ohio: This is the committee that is just being developed.

Rhode Island: An agencywide data governance body has not been formally identified at this time: however, the department anticipates a governing body to be established through the pilot project for Local–State Data Integration for Asset Management and Safety Analysis.

Washington State: Washington State DOT is currently establishing an EIGG. Roles and responsibilities are currently being defined and discussed.

8. Do you have a data governance body that specifically focuses on data for safety in the DOT? If so, explain how it works.

Alaska: No enterprise safety data governance body exists. Most successes are a result of collaboration between dedicated staff from multiple work centers. The TIG Data Management Team focuses on road network and safety related data that includes the RDS and crashes. The data governance framework is not specific to safety data though. The TAMIS development reflects the importance of data governance for safety. The HSIP process also involves data governance best practices. The new crash analysis and reporting system also considered data governance.

The TIG has developed data principles (similar to the AASHTO Data Principles) to guide the actions of the Data Governance Board, Data Management Teams, Data Stewards, Data Custodians, and Data Owners. These founding principles will guide the data governance

structure toward building and maintaining a quality data set that customers want to use and that data stewards will want to always contribute to and support. The TIG Data Principles are:

- Principle 1: All SIRIS critical data shall be described by Metadata.
- Principle 2: All SIRIS critical data shall have a defined Data Steward.
- Principle 3: SIRIS critical data shall not be duplicated.
- Principle 4: SIRIS data governance shall seek a balance between all that is possible and what is practicable.
- Principle 5: The owners or experts of a data set shall be the Data Steward.

Idaho: The TRCC currently serves this function.

Iowa: Yes, a subset of the statewide TRCC.

Louisiana: No.

Maryland: The TRCC acts as a traffic safety governance body in that the Technical Committee sends recommendations to the Executive Committee on data governance-related topics, but the Maryland State Police is the ultimate data governing body.

Michigan: No.

Montana: No.

Ohio: The Highway Safety Section does this informally to provide consistent data to the districts.

Rhode Island: Rhode Island DOT does not have a data governance body at this time, however, the department anticipates a governing body to be established through the pilot project for Local–State Data Integration for Asset Management and Safety Analysis.

Washington State: The MSEC and MSIG are de facto governance bodies for safety data, as these groups set the policy and technical direction for Washington State DOT.

9. Have your safety data workflows been analyzed and mapped? Please provide an example.

Alaska: The multiagency Crash Data Repository (CDR) provides a central distribution for the new electronic crash reports from TraCS and other proprietary systems. Agencies developed the CDR following ITS systems engineering principles. The concept of operations detailed the crash data workflow. A high-level work flow analysis is shown in Figure 2.

The department is procuring a new CRASH to replace the 30-year-old mainframe legacy system. The new system will be integrated with the RDS through SIRIS. The concept of operations and detailed system needs and requirements for the new crash system provides work flow details (current and envisioned) in sufficient detail to procure the system. Alaska DOT&PF modeled the safety data workflow for processing crashes into the department's transportation

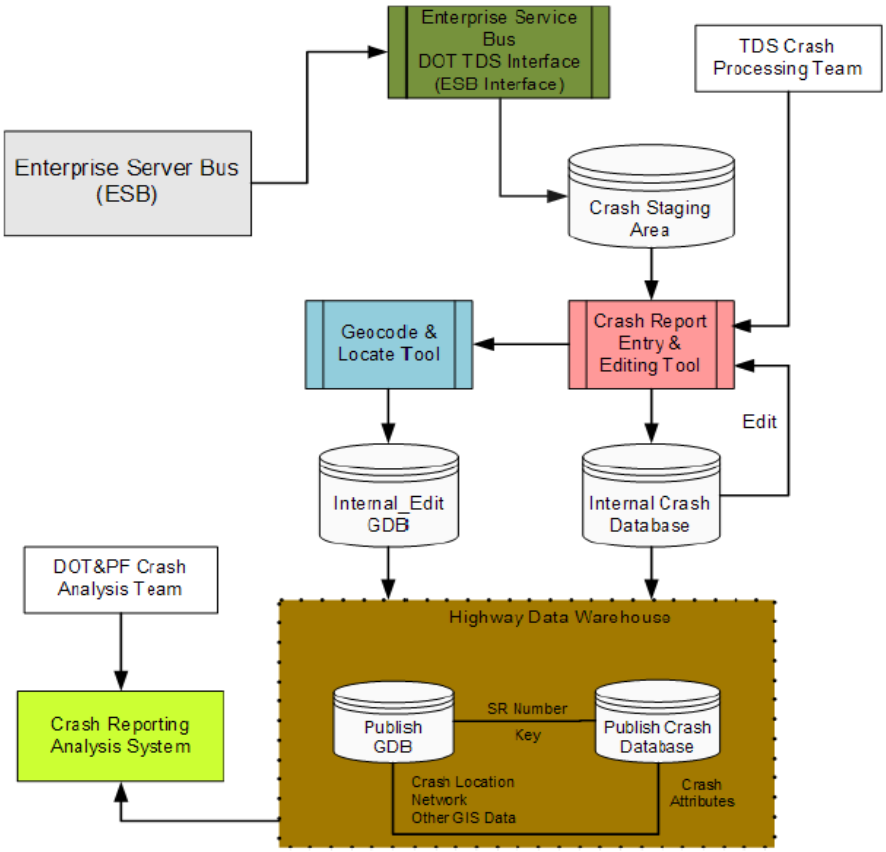


FIGURE 2 Alaska DOT&PF crash work flow analysis.

databases using Unified Modelling Language Use Cases. These work flows were part of the Concept of Operations and User Needs and Requirements for the new crash data system.

Workflow is another important piece to data governance, i.e., work flow defines the technical and policy related activities to be performed to execute the data governance. The SIRIS data governance workflow outlines a series of steps to take when considering new data sets and implements a strategy for governing each data set. Safety data sets are an integral part of the work flow analysis and mapping. There are three steps in the workflow analysis and mapping:

- Register and catalog existing and new data sets. The first step is to register and catalog existing and new data sets. The registry is simply a catalog of each data set and its metadata. Fortunately the TAM data integration team is creating an information system and data registry that serves a similar purpose for all department critical data sets. They will use the SIRIS data elements as it first entry. Sharing the data registry will reduce any duplicative efforts between the TAM efforts and SIRIS data governance.
- Evaluate and score existing and new data sets. The transition team created a Data Value Assessment Form to evaluate and score new data sets. This step will allow the transition team to define the critical data elements and document sufficient descriptions of each one. The Data Value Assessment Form includes a list of questions about the proposed data request. If the Data Management Team determines that a proposed data set is critical, they will determine

where on the data management solutions spectrum the data set falls. This step is essential as it determines where the data will be stored and how the data set will integrate with SIRIS components. An illustration of the data management solutions spectrum is shown in Figure 3.

If a data set were to fall in the "registered in catalog only," it will be stored external to SIRIS components but registered in the SIRIS catalog to enable management and access. The further to the right of the spectrum the data set falls, the more closely it integrates with SIRIS.

- Data Management Team review. The Data Management Team will review and notify the individual or group that initiated the request with feedback and a formal response. If the data set is not selected as a critical SIRIS data set, an explanation will be provided. If the requestor wishes to pursue the discussion further, the Data Governance Board will review and respond. If the data set is selected (i.e., considered critical to SIRIS), the team will provide feedback and suggestions to the requestor along with further instructions on next steps.

It is not the intent of the Data Management Team to turn down a request or to do all the work if the request is approved. The overall intent is ensure improvements to the data are ongoing and to always maintain focus on developing quality data sets. This is also an education process for those requesting the data. Often a requestor is unaware of the level of effort it takes to "just add a data layer" or to "just revise a current layer." It is the Data Management Team's job to educate the requester that if they want quality data then these are the questions (Data Value Assessment Form) that must be answered in order to ensure a quality data set. If the team can't approve it then the requestor has more knowledge about what it takes to provide and maintain quality data. Also, as time goes by, users start to think of the SIRIS data set as an asset or resource that they can truly value and support.

A key point to recognize is that this process is addressing the key data elements that should be included in the spatial geodatabase and is integral to the location referencing process. There could be many fields associated with a data set that can potentially be stored in another database. In this case, the key fields are stored in the geodatabase while most of the other fields are in another database. In the safety case, both data sets are in Oracle, with the primary data sets for location referencing in the geodatabase.

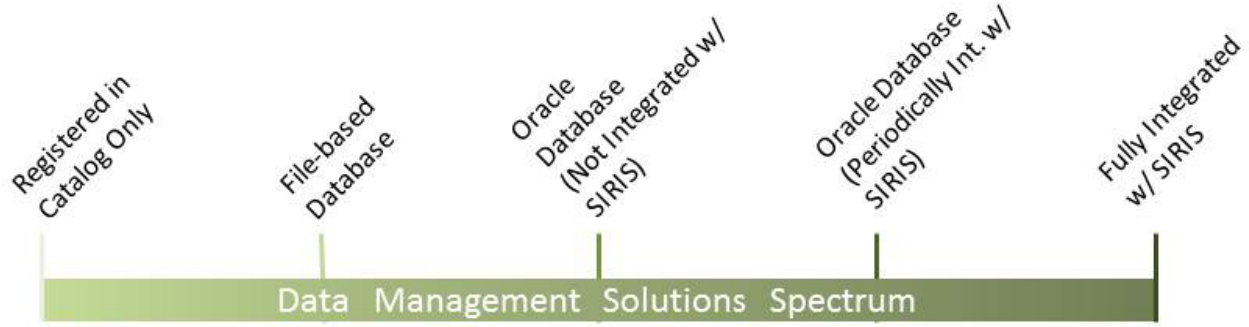


FIGURE 3 Alaska DOT&PF data management solutions spectrum.

Idaho: No.

Iowa: Analyzed, not mapped.

Louisiana: No.

Maryland: Yes, Maryland SHA has analyzed and mapped the high-crash locations and workflows in a Fund 76 Flow Chart as shown in Figure 4.

Michigan: Michigan DOT currently does not have a defined workflow process for all areas of Safety. Safety Analyst is determined internally with references to Michigan Sufficiency, CRASH, and other databases. The department's Roadsoft efforts have resulted from continuous contributions from both state and local agencies along with the utilization of framework information from the Department of Technology Management and Budget–Center for Shared Solutions (DTMB-CSS).

Montana: Analyzed but not mapped.

Ohio: This has not been created for the Ohio DOT specifically. Figure 5 displays the relationship between the department and the Ohio Department of Public Safety (DPS).

Rhode Island: There is no formal safety data workflow at this time. One will be established as part of the pilot project for Local–State Data Integration for Asset Management and Safety Analysis.

Washington State: Yes. A data workflow diagram for the Highway Safety Project Program–Process was prepared as part of the strategic plan for sustainable highway safety at the department.

10. Have your data business rules been documented to facilitate safety data processing, quality assurance, interpretation, and use and to ensure continuity with staff turnover?

Alaska: With the transition to a new data storage system, there is an effort to update the crash entry desk manual to include new processes and QA/QC. The purpose of the document is such that a new person can sit down with it and adequately process a crash just by reading it.

Idaho: Yes, through ITD's safety business data.

Iowa: No, except for the data contained in the Geographic Information Management System (GIMS).

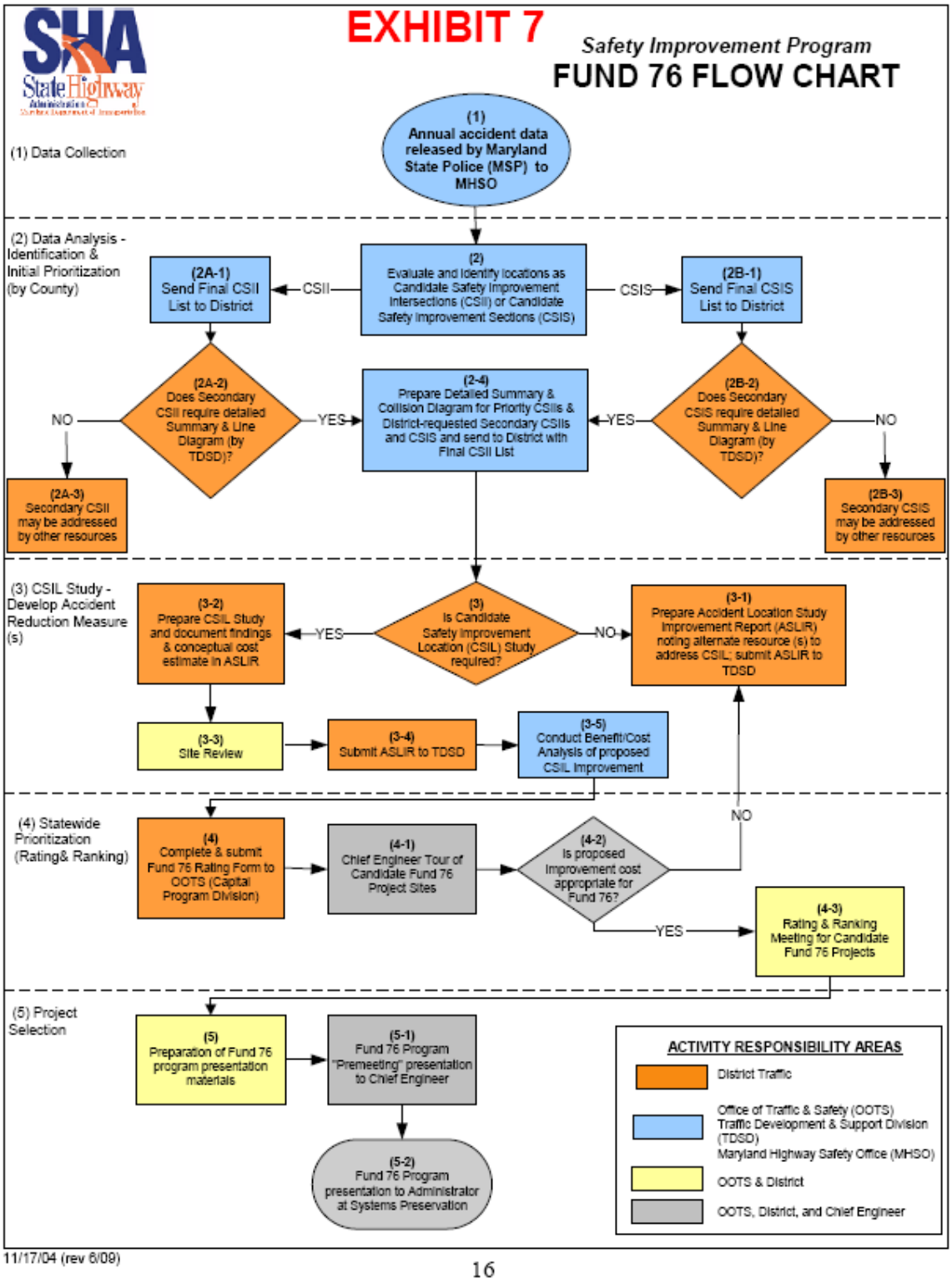


FIGURE 4 Maryland SHA Fund 76 flow chart.

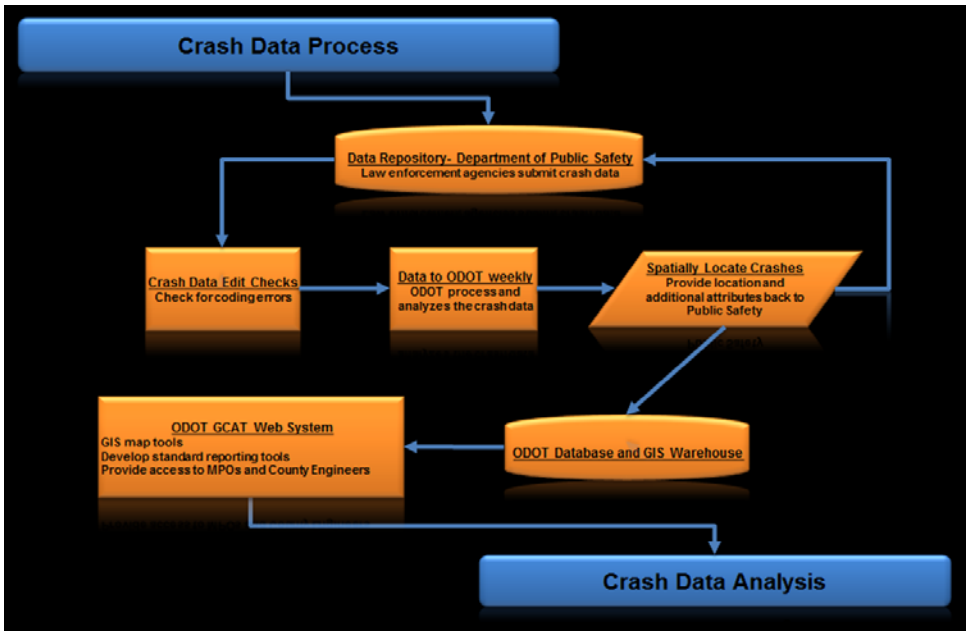


FIGURE 5 Ohio DOT and DPS crash data flow diagram.

Louisiana: No.

Maryland: SHA does not have document standard operating procedures, but recognizes the value.

Michigan: No.

Montana: No.

Ohio: The IT process is very well documented. The functions of the Highway Safety Section have not been formally documented. This has resulted from Ohio DOT efforts to regularly attempting to improve the quality of the data.

Rhode Island: The pilot project for Local–State Data Integration for Asset Management and Safety Analysis will assist Rhode Island DOT in identifying and documenting the processing, quality assurance, interpretation, use, and staff resources required now and going forward with this data collection effort.

Washington State: The TDGO Collision Office is currently updating the CLASS coding manual that will provide some information to users of the crash data about coding procedures and practices. Washington State DOT is not aware of any other activities described in the question. Please note that CLASS is a legacy system.

11. Have common geospatial and linear reference-based systems been established for:

Alaska: (General comment) The Program Development Division's TGIS Section maintains the department's SIRIS, which is composed of the RDS, the Crash Data System, and the Traffic Data System. The RDS is the Alaska DOT&PF's LRS which is based on the department's road centerline network. It includes many common roadway inventory features and attributes and currently covers all roads in Alaska with a functional class rating above local. RDS contains the spatial and LRS foundation and the road centerline–LRS network. The RDS also contains other highway attributes such as roadway designations, functional classification, government boundaries, mileposts, traffic stations, environmental sites, maintenance categories, speed zones, and significant features, e.g., rivers. The three separate SIRIS components integrate via through a common road centerline–LRS network. The road inventory data collection is through a professional services contract.

Idaho: (General comment) Prior to answering the specific questions for section 11 below, Idaho uses a route identifier with beginning and ending milepoints to define its segments. This LRS is defined for all state highways, federal-aid highways, and most local roads (many of which are in the midst of clean up). It is ITD's desire, through ARNOLD, to extend this definition to all public roads in the state. However, this desire has not yet been realized (an estimation is approximately a year, depending on availability of resources).

11*a*. Roadway data: basic cross-section information that includes lane widths, shoulder widths, and median width.

Alaska: The road inventory data collection also includes digital imaging (images every .005 mi), LIDAR, and pavement conditions. A professional services contract provides feature extraction, which includes lane widths, shoulder widths (where possible since many of the shoulders are substandard), and median width. Other feature extraction is also possible through the professional services contract pending funding.

Idaho: Yes for the state highway system, plus HPMS samples.

Iowa: Yes.

Louisiana: DOTD has an LRS base map (maintained by Section 21: Data Collection and Management Systems Section) that includes roadway attributes for most public roads in Louisiana, including both state and nonstate routes, as well as some private roads. Data for ramps and bridges are also included within the LRS. The base map was originally developed using any available information from local agencies (provided by less than 10 agencies, mostly MPOs). DOTD is currently undertaking multiple projects to collect roadway information for all public roadways in the state. The Local Roads Data Collection project is an effort to collect roadway inventory data (at a minimum the FDE) on local roads in Louisiana using data collection vans. Further, the DOTD is offering local agencies an opportunity to "piggy-back" on this effort by contracting directly with the data collection vendor to collect additional data elements the local agencies would like to have collected. In addition to collecting local roadway data, this project will also assist the DOTD in cleaning up and validating the road ownership of local roads.

Maryland: Yes.

Michigan: Yes.

Montana: Yes.

Ohio: Yes.

Rhode Island: On state roadways only.

Washington State: TRIPS, the roadway data system, tracks the LRS on a weekly basis. The geospatial system for the LRS is updated annually, using a snapshot of TRIPS on a given date. The most recent LRS is the 2013 LRS. The GIS roadway data that are currently available to Washington State DOT staff is the 2012 year end snapshot.

11*b*. Reportable motor vehicle crashes on all public roads in the state.

Alaska: The new Crash Data System is a two-tiered system. The first system, the crash data entry system, is deployed and is currently accepting electronic crash reports. This allows crash data processors to locate a crash on the RDS road network and add crash information to the Oracle database. The second system, CRASH is in the procurement process, with an anticipated operational date of January 2015. The TraCS mobile data terminals potentially could provide very accurate spatial locations down the road. See the note under ARNOLD on the status of all public roads.

Idaho: Yes, but only on the LRS-defined roads, essentially the state highways and other federal-aid routes.

Iowa: Yes.

Maryland: Yes.

Michigan: Yes.

Montana: Yes.

Ohio: Yes.

Rhode Island: On sate roadways only.

Washington State: The CLASS system tracks crash location using the TRIPS location system, so crash locations are referenced in the most current TRIPS LRS. Snapshots of TRIPS are captured annually and corrections are made after the snapshot date (including location corrections). These year-end snapshots are used to create GIS layers annually. The latest GIS layer for crash data is 2012.

11*c*. Traffic volume data.

Alaska: The traffic site locations are included in the new traffic analysis system, Traffic Server (Transmetric America). The traffic stations are integrated with RDS, so the volumes have both LRS and spatial location referencing. Regional traffic staff are migrating all traffic data (raw and summary) to the new system, which was operational at the end of 2014.

Idaho: Yes, but again only on the LRS-defined roads, essentially the state highways and other federal-aid routes.

Iowa: Yes.

Maryland: Yes.

Michigan: Yes.

Montana: Yes.

Ohio: Yes, Ohio DOT is working on all public roadways.

Rhode Island: On state roadways only.

Washington State: Traffic volume estimates are incorporated into the TRIPS year-end snapshots, although these estimates are not directly available as part of the current TRIPS LRS (described in Section A, Question 11a). The most recent traffic count data available as point or line data in GIS is for 2012.

11*d*. Asset data: bridge, pavement, signage, and other asset datasets.

Alaska: The road inventory data collection program includes road centerline data collection, digital imaging, LIDAR, and pavement condition. Any feature viewable in the digital imaging can be extracted for location (spatial and LRS) as well as attributes. Bridges (centerpoint and length) and certain signs (speed limit and milepost) are routinely extracted and available in the Roadway Information Portal (internal for Alaska DOT&PF use only).

Idaho: Yes, on the LRS-defined roads, essentially the state highways and other federal-aid routes. In addition the category of "surface type" on certain local jurisdictional roadways is also captured.

Iowa: Yes.

Maryland: Yes.

Michigan: Yes.

Ohio: Yes, for pavement. Yes, for bridge. A major overhead sign inventory has been conducted.

Rhode Island: On state-owned and -maintained bridges, state roadways only.

Washington State: Location information capturing rules for assets can vary between regions, may or may not coincide with practices used for the 2013 GIS LRS, and may not include all the standard location referencing data columns used to describe the state route LRS. Efforts are underway to better integrate bridge inventory data with the GIS LRS.

11*e*. Maintenance data.

Alaska: The current MMS is integrated with the legacy mainframe Highway Analysis System but not the new SIRIS–RDS. The department just issued a request for proposal to procure a new maintenance management system that will be fully integrated with SIRIS–RDS.

Idaho: Yes, for the state highway system along with some off-system (local) routes where maintenance agreements with ITD exist.

Iowa: Yes.

Maryland: No.

Michigan: Yes, for PBM.

Ohio: The new labor tracking system should have this ability. Unsure if anyone at the Ohio DOT has the experience to be able to analyze this information.

Rhode Island: On state roadways only.

Washington State:

- Highway features, HATS data includes the location and condition of culverts and other maintenance activities.
- SiMMS (signals and illumination data) is managed by the Maintenance Operations Division.
- Maintenance Operations tracks where maintenance vehicles have been operating, the materials deployed, and the actions taken.

11*f*. Incidents on major corridors.

Alaska: The department's traveler information system, http://511.alaska.gov, uses the SIRIS–RDS road centerlines. Any incident reported will be located on the LRS and spatial road network.

Idaho: Not sure whether Idaho collects this data.

Iowa: Yes.

Maryland: Yes.

Michigan: Yes.

Ohio: This is not really a formal data set. Ohio DOT does have a bottleneck list based on INRIX data.

Rhode Island: On state roadways only.

Washington State: Location information is captured differently across the regions, depending on the sophistication of the tools used by the Incident Response Teams. The location information quality can vary from specific location information based on GPS location, to descriptions of location consisting of state route number, direction and "in the vicinity of" general landmarks or towns.

12. Do the systems listed in Question 11 integrate with the LRS mandated for HPMS and for ARNOLD?

Alaska: Yes, the RDS integrates with the LRS mandated for HPMS and for ARNOLD. The department maintains the centerlines and LRS for the primary network (approximately 2,600 roads), which consists of roadways that are functionally classified above local or select local roads that carry a particular interest to the department. However, Alaska is challenged by the number of roads off the connected road network, many of which are in remote locations. Alaska DOT&PF uses imagery and data sharing to the greatest extent possible, but it is still a challenge to get the correct centerline network and LRS for ARNOLD for all public roads. TGIS has a Secondary Road Network project to add these roads to meet the ARNOLD requirements by the 2015 HPMS submittal deadline.

Idaho: ITD uses its LRS to organize and report sample and universe data items (not grouped data, since it is aggregate data) for HPMS; ITD desires to integrate all these elements through ARNOLD once it exists. It is foreseen that the department's current technology infrastructure will have to be extended to more completely handle the dual-carriageway aspect of ARNOLD. Also, it is the work involved in registering all public roads with the LRS that has not yet been done (and a means to keep it up to date).

Iowa: Yes, the traffic and safety data can integrate with the same LRS Iowa will be submitting for ARNOLD.

Maryland: SHA has one LRS that includes local roads but most data tied to the LRS is SHA-maintained data only.

Michigan: Yes.

Montana: Yes.

Ohio: Everything will be based on the common LRS.

Rhode Island: Yes, LRS for all public roads will be established as part of Esri Roads and Highways contract.

Washington State: Washington State DOT is creating an all public roadways spatial LRS system (ARNOLD); the state 2013 GIS LRS is the state system portion of it. The timeline for ARNOLD is dependent on Washington State DOT resources.

13. Have SLAs been established for data timeliness, accuracy, completeness, consistency–uniformity, and accessibility been implemented? If so, in what areas?

Alaska: No SLAs have been implemented. Alaska DOT&PF understands the importance of the SLAs. However, there are several steps that need to be completed before drafting them. These steps include

- Fully implementing the TAMP data business plan and governance structure;
- Executing the TAMIS data system architecture and integration points;
- Executing the Esri Enterprise Advantage Program;
- Implementing Esri's Roads and Highways; and
- Completing the information services organizational structure and the hardware relocation to the State Enterprise Technology Services centralized location.

Idaho: Unsure.

Iowa: No.

Louisiana: No.

Maryland: SHA is currently working on a data management plan and metadata standards.

Michigan: No.

Montana: Yes between Montana DOT and DOJ for crash data.

Ohio: A data owner (division–office–section) has been identified for all of the items in Question 11. However, Ohio DOT believes there are some great improvements that could be made for 11*d*, 11*e*, and 11*f* to formalize the process.

Rhode Island: Not at this time.

Washington State: General agreement between business units have occurred, but these are not necessarily in the form of a service level agreement.

14. Have the roles, responsibilities, and accountability for data stewards and data owners been codified (e.g. in job positions)? If so, for what areas?

Alaska: The department and the Transportation Information Group are both defining the roles, responsibilities, and accountability for data stewards and data owners. The new Policy and Procedure for Data and Information Systems Governance (draft) discussed elsewhere sets the stage for this discussion at the enterprise level. The Policy and Procedure is still waiting approval.

Table 3 describes the roles and responsibilities for the TAM data governance framework. The goal is to implement a data governance program that specifically would support the safety program and enable the integration of safety considerations into project development. As the TAM implementation moves forward, the department will be able to define the cultural and institutional issues that are inhibiting data governance and take actions to mitigate these issues.

Idaho: Unsure.

Iowa: Yes, for all.

Louisiana: No.

Maryland: These are not codified in formal job descriptions, but do exist for internal postings.

Michigan: Yes, but only for two job positions. Michigan DOT has identified a data manager with the current focus on capital program data, GIS, and asset data. This will likely be expanding as Michigan DOT's maintenance and other asset management systems are developed. The second is the chief data steward for Michigan DOT. This position is to assist the state in developing and implementing data management practices and artifacts throughout the state's operations, primarily back to Michigan DOT. This position also chairs the department's Data Governance Council. Michigan DOT does not believe that there will be very many full-time data stewards; however, regular business position will include data quality, consistency, completeness, etc. as part of their normal job responsibilities.

Montana: Yes, for traffic data, HPMS, and roadway data.

Ohio: No, nothing official.

Rhode Island: No, there have been no formal roles set up at this time for data stewardship. Rhode Island DOT is anticipating that this will be established as part of the pilot project for Local–State Data Integration for Asset Management and Safety Analysis.

Washington State: Yes, for the individual datasets of crash, roadway and traffic volume. The roles and responsibilities of other data systems may or may not exist. This is currently being discussed at the EIGG. Washington State DOT's *IT Manual: 400.01 Data Management Standard Practices* does define the roles and responsibilities for data stewards and data owners. This standard is referenced by Executive Order 1037.01: Electronic Information Management.

TABLE 3 Alaska DOT&PF Roles and Responsibilities for the TAM Data Governance Framework

Role	Responsibility	Office
Data Governance Council	Develop the policies and procedures used by the division for managing the data programs used to support the Statewide Strategic Plan and to meet agency and division goals.	Specific teams that may include TAM Integration Team and Engineering Automation Team.
Data Custodian	Develop and maintain the application databases, data dictionaries, data models, and metadata definitions, security interfaces, and network support.	People who maintain data and know the most about the technical details to make it work.
Data Owner	Manage the data metadata and data dictionaries for information systems within their area of responsibility for a business unit. Present requests to the Data Governance Council regarding new applications or enhancements to existing applications to meet business needs.	Section or business unit that is in charge of the data set.
Data Steward		Person who manages the business unit.
Data Stakeholder (internal)	Participate in Data Work Groups to provide input regarding use of data applications.	
Data Stakeholder (external)	Participate in Data Work Groups as requested to provide input regarding use of data applications.	
Communities of Interest	Provide input through outreach and communication on the data and information needs regarding specific programs.	
Data Working Groups	Make recommendations to the Data Governance Council on enhancements to data programs that support agency business operations. Facilitate developing strategies and plans to implement new applications and address issues regarding data quality, data consistency, and data accuracy.	

15. What cultural and institutional issues exist that may inhibit implementing a data governance program that would support the safety program, and integration of safety into project development?

Alaska:

- Disconnected islands of data and GIS applications.
- Inconsistent data sharing procedures from data owner state and local agencies.
- Roles and responsibilities not assigned, e.g., no clear ownership of data.
- No enterprisewide data quality measurement of data.
- Lack of hardware and software and expertise to support enterprise data management, asset management, and GIS initiatives.
- No SLAs defined for assessing the quality level of critical data.
- No enterprisewide data dictionaries and metadata.
- No enterprisewide data models.
- Inconsistent buy-in for data governance policies and structures.
- Change management associated with the department's information services reorganization for work flow and organizational structure.
- The department's information services hardware relocation and upgrade to the state and Enterprise Services computer facilities.
- Buy-in and support for data governance (upward and horizontal).

Idaho: With the development of Idaho's Highway Safety Corridor Analysis program it has gained institutional support (support memo from CEO) within the department. With that comes a cultural shift to adopt the business model that incorporates safety into project development.

Iowa: The Department of Health is challenged in the ability to release personal or private information from emergency room visits.

Maryland: An institutional issue is the historic organization of roles and responsibilities for data collection and distribution within SHA and between the Maryland State Police and DOT.

Michigan: While Michigan DOT's focus has been on preserving the condition of existing data assets, the difficulty has been trying to address the need to collect additional data elements because they are required (legislatively) or necessary (modeling requirements) due to resources. To overcome this Michigan DOT is looking at new tools and ways of meeting the needs of the department's customers. Supplementing current design tools and practices with safety tools (FHWA's Interactive Highway Safety Design Model and Michigan DOT's HSM Spreadsheet) that would support project evaluation and development should be viewed as a data training opportunity where designers will see the benefit of enhanced data.

Montana: With staffing issues and not enough time available to get everything completed, data governance gets pushed out. Decentralized IT in Montana DOT also creates a challenge.

Ohio: Ohio DOT's current executive leadership understands the importance of data and its quality and availability. Therefore, they have been very supportive. Data-driven safety decisions have been integrated into the design exception process and the HSIP project selection process.

Rhode Island: Issues include not having enough resources and buy-in from management regarding the importance of capturing data and properly maintaining–updating the data once it is gathered.

Washington State: Washington State DOT is transitioning to a more multimodal and targeted solution-oriented organization. This includes a greater focus on preserving, maintaining, and operating the existing system. Staffing and expertise levels are being challenged. Several efforts are underway to create a more cross-functional organization. Continued budget reductions and business focus changes are increasing the complexity of discussions. The issues of data integration and management are challenged as data and research are often conducted within a targeted rather than enterprise scope due to the limited budget environment. It is also difficult for the high-level experts familiar with data integration needs and benefits to clearly articulate the comparative need when imminent staff reductions, projects cuts and resources across the agency are occurring. It is difficult to sell the potential benefits of such a data governance program since extra resources are needed during the adoption process. The department is facing a challenge with its ability to keep up with technology, react to new technologies and requirements, and support its data management efforts too.

There are perceptions that "my data is unique," "designing for everyone's needs will slow me down;" "it's my data" (ownership versus stewardship); and "I can't address your need with this source of money" (funding silos).

Expectations, perceptions, and understanding of data management and uses vary across the department. Contributing factors include generational familiarity with information technology and data analytics; technical disciplines and the degree to which the discipline has integrated technology and data analysis; and policies that address specific aspects of information management or specific functions rather than a comprehensive policy framework. These issues are common amongst institutions. Washington State DOT is taking steps to address these by developing an enterprise information governance strategy.

SECTION B: DATA MANAGEMENT

This section relates specifically to crash and roadway data.

1. Do you have a process and system for archiving location referencing and historical road inventory data? If so, please describe your process, and how you utilize this archived information. Can the archives be used to accurately locate historical crash information? Are there any problem areas?

Alaska: The spatial data management tools allow retired roadway segments to be time stamped. Published data sets provide users the current road network but the historical road network is available. The department's current network management tool for LRS editing provides two editing options:

- Retire the old alignment if it's no longer used as a public road, and
- Rename and renumber the old alignment if it continues to be used as a public road.

Alaska DOT&PF believes Esri's Roads and Highways, which will be implemented in the near future, can provide these two options. Realignments also impact the inventory features and attributes associated with the old and new alignment.

Although Alaska DOT&PF is still about a year away from full implementation of the new crash system, the department anticipates the crash information will be easily located from the archived road network. The one caveat is getting timely notification on road network changes (see the discussion of CAD–GIS).

Idaho: ITD maintains a history of recorded HPMS data items for the entire state highway system and a sampling of nonstate highway system federal aid roads back to 1998. This data is maintained on the mainframe in data files as well as an archive database. With the implementation of the new LRS, ITD can record temporal data for some condition and performance data items (most HPMS data items) whenever the LRS changes, so that the location is always "findable." For prior-year records, it would be a manual process to relocate historical crashes, primarily because of re-mileposting, and recalibration of the roads that occurs over time. Crash data can be pulled using either the segment code–milepost method for state roads and federal-aid roads, location information such as name of road for all roadways, or by latitude–longitude information for crashes from 2007 and forward. ITD has crash data easily accessible from 1997 to current and can go back as far as 1987 with more difficulty.

Iowa: Yes, Iowa timestamps and versions every record as it's being edited in both the business data and the LRS so Iowa can both look at any point in time and run analysis at any point in time.

Louisiana: DOTD currently maintains a dynamic database of roadway information for the state maintained roadways. Changes to the roadway inventory are not maintained in a standard archive format. Annual snapshots are available.

LRS is available on all public roads. LRS is continually corrected, updated, and verified on the state-maintained system, but these changes are not tracked. The LRS is archived annually. The yearly snapshot is available to agencies outside the DOTD. The LRS control sections and subsections may not coincide with intersection locations. Control sections tend to be corridors and subsections are defined by changes in road system attributes.

Maryland: Yes, SHA's LRS and crash data is archived on a yearly basis. Regardless of timeframe, the SHA cannot accurately locate crash information (present or past) due to issues with initial crash data collection. Ideally, crash locations would be collected using GPS at the crash site and then mapped to the LRS, but currently, crash locations are recorded by the Maryland State Police at the location where the report is filed which may only reference the general vicinity of the actual incident. In addition, SHA's LRS is based on county, route and mile point and is not a truly temporal-based LRS, so locations of mile points may shift slightly from year to year as road configurations are changed–updated.

Michigan: Yes. Michigan DOT is keeping 10 years of crash data live. Michigan DOT uses the data to perform countermeasure before and after studies. The crash data locations are migrated from year to year so that the locations maintain consistency with the existing version of framework (linear referencing).

Montana: Yes, LRS and roadway datasets are copied and archived annually and the archives can be used to accurately locate historical crash information. There is potential for a time lapse issue if crash data, which occurred on a specific date, does not synchronize with roadway changes that are archived annually.

Ohio: Once a year the official road inventory files are updated. At this time, the linear changes to the road inventory file are recorded and distributed. When a portion of roadway is retired, the crashes then fall off the system, but coordinates and historical LRS information is recorded. While there is some limited access to this information, it is not really utilized.

Rhode Island: Not at this time.

Washington State: Yes, annual year-end snapshots are created. Refer to Section A, question 11*a* and 11*b*. Conversion from year-end snapshots to the current LRS is problematic. The tool currently in use at Washington State DOT is not working correctly (erroneous locations are produced in certain locations). It is not clear how stable these archives are across time. This may need to be reviewed when the U.S. DOT guidance on *Increasing Access to the Results of Federally Funded Scientific Research* is released. It is anticipated that this may require additional data curation to ensure the specific data set used in research is captured.

2. Are there established procedures to review and inventory available data, e.g., a data registry?

Idaho: ITD collects condition and performance data on the entire state highway system and some of the nonstate highway system federal-aid routes, per HPMS requirements. Some QA procedures have been established in recent years. Some are still to be established.

Iowa: Yes.

Michigan: Michigan DOT has purchased one, and are in the process of implementing it. The department has it "filled in" for the data that handles capital programming, and for portions of asset data. Michigan DOT has not started the processes of reviewing the adequacy of these.

2*a*. Have the data sets critical to safety data programs been identified and catalogued?

Alaska: The critical safety data sets have been defined as part of the HSIP, SHSP, and the TRCC. These elements are part of SIRIS and the Crash Data System. The MIRE elements still need a bit of work. A formal catalogue registry will be developed as part of the TAM data business plan.

Idaho: ITD maintains some data items that are vital to crash analysis for the entire federal aid system (such as AADT), and some data items only on the state highway system and a sampling of the federal aid system beyond that (such as surface type). Crash data is collected for all public roadways.

Iowa: Yes.

Michigan: Yes, MIRE, MIRE FDE, Safety Analyst, HSM, and MAP-21 are considered as being critical to the safety datasets. Consideration for prioritization is critical at this point and time due to the number of attributes and available resources to collect them. At this point most Michigan DOT roadways contain the MIRE FDE and requirements for MAP-21; however a catalog has not specifically been developed.

Montana: Yes.

Ohio: Yes, the highway safety section works very closely with the transportation management section.

Rhode Island: No.

Washington State: Washington State DOT has set specific retention schedules for some data sets. Metadata requirements are outlined for some, but not for all data. The Data or Terms Search application is a catalog that provides data seekers information about the data Washington State DOT owns and maintains. It contains data that describe the content, quality, condition and other characteristics of Washington State DOT's data assets. The Data or Terms Search contains business terms which describe concepts important to the business and maintained by subject matter experts.

2*b*. How are the procedures implemented?

Alaska: Formal procedures to implement the data catalogue and registry will be developed as part of the TAM data business plan and governance work later this year.

Idaho: Data collection is part of the annual process for Roadway Data (to collect traffic counts) and Asset Management (to collect pavement geometrics and condition). Standards are established for most of these items by AASHTO, FHWA, ASTM, and others. Data reviews are typically part of daily, weekly, or annual processing, depending on the data item in question. For example, traffic data is reviewed upon processing counts, as well as when reviewing monthly and annual reports. Data submitted via HPMS is typically reviewed during the annual submission review. Crash data is submitted using an electronic platform.

Iowa: As needed.

Michigan: These have not been implemented yet.

Ohio: Staff from the transportation management section typically complete all of the updates for the road inventory data. The highway safety section has used staff to collect additional critical elements, mainly for intersections.

Rhode Island: Not applicable.

Washington State: Not applicable.

2*c*. Are new data sets evaluated using a structured process or an ad hoc analysis?

Alaska: The TIG is developed a structured process to evaluate new data sets. An essential piece to the SIRIS data governance plan is to define critical data and to provide guidance to SIRIS operators and users about what comprises critical data. Attempting to govern all data recorded by DOT&PF business units would be an enormous and overwhelming task. Therefore, a certain level of data needed to be defined as critical and governed through an agreed upon process. In order to determine SIRIS critical data, the transition team developed four categories of data shown in Figure 6.

Category 1, Development Data, is not considered critical data. This includes data that is not ready for circulation to others in an official capacity, nor is there intent for the data to be accessed by other systems or users directly, e.g., internal databases, spreadsheet or data files that individuals or groups use for working projects. SIRIS comprises Category 2, Production Data and Published–End User Data. Both are considered critical SIRIS data sets.

Category 3, External to SIRIS Published Data, are also viewed as critical SIRIS data sets if they are data sets that SIRIS components rely upon such as those related to crash, traffic or RDS. Category 4, End User Reports, is not considered critical because it is created for a specific use and is not queried by other systems.

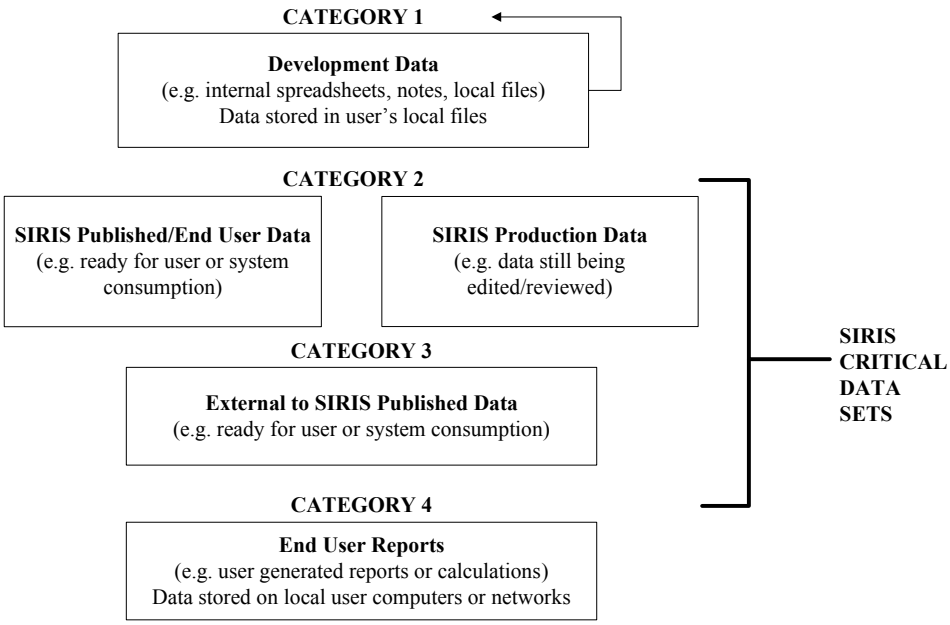


FIGURE 6 Alaska DOT&PF SIRIS data categories.

Idaho: Both. Some of ITD's roadway data systems are new enough that QC procedures have not been firmly established. Crash data is a combination of structured processes and edits are run annually on all reports from the previous year looking for issues. The ITD also does ad hoc analysis with the crash data.

Michigan: Michigan DOT is not developing new data sets. Data sets that have been collected in traffic and safety have utilized modules developed by LTAP as part of Roadsoft. The data gets migrated annually with framework and crash updates.

Montana: Currently ad hoc but may be more structured in the future.

Ohio: This is usually a structured process by holding meetings with all parties that may use the data.

Rhode Island: No.

Washington State: Washington State DOT's intent is to follow a structured process for new datasets. DOT relies on voluntary compliance with IT and data management policies and the willingness of the particular business office leading the effort to collaborate with other offices across the department.

3. Are safety-related data collection and management plans, metadata, and standards in place?

Idaho: Some are in place for the purposes of collecting and reporting HPMS data. Crash data has established standards for data collection.

Iowa: Somewhat.

Louisiana: Metadata exist for the existing roadway STL data and Highway Needs Database. Business rules exist for roadway attributes. Limited metadata exist for GIS mapping functions.

Maryland: Somewhat. Michigan DOT uses Model Minimum Uniform Crash Criteria (MMUCC) but the data is ultimately owned by the Maryland State Police.

3*a*. Do you maintain a safety data model?

Alaska: The closest model Alaska DOT&PF has to a safety data model is the SIRIS–RDS spatial data model. This data model contains many of the fields used in the crash program. The TIG is implementing a data governance structure for the Alaska DOT&PF data programs: traffic, crash, traveler information, road weather management, and TAM (note that the asset management piece is outside of the department's formal TAMP and TAMIS, but will be fully compatible with the department asset management data model). The data model and data integration plan will define the format and data definitions needed to enable data integration, interoperability and accessibility. This also includes identifying data owners, stewards and custodians, a key objective of the TIG data governance. TIG cannot be the stewards or

custodians for all the critical data as it is entirely impractical and would ultimately lead to stale data sets.

Idaho: No.

Iowa: Yes, for roadway data.

Maryland: Maryland SHA uses MMUCC.

Michigan: Yes.

Ohio: Yes.

Rhode Island: Not at this time.

Washington State: A data model exists for the crash data and roadway data. Metadata are being captured and updated into a central metadata repository, the Data or Terms Search application.

3*b*. Do you maintain safety data dictionaries?

Alaska: There are no stand-alone safety data dictionaries. The spatial data model serves some needs. Otherwise, the standard MIRE and MMUCC publications serve the department's needs:

Idaho: ITD does not maintain a data dictionary for much its pavement management system. Crash data does maintain a data dictionary for its data

Iowa: Yes, for roadway data.

Maryland: Maryland SHA uses MMUCC.

Michigan: Along with others. These are likely out of date. For MIRE, MIRE FDE, and Safety Analyst, the data dictionaries are integrated as part of the program or process. Roadsoft data dictionaries reside at the Michigan LTAP Center.

Montana: Yes, ISD.

Ohio: Yes.

Rhode Island: Not at this time.

Washington State: A most recent crash data dictionary is not currently available at the department. The CLASS crash coding manual from 2011 was withdrawn from general use in 2013 and is currently under revision. A scaled-down data dictionary is currently being developed and will be the resource document for staff working in safety.

Documents related to some of the data elements in some of the other Washington State DOT data marts are available online or from individual data stewards.

3*c*. Do you maintain standard metadata about your safety-related data sets?

Alaska: The existing national standards serve Alaska DOT&PF's metadata needs. The law enforcement crash form has definitions, instructions, and examples. Hopefully the TAMIS data registry will further advance the department's metadata capabilities.

Idaho: HPMS requires some metadata for traffic and condition collection methodologies, frequency, etc. Crash data does not maintain metadata.

Iowa: Yes, for roadway data.

Maryland: SHA maintains metadata with the Traffic Analysis Network Garage database.

Michigan: No.

Ohio: Yes.

Rhode Island: Not at this time.

Washington State: Metadata exists for some of the data marts but may not be up to date or as detailed as those required for GIS layers. Information in Washington State DOT GIS layers are required to meet basic GIS metadata standards and are the responsibility of data stewards.

3*d*. Are database business rules established and who establishes them?

Alaska: Spatial database rules are established for the geodatabase update process. GIS tools developed by the department's TGIS section have implemented many of the business rules. Additionally, the crash processing staff has an extensive crash processing manual and a portfolio of rules to ensure crash quality.

Idaho: The program used to input the crash data uses extensive business rules to ensure accurate information. The rules are established by the Office of Highway Safety (OHS) data analysts.

Iowa: Yes, the appropriate person.

Maryland: SHA is in the process of establishing a Memorandum of Understanding with the Maryland State Police for data sharing and usage. Business rules are currently being established–re-established.

Michigan: Technical business rules and relationships have been developed. The mechanism for this needs to be redeveloped (the originals were done nearly 20 years ago).

Montana: Yes, ISD.

Ohio: The DPS has established many business rules for data collected by officers. The highway safety section has added several additional rules based on how engineers typically use crash data.

Rhode Island: Not at this time.

Washington State: Database business rules are established by the data owners and stewards.

3*e*. Who is responsible for keeping safety-related data models, data dictionaries, and metadata updated?

Alaska: The Transportation GIS Section maintains the spatial database model.

Idaho: The HPMS Coordinator is responsible for reporting HPMS metadata and updating HPMS data structures. OHS maintains the data dictionary for the crash data.

Iowa: Roadway data is in Research and Analytics.

Maryland: SHA Office of Traffic and Safety, IT Section.

Michigan: IT staff, also supported by Michigan DOT.

Montana: ISD.

Ohio: The highway safety section.

Rhode Island: No one at this time. This will most likely be with asset management and GIS in the future.

Washington State: For crash data, TDGO is responsible for updating crash data–related data models (in coordination with ITD's Information Resource Management Group), data dictionaries, and metadata. For any other dataset, it depends on the owner of the database and data stewards.

3*f*. Have data migration, integration, and archiving business rules been established?

Alaska: The archiving business rule described for road centerlines also applies to business data. There is a detailed migration plan for the transition from the legacy mainframe database to the SIRIS–RDS environment. The missing piece is a portfolio of business rules for integrating SIRIS–RDS with other databases. The TAMIS project has already addressed the applicable TMA-related databases and potential integration points. The obvious next step is to develop the integration and migration business rules.

Idaho: This is currently underway as the LRS becomes integrated with the pavement management system, and the traffic data system becomes integrated with the pavement management system. Furthermore, in the coming 1 to 2 years, ITD will be integrating LRS data directly with the traffic data system. Crash data is currently not integrated with other systems.

Iowa: Yes.

Maryland: SHA keeps data forever in a live database (not an archive) for research purposes. SHA has all crash data since 1980, fatal reports since 1962, and all fields populated since 1993. The Maryland State Police only keeps data for 5 years.

Michigan: Yes, but Michigan DOT has to work on archiving.

Ohio: Yes. The records retention for safety-related data (crashes, priority locations) is 10 years. The DPS maintains a 5 year database.

Rhode Island: Not at this time.

Washington State: Data archiving business rules have been established for the crash, roadway and traffic data. Data integration discussions have been initiated but no business rules or agreements have been established.

4. Are all reportable crashes (including local) captured in an electronic data system? Are they all spatially referenced?

Alaska: Most law enforcement-reported crashes are received electronically from TraCS or proprietary mobile data terminal reporting systems. The state of Alaska created a central CDR to meet the state's archive requirements. When crash reports are committed to the CDR, DOT&PF gets a copy. When fully implemented (hopefully, in the near future), the CDR process will deliver about 90% of the annual crash reports electronically. The remaining paper copies come from several LEAs that have not implemented TraCS or a proprietary system, driver reports, or remote locations. Some of the TraCS reports do have *X*, *Y* coordinates supplied in the field. As the electronic reporting system is fully implemented, Alaska DOT&PF anticipates more crash reports will be spatially referenced at the crash site. When the Secondary Road Network is completed (see ARNOLD discussion), almost all the crashes on public roads will be spatially referenced. There still will be crashes where the location is poorly described. This is particularly true with driver reported crashes.

Idaho: Yes, they are all electronic and they have all been spatially referenced since mid-year 2007.

Iowa: Yes and yes.

Louisiana: The DOTD has located on-system crashes and many off-system crashes with GPS coordinates. There are approximately 150,000 annual crashes statewide with a breakdown as follows:

- 90,000 crashes on the state roads (95% are located on the base map with some requiring manual corrections); and
- 60,000 crashes on the local roads (50% are auto-landed, with the remaining requiring manual correction). Overall, 90% of the local crashes are located on the base map. On local roads, DOTD is working with HSRG to locate all local crashes. Crashes from 2010–2012 will be located by the end of 2013. LTAP is working with HSRG to establish a curve database for local roads to support targeted low cost improvement projects.

Maryland: Beginning January 2015, all Maryland state and local crashes must be reported using the Automated Crash Reporting System developed by the Maryland State Police. This system can capture *X*, *Y* locations but, at this time, there is no process to validate the location of reported crashes (i.e., if crash isn't reported until an officer is at the barracks, the *X*, *Y* will be wrong).

Michigan: Yes.

Montana: Ultimately, yes. The Montana Highway Patrol (MHP) enters all crash data into their SmartCop system, and then Montana DOT transfers a copy of the SmartCop data into a crash database–analysis system, which does link all crashes spatially (Traffic Safety Engineering).

Ohio: Yes. Crash data is entered electronically by Ohio DOT's partners at the DPS. Ohio DOT spatially locates crashes whenever possible (approximately 95% located in 2014).

Rhode Island: All crashes are captured. Only crashes on state roads are spatially referenced.

Washington State: Yes and yes.

5. How are network screening Business Intelligence tools used to automate current manual practices for safety-related decision making? (Examples: HSM tools, others?)

Alaska: Intersection Magic is one of few automated tools that the department uses for safety analysis. Intersection Magic can diagram multiple crash types at locations of interest, primarily at intersections. The program's utility provides resolution on the number, conflict directions, and types of crashes (angle, turning movement, run-off-the-road, fixed object, pedestrian–bike, and more). Once a predominant crash type, direction, etc., are identified. The department seeks countermeasures to address those crashes. This type of tool will be duplicated or otherwise made available through the new CRASH system.

Idaho: These tools are currently being developed.

Iowa: It is not an automated process.

Louisiana: Given the lack of database integration to date, the DOTD process for network screening is essentially a manual process relying on basic methods (crash frequency and rate). This limits their ability to effectively use more advanced safety analysis methods. The safety office has begun the process towards incorporating HSM into their highway safety improvement process.

DOTD is implementing VisionZero (a self-contained safety analysis tool) for network screening and project prioritization. As part of this process, SPF's have been developed for two-lane rural roads with remaining roadway types being completed by the end of 2014. This tool will be used by central office staff to support statewide and district level safety analyses.

LTAP is helping local agencies to assess safety problems and to improve project selection. A recent effort was completed through combining crash records by street name for all parishes. The top 20 parishes have been identified for targeted assistance.

Some MPOs (including New Orleans and Lafayette) and parishes (East Baton Rouge) have developed their own mapping and crash analysis procedures. Some have experienced quality and location issues with their crash data and overall these databases are not integrated with the DOTD crash data.

Maryland: Most of Maryland's network screening is done manually. SHA does use HSM tools selectively for project specific analysis but not network-wide. SHA explored the use of Safety Analyst but found it was not compatible with SHA datasets.

Michigan: Michigan DOT utilizes Safety Analyst for roadway network screening. The entire statewide network is screened utilizing Safety Analyst, supplemented by Roadsoft, and crash database information.

Montana: Montana DOT has developed SPFs and Level of Service of Safety (LOSS) ratings for the rural on-system network. These tools are available within the Safety Information Management System for network screening.

Ohio: Ohio utilizes AASHTOWare Safety Analyst to conduct network screen and countermeasure evaluation. Ohio has developed its own spreadsheet tool to complete HSM calculations for project analysis similar to the ones created using the NCHRP 17-38 project.

Rhode Island: Rhode Island DOT currently uses HSM methodology. However, the department will begin to use Safety Analyst within the coming year.

Washington State: AASHTOWare Safety Analyst is currently in use for network screening. HSM spreadsheets are used for Part C predictive modeling, and the iSATe tool is used for analysis of freeways and interchanges. Other Washington State DOT available tools are also being developed.

SECTION C: DATA GOVERNANCE: INTEGRATION

1. Have linkages between roadway, crash, injury surveillance, citation, road weather, health records, and other data systems been established? How well are the linkages working? (Examples: production server linkage, manual integration*)*

Alaska: Roadway, traffic, and crash data have been linked. Crash data have not been linked to these other databases, although potentially could be with the upcoming TAMIS implementation.

The department has a modern road weather information program (http://roadweather.alaska .gov), so the relationship between crashes and road weather is a potential analysis area.

Much of the potential linkage has been limited by

- No emphasis on server upgrades or deployment of storage capabilities to handle safety data;
- No department governance program;
- No statewide governance program;
- Widespread use of a common LRS;
- Lack of a coordinated data collection vision; and
- Stovepipes of GIS deployment.

There are more reasons, but the five above are the most significant. A new Information Systems and Services Division have been created to address these and other departmentwide concerns that were addressed in a recent Information Services Work Group.

Idaho: ITD is in the process of starting a data warehouse project. The initial concept of operations with all the partner agencies has been performed. This is sponsored under the leadership of the TRCC and initial financing has been obtained to start the detailed development of this project.

Iowa: Some for roadway and crash data.

Maryland: Most linkages that exist are mostly done on a project by project basis. SHA does, however, link certain types of crash data against asset data. For example, wet pavement crashes are screened against low friction areas and aid in the prioritization of resurfacing projects. Also for example, pedestrian crash data is screened against asset data (i.e., sidewalks, accessible signals, and Maryland Transit Authority ridership data) to aid in prioritization of pedestrian-related safety improvements.

Michigan: There is currently a plan being developed to gain data linkages across Michigan agencies. UMTRI (University of Michigan Transportation Research Institute) is working to develop better deterministic data linkages along with other ways to support this process.

Montana: Partially.

Ohio: Only really between crash and roadway. The Ohio Emergency Medical Services Department has linked crashes to hospital data (when matches can be identified), but it is not available outside their agency. Ohio DOT is currently working on collecting electronic citation data with a TRCC-funded project. No other connections have been made at this time.

Rhode Island: No.

Washington State: Manual integration of roadway and crash data occurs periodically at Washington State DOT. The WTSC are in the process of establishing a system of integrated data (crash, roadway, injury surveillance, health records, and court data).

Manual integration of roadway and crash data across multiple years is done. However, differing levels of precision may occur because of the dynamic nature of the state system LRS, and the lack of tools that can reliably transfer locations across different LRS dates.

2. How have crash records been integrated with other agency data in support of programs outside of the crash records and analysis function, e.g. TAM, performance management, project scoping–preconstruction?

Alaska: Crash data is part of the *Alaska Preconstruction Manual's* design standards. Traffic and Safety staff review crashes and propose cost-effective measures to address correctable crashes. The *Alaska Preconstruction Manual* requires use of the existing crash data reporting system and will be updated for the new CRASH.

Iowa: Some crash data has been uploaded to the Iowa DOT GIS Portal.

Maryland: Most crash data is integrated with other agency data on a project by project basis.

Michigan: Crash data has been integrated into the UMTRI effort through the Ohio State Highway Patrol (www.michigantrafficcrashfacts.org), that is available to anyone one the web and supports the Michigan SHSP. Crash data is utilized in the following agencies: Judicial, Department of Community Health, Department of State, Department of Natural Resources and Environment, Department of Education, and Department of Management and Budget. External to the state of Michigan there is the Transportation Improvement Association of Michigan and Michigan LTAP (Roadsoft). Michigan has a LRS that is also available for anyone to download through DTMB-CSS.

Montana: A safety review is completed for projects with a scope of work greater than a seal and cover. This includes reviewing crash data for the specific project and recommending countermeasures to address any identified crash issues.

Ohio: At this time, only crash frequency and severity has been implemented with the TAM. Crash analysis is required for all design exceptions and Ohio DOT tracks crashes similarly to pavement conditions across the state.

Rhode Island: No.

2*a*. What safety data integration efforts have been most successful?

Alaska: By far the most successful is the comprehensive SIRIS, which is composed of the RDS, the Traffic System, and the Crash System. RDS is the Alaska DOT&PF's LRS which is based on the road centerline network. SIRS RDS provides the integration using a common road centerline/LRS network. Integrating the Traffic and Crash systems with RDS through SIRIS will make it easier to integrate and link data from other transportation datasets such as bridge, pavement, and maintenance systems. Alaska DOT&PF believes they are well ahead of most of the other data systems for the upcoming TAMIS implementation in terms of a common LRS, centerline coordinates, metadata, and database structure.

Idaho: The roadway data and crash records has been the most successful. ITD is in the process of integrating the TAM data.

Iowa: The GIS Portal includes roadway and crash information.

Maryland: Integration of crash data and congestion data has allowed Maryland to make better decisions. Historically, SHA has relied on crash rate alone to identify areas to address safety issues. Through integration with congestion data, SHA has been able to better identify areas truly needing to be addressed for safety versus areas where there are a high number of crashes due to congestion (i.e., fender benders). Knowing the difference between these reasons for high crash rates, SHA has been able to better strategize how to address the issue, either through engineering, enforcement or education. SHA has further been able to identify the top 3 issues:

- High-speed merge or short weave areas,
- Pedestrian issues where there is high congestion, and
- At-grade crossings on high speed roadways.

Michigan: Development of a statewide (e.g., all roadway) crash database. Safety Analyst and Roadsoft have been very successful in integrating roadway and crash data together.

Montana: Montana recently completed an upgrade of Montana DOT's Safety Information Management System (SIMS) software. Montana DOT now has a nightly interface that brings over MMUCC-compliant crash data from the Montana Highway Patrol. The SIMS project also included the integration of many of the MIRE FDE data elements as well as the MHP citation data.

Washington State: Crash data are routinely used in project scoping and preconstruction for evaluation and analysis. The department is currently integrating crash, roadway, traffic, and illumination system information to support decisions about illumination reform. The analysis is supporting decisions about LED conversion, lighting system removal, and prioritization of pole replacement after being hit.

Washington State DOT uses data to support performance assessment of projects and to guide changes in the safety program. Projects also use data for design and operational decision making.

2*b*. What integration initiatives have been less successful and why?

Alaska: There are three integration areas that have not progressed as fast as the department would like:

- CDR full implementation. The CDR will provide seamless electronic data transfer from the DMV to DOT&PF once the crashes are accepted at the CDR. The reason is that DMV has not completed the required database business rules on their side to implement the electronic transfer. Additionally, Alaskan LEAs operate on different data platforms; interfaces between these platforms and the CDR have not been completed. Loss of programming staff and leadership turnover are contributing factors.

- Integrating health and crash records at the state level. Alaska DOT&PF is ready to have the conversation. However, the health records community is still sorting out the required privacy and database requirements needed for this linkage.
- TAMIS. DOT&PF has completed a high-level database analysis, including the integration points, for all the TAMIS-related databases. Now comes the hard part—implementing TAMIS. A project champion to lead the effort and considerable hard work are yet to come.

Idaho: Project scoping and preconstruction have been less successful because this work has yet to be done.

Iowa: Any initiatives dealing with personal or private information.

Maryland: Not applicable.

Michigan: There have not been less successful integration initiatives, but successful ones that may have lost potential due to lack of updates to modern data use practices and interfaces.

Washington State: Individual business units are typically doing the integration activities. While these may be successful for the business need, the enterprise need may receive differing levels of consideration. This means that multiple efforts may occur. Data collection for these efforts may also occur at a greater or lower precision level necessary to be cost effective, optimal for future use, or sustainable over time.

3. Does your agency make use of design or as-built plans to update road network geometry or GIS? If so, describe your process, and any benefits it has had for improving crash analysis?

Alaska: Lack of the capability to use design and as-built plans to update road network geometry has been a longstanding issue. The department worked with the Volpe National Transportation Systems Center and the FWHA Office of Safety for a state DOT peer exchange to see how five other states were addressing similar challenges. The lessons learned from the peer exchange are being molded into the Engineering Automation Team's GIS/CAD Working Group initiatives to improve workflow efficiencies and integration for the GIS and CAD platforms. It has not been implemented yet.

Idaho: Yes. At the end of a project, as-built plans are required for updates. It is unclear if this information is used in a structured manner for improving crash analysis. If it is done, it is accomplished on an informal basis at the District level.

Iowa: Yes, Research and Analytics reviews plans from the Electronic Records Management System and inputs the roadway features into GIMS. Iowa DOT is currently working on an automated process for pulling necessary data from design plans. In addition, Research and Analytics receives design plans from local agencies on new routes.

Maryland: No, but the SHA is interested in pursuing this further.

Michigan: No.

Montana: No, Montana DOT use GPS from field collection to update geometries.

Ohio: Yes, staff uses design plans to update the road inventory and LRS each year. Ohio DOT believes it improves the timeliness of data because the inventory data can be collected and then processed once the project is complete.

Rhode Island: Rhode Island DOT currently does not have the processes in place to link as-built plans, work orders, etc. to account for changes to the roadway network. However, the Department is working on developing the processes through Viewworks program and AutoCadd so it becomes a seamless effort in the future.

Washington State: TDGO uses contract as-built drawings to update the tabular geometrics in the roadway data mart (TRIPS). The general shape of geometry from contract plans and tabular information from TRIPS are used to determine where changes start, stop, and their length, and the GPS data for the final shape of the GIS and geometry. Timeliness of as-built data can be a challenge as it relies on manual entry. Efforts are underway to improve the business workflows surrounding the update and maintenance of as-built drawings. This should help provide more timely and reliable information in the future. Efforts are also underway to use ProjectWise's GeoConnector to integrate GIS and CAD data.

4. What data access and visualization techniques are being used to facilitate the application of safety data for decision making for (*a*) the safety program and (*b*) elements in the project development process? Please provide examples.

Alaska: The role of GIS is increasingly important in visualizing a wide range of transportation information. Alaska DOT&PF is part of AASHTO's Innovation Initiative (formerly named the Technology Implementation Group) UPlan. UPlan offered Alaska an excellent opportunity to jump start the department's ArcGIS Online capabilities in Alaska's Transportation GIS for a wide variety of applications including crash data analysis. Note that the department's policy does not expose crash data externally, so Alaska cannot provide any links in this report.

Examples include:

- ArcGIS Online (public):
  - Road network with mileposts;
  - Functional classification;
  - Alaska ports, harbors, and ferry terminals;
  - Maintenance stations;
  - Traffic counts;
  - Mobile LIDAR routes;
  - Proposed DOT&PF regional boundaries; and
  - STIP project viewer.
- Esri Maps for Office.
- Named intersection, named segments, and corridor analysis.
- Intersection Magic.

Idaho: ITD is not aware of visualization techniques being used to facilitate the application of safety data for decision making. The department would be very interested in learning from others regarding these techniques.

Iowa: Intersection Magic (collision diagrams), ArcGIS, and Crash Mapping Analysis Tool.

Maryland: Data access and visualization is done through GIS, both through interactive web mapping applications and through static maps. SHA's eGIS intranet application provides easy access to data and analytic tools, and serves as a collaborative environment for various business units to overlay critical business data to make more informed, data-driven decisions. SHA also creates a static, statewide safety map that is updated regularly to show SHA's ranked, top 20 corridor locations for safety improvements based on pedestrian and vehicle crash locations and SHA's severity index. For example, Figure 7 shows a section of Maryland's statewide map with targeted improvement areas for pedestrian safety.

Michigan: Both *a* and *b*. Michigan DOT has invested in a photo log to aid in the understanding of locations. The photo log is used by both safety and development areas. GIS is becoming a more standard application for information collection and communication.

Montana: Safety engineering personnel have access to visualize crash data within a GIS tool in the SIMS or using the desktop version of ArcMap. Other personnel in the department have access to .pdf maps that have been generated showing LOSS and identified crash patterns. Examples are shown in Figure 8.

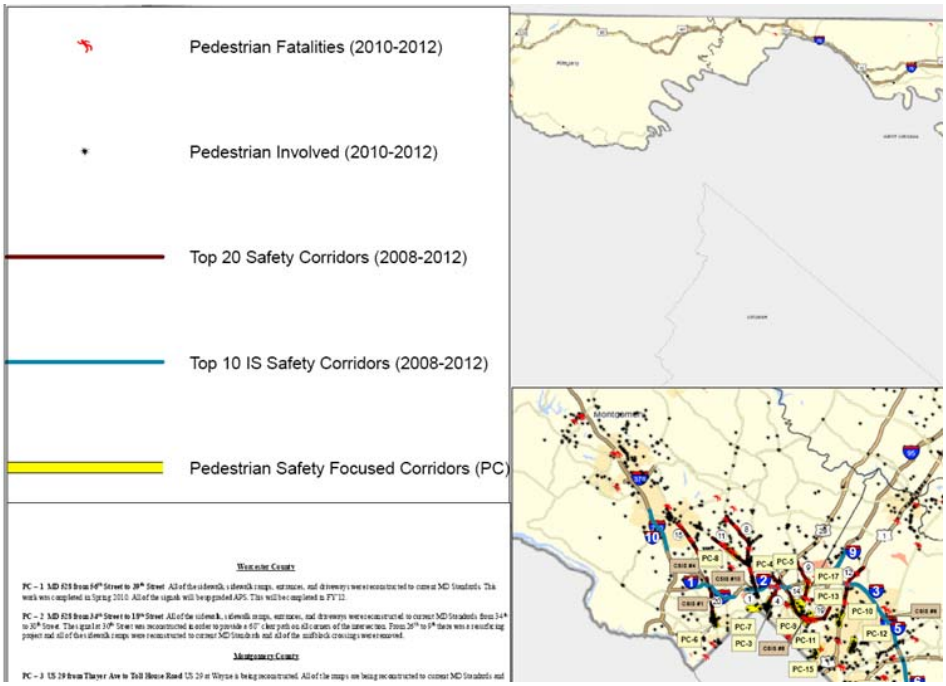


FIGURE 7 Maryland SHA targeted improvement areas for pedestrian safety.

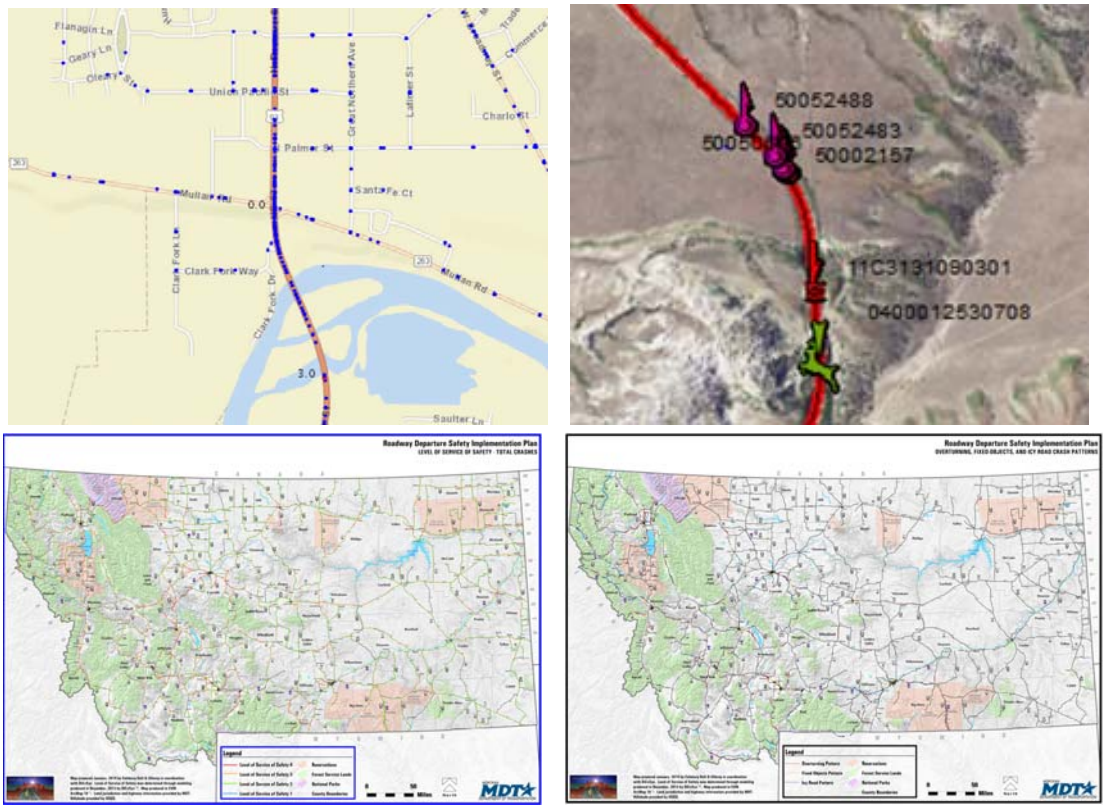


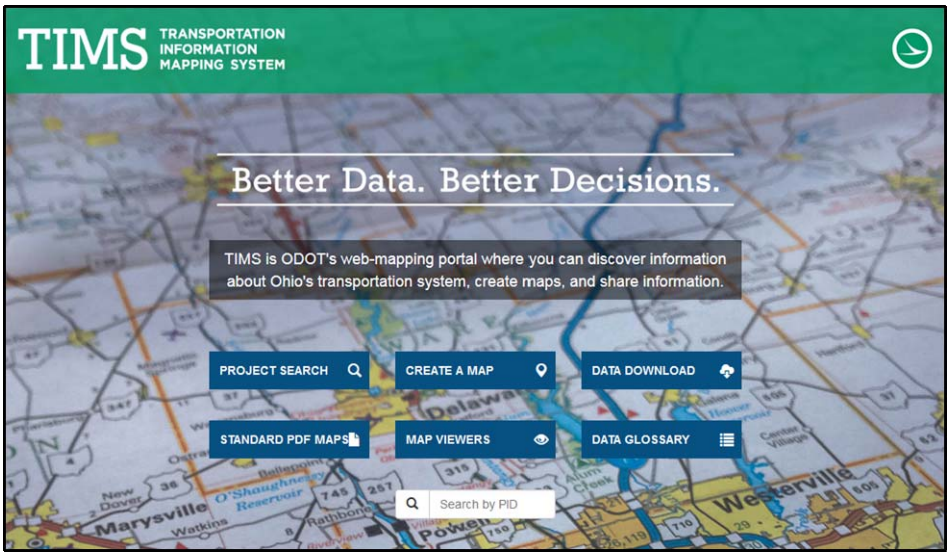
FIGURE 8 Examples of Montana DOT GIS crash visualization tools.

Ohio: Ohio has been using an internet mapping tool to query and analyze crash data since 2008. This application is specific to crash data while the newly release Transportation Information Mapping System includes assets, road inventory, traffic volumes and crash data. The department is also able to implement specialized maps for the office which includes the crash data. Both applications allow the export of data to be analyzed in a Microsoft Excel tool. This tool automates the creation of tables and charts that can be used to identify patterns at an individual location or for an entire county. This export is also used for the input as the observed crash data for Ohio's Highway Safety Manual Excel Analysis tool. All Ohio DOT staff, public officials and consultants have access to these tools. They are not available publicly because the department's data is not the authoritative dataset for the state. Figure 9 illustrates an example of this tool.

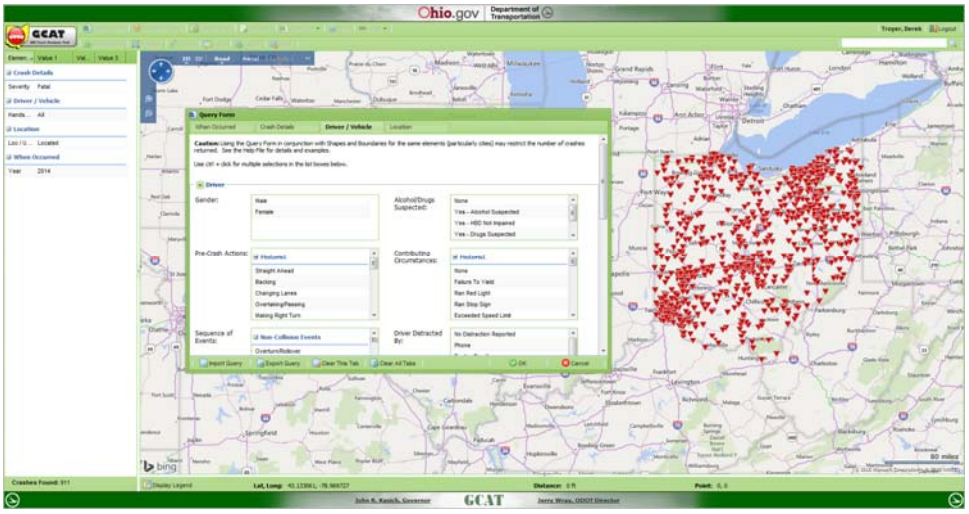
Rhode Island: Rhode Island DOT has updated the GIS road network to include LRS for all roadways through ESRI. The department has been developing heat maps for locals to help them address safety issues on their roadways/intersections.

Washington State: Crash data for both *a* and *b* are accessed using either Safety Analyst or the DOT data warehouse reports. The DOT data warehouse reports provide standard crash summaries (sample images of reports are available at http://www.wsdot.wa.gov/mapsdata /collision/collision_reports.htm).

GIS is used to produce maps showing crash locations and for project scoping-related analysis.



(a)



(b)

FIGURE 9 Ohio DOT GIS Crash Mapping Tool example: (*a*) http://gis.dot.state.oh.us /tims/ and (*b*) http://www.dot.state.oh.us/Divisions/Planning/ProgramManagement /HighwaySafety/HSIP/Pages/GCAT.aspx.

SECTION D: PROGRAM ASSESSMENT

1. Have there been efforts (e.g., RSDP, RDIP, Traffic Records Assessment) to evaluate your safety data management practices, e.g., with a capability maturity model or other type of program self-assessment? What value have these efforts provided? Does your agency also conduct its own internal self-assessment? What specific actions have resulted from these assessments to improve data management?

Alaska: The most recent work has involved:

- Work flow analysis for the new crash system involving the concept of operations, user needs, and user requirements,
- RSDP, and
- CDIP.

The department specifically asked the RSDP and CDIP teams to focus on the department's crash program in the envisioned electronic crash reporting and the SIRIS–RDS spatial environment rather than on the paper crash report and legacy mainframe database environment. The report recommendations are detailed below.

The maturity assessment, observations, and recommended actions most definitely will help as the department transitions to electronic crash reporting and the CRASH.

Idaho: A Traffic Records Assessment has been performed and a matrix of recommendations has been generated to turn these recommendations into projects, many of which are managed by the TRCC. The value has been significant as Idaho moves toward the implementation of the Data Warehouse project. ITD does not perform a structured internal self-assessment.

Iowa: Yes, the NHTSA assessment conducted with a group of peers from other states. The assessment provided excellent guidance and direction. Iowa conducts some internal self-assessment as necessary. One of the results of these assessments has been the creation of the Iowa DOT Traffic Safety Data and Analysis website.

Louisiana: RDIP.

Maryland: SHA is currently in a Traffic Records Assessment Program, which has helped to identify data collection strengths and shortcomings. The Office of Planning, Data Services Engineering Division, has also conducted an internal assessment for updating the RSDP by reviewing data collection in the MMUCC–MIRE standards.

Michigan: Michigan DOT has participated in RSDP and the report is attached along with the most recent Traffic Records Assessment. RSDP aided in determining connections, availability and direction of data sets within Michigan DOT. The department is aware of RDIP. Michigan DOT has begun efforts to create enterprise-level data sets for assets and operational-level activities.

Montana: No evaluations of Montana DOT's safety data management practices have occurred since the recent upgrade of the safety information management system.

Ohio: Ohio believes this has been completed informally when creating Ohio's online mapping tool. The biggest part of this effort was identifying data owners and quality issues.

Rhode Island: Rhode Island DOT has been involved with both a CDIP and RDIP. Both were valuable because the assessment identified the department's strengths and weaknesses and allowed DOT to develop a plan to improve crash data and roadway data involving all stakeholders. At this time, the pilot project for Local–State Data Integration for Asset

Management and Safety Analysis will help with conducting an assessment, where a separate internal assessment will not be necessary at this time.

Washington State: A NHTSA Traffic Records Assessment was completed in April 2014. Self-assessments are not performed but staff responds to ad hoc feedback from users. The business offices have not been involved in any actions resulting from these assessments to improve data management. TDGO has also engaged users to provide feedback to data improvement efforts.

2. What procedures are in place to identify risks, gaps, and overlaps in data collected, managed and used in the DOT safety programming activities and the project development process?

Alaska:

Crash Data Improvement Program

Although not in place, the following action plan activities will take place following the transition to electronic crash reporting:

- Establish a formal, comprehensive data quality management program to include:
  - Error correction logging,
  - Feedback to law enforcement,
  - Targeted training,
  - Additional edit checks,
  - Periodic audits of crash reports, and
  - Data quality performance measurement.
- Develop a metric calculating the time between the crash event and data availability on the statewide crash database (inclusive of all component processes). This should be recorded for each crash event, and the average value over all crashes should be reported as the average reporting delay. Report this value for the entire crash records system and individually for each law enforcement agency.
- Develop a metric calculating the time between the crash event and data submission to DMV. The average overall crashes and for each law enforcement agency should be reported on a periodic basis.
- Develop timeliness metrics for component processes, including error correction, location coding, and other key processes. These should be reported on a periodic basis to all stakeholders including the Alaska TRCC.
- Develop measures of crash data accuracy based on the following metrics:
  - Automated review of the accuracy of a small number of critical data elements. This check should include validation that the reported elements meet the data type and allowed range as well as verifying the logical consistency among data fields.
  - Comparison of original (as submitted) data to corrected data based on the recommended transaction table.
- Develop measures of crash data completeness based on the following metrics:
  - Automated review of missing and unknown values in critical data elements.

  - Comparison of current to prior years reporting levels statewide and for each LEA.
  - Comparison of current to prior years on proportion of injury+fatal/total crashes statewide and for each LEA

Roadway Safety Data Partnership

Although not in place, the following action plan activities will take place following the transition to electronic crash reporting for:

- Roadway data collection:
  - Completeness: develop a local roads inventory database with at least a moderate level of detail on the local roadways.
  - Timeliness: require submittal of as-built plans in a timely manner.
  - Accuracy: establish external verification processes to compare the data in the database against data collected via field observations.
  - Uniformity–consistency:
    - Develop data coding standards and share them with all who submit or enter data.
    - Conduct validation checks to assess uniformity–consistency across years.
    - Develop procedures for tracking roadway locations across multiple years in the database.
    - Develop procedures to ensure that data elements are coded consistently across multiple years.
    - Ensure that data coding is consistent for all public roadways (not just state-maintained roadways).
    - Ensure that updates to the data collection forms and/or the database are reflected in standard data collection protocols and instruction manuals.
- Data analysis tools—network screening:
  - Ensure linkage of crashes with both traffic and roadway inventory data.
  - Ensure sufficient linked database coverage to include locations with zero crash frequency.
  - Identify gaps in the current databases and enhance the systems to include all state-maintained roads.
- Data analysis tools—evaluation:
  - Develop a 5-year minimum historical database for crashes and traffic volume data. Ideally, the databases would cover all public roads, but could be accomplished by collecting data for a specific subset of roadway locations.
  - Move toward collection of statewide data for crash and traffic volume. Maintain historical data for at least one of these.
- Data analysis tools—accessibility:
  - Develop policies and procedures to meet the data needs of all safety partners.
- Data management and governance—people:
  - Create or use existing cross-functional teams (e.g., the state TRCC, executive panels) to develop data quality standards and data improvement project review and coordination.

  - Create a data governance group composed of agency executives and senior management.
  - Ensure cross-functional user input into data improvement decision making.
  - Establish liaisons between the data governance group and data improvement project managers.
- Data management and governance—policies:
  - Develop problem prevention strategies.
  - Benchmark data quality against industry standards.
  - Publish a data governance manual–handbook.
  - Develop a data catalog.
- Data management and governance—technology:
  - Develop and maintain data definitions and business rules.
  - Standardize all data quality and data integration tools statewide.
  - Adopt service-oriented architecture and open database connectivity as standards.
- Data interoperability and expandability—interoperability:
  - Create linked datasets including crash, roadway, and at least one other traffic records data source (e.g., injury surveillance data).
- Data interoperability and expandability—expandability:
  - Plan for enterprisewide system architecture.
  - Implement GIS standard tools for visualization and spatial analysis.
- Data interoperability and expandability—data linkage:
  - Establish a single standard location coding method.
  - Implement electronic automated linkage among key databases.

Idaho: The highway safety data is collected and managed within the Office of Highway Safety. This provides for a single point source and management of this highway safety data which controls the risk and gaps and overlaps in data collected.

Iowa: This is handled by statewide TRCC. In addition, GIMS is the asset management database for the agency and in turn will eliminate the redundancy in data collected.

Maryland: SHA participates in federal programs (i.e., Traffic Records Assessment) and safety data audits.

Michigan: None, however as needs and available resources have been available additional attributes have been determined through visual inspection of aerial–satellite imagery. Examples of this have been interchanges and driveways on Michigan DOT roadways.

Montana: No formal procedures are in place.

Ohio: None officially. However with the aforementioned project, multiple data sets were requested that were not available.

Rhode Island: None at this time.

Washington State: Washington State DOT routinely discusses risks, gaps, and overlaps of its data efforts. These are typically discussed as part of MSIG or MSEC. These activities are carried out as deemed appropriate versus a more formal standing meeting.

3. Are there processes in place for data users to assess the quality of your safety-related data and communicate this information to data stewards?

Alaska: The only formal quality assessment loop in place for safety-related data is the HPMS review each year. The most direct communication of data quality is within the Program Development Division and other federal-aid work programs. These include the STIP, highway designations, traffic, and real-time systems. There is informal communication with the state and regional traffic and safety staff, the regional traffic data staff, the asset management teams, and regional engineers on data quality issues.

Note that the department has a panel member for NCHRP 08-92: Implementing Transportation Data Program Self-Assessment. The objectives of this research are to (*a*) test the feasibility of the data program self-assessment process and (*b*) produce a guidebook for transportation agencies to implement data self-assessment methods. The guidebook will be aimed at helping decision makers and data practitioners at state DOTs and MPOs evaluate and improve their data programs to better support policy choices, infrastructure investments, and agency functions. The self-assessment will use the capability maturity model to evaluate and improve agency data programs. The project will be completed in 2015.

Idaho: The District Traffic Safety Engineers assess the quality of the data and are able to communicate quality information to the Office of Highway Safety.

Iowa: Yes.

Maryland: The Office of Traffic and Safety works directly with the Maryland State Police to improve crash data.

Michigan: No.

Montana: No formal processes are in place; however, the primary users of the safety-related data are also the data stewards making assessment of the data quality part of the day-to-day activities.

Ohio: Only informally. There is a process to update specific records but not entire data sets.

Rhode Island: No formal process is in place.

Washington State: Users have commonly communicated concerns directly to the TDGO.

4. How do you prioritize DOT safety data needs? Do you perform a risk analysis?

Alaska: Safety data needs have been prioritized through the data value assessment process, and to some extent, through the work group that created the MMUCC 4-compliant crash forms

and the new crash system user needs, user requirements, and procurement process. A formal risk analysis has not been completed. See the comments covering the CDIP and Traffic Records Assessment above.

Idaho: The ITD prioritizes the safety data needs through communications with the District Traffic Safety Engineers and other customers of the safety data.

Iowa: Iowa prioritizes safety data needs as necessary. The Iowa DOT is currently developing a web analysis tool and a safety GIS portal. Iowa does not perform a risk analysis.

Maryland: The MHSO has a problem identification process that includes analysis of traffic safety data from established statewide sources, particularly those recommended in NHTSA's traffic records information system model. The process is managed by the MHSO, with historical data collected and analyzed over time through a uniform process. This problem identification process supports managers in establishing the statewide priority areas on which MHSO focuses its highway safety efforts.

Michigan: Such needs are identified by traffic and safety through the determination of what is required to utilize various safety models. For safety analysis, Safety Analyst performs network surveillance as Part B of the HSM, while Michigan DOT has developed a HSM spreadsheet to fulfill Part C of the analysis process. MIRE FDE, and an understanding of the MAP-21 data requirements, is helping to drive the direction of data needs within Michigan DOT.

Montana: No formal process currently exists to prioritize safety data needs.

Ohio: Ohio DOT is mainly looking at MIRE FDE and trying to improve the quality of these limited data elements. No risk analysis has been completed.

Rhode Island: Safety data needs at this time are addressed as they are presented.

Washington State: A risk analysis was carried out years ago by Enterprise Risk and Safety Management headquarters to drive priorities for the roadside data collection program. This was done based on a weighted assessment of needs. The roadside data collection program is temporarily on hold. No other prioritization is taking place of safety data needs.

SECTION E: CLOSING

1. What would motivate your agency to implement a comprehensive data business planning process for the DOT?

Alaska: Alaska DOT&PF motivations are

- The opportunity to establish an improved planning process as the department shifts to a new data collection, storage, and reporting regime.
- Better data integration across business areas, e.g., transportation asset management.

- Increased capabilities for spatial delivery of crash data to support the HSIP and SHSP.

Idaho: Capturing the true economic cost of crashes is a high priority as this would better aid in the business of programing highway safety projects in the HSIP with a better economic model and B/C analysis.

Iowa: Iowa DOT is on that path now.

Maryland: A comprehensive data business planning process is a step in the development of a diverse data-driven decision-support process throughout the DOT. DOTs are inherently data rich organizations, but much of the data is not integrated and treated like the valuable asset that it is in many DOTs.

Michigan: Michigan DOT has established a Data Governance Council that is still getting its feet under it. This will cover all data.

Montana: The EA project that is just underway will have a data governance component and data management strategy.

Rhode Island: The results of the pilot project for Local–State Data Integration for Asset Management and Safety Analysis should motivate Rhode Island DOT to implement a comprehensive data business planning process in regards to safety data and governance.

Washington State: Washington State DOT's motivations are:

- Directive from the Secretary of Transportation.
- Heightened level of awareness of problems and opportunities.
- Clear understanding of the distinctions between data (content) and technology (tools that enable collection, storage and use of content). Currently, technology is often viewed as the solution when Washington State DOT really needs more clarity about the business need or curation of the content.
- The appointment of a lead office with specific responsibility, oversight role, and ability to enforce necessary data policies;
- A data governance group with the responsibility for oversight at a high level, but not just from a policy perspective.
- Demonstration projects (scaled appropriately) to demonstrate the value of analysis in support of the decision-making process and to overcome concerns.
- Financial support across the business units (shared financial responsibility) for data management and integration necessary to operate and maintain the state route system cost-effectively.

2. What safety-related business process areas would benefit the most?

Alaska: The following areas would benefit the most:

- Spatial analysis;
- Positive feedback to law enforcement agencies; and
- Integration with other program areas, including transportation asset management, highway design, health, and road weather.

Idaho: The creation of a data warehouse is a priority so records among the agencies can be linked to obtain a comprehensive picture of the impact of traffic crashes in Idaho.

Iowa: Effective data planning would make it easier for everyone to use safety data such as the media, legislature, cities, counties, enforcement, and department staff.

Maryland: The integration of safety and asset management data is one that would benefit greatly.

Michigan: Michigan DOT suspects that benefits to safety will accrue based on how well the department can establish and maintain many more engineering facts about the highway system. Michigan DOT will do this to improve the asset management processes, and this improved data will benefit the safety community. The biggest issues are the lack of monetary and staff support to determine MAP-21 proposed data requirements for all public roadways.

Ohio: There always has to be a benefit monetarily; however this is traditionally difficult to lockdown. A major benefit is creating easy access to data where casual users can obtain the majority of answers.

Rhode Island: Asset Management–GIS would benefit the most as they will require additional resources to effectively process and maintain the data.

3. What questions do you have for your peers regarding improving safety programs through data governance and data business planning?

Alaska: Alaska DOT&PF is interested in

- How agencies go about crash form spot checks, including:
  - Sample size and whether the sample size is different for different crash severities,
  - Fields checked,
  - Metrics,
  - Feedback to crash processing team, and
  - Past performance.
- How agencies established an agency wide safety governance council? How does it function? What are the strengths and liabilities?
- Do any agencies have separate metadata and data catalogs?

Idaho: Obtaining information on successful design and implementation of data warehouses.

Iowa: Do you have a web analysis tool? Did a consultant design and build that tool?

Maryland: SHA would like to hear about policies and practices from state DOTs on the sharing of safety data.

Michigan:

- How can the safety community focus attention on as-built and maintenance processes to improve the quality of the engineering and roadway feature sets?
- To some degree safety analysis depends on the success of asset processes. How can the safety community make those decision makers successful?
- The MIRE FDE has been available for over 2 years. What have been the best practices of agencies to collect this information on all public roadways?
- What should be considered as a public road due to higher-volume private roadways that require signalization?
- What are some of the most successful automated data collection practices and processes along with the respective errors?
- How do you get local agencies to buy-in for collection of roadway data elements?
- Have roadway data models been considered as part of the baseline data development until actual values are available?
- How can crowdsourced data be utilized?
- What is the future of data collection considering the potential for automated vehicles?
- Should a hierarchy of data collection be established to address automated vehicle implementation? On what future platforms should data be collected and what for?
- Can the SHRP 2 Naturalistic Driving Study data be used to supplement currently unavailable datasets through the use of models and available characteristics in a roadway information database?

Ohio: Has there been any resistance with DPS supply citation data to the state DOTs?

Rhode Island:

- How are other states organized to manage safety data and what was their process for making changes to their structure?
- What difficulties and successes have other states encountered with collecting–processing–governing safety data?

Washington State:

- What is the key to data integration?
- How does a transportation agency create awareness of problems and opportunities in data governance?
- How does a transportation agency advocate and gain support for analytics, data integration, and adherence to data management policies in such challenging times?
- How does a transportation agency move cost-effectively from mainframe systems and traditional data collection processes to more sustainable data systems, storage, and innovative data collection (such as lidar)?

- How does a transportation agency gain support for correct and consistent location referencing for any data collected on the state system?
- How do you articulate the business need for types of information at a resolution digestible within the time limits of an executive's workload?
- How do you manage seamless adoption of new information technologies within your organization (such as roadway sensors, lidar, or open data architecture) while maintaining access to quality data during the transition?

Research Needs Statements

The following statements of possible research needs were generated. The peer participants identified the following as possible research needs areas. A full description of each follows.

1. Determining Metrics for Successful Data Governance.
2. Peer Exchange on Executive Perspective on Managing Transportation Data and Information as an Asset.
3. Essential Elements of Data Integration to Drive Business Decisions in Transportation Agencies.
4. Data Governance in the Context of Centralized IT.
5. Crash Data Life-Cycle Practices.
6. Effect of Location Accuracy on Safety Data Analysis: A Case for Data Governance.

RESEARCH NEEDS STATEMENT 1

Determining Metrics for Successful Data Governance

Research Needs Statement Proposal

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PROBLEM STATEMENT

Measuring the benefits and performance of an established data governance function is challenging. In March 2015, a peer exchange was held on the topic of Improving Safety Programs through data governance and Data Business Planning. The peer exchange included representatives of safety planning, data management and information technology functions at 10 state DOTs.

During the peer exchange, some participants acknowledged several benefits of having good data governance function, but were not able to identify a method for measuring those benefits. Participants noted how difficult it is to convince department management that establishing a data governance function would benefit the organization, as well as the difficulty participants have in demonstrating progress, results, and value of performing the governance functions.

RESEARCH OBJECTIVE

The purpose of this research is to identify potential organizational or operational changes that would result from a successful data governance program, as well as the relevant performance metrics that correspond to those organizational or operational changes. These performance metrics would guide those actually involved in the governance provide management with a better understanding of what the value of governance is to the organization.

Metrics could consider

- Reduction in the redundancy of data and the associated costs, based on counts of data systems or tables;
- Increases in internal and external data sharing based on the number of agreements in place;
- Improvements in efficiency and agility based on the speed or response time for adding data elements or implementing data improvements;

- Increased awareness of how to find and use data based on the extent and coverage of metadata; and
- Reduced ambiguity in data definitions based on the quality of metadata or coverage of an agencywide glossary.

This research would identify and document examples of documented benefits from data governance from both DOTs and other public- and private-sector organizations. The product of the research would be a framework for evaluating data governance programs, a sample set of metrics and documented examples of how these metrics have been derived and applied.

RESEARCH NEEDS STATEMENT 2

Peer Exchange on Executive Perspective on Managing Transportation Data and Information as an Asset

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PROBLEM STATEMENT

Transportation agencies have a long history of developing comprehensive management systems focused on particular business areas, e.g. pavements, roadway inventory, and crash. More recently, state DOTs have worked to integrate these data resources to meet the needs of complex enterprise decision-making scenarios such as asset management, emergency operations, and network safety analysis. In addition, through open data and other initiatives, external stakeholders are increasingly accessing and using transportation agency data in a wide variety of ways including transportation access (e.g., congestion, work zone, snow removal), commerce (transportation logistics, market analysis), and stakeholder (local agency coordination, performance analysis, legislative).

The increasing use of agency data internally and externally requires that the data is properly governed, i.e., there is effective oversight of the management of data assets and the performance of data functions. As transportation agencies continue to move towards data-driven decision making, it is essential that the data resource is managed correctly to ensure accuracy, completeness, and accessibility. For risk avoidance, the data should be of sufficient quality and the data characteristics properly documented. This also requires an enterprise organizational view of the data resource.

In March 2015, a peer exchange was held on the topic of Improving Safety Programs through data governance and Data Business Planning. The peer exchange included representatives of safety planning, data management, and IT functions at 10 state DOTs. One of the major issues of concern raised by a number of participants was how transportation agencies organizationally align to more effectively manage the data resource and data business planning in an information society. Different participants identified the following problem areas:

- Organization staffing and data structures designed around traditional stovepipe areas (e.g., pavements, bridges, crashes) rather than enterprise business planning activities such as program development and network safety analysis;
- Lack of information on the value to transportation agencies of effective data governance;
- Rapid increase in data collection technologies (e.g. lidar, mobile) leading to complex data management issues;
- Growing complexities of data management given changing data types (e.g., graphic images, video, documents, mapping);
- Increasing demand for information towards data-driven decisions;
- Challenges in the integration of local agency transportation data systems;
- Increasing public and legislative expectations of readily accessible transportation information;
- Increasing federal data reporting requirements;
- Growing demand for the integration of external data sources into agency business processes such as environment, meteorological, and demographic;
- Demand for the rapid deployment of data resources in emergency situations, including real-time data collection;
- Increasing demand for data and tools by agency knowledge workers for program–project development, data mining, and spatial analytics; and
- Risk of inaccessible data or the use of inaccurate data.

OBJECTIVE

The purpose of this peer exchange is to create a strategy to institute a data governance framework in state DOTs. This framework help DOTs move toward the goal of implementing transportation agency data governance and will help to identify potential organizational models–characteristics for effectively institutionalizing the management of transportation data resources. To accomplish this, the proposed exchange will bring together teams of state transportation agency executives and information system professionals. State agencies would present case studies illustrating current successes and challenges in data governance. Presentations would also focus on the following topics:

- Organizational structures focused on the information organization;
- Enterprise Data Governance Council—mission, members, and roles;
- Institutionalizing data governance authority (i.e., conferring authority on the Data Governance Council to take actions to modify the business and technical environment to achieve the department policy);
- Private–public examples of effective data governance;
- Knowledge organization–future trends;
- Open data initiatives; and
- Potential funding and revenue options.

Ultimately, the discussions from the proposed peer exchange would be documented portraying an executive view on effective data governance needs and practices and the identification of potential organizational solutions.

RESEARCH NEEDS STATEMENT 3

Essential Elements of Data Integration to Drive Business Decisions in Transportation Agencies

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PROBLEM STATEMENT

In March 2015, a peer exchange was held on the topic of Improving Safety Programs through data governance and Data Business Planning. The peer exchange included representatives of safety, planning, data management, and IT functions at 10 state DOTs. One of the major issues of concern raised by different participants was the lack of data integration across data sources and systems to facilitate business decisions in transportation agencies. Data integration allows for analysis across data sources to optimize decision making based on performance-based criteria.

Agencies have different data inventories, IT, GIS, and data governance structures and practices. While the practices may be different, there are commonalities in the needs of today's DOTs. These data-driven organizations are requiring that business decisions consider impacts beyond single business units and primary intent. For example, decisions for safety countermeasures can impact maintenance costs and needs, and the durability of the countermeasures is impacted by winter maintenance activities. In order to make strategic decisions that consider multiple criteria, it is necessary for data to be integrated in a manner that facilitates review across time and in a geospatial framework.

RESEARCH OBJECTIVE

The purpose of this research is to

- Identify the elements and capabilities necessary for integration across data systems to support data-driven decisions for agencies across planning, programming, project development, operations, and maintenance. At a minimum, integration implies that data is available for a

location across time (at least 5 years), any changes to the system in that same period is known, and that data about the roadway geometrics, traffic volume, and crashes is known for the location or set of locations).

- Identify key requirements for the LRS in GIS to ensure that the integrated information can be visualized within GIS.
- Consider how off-the-shelf applications can be tailored and how to drive successful data integration across multiple vendors.

At a minimum, it is anticipated that the results of this research would

- Develop criteria for assessing the level of data integration within a state DOT for the following activities: system planning; system screening; evaluation of contributing factors and associated roadway and traffic conditions; identification of countermeasures; evaluation of potential countermeasures based on capital and maintenance cost; and conducting before and after studies to evaluate the impact of projects or treatments on system performance, maintenance, and operational costs.
- Develop a maturity model that can be used to assess the maturity of data integration at a DOT. Ideally, the model would apply to data systems across all business units of the agency but as a minimum, it has to apply to the following: capital project data, crash data, roadway data, traffic data, maintenance activities, and costs, and include the assessment of an all public roads LRS that accounts for changes to the system over time.
- Provide recommendations and strategies for successful tailoring of off-the-shelf applications to integrate data and to drive vendors to support data integration across products.

RELEVANT RESEARCH NEED STATEMENTS

- Open Architecture to Support Data Integration Projects and
- Guidelines for Conducting Business Process Reviews for Successful Data Integration Projects to Support Asset Management and Safety Management Systems

RESEARCH NEEDS STATEMENT 4

Data Governance in the Context of Centralized Information Technology

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PROBLEM STATEMENT

In March 2015, a peer exchange was held on the topic of Improving Safety Programs through data governance and Data Business Planning. The peer exchange included representatives from management, safety, statewide data, GIS, and IT functions encompassing 10 state DOTs. One of the issues of concern raised by different participants was related to the role of safety data governance programs, in a situation where IT services and governance are centralized, either within a state DOT or across all state government agencies.

Many states have centralized their IT infrastructure, services, and governance in order to consolidate provisioning and maintenance of hardware and software, to achieve cost savings through reduced duplication across state agencies, and to provide a single version of the truth. A number of participants acknowledged the potential advantages of centralized IT and expressed an interest in gaining a more in-depth understanding of these advantages. Participants also sought to understand successful models for data governance and how centralized IT (at both the DOT and state government levels) will affect specific DOT data programs, such as safety, road inventory, and asset management.

RESEARCH OBJECTIVE

The purpose of this research is to develop case studies that provide insight into the benefits and challenges associated with implementing a data governance program in a DOT where IT functions have been centralized—either within the DOT, into another agency, or statewide. Key issues to be explored include

- The relationship between established statewide IT governance and state DOT data governance;

- The definition of data ownership, stewardship, and custodial roles for situations in which DOT data sets are hosted and managed by central IT staff;
- The roles assigned to centralized IT and DOT data program staff and the perceived advantages or benefits from transfer of roles to a centralized IT function that manages DOT data; and
- Centralized IT and DOT staff perceptions of challenges and successful strategies for creating and sustaining productive working relationships between IT and DOT business units.

The product of the research would include

1. Identification of state DOTs operating under centralized IT arrangements (both statewide, governmentwide, and agencywide) and characterization of the variations across states in the specific functions and responsibilities that are centralized;
2. Case studies of selected DOTs that illustrate benefits, challenges and successful practices; and
3. A synthesis of common themes from the case studies that would be of value to states that are currently implementing or transitioning centralized IT services.

RESEARCH NEEDS STATEMENT 5

Crash Data Life-Cycle Practices

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PROBLEM STATEMENT

Crash data are collected by all state DOTs. Crash data are an integral and necessary element to highway safety improvements and driver behavior interventions. How crash data are collected, stored, analyzed, and disseminated differs from state to state. The processes are developed as needed to address specific state conditions. There are no standard best practices for these processes. The variety of methods associated with crash data life cycle provides an opportunity to compare and contrast parts of the cycle for timeliness and completeness.

Data collection requires state DOTs to have relationships with LEAs throughout their state. The software platforms LEAs use to collect crash data may differ from agency to agency. How some states successfully handle the variety and inconsistency of crash data produced in the field may be helpful to other states struggling with this issue.

Data storage presents a number of decision points that differ by state. What data platform was chosen for the database? How much data clean up occurs as the data are entered into the database? For what amount of time is the data stored? How do states handle personally identifiable information?

Crash data analysis too will differ from state to state. Does analysis occur solely in house with highway safety engineers? Is the data analyzed by research institutions? Is the data available for public analyses? How does the state DOT handle legal challenges to their analysis conclusions? What analyses are done?

Data dissemination varies greatly as well. Some states keep the data in house and do not offer easy access to the data by the public. Some states provide a series of data summations. Other states put the unprocessed, de-identified crash reports out for the public to review. What are the consequences of these different data communication efforts? What are the advantages and disadvantages? What are the legal challenges and requirements associated with these methods?

In March 2015, a peer exchange occurred with 10 state transportation agencies, FHWA Office of Safety, and AASHTO safety stakeholders. The peer exchange topic was improving safety programs through data governance and data business planning. The peer exchange participants included senior management, IT directors, and specialists in spatial information, data management, and highway safety. Participants identified a need to summarize state DOT crash

data collection life cycles, including problem areas related to crash data collection, storage, analysis, and dissemination.

- There is no compendium of state crash data practices to assess best practices.
- Some states have difficulties collecting crash data, some states have difficulty organizing collected crash data, and some states find challenges in data analysis and data communication.
- There is a lack of guidance for crash data managers when data collection, storage, analysis, and communication challenges arise.
- There is a need to determine return on investment for moving to an all-electronic data system.
- There is a need to determine the best way to market best crash data collection practices, once identified, to executives.
- There is a need to have crash data life cycle written out for succession planning.

RESEARCH OBJECTIVE

The purpose of this research is to summarize methods of crash data collection, storage, analysis, and data dissemination by state to determine best practices. This research will also summarize the legal authority state DOTs possess to collect crash data. Collection, storage, analysis, and dissemination methods will be compared. Data entry speed, existence of a backlog, time from collection to highway safety engineers, and response times to public requests of data will also be summarized. The research will also examine how data governance can be effectively implemented for each of the crash data life-cycle elements to improve safety programs.

At a minimum, it is anticipated that the results of this research would:

- Provide state DOTs a directory of crash data manager contact information.
- Provide state DOTs a compendium of crash data collection methods.
- Provide state DOTs a compendium of data storage types, database types, and advantages and disadvantages of each system.
- Provide state DOTs compendium of analyses performed by state DOTs on crash data beyond HSIP requirements.
- Provide state DOTs a compendium of crash data communication efforts, within and outside of the DOT.
- For each state DOT, report time from crash event to data availability on statewide crash database.
- The compendium of crash data life cycles will highlight collection, storage, analysis, and communication methods shared by states. Shared methodologies will be highlighted and compared.
- Establish best practice strategies for implementing data governance at each crash data life-cycle element

Historically, transportation agencies have employed different organizational models to develop crash data systems. Improving crash data systems will hinge on existing technical

architectures, information system management practices, business process organization, and organizational culture.

This research is intended to help agencies to assess their existing crash data life cycle, identify goals in improving their crash data system, and operationalizing data governance for their safety data programs. State DOTs will vary greatly in crash data practices, but will likely identify at least a few states with similar challenges and systems. States may share similar methods for part of the crash data life cycle, and can use each other as resources.

To assist agencies in improvement of their crash data methods, the research should be packaged with the identification of crash data life-cycle best practices and state DOT data governance strategies.

RESEARCH NEEDS STATEMENT 6

Effect of Location Accuracy on Safety Data Analysis
A Case for Data Governance

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PROBLEM STATEMENT

In March 2015, a peer exchange was held on the topic of Improving Safety Programs through data governance and Data Business Planning. The peer exchange included representatives from management, safety, statewide data, GIS, and IT functions encompassing 10 state DOTs. In break-out groups and subsequent discussions concern was raised by different participants regarding the influence of locational accuracy of data used in assessing safety outcomes.

GPS technology has evolved tremendously over the past 20 years from an expensive luxury to a cost-effective necessity in data collection. All data in transportation have a very important location component. Where something is, is as important as what it is. Linear referencing is a standard practice in the transportation industry. A LRS condenses the elements of a real-world transportation network, in three dimensions, into a one-dimensional representation. In this manner, the LRS provides a common operating environment for all DOT data, across the enterprise. Some participants acknowledged the potential advantages of location accuracy standards, but expressed the need for gaining a more in-depth understanding of the B/C of imposing locational accuracy standards for safety, road inventory, and related data. Other participants also sought to identify successful models for data governance in the context of the safety data life cycle, which moves data from local organizations (primarily law enforcement), through the state DOT, to the federal level.

RESEARCH OBJECTIVE

The purpose of this research is to develop case studies that provide insight into the benefits and challenges associated with implementing a locational data collection standard in a DOT and across the data life cycle of safety and safety-related rod inventory data elements:

- The technology–methods used and levels of location accuracy that crashes, road inventory, and assets collected across a DOT;
- Define each data owner, steward, and custodial role and who performs it (including DOT and non-DOT entities responsible for these roles);
- Identify the QA/QC process for locational accuracy for each data element, including who performs it, costs, and staff effort dedicated to location accuracy; and
- Determine the cost-effectiveness of an enterprise locational accuracy standard for all safety and safety-related data, through a comprehensive data governance policy.

The product of the research would include

1. Identification of the safety data life cycle in different state DOTs and characterization of the variations across states in the specific functions and responsibilities from data collection to analysis;
2. Case studies of selected DOTs that illustrate benefits, challenges, and successful practices; and
3. A synthesis of common themes from the case studies that demonstrate the role of data governance in delivering accurate, up to date, and reliable data for safety and performance analysis.

APPENDIX A

Highway Safety Terms

Acronym	Term	More Information
CDIP	Crash Data Improvement Program	CDIP is part of the FHWA Office of Safety's RSDP to provide states with a means to measure the quality of the information within their crash database. CDIP can provide metrics to measure where the crash data stands in terms of timeliness, accuracy, completeness, consistency, integration, and accessibility. CDIP also can help familiarize the crash data collectors, processors, maintainers, and users with the concepts of data quality and how quality data helps improve safety decisions. Available at http://safety.fhwa.dot.gov/cdip/.
FDE[a]	Fundamental Data Elements	Term used in the August 1, 2011, Guidance Memorandum on FDE to Improve the HSIP, identified 38 data elements that provided a sufficient set of roadway and traffic data elements that a state could combine with crash data in an analysis process to identify safety problems and to make more effective safety countermeasure decisions for their HSIP.
HSIP[b]	Highway Safety Improvement Program	A core federal-aid program. The goal of the program is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-state–owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. The specific provisions pertaining to the HSIP are defined in Section 1112 of MAP-21, which amended Section 148 of Title 23, United States Code (23 USC 148). Available at http://safety .fhwa.dot.gov/hsip/.
HSM	*Highway Safety Manual*	AASHTO *Highway Safety Manual* website: http://www.highway safetymanual.org/. Integrating the HSM into the project development process available at http://www.highwaysafetymanual.org/pdf/hsm_integration.pdf.
MIRE[c]	Model Inventory of Roadway Elements	A recommended listing of roadway inventory and traffic elements critical to safety management. MIRE is intended as a guideline to help transportation agencies improve their roadway and traffic data inventories. It provides a basis for a standard of what can be considered a good–robust data inventory and helps agencies move towards the use of performance measures. MIRE, Version 1.0 available at http: //www.mireinfo.org/collateral/mire_report.pdf and http://www.mireinfo.org/index.html.

[a] FHWA. State Safety Data Systems Questions and Answers. FHWA, U.S. Department of Transportation, Jan. 2, 2013. Available at http://www.fhwa.dot.gov/map21/qandas/qassds.cfm.
[b] FHWA. HSIP. FHWA, U.S. Department of Transportation. Available at http://safety.fhwa.dot.gov/hsip/. Accessed Aug. 15, 2-14.
[c] FHWA. About MIRE. FHWA, U.S. Department of Transportation, 2014. Available at http://www.mireinfo.org /about.html. Accessed Aug. 15, 2014.

Acronym	Term	More Information
NHTSA Traffic Records Program Assessment		Traffic records system components: Crash Data System, Vehicle Data System, Driver Data System, Roadway Data System, Citation and Adjudication Systems, and Injury Surveillance System. NHTSA Traffic Records Program Assessment Advisory (DOT HS 811 644), July 2012. Available at http://www-nrd.nhtsa.dot.gov /Pubs/811644.pdf.
RDIP	Roadway Data Improvement Program	RDIP is part of the FHWA Office of Safety RSDP to help transportation agencies improve the quality of their roadway data to support safety initiatives. These improvements include data elements collected, data collection practices, geospatial data referencing, data storage, data maintenance, and linkage of roadway-related data with other safety data. RDIP can provide roadway database managers and other traffic safety professionals a tool to assist them in identifying, measuring, and ultimately improving the quality of the data that is characterized by the timeliness, accuracy, completeness, consistency, integration, and accessibility of roadway data, accuracy, completeness, consistency, integration, and accessibility. Available at http://safety .fhwa.dot.gov/rsdp/resources.aspx.
RSDP	Roadway Safety Data Program	The RSDP supports the vision and mission of Safe Roads for a Safer Future—A Joint Safety Strategic Plan for the FHWA Office of Safety, Office of Safety Research and Development and Resource Center Safety and Design Technical Services Team. The RSDP focuses on the Safety Strategic Plan goal to improve safety data and expand capabilities for analysis and evaluation. Available at http://safety .fhwa.dot.gov /rsdp/ and http://safety.fhwa.dot.gov/rsdp /resources.aspx.
WRTM	Weather Responsive Traffic Management	Weather Responsive Traffic Management is a FHWA Road Weather Management Program to improve traffic flow and operations during inclement weather, minimize delays, and reduce crashes using a combination of advisory, control and treatment strategies. Available at http://www.its.dot.gov/connected_vehicle/road_weather.htm.

KEY TERMS FROM THE NHTSA TRAFFIC RECORDS PROGRAM ASSESSMENT

- Data system. One of the six component state traffic records databases such as crash, injury surveillance, etc.
- Data file. Such as “crash file” or “State Hospital Discharge file.” A data system may contain a single data file, such as a state’s driver file, or more than one. For instance, the injury system has several data files.
- Record. All the data entered in a file for a specific event (a crash, a patient hospital discharge, etc.).
- Data element. Individual fields coded within each record.
- Data element code value. The allowable code values or attributes for a data element.

- Data governance. A set of processes that ensure that important data assets are formally managed throughout the enterprise.
- Data linkages. The links established by matching at least one data element in 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 or integration 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 which supports critical business processes and enhances data quality.
- Data integration. The discrete linking of databases for analytic purposes.

APPENDIX B

List of Acronyms

AASHTO	American Association of State Highway and Transportation
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADA	Americans with Disabilities Act
ARNOLD	All Roads Network of Linear referenced Data
CAD	computer-aided design
CDIP	Crash Data Improvement Program
CDUG	Michigan Crash Data Users Group
CDR	Crash Data Repository (Alaska DOT&PF)
CHART	Coordinated Highway Action Response Team (Maryland SHA)
CLAS	Collision Locations and Analysis System (Washington State DOT)
CMF	crash modification factors
CODES	Crash Outcome Data Evaluation System
CRASH	Crash Analysis and Reporting System for Highways (Alaska DOT&PF)
D&ES	Design and Engineering Services (Alaska DOT&PF)
DMV	Department of Motor Vehicles
DOJ	Department of Justice
DOT	Department of Transportation
DOTD	Department of Transportation and Development (Louisiana)
DPS	Department of Public Safety (Ohio)
DSED	Data Services Engineering Division (Maryland SHA)
DTMB-CSS	Department of Technology Management and Budget—Center for Shared Solutions (Michigan DOT)
EA	Enterprise Architecture
EAT	Emphasis Area Team (SHSP)
eGIS	Enterprise GIS Portal (Maryland SHA)
EIGG	Enterprise Information Governance Group (Washington State DOT)
EMS	emergency medical services
FARS	Fatality Analysis Reporting System
FDE	fundamental data elements
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
GIMS	Geographic Information Management System (Iowa DOT)
GIS	Geographic Information System
GIS-T	GIS in Transportation
GPS	global positioning system
HATS	Highway Activity Tracking System (Washington State DOT)
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
HSM	*Highway Safety Manual*
HSRG	Highway Safety Research Group (Louisiana State University)
ISD	Information Services Division (Montana)

IT	information technology
ITD	Idaho Transportation Department
ITS	intelligent transportation system
LEA	law enforcement agency
LOSS	Level of Service of Safety (Montana)
LRS	linear referencing system
LRTP	long-range transportation plan
LTAP	Local Technical Assistance Program
MAP-21	Moving Ahead for Progress in the 21st Century Act
MHP	Montana Highway Patrol
MHSO	Maryland Highway Safety Office
MIRE	Model Inventory of Roadway Elements
MMS	maintenance management system
MMUCC	Model Minimum Uniform Crash Criteria
MPO	metropolitan planning organization
MSEC	Multimodal Safety Executive Committee (Washington State DOT)
MSIG	Multimodal Safety Issue Group (Washington State DOT)
MVA	Motor Vehicle Administration
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NSC	National Study Center for Trauma and EMS (University of Maryland, Baltimore)
PBM	Performance Based Management System (Michigan DOT)
QA/QC	Quality assurance–quality control
RDS	Roadway Data System (Alaska DOT&PF)
RDIP	Roadway Data Improvement Program
RSDP	Roadway Safety Data Program
RSDPCA	Roadway Safety Data Program Capabilities Assessment
SHA	State Highway Administration (Maryland)
SHRP 2	Strategic Highway Research Program 2
SHSP	Strategic Highway Safety Plan
SIMS	Safety Information Management System (Montana DOT)
SiMMS	Signals Maintenance Management System (Washington State DOT)
SIRIS	Spatially Integrated Roadway Information System (Alaska DOT&PF)
SLA	service-level agreements
SPF	safety performance functions
STIP	statewide transportation improvement program
TAM	transportation asset management
TAG	Technical Advisory Group
TAMIS	TAM Information System (Alaska DOT&PF)
TAMP	Transportation Asset Management Plan
TDGO	Transportation Data and GIS Office (Washington State DOT)
TGIS	Transportation GIS (Alaska DOT&PF)
TIG	Technology Implementation Group (Alaska DOT&PF)
TMC	Traffic Management Center
TraCS	Traffic and Criminal Software
TRB	Transportation Research Board

TRCC	Traffic Records Coordinating Committee
TRIPS	Transportation Information Planning and Support System (Washington State DOT)
TSMS	Traffic Signs Management System (Washington State DOT)
UMTRI	University of Michigan Transportation Research Institute
WRTM	Weather Responsive Traffic Management
WTSC	Washington State Traffic Safety Commission

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