Report

Highway Safety Manual Lead State Second Peer Exchange Baltimore, Maryland

NCHRP Research Project Statement 17-50

Lead States Initiative for Implementing the Highway Safety Manual

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Disclaimer

Contents

Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AADT	average annual daily traffic
ALDOT	Alabama Department of Transportation
BC	Benefit Cost
Caltrans	California Department of Transportation
CARE	Critical Analysis Reporting Environment
CDIP	Crash Data Improvement Program
CMF	Crash Modification Factor
CORRECT	Cost-Benefit Optimization for the Reduction of Roadway Environment Caused Tragedies
DOT	Department of Transportation
EB	Empirical Bayes
EIS	Environmental Impact Statement
FAQ	Frequently Asked Questions
FDE	Fundamental Data Element
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FY	fiscal year
GIS	geographic information system
HCM	*Highway Capacity Manual*
HRRR	High-Risk Rural Road
HSM	*Highway Safety Manual*
HSIP	Highway Safety Improvement Program
I	Interstate
IDOT	Illinois Department of Transportation
ISATe	Enhanced Interchange Safety Analysis Tool
IHSDM	Interactive Highway Safety Design Model
FDOT	Florida Department of Transportation
LA DOTD	Louisiana Department of Transportation and Development
LIDAR	light detection and ranging
LRS	linear referencing system
LTAP	Local Technical Assistance Program

MaineDOT	Maine Department of Transportation
MAP-21	Moving Ahead for Progress in the 21st Century Act
MDOT	Michigan Department of Transportation
MIRE	Model Inventory of Roadway Elements
MIS	Management Information System
MoDOT	Missouri Department of Transportation
NCHRP	National Cooperative Highway Research Program
NHDOT	New Hampshire Department of Transportation
ODOT	Ohio Department of Transportation
PennDOT	Pennsylvania Department of Transportation
QA/QC	quality assurance/quality control
RDIP	Roadway Data Improvement Program
RISE	Roadway Improvement Safety Evaluation
RSA	Road Safety Audit
SA	Safety Analyst
SAFETEA-LU	Safe, Accountable , Flexible Efficient Transportation Equity Act: A Legacy for Users
SHSP	Strategic Highway Safety Plan
SPF	Safety Performance Function
TRB	Transportation Research Board
TSP	Transit Signal Priority
UDOT	Utah Department of Transportation
usRAP	U.S. Road Assessment Program
VDOT	Virginia Department of Transportation
WSDOT	Washington Department of Transportation

Executive Summary

This report summarizes the presentations and discussions for the *Highway Safety Manual* (HSM) Lead State Second Peer Exchange held through the National Cooperative Highway Research Program (NCHRP) 17-50, *Lead State Initiative for Implementing the Highway Safety Manual* Project. The meeting was held in conjunction with the Transportation Research Board (TRB) Highway Safety Performance Committee, ANB25. Attendees included representatives from the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), state departments of transportation (DOTs), academia, and the private sector. The format of the workshop provided opportunities to share challenges and best practices. Topics were generally introduced by brief presentations and followed by facilitated discussion. The presentations were provided in electronic format at the peer exchange and are posted on the NCHRP 17-50 Project SharePoint Site along with other shared resources.

Objective

The objectives of the NCHRP 17-50 Project are (1) to help with the widespread effective implementation of the HSM across the country through monitoring progress, (2) providing technical assistance and organizing and facilitating two peer exchanges, and (3) developing an HSM User Guide based on the experiences and examples of the lead states. The User Guide will be used to assist highway agencies in implementing the HSM.

Introduction

The HSM has the potential to bring about major changes in the accuracy and completeness of safety analyses conducted by highway agencies. However, as with any new analysis tool, the HSM will only be effective if it is implemented by the state agencies. Recent experience has shown that one of the best approaches to encourage states to implement new methods is to share experiences and best practices. Lead state initiatives and peer exchanges are becoming an increasingly common approach to spread new information that is ready for implementation by highway agencies. As such, a Safety Performance Function National Summit was held in Chicago, Illinois, in July 2009 (http://ict.illinois.edu/conferences/spfsummit09/index.htm), and an HSM Lead State Peer Exchange was held in Schaumburg, Illinois, in November 2010 (http://ict.illinois.edu/conferences/hsmworkshop2010/).

As part of the NCHRP 17-50 Project, two peer exchanges were planned to bring together representatives from 13 states that are leading the way on HSM implementation. These states benefit directly from the peer exchange and will provide information and examples to other highway agencies.

The first NCHRP 17-50 peer exchange took place on August 10 through 11, 2011, in Irvine, California. The second peer exchange took place on August 27 through 29, 2012, in Baltimore, Maryland. The agenda for the second peer exchange is provided in Appendix A. These 2-day workshops provided an informal setting in which state representatives and other invited guests shared their HSM implementation experiences, including best practices, successes, and lessons learned. The workshop format supported networking and information sharing between peers. This was accomplished through states' 10-minute presentations, followed by facilitated discussions. The topics focused on state implementation status, capacity building, HSM calibration, data, HSM implementation best practices, HSM barriers, case studies, and resources and support. This report summarizes the proceedings from the NCHRP 17-50 HSM Lead States Second Peer Exchange and the evaluation comments received from the participants. A list of attendees is provided in Appendix B.

*The **goal of the HSM Lead State Initiative** is to advance implementation of the HSM.*

*The **goal of this HSM Lead State Peer Exchange** is that each state learns at least one item that it can bring back to its agencies to advance HSM implementation.*

Meeting Proceedings

Session 1: States Progress Update

Alabama Department of Transportation (ALDOT)

Dan Turner, University Transportation Center

Alabama is currently working on an HSM implementation scoping study. This is focused on identifying users and user needs, Safety Analyst (SA) and Interactive Highway Safety Design Model (IHSDM) capabilities and deployment, integration of the Critical Analysis Reporting Environment (CARE) and Cost-Benefit Optimization for the Reduction of Roadway Environment Caused Tragedies (CORRECT) with SA, among others.

Alabama is also working on integrating CARE software with the HSM procedures. This is in response to the end users' need for a tool for site-specific projects. A nationwide survey was conducted to find out how many users were testing SA and CARE and to identify strengths, weaknesses, and gaps. This is mainly because ALDOT's ultimate goal is to combine SA and CARE into one software platform. The general recommendation for implementing changes is to build out CARE in increments.

In terms of data, according to the Office of Safety Operations, ALDOT currently has 25 to 30 ongoing projects. The agency has identified desired data elements and has initiated this long-term data collection effort.

ALDOT has completed a comprehensive training effort focused on its executives and managers and plans to continue providing in-depth training sessions to different target groups.

Safety Performance Functions (SPFs) and calibration efforts have been completed using Alabama data. One of the findings is that results from the new SPFs are superior to calibration factors.

The ALDOT implementation plan is flexible and planned to be implemented in tiers. Implementation actions include reaching out to Office of Safety Operations and ALDOT bureaus and divisions and implementing HSM by component or activity based on needs. Examples of implementation actions include work zone training and a pilot version of the Roadway Improvement Safety Evaluation (RISE) for maintenance overlays.

Several research topics are planned or underway (examples include converting link node data from a crash reporting system, using air photography for intersection evaluation, and Road Safety Audit [RSA] guide manuals.

California Department of Transportation (Caltrans)

Craig Copelan, Caltrans

California's HSM implementation plan has four basic components—training, research, management support, and education. Training and education efforts have been completed. Some of the recently completed research efforts include the evaluation of existing systems against SA, evaluation of existing tools for safety analysis, and studying SPF development versus calibration. Caltrans is currently developing Class 1 and Class 2 SPFs.

One of Caltrans' greatest challenges was reaching out to others. The agency found that webinars are a low-cost solution to introduce the HSM to various groups, such as local agencies.

Another challenge is data. Although Caltrans has acceptable data for the state highway system, data for local roads needs improvement. Geographic information system (GIS) solutions are being carried out and a Traffic Injury Mapping System Web site has been created (http://tims.berkeley.edu/).

One of the goals of the state Strategic Highway Safety Plan is to reduce run-off-road collisions. HSM-related projects have been developed to achieve this goal. Examples of projects include systemic improvements, RSAs, and integration of safety analysis into the project development process.

Florida Department of Transportation (FDOT)

Joe Santos, FDOT

Florida's progress is currently on schedule with the recent completion of a 2-day statewide training event that included 7 districts and about 40 people. The training target audience was safety analysts and was focused on HSM Part C project-level implementation.

FDOT is currently working on some pilot projects. The University of Florida is conducting segment and intersection calibration using roadway characteristic inventory data.

FDOT has successfully engaged upper management and has a safety champion in each district.

Illinois Department of Transportation (IDOT)

Priscilla Tobias, IDOT

IDOT conducted an HSM 2-day training for all the districts, including local agencies. The NCHRP 17-38 spreadsheets were integrated into the training. IDOT also conducted a 1-day workshop focused on interchanges and freeways. Some districts are using that module with the assistance of the spreadsheet application. IDOT modified the NCHRP 17-38 spreadsheets based on user feedback to make it more user-friendly and flexible. Development of a new version of the tool is underway. IDOT plans to conduct a webinar with the districts to demonstrate how to use the new version of the tool. The Enhanced Interchange Safety Analysis Tool (ISATe) spreadsheets and manual for freeways and interchanges are available in IDOT's Web site for district engineers to use in Phase I/design analysis.

Users were having trouble accessing IDOT's data system. Workshops have been held to address this problem, teaching users about the data system, data analysis, how to use the data and benefit-cost procedure. An updated benefit-cost tool is available on IDOTs Web site. IDOT is currently developing guidelines on using the safety analysis tools.

IDOT continues to use the state-specific safety performance functions developed in 2007 for network screening, transparency report, and planning and programming processes. HSM calibration efforts for multiple facility types are underway.

In addition, IDOT is finalizing the Road Safety Assessment policy (handout). The agency hosted a safety summit that was attended by government representatives. The Governor's office is providing support for applying the HSM into the transportation process.

There is an ongoing data collection methodology research project on the state system; the next step is to collect data on the local system. Regarding the SA application, IDOT faced some challenges with the data and system.

Louisiana Department of Transportation and Development (LADOTD)

April Reinhard, LADOT

The first step LA DOTD took was to conduct training to familiarize everyone with the HSM. This included district engineers, traffic engineers, planners, and "higher ups."

LA DOTD supplemented the data collection process to collect data about local roads. In the agency, traffic and safety functions are separated—safety is in the Planning Division and traffic is in the

Engineering Division—so it can be difficult to balance. It was important that representatives from various divisions, such as planning, preservation, and design, be involved.

Louisiana just finalized its implementation plan about 6 months ago. The action plan has a timeline to make it measurable. LA DOTD is working on incorporating the HSM into the policy and has developed a project map to track progress. IHSDM has been used in a few projects. Details are provided in the IHSDM presentation described in session 9.

SPF development is under contract with staff at the Colorado Department of Transportation, and LA DOTD is planning to do calibration as well.

One of the major challenges is institutional resistance because divisions show support for the *Highway Capacity Manual* (HCM) rather than the HSM. Another challenge is that people go directly to the Crash Modification Factors (CMFs) application instead of using predictive methods.

Maine Department of Transportation (MaineDOT)

Darryl Belz, MaineDOT

MaineDOT's Strategic Highway Safety Plan was signed in August 2012, with upper management support.

The FHWA resource center provided an overview to the agency's upper management and full hands-on training to the MaineDOT staff. Participants included representatives from safety, design, and planning bureaus.

Maine DOT is currently evaluating the implementation of SA and plans to evaluate the IHSDM application to the design process.

Some of the barriers Maine DOT has encountered are lack of resources and training. For instance, the agency is experiencing high turnover because many engineers are retiring or resigning. Also, the application of the HSM in unconventional designs is limited, making it difficult for to train outside partners.

The next steps include calibrating HSM SPFs and developing severity and crash-type distributions for rural two-lane roads and intersections. Maine DOT is planning to assess data needs on local road system and collect missing data. The agency also plans to continue expanding the use of the HSM into environmental and other documents beyond design exceptions. The plan is to have the HSM fully implemented by the year 2014.

Michigan Department of Transportation (MDOT)

Tracie Leix, Dean Kanitz, and Wayne Schoonover, MDOT

Michigan has been presenting information to upper management levels to gain more support for implementing the HSM. With regard to policy, the Safety Division has a direct impact on safety projects but no impact on planning. Currently, MDOT is working with regional engineers to get written statements added into the policy. HSM analysis has been added into the project scoping checklist and may become part of value engineering studies. At this time, application of the HSM is optional at MDOT. The agency is also using SA of the transparency report.

Michigan is collecting data using digital methods. Driveway and interchanges data will be implemented into the SA. Much information that is currently in paper format is planned to be converted to digital format. The Local Technical Assistance Program (LTAP) office is creating a software program that will be used for the actual labeling of interchange infrastructure. Research on roundabouts and passing lanes is posted on the research Web site, and a comparative analysis will be conducted. The plan for fiscal year (FY) 2014–2015 includes development of urban and suburban SPFs.

MDOT gives local jurisdictions that are using the HSM in analysis a scoring bonus on funding for traffic safety programs. Bonus points have been granted to High-Risk Rural Road (HRRR) and local safety programs.

LTAP organized training seminars for local agencies and elected officials to introduce them to the HSM and provide a better understanding of data and analyses. The training for elected officials attempts to direct them to contribute resources to the HSM by creating interest in safety projects. The training sessions are funded by HRRR and local safety programs. LTAP is currently working on customizing spreadsheets for application of predictive methods.

From experience, MDOT found that the best time to conduct training is in the winter (off-construction season). Local agency personnel are too busy during summer and cannot attend training events.

Some of the challenges MDOT faces include the cost of the manual for training participants, but the HSM loan program is helping with this issue. Having HSM available at the LTAP helps minimize this barrier. NCHRP 17-38 spreadsheets have also proven to be useful.

Missouri Department of Transportation (MoDOT)

Ashley Reinkemeyer, MoDOT

Missouri is beginning to incorporate the HSM into design exceptions. The HSM has already been used in the central office to set speed limits on expressways. Most of the work at the districts is about resurfacing. The most common applications so far are support documentation, planning, alternative analysis, and value engineering.

MoDOT is working on calibrating and trying to implement SA.

MoDOT conducted in-house training for 7 districts, for a total of 250 people from the Design, Traffic, Planning, and Safety divisions. Local training was also provided at a traffic and safety workshop.

Missouri found it challenging to continue re-training people to maintain knowledge of the HSM despite the latest reduction in staff. Districts that use the HSM are not asking questions, but rather are trying to use it on their own as they go along. This is causing some errors in HSM application.

The next steps include an upcoming training in December 2012 and coordinating training for local jurisdictions. MoDOT would also like to identify a “power user” in each district who is committed to implementing the HSM (to keep the momentum going). Next steps also include calibration, and SA implementation, and developing CMF training for all the districts.

New Hampshire Department of Transportation (NHDOT)

Stuart Thompson, NHDOT

New Hampshire has three separate avenues to obtain Highway Safety Improvement Program (HSIP) funds—network analysis, systematic approach, and RSAs. Network analysis is applied to the transparency report. The systematic approach is used in conjunction with SA. An example is the development of a map filtering out the locations with the highest number of speeding violations. As a result, the number of citations increased. Districts select the locations for conducting RSA and are using the HSM for evaluation.

NHDOT is also working on an electronic method to improve its crash data. Using the Model Inventory of Roadway Elements (MIRE) program, the agency has developed a tool to locate intersections. NHDOT has been collaborating with FHWA and another consultant in this effort.

Ohio Department of Transportation (ODOT)

Jonathan Hughes, ODOT

Ohio has good executive support because Greg Murphy was on HSM panels in 2004 and then became chief of staff and assistant director.

SA is up and running and the district traffic safety engineers are pleased with it. CH2M HILL is calibrating safety performance functions. Design exceptions procedures are almost complete and expected to be out early in 2013.

ODOT met with the Planning, Operations, and Engineering Design divisions to strategize the best approach for training. Training included fundamentals of GIS, crash analysis, and the predictive methods. Because the HSM is used every day, and the engineers only use it occasionally because they are often out in the field, additional resources are posted on ODOT's Web site. ODOT is concluding the statewide detailed training now and working on integrating HSM with existing safety procedures regarding how projects are scored and prioritized.

All consultants and state engineers must perform safety studies through a traffic academy to get prequalified as part of the project development process. ODOT is working on incorporating the HSM into this process and is going to set up a SharePoint site to post materials online.

Utah Department of Transportation (UDOT)

Scott Jones, UDOT

In Utah, the Traffic and Safety Division of UDOT is partnering with the Central Planning Programming Group and Central Maintenance to undertake a program of highway assets inventory for the entire state system using light detection and ranging (LIDAR) surveying. The contract for data collection and processing is $2.5 million ($750,000 from HSIP) and includes 6,000 centerline miles. Data collection will be completed this fall, but the actual data will be delivered in the first quarter of 2013. UDOT also partnered with a local university to refine its Empirical Bayes (EB) model.

UDOT is planning to obtain an SA license to compare results with its existing methods. To enhance overall knowledge, internal and external partners and UDOT divisions will be sharing knowledge with each other. UDOT plans to do a technology transfer on EB methods.

The Planning Division formed a partnership with the ESRI to share resources online and to determine how to perform a more-robust safety analysis using statistical methods and show the results online. In addition, the division would like to figure out how to represent safety in geographic layers. ESRI is highly motivated and has been working with the division free of charge while tools are being created.

UDOT also has conducted significant statewide HSM training.

Virginia Department of Transportation (VDOT)

Stephen Read, VDOT

VDOT started its Strategic Safety Plan update last August and is planning to get it signed by October. It includes references to the HSM in engineering and data strategies. It promotes Transit Signal Priority (TSP) and RSA in planning and project evaluation. It also includes enhanced data collection, systems, and analysis tools.

VDOT targeted site sub-types to look at SPF development, calibration, and proportions. The agency also reviewed options to conduct statewide analyses versus VDOT districts for each element and frequency.

VDOT provided a presentation on its pilot study of last summer, which examined calibration and provided information on whether to develop SPFs by themselves or use calibrations, tables, and proportions. VDOT is concluding the development of the last set of average annual daily traffic (AADT) -based SPFs for multi-lane arterials, freeways, and intersections. The agency is also conducting calibration and crash severity distributions.

In addition, VDOT is conducting some more-detailed RSAs, focusing on other factors, systemic measures, and 40- to 60-mile projects to identify deficiencies. VDOT is starting to use the NCHRP 17-38 enhanced spreadsheets for alternative analysis and project evaluations. These are used without Virginia calibration factors and proportions.

VDOT has a new linear referencing system (LRS) system in GIS, but has experienced problems with crash coding. The agency is trying to identify the data elements with the most utility for the most users and is currently focusing on asset management, budgeting, and performance measures.

A challenge for Virginia is that its district traffic engineers are extremely busy, and some of its on-call consultants are not familiar enough with the HSM.

Washington Department of Transportation (WSDOT)

John Milton, WSDOT

WSDOT is using a combination of existing and newly developed safety performance functions; the question is which statistics to use. The agency is also working on calibration and found that some models are challenging. WSDOT is making a concerted effort to develop SPFs and encourage other states to consider the pros and cons of new SPFs before developing new models. PennState University is leading this effort.

Some actions accomplished to date include the implementation of SA, incorporation of policy changes into the design manual, the recent use of HSM in planning studies and implementation in local projects, and cost-benefit discussions in relation to part C of the HSM and why, how, and under what conditions it should be used.

WSDOT is investigating how to account for very high and very low AADT volumes. The principal issue is transition sections between rural to suburban areas and suburban to urban areas. Studying how and when crashes occur has given WSDOT a better idea of what it can do to prevent crashes.

The intent of the state's Sustainable Highway Safety Program is to move away from a standard-based approach. It now requires all safety performance functions to fall into a pattern, and a worksheet was developed as a guide.

Barriers WSDOT has faced have included data collection and users concerned about differences in approach. Regional offices believe that these are minor barriers and are positive about the approach, but want an executive policy in place before making changes. Going forward, they will continue to demonstrate the need for change.

The next steps include finishing research on safety performance functions, continuing to highlight the need for change, and deciding what policies are necessary for implementation.

An important takeaway from WSDOT's implementation efforts is that champions are essential to implement and assist because there is no office dedicated specifically to safety. Timing in conjunction with program building is a key to success.

Session 2: National Efforts

FHWA Update: Resources, Training, Guides, and Support

Mshadoni Smith, FHWA

Mshadoni, who is the point of contact for the HSM, provided an update on FHWA's ongoing efforts to support implementation.

Data-driven safety challenge: The biggest challenge that states have in this area is ensuring that their data are complete, timely, and accurate. FHWA also must ensure that states are collecting and using all of the data necessary to make good decisions—crash, traffic, and roadway data. To this end, FHWA issued a guidance document last summer on the fundamental roadway data elements that all states should collect for comprehensive data analysis. FHWA worked with more than 10 states through the Crash Data Improvement Program (CDIP), providing workshops, knowledge transfer, and recommendations on how to improve crash data systems. The CDIP online guide is posted on the FHWA Web site. The CDIP will be expanded in FY 2013. In addition, FHWA is expanding its technical assistance package this year by offering states Roadway Data Improvement Programs (RDIPs), which will provide similar assistance for the states' roadway data. The first RDIP will be held in North Carolina late this year.

FHWA is also providing ongoing guidance, training, and technical assistance to states as they begin to implement the HSM and systemic planning.

Roadway Safety Data Partnership: This is a coordinated approach to advance the safety data state-of-practice. Several ongoing plans and programs include Fundamental Data Elements (FDEs), CDIP, RDIP, and MIRE, among others. Provided under the same partnership umbrella are tools and analyses, data management, and training and marketing efforts.

Regarding safety data, FHWA released a mid-project report detailing preliminary findings on states' data capability assessment. Some of the preliminary findings show that organizational structures and agency relationships can be a challenge; states are having issues collecting local data, and they need to improve coordination between divisions and need support in analysis tool implementation.

FHWA is hosting Roadway Safety Data Partnership peer exchanges with various states to have an open discussion and provide information about current practices, approaches, and techniques that can be directly applied to fill gaps in capabilities at the state and federal levels.

In addition, FHWA held an FDE Webinar showcasing ODOT and UDOT case studies. Fact sheets and presentations are available for download from the FDE Web site.

FHWA launched the Safety Data Community of Practice (SafetyCOP). The intent is to use this platform as a medium to seek solutions to problems, provide insights based on states' experiences, and provide updates on new programs, resources, data, and other relevant information.

The MIRE Management Information System MIRE MIS) report has been completed and will be made available this fall. It provides information on performance metrics and data collection methods synthesis. Local program is looking at how to collect intersection data.

A major analysis tool effort is the pooled fund, which comprises 15 states. This year's focus is SPF guidance and resource assessment. SPF resource assessment will identify an online tool to serve states and regions interested in developing their own SPFs or calibrating the default HSM SPFs.

The *HSM Integration Guidebook* is a resource to help states integrate the HSM into the project development process. It provides examples of the various phases of project development where HSM is

applicable. The intended audience is planners, managers, designers, traffic engineers, and safety analysts.

Additional guides and resources can be found on the FHWA Web site, including the *HSM Implementation Guide for Managers, HSM Training Guide*, and HSM case studies.

The National Highway Institute and the Resource Center delivered HSM training for local agencies (HSM Lite), a roadway safety management course (HSM for planners), HSM practitioners course suite, human factors workshop, and new approaches to safety analysis.

Web-based training courses include IHSDM, HSM online overview, application of CMFs, and science of CMFs.

It is planned to develop the CMFs in Practice series. This will include technical processes and case studies to illustrate the application of CMFs. In addition, the CMF clearinghouse has now more than 3,000 CMFs for nearly 1,000 countermeasures. FHWA has developed *A Guide to Developing Quality Crash Modification Factors*, which contains information on how to develop state-specific CMFs.

The ISATe is about to be released. This was part of the NCHRP 17-45 Project. Deliverables include a predictive method for freeway facilities to be included in the next edition of the HSM and a software tool that implements the method (ISATe).

The IHSDM is currently being updated to include the freeway predictive method.

Last, a draft report about the systemic safety project selection tool will be made available upon request. Pilot projects are planned in Kentucky, New York, Washington, and Missouri. Workshops will be held at the TRB meeting in 2013.

AASHTOs Strategic Plan and Web Site Update

Priscilla Tobias, IDOT/Kelly Hardy, AASHTO

Priscilla Tobias, John Milton, Geni Bahar, and Karen Dixon work as part of the committee.

The committee is working on a spreadsheet that captures the tools that different states have developed, along with contact information. The focus of this summary is to list analysis tools.

The committee is also developing a spreadsheet that lists critical conferences and meetings (such as AASHTO's meeting). The main intent is to make sure the HSM message is passed along at these meetings to other states.

To address local agencies' challenges (for example, data collection) the committee is planning to hold a workshop at the next LTAP meeting. Discussion points will include how to tackle data issues. Priscilla Tobias, Tim Colling, and Geni Bahar are currently working on the workshop elements.

The committee also is working on a joint effort with TRB and AASHTO to identify gaps in the HSM.

During the peer exchange, a draft HSM Frequently Asked Questions (FAQs) document was distributed. States are expected to provide comments/feedback to ensure that the content covers most of the typical questions about the HSM.

States are encouraged to participate in the pooled fund effort. Several deliverables are underway, including a decision tree, SPF guidebook, and feasibility of SPFs clearinghouse.

Scott Jones, Mike Curtit, and Priscilla Tobias are working on the NCHRP 20-7 Project. Another ongoing research project is NCHRP 17-48, with Charles Zegeer as the principal investigator. This project is

focused on developing a national agenda for highway infrastructure and operations safety. The agenda will include a detailed methodology for identifying and evaluating research needs in these areas.

The next steps include an upcoming project on incorporating safety into resurfacing, rehabilitation, and restoration projects.

Kelly Hardy/AASHTO mentioned that the HSM freeway chapter is currently being reviewed. The release will be a standalone document, along with companion tools.

The HSM Web site is currently being redesigned. A consultant is working with TRB and AASHTO committees on Web site updates. The new site will be oriented toward implementation. It will contain additional information on how to implement the various steps of the HSM (for example, instead of showing a link to training, it will provide information on how to train a group of people).

States are encouraged to use the HSM user discussion forum to discuss questions related to the HSM. Most of the responses to questions are handled by Mike Dimauita and Clayton Chen.

NCHRP HSM-Related Projects

Mark Bush, National Academies

Mark Bush provided a summary of NCHRP publications that have been completed, are ongoing, and are programmed for the coming FYs. Guides completed to date include the following:

- NCHRP 17-15, *Accident Mitigation on Congested Rural and Exurban Two- and Three-Lane Highways*
- NCHRP 17-41, *Human Factors Guide*
- NCHRP 17-43, *Long-Term Roadside Crash Data Collection Program, VA Polytechnic Institute*
- NCHRP 17-45, *Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges*
- NCHRP 17-46, *Comprehensive Analysis Framework for Safety Investment Decisions*
- NCHRP 17-50, *Lead States Initiative for Implementing the Highway Safety Manual*
- NCHRP 17-54, *Consideration of Roadside Features in the Highway Safety Manual, TBC in August 2013*

Research projects for FY 2012

- Development of comprehensive approach for serious traffic crash injury measurement and reporting systems
- Measuring performance among state DOTs; sharing good practices for serious crash injury
- Safety prediction models for six-lane and one-way urban and suburban arterials

Research projects for FYI 2013

- NCHRP 17-62, Improved Prediction Models for Crash Types and Crash Severities
- NCHRP 17-63, Guidance for the Development and Application of CMFs

Among the future projects for consideration are research projects on roundabouts, managed lanes, and other intersection types.

FIGURE 1: Lead States Peer Exchange Day 1

Session 3: How is the HSM being Used or Misused

Common Uses (and Misuses) of the HSM

Karen Dixon, Texas Transportation Institute

There are several ways in which the HSM can be misused. These can occur at various stages/levels. Some of the most typical are related to administration, users, logistics, calibration, and reporting.

Administrative Issues: Some DOTs are reluctant to incorporate the HSM into their policies. Of those that do, the engagement of upper management and their level of understanding of how the HSM can benefit their project decisions are key for a successful implementation. It is important to think about how to ensure the institutional memory of the HSM.

General Issues: At a user level, general issues include a differentiation between predicted and expected terminology, when the EB method is needed, and so forth (for example, application of the expected method without inputting the crashes).

Use: In cases when there are not enough data, users might consider this to be a limitation. However, sections of the HSM can still be used with moderate amounts of data.

Another issue is the incorrect application of CMFs. Adding them together, applying them to the incorrect crash type, or paying attention to the base conditions are some of the most common misuses.

Many people perceive the HSM is only available for crash prediction. If they do not intend to perform crash prediction, they do not think it is useful. Case studies would be very helpful to demonstrate how this is not true.

Logistics: Many agencies hire consultants to assist them with their safety needs. However, there is no way to ensure that consultants are fully exposed to training. States need to be made aware of where to go for feedback or assistance. Several resources are available online that are offered at no cost.

Calibration: It is important to understand what calibration means. Common questions in this regards include whether HSM results can be reported based on models that were not calibrated (no calibration factors), what is the difference between new SPFs and calibration factors, and when each is needed.

Reporting: A good understanding of results acquired with the HSM is important. Make sure that words do not connote harm are used in the documentation. Avoid using “hazard” or “unsafe” but instead discuss “opportunities to reduce crashes” or similar language.

Lead States Discussion: Common Uses and Misuses of the HSM

Moderator: Mshadoni Smith, FHWA

During this discussion, lead states highlighted some of the strategies they have implemented to avoid some of the common mistakes when using the HSM.

CMFs: Many states agreed that the CMF clearinghouse sometimes can be overwhelming. For this reason, some states came up with their recommended CMF list. For example, UDOT and the Pennsylvania Department of Transportation [PennDOT] took a different approach and developed their own CMF).

VDOT reported that users sometimes combine CMFs for different crash types. For instance, lighting-related CMFs with all-day crashes and weather-related CMFs with all crashes are combined, among others.

One specific comment about the CMF clearinghouse was related to lead and lagging left turns. Results show no statistical difference between countermeasures.

States are encouraged to send their comments on issues about the clearinghouse to FHWA for correction (for example, rating issues, missing CMFs).

FHWA is currently considering fine-tuning the CMF selection for inclusion on the CMF clearinghouse (five-star rating versus analytical method). From now on, CMFs will only be included if they were reported in a reliable research study.

It is a good practice when working on CMF selection to look not only at the reduction but also at the condition of the crash and to make sure it is suitable to the project. CMFs studies and background documentation provide extensive documentation about CMFs.

For example, ALDOT found a CMF that fit a project; however, the Manual on Uniform Traffic Control Devices Group banned that CMF. And on a freeway conversion, chevron pavement marking was used at an exit ramp.

Another example is from Maryland DOT, which had an issue with application of CMFs to traffic control devices, which may cause a conflict with standards/manuals.

Tools: IDOT developed an upgraded version of the NCHRP 17-38 spreadsheets. However, to make sure users are applying it correctly, they are planning to conduct a Webinar demonstrating how to use the tool. IDOT's benefit-cost tool accounts for CMF application with the appropriate crashes. IDOT also has a user's guide that provides information about the CMFs.

ODOT's customized benefit-cost tool spreadsheet has built-in functions to account for weather-related crashes. This eliminates the potential for double-counting crashes.

Training: Training sometimes is not enough. Case studies highlighting HSM predictive methods are needed.

Session 4: Capacity Building

UDOT – Capacity Building

Scott Jones, UDOT

Not enough people at UDOT are familiar with the HSM methods. However, they have been using similar methodologies for a few years. There are similarities between the HSM and UDOT's methods. It is important to emphasize that both methods are data-driven (quantitative versus qualitative). UDOT is working on a department-wide integration to enhance its ability to quantify safety, expand knowledge, and improve data-driven program processes.

Utah has conducted a strong media campaign promoting the HSM since 2006. About 70 percent of people in the state are familiar with the "Zero Fatalities" campaign.

UDOT held a number of HSM workshops targeted to different audiences. A consultant developed materials and conducted training. Four-hour training sessions were offered to designers, program managers, and traffic engineers. Region-specific training on the application of predictive methods was also conducted.

Attendees pointed out that the material was too technical. Designers were not interested in the technical details. They had difficulty understanding how HSM methods fit within current UDOT processes. Due to staff turnover, maintenance of the knowledge base acquired during the trainings has become an issue, so ongoing trainings will be necessary. To maintain a knowledge base in the state, a core group is needed to answer questions from other districts and local jurisdictions.

The next steps for UDOT include developing an internal committee composed of members from both central and regional offices to determine when and how to incorporate HSM methods into existing processes and how to divide implementation responsibilities.

Lead States Discussion: Capacity Building

Moderator: Scott Jones, UDOT

PennDOT shared that when it first provided training, people were not interested in attending. PennDOT has increased efforts this year to encourage the use of the HSM, and people have become more interested in learning the methods.

It was suggested that training be developed and targeted towards various audiences/paths (for example, designers and planners).

Most training sessions begin with a long introduction to each chapter. It would be more effective if training was geared by topic and principles were taught before being related to a specific area of the HSM. Designers and engineers who do not handle the safety program enjoy the training more when they are presented with background information and then taught how to apply it.

ALDOT conducted four 2-day advanced training sessions for managers, designers, and county engineers. The first day focused on examples and spreadsheets and the second day was mainly geared toward Chapters 11 and 12 of the HSM. After the first day, participants filled out comment forms and the feedback was positive. About half have started using the HSM, but the other half is not interested in applying it. Barnett's opinion is that being able to design an intersection and also understanding how to apply safety creates a more well-rounded approach to intersection design.

IDOT conducted an "approaches to highway safety training" class. The target audience included designers, planners, and others. Background information was provided to this new group, stressing the importance of not just explaining what each chapter does, but showing real examples of how to use it.

FDOT conducted a 2-day training course giving a brief explanation of the manual, then focusing on Part C with hands-on examples. Feedback showed that people were able to follow this training method better. FDOT made the training material more state-specific and is working on incorporating it into its procedures.

Session 5: HSM User Guide

Lead States Discussion: HSM User Guide

Moderator: Kim Kolody, CH2M HILL

A draft version of the User Guide was provided to the lead states for feedback in May. The main comment was that the User Guide should follow the same format as the FHWA Integration Guide (planning, alternative analysis, design, and operations and maintenance). The latest draft version was reorganized to follow the project development process.

FHWA released a number of guides in support of HSM implementation. One of the objectives of the User Guide is to fill the gaps not covered in the other HSM guides. FHWA guides are targeted to executives and managers. However, no specific guides are focused on the users/analysts.

This guide should have enough information to provide a complete picture of the HSM to a new user; however, the process of learning the HSM methods requires trial and error.

It was suggested that Part B should not be neglected because it illustrates how to incorporate safety into the planning process. The User Guide still needs to tie in planning and project development.

Including formulas in the User Guide can be beneficial for a new user, walking them through the process. A general recommendation was to abbreviate the examples and include formulas and results without the middle steps. It is also beneficial to be able to picture examples and have equations on each page. This allows users to follow examples easier, without flipping pages back and forth.

Examples included in the User Guide are presented in a different way than the HSM. They are easier to follow and understand. States recommended that the examples should be more applicable to their day-to-day job (for example, design exceptions). The examples showing screen captures of the NCHRP 17-38 spreadsheets were well-received by the states. More examples working with CMFs should be included.

FDOT noted that it has been struggling with data and this manual has guidance that discusses the effects of having incomplete data and how it affects the decision-making process.

Many attendees thought it would be useful to have a matrix or flow chart that pointed users in the right direction within all the different guides depending on what they are looking for.

The next steps for development of the User Guide are submitting the next draft to the panel for review, addressing their comments, and producing a final draft.

In summary, the following conclusions were reached:

- Analysts are the User Guide's target audience.
- The guide should be organized by planning, alternative analysis, design, operations and maintenance, and other applications.
- The guide should include enough level of detail to make it understandable (formulas). Examples should be abbreviated.
- More-realistic examples should be provided.

Session 6: Calibration Efforts: National and State

SPF Calibration Efforts: National and State

Karen Dixon and Geni Bahar

The focus of this session was calibration, but also provided some details on SPF development. There are still some uncertainties regarding the use and development of SPFs in terms of network and in context of the project. Data collected for calibration will be very useful for future development of SPFs and will save time and money.

The HSM general crash prediction model comprises three terms—SPF, CMFs, and the calibration factor. The SPF is based on specific fixed geometry conditions that serve as the "base case." Adjustments to the SPF base conditions are made by multiplying the SPF by the appropriate CMF. This converts the base conditions to the site-specific conditions. To adjust the generalized SPF estimates to local conditions, this is multiplied by a local calibration factor.

If the proportion of crashes in a state is very different from the proportion of crashes that are the default in the HSM, there might be bias. If reporting thresholds are different between a state and the HSM safety performance functions, a calibration factor different than 1 should be expected.

Applying the base predictive model can be straightforward for segments, but can be a bit challenging for intersections. AADT data for minor roads are not always available. Lack of information about minor-road AADT is one of the biggest problems states face.

Calibration is done because state roads have unique characteristics. Calibration provides a method to address local variations (for example, climate, animal populations, crash reporting thresholds, and crash reporting procedures). There may be an overrepresentation of animal crashes or an underrepresentation of single vehicle crashes without calibration.

The calibration process begins with a randomly selecting 30 to 50 sites with a minimum of 100 crashes per year. However, not all facilities will have 100 crashes per year, so if a site has no crashes, it is still a good representative site and should not be thrown out. If data exceed the 50 sites, there is no real downside. It only means there is more data to maintain. It is recommended that statistical procedures be used to refine sample size. For example, VDOT had data for its entire roadway system available for calibration and developed its own sampling procedures to select the appropriate sample size.

As part of the HSM data needs, there are required and recommended data elements. Required data must be collected. Recommended variables should, if possible, be collected. If not available, default recommendation values are available in the HSM. With these data, predicted values for each site can be calculated. The last step of the calibration process is to divide the total observed crashes by the total predicted crashes. Calibration factors should be replaced every 2 or 3 years.

Calibration uses data from other states; it is not as precise as developing state-specific SPFs, is easy to apply, and uses a subset of total data. Calibration allows users to archive data and recreate calibration factors later. SPFs use data from locally derived distributions, are more costly to develop and maintain, and require a large data set and statistical analysis.

Another frequent question is, "What is the difference between SPFs in Part B (SA) and SPFs in Part C (IHSDM)?" SA, Part B, is used for network screening and general planning. SA does not use CMFs. It treats all facilities as the same, applying only exposure and length. It has a wide variety of procedures, including application of crash rates. Part B can be used with Part D CMFs, but not with Part C CMFs. The IHSDM includes Part C predictive methods. It is a tool for site-specific projects, provides predicted

crashes for a facility type using the EB method, and uses specific site features (CMFs). The use of SA is not discouraged, but in context with calibration, it is not a true representation.

An NCHRP Users Guide for calibration of HSM SPFs in under development. The vision of the guide is to provide a clear and practical document for HSM calibration. It is targeted to a wider audience (from senior managers and decision makers to engineers and consultants). Development is being coordinated with the SPF Decision Guide and SPF Development Guide.

Lead States Discussion: Calibration Efforts

Moderators: Karen Dixon and Geni Bahar

Results of the state-of-practice SPF calibration survey conducted on August 2012 have been summarized and some of the findings are discussed below.

Responses were received from Alabama, California, Florida, Illinois, Louisiana, Maine, Missouri, New Hampshire, Ohio, Utah, Virginia, and Washington.

Five states have calibrated Part C SPFs—Washington, Virginia, Alabama, Florida, and Utah. WSDOT has calibrated all facility types.

Table 1 summarizes the state of practice on SPF calibration.

HSM Chapter	Divided	Undivided	Intersections			
			Stop Control		Signalized	
			3-leg	4-leg	3-leg	4-leg
10. Two-Lane Rural Roads	WA, UT, FL, AL	-	WA, UT, FL	WA, UT, FL	-	WA, UT, FL
11. Multi-lane Rural Roads	WA, VA, FL, AL	WA, FL, AL	WA, FL	WA, FL	-	WA, VA, FL
12. Urban and Suburban Arterials	WA, FL, AL	WA, FL, AL	WA, FL	WA, FL	-	WA, FL

Table 1: State-of-Practice SPF Calibration

Most lead states are in the process of calibrating/expanding calibration.

Alabama, Washington, and Oregon have compared the performance of their own SPFs against the default HSM SPFs and found the results to be different. Florida has not found significant differences.

UDOT and FDOT reports are available. Other states' reports will be available upon completion.

Lessons Learned:

How large a sample size is too large for calibration?

ALDOT calibrated two-lane rural roads, multi-lane divided rural roads, and two-lane urban and suburban arterials. Homogeneous sites were used for analysis.

- **Two-lane rural:** Sample size comprised segments greater or equal than 0.05 mile (10 percent of total population)
- **Multi-lane rural:** Sample size comprised 40 percent of total population (4,000 sites); in addition, a validation dataset was sampled.

- **Two-lane urban and suburban arterials:** Sample size comprised 50 percent of total population (5,000 sites).

Virginia calibration efforts for districts led to innovative approaches due to insufficient sample size for sites and crashes. The general recommendation was to develop regional calibration factors.

- Calibrated four-lane divided rural and four-leg signalized intersections
- Segments: 1,400 sites and 3,125 crashes per year
- Intersections: 127 sites and 705 crashes per year
- VDOT's methodology to select a sample size was based on a trial and error approach. VDOT calculated regression coefficients based on a set number of sites, and tested whether the SPFs coefficient estimates were statistically stable. If not, they kept increasing the number of sample sites.

What about exposure data?

A typical question is whether traffic volume should be a parameter for separate SPF calibration (that is, high volume versus low volume urban arterial).

ALDOT stated that it would be very difficult to establish at what point SPFs change due to AADT. ALDOT used traffic volumes to generate homogeneous sites.

VDOT looked at high versus low volumes for its Part B SFPs. VDOT used AADT for 5 years for both segments and intersections, and has one of the most-complete count databases in the nation, including counts on local roads.

What about crash data?

Another common question among states is whether it is better to develop statewide versus regional calibration factors. Based on states' feedback, it depends in part on the completeness and quality of the data. VDOT's District 1 has major differences with the rest of the state (in congestion levels, demographics, and other areas). Therefore, VDOT recommended developing district-specific calibration factors and developed factors for different severity levels.

Due to data availability, ALDOT developed total crash frequency calibration factors.

Geometric and Traffic Control Data

It is recommended to get data for all the various elements used in the models using resources such as Google StreetView.

The states discussed how they handled missing data. Alabama was missing data on driveway density and driveway type, so assumptions were made. Curve and grade data are available, but because they are not completely accurate, curves were eliminated from their study. Oregon did something similar to Alabama with horizontal curves. Virginia does not have a strong central database that includes intersection lighting, so VDOT reviewed police reports to identify these facilities. The Virginia state system has about 80,000 intersections. Michigan's data sometimes indicate signalized intersections when there is actually a flashing beacon. This information is not accurately represented in the MDOT inventory.

Data Management

Some best practices to improve data management are trying to team up with the appropriate asset management group, set up a calibration cycle for data collection, pay attention to reporting threshold changes, and promote multiple agency collaboration.

Regarding data collection cycles, Virginia proposed to update its SFPs every 3 to 5 years.

Alabama suggested prioritizing calibration efforts based on results of pre-screening (for example, facilities with average expected crashes consistently higher than predicted by HSM base SPFs).

Develop Local SPFs versus Calibration

It is recommended that states develop their own SPFs for more-robust results. Typically, a robust and complete data system is required for SPF development. SPF development is more expensive than calibration. ALDOT recommends beginning with the most-common facility type to assess data availability and accuracy. VDOT recommends starting with sites with the most data available.

Alabama Calibration Efforts

Yingyan Lou, University of Alabama

Alabama discussed its calibration efforts. The segment lengths used were 1/100 of a mile. There was a large enough population from which to create an estimation set and validation set. The estimation set is used to calibrate and develop a model, which provides good performance measures; but how the models actually perform when using them in prediction needs to be evaluated using validations sets. Alabama stressed that predicting the number of crashes that will occur is not a valid prediction; rather, only the probability can be predicted.

The mean or average is the most-common functional form used for negative binomial regression. Variance is another factor that is also needed. The shape of the SPF curve needs both elements—the mean and the variance.

The HSM-recommended calibration method is sort of a linear relation and is not consistent with negative binomial regression used in the first place to develop a base SPF. ALDOT recommends using negative binomial regressions to develop calibration factors. Alabama applied a log factor to create a relationship between the functional form and the calibration factor. Log-likelihood represents the overall probability that the total number of crashes is going to occur. Mean performance measures are comparing the prediction based on probabilistic methods with observed crashes that are random events, which is not exactly an equal comparison. For this reason, the negative binomial method applied to the calibration process is recommended to make a better comparison.

After developing calibration factors using negative binomial methods, ALDOT also calculated the calibration factor using the recommended HSM approach and found that both sets of calibration factors were very similar.

Session 7: Data Challenges, Methods and Approaches

Data Collection: Illinois Data Research Project

Priscilla Tobias, IDOT

IDOT has been improving its roadway and crash database for a few years now. In 2007, IDOT developed SPFs for the state route system. These SPFs were used for network screening, identifying 5 percent locations, and estimating critical Potential for Safety Improvements for segments and intersections, system-wide analysis for countermeasure implementation, prioritizing locations, and allowing IDOT to begin using performance-based planning and programming.

However, the SPFs were too general for use with the HSM Part C predictive methods. Additional data elements were needed for developing more-robust SPFs (such as example of data elements not available: driveway density, skew angle, left and right turn lanes, alcohol establishments, bus stops, schools, and roadside hazard rating).

IDOT's existing data collection methods and systems include a roadway inventory system, GIS, NAVTEQ, and video and field data collection. Nonetheless, some data gaps still need to be addressed.

IDOT proposed an improved analysis action plan comprising four major steps—identifying data needs and gaps for HSM models, conducting a research project to identify methods for collecting data, calibrating HSM SPFs for Illinois, and evaluating calibration results to identify areas for SPF development.

The research project is being conducted by Southern Illinois University at Edwarsville. The first phase of the project is focused on identifying input data needs, literature review, conducting laboratory testing, and recommending techniques for field testing. Phase 2 of the project is focused on identifying a set of segments, conducting field experiments, data reduction, conducting foot-on-ground surveys, and assessing data quality, collection, utility, and cost.

The researcher is currently post-processing data from three separate collection methods from various roadway segments—global positioning system data logger, global positioning system -enabled photo/video log, and mobile LIDAR. The final objective is to determine the most advantageous technique or hybrid combination of techniques based on assessment of data quality, productivity, collection, utility, and cost.

IDOT collects data on state routes every 2 years, and every 5 years on the local system, including AADT, speed, and related information.

IDOT's calibration efforts will be completed in 9 months, while SPF development will take 18 months. A consultant is working on the calibration and a university is developing SPFs. They hold scheduled progress calls and panel meetings to ensure that they are staying on track.

Data Collection – MIRE MIS Intersection Data Collection Tool

Nancy Lefler, VHB

The MIRE MIS intersection data collection tool is a project developed for NHDOT and sponsored by FHWA.

MIRE is a data dictionary of roadway and traffic elements critical to safety management.

MIRE MIS is the evolution from a list to a Management Information System. It provides information on mechanisms for data collection, processes for handling data, and provides performance metrics. NHDOT and WSDOT were selected for pilot projects and were given the option to select what data they wanted to be collected. NHDOT requested intersection inventory for SA.

The intersection inventory collection tool for NHDOT is GIS-based. It pre-populates existing inventory, and additional data are integrated into the model through a user interface with assistance of available aerial imagery. It allows for multi-user editing and multiple versions.

It features a custom toolbar for executing GIS and exporting intersection inventory for use in SA. It also allows NHDOT to update the intersection inventory and import it into SA.

The work plan for this project outlined the steps of the project—data collection, manual development, training sessions, and so on.

Data were collected with assistance of part-time students. One of the biggest challenges was collecting speed limit data because no existing inventory was available. Students navigated the corridor manually using Google StreetView. Turn lane data were recorded indicating whether it was present or not and did not include geometric measurements. This additional information might be needed for IHSDM.

As part of the quality assurance/quality control (QA/QC) process, an independent GIS analyst checked the data and provided feedback to the students.

The project was completed successfully. A total of 10,300 intersections were collected in 1,600 hours, with an average of 9 minutes per intersection. Collection time and error rates improved over time.

The keys to success included developing a work plan, being in constant communication with the client, having an FAQ document available for analyst, allowing flexibility for data collection, and using GIS tools.

A MIRE data collection guide and paper on performance measures for data collection are under development. The project was funded by FHWA, with a total budget of $200,000.

Systems Integration – Transportation Data System Integration

Stephen Read, VDOT

VDOT maintains a total of 60,000 miles of roadway. VDOT is improving its data through its Asset Management Division. In addition, intelligent transportation system and traffic assets data are being added to the database from video logs. This method was not effective for collecting signals. Overall, the method was limited.

VDOT developed a community of interest to share data needs. With input from various divisions, VDOT developed a list of assets needed and coordinated with other groups to collect various data elements.

The Traffic Records Electronic Data System provides the ability to process police reports electronically, including automated submission to the Department of Motor Vehicles. This system eliminates the manual data entry into a central database, allows automated information exchange with the VDOT roadway network, and adds incident reporting and trauma registry integration.

VDOT has implemented an LRS for pavement management. For pavement data collection, data are being acquired every 36 feet. This allows obtaining grades, if needed, and indirectly, points of deflection. For horizontal data, the methodology is not as accurate yet. VDOT is also collecting railroad information.

In the new LRS system, the roadway network is coded by direction.

VDOT's Web-based Roadway Network System is a comprehensive platform used to maintain and QA/QC data attributes for different divisions (roadway system, speed zones, traffic counts, crashes, structures, railroad crossings).

The Roadway Network System is a straight-line diagram that contains roadway characteristics. It includes several tools and GIS features, allows users to query data, provides visualization in Google Earth and Bing, and exports to different file formats (Excel, jpeg, kmz).

The VDOT GIS integrator program currently supports numerous applications and users over 100 data layers in a centralized warehouse. Most business data are location-based for mapping and analysis. Some examples of GIS layers are roadway network, traffic counts, facilities, hydrology, stormwater, and civil infrastructure. The integrator is also used as a standards and reports repository.

Some of the recommendations to enhance the GIS integrator are linking it to the asset management and performance measures, adding local streets to the LRS (non-VDOT system), adding roadway alignment, developing datamart for traffic engineering asset details, and collecting intersection attributes.

In conclusion, data needs to implement the requirements of the Moving Ahead for Progress in the 21st Century Act (MAP-21) and best practices will require integration; systems approaches are needed for large data collection management and reporting; management support and coordination with GIS and other divisions are key for success; and it is important to go through the process of deciding what data are more important in order to use funds more efficiently.

Lead State Discussion: Data Collection and Systems Integration

Moderator: Kim Kolody, CH2M HILL

A key item related to data efforts is to prioritize data collection. Data important to the states's current needs should be identified. Data can be collected using methods such Google Earth and LIDAR survey.

WSDOT has performed a weighted analysis to identify the data attributes that have a direct effect on a large group of crashes (for example, two-lane rural roads). WSDOT set up three priorities within functional classes (urgency, cost to collect, and pay off).

Some DOTs are having problems updating their databases. Part of the problem is that data collection is considered to be a maintenance activity and data are collected that are not necessarily safety-related. Some states do not have updated information (for example, they have outdated AADT values). A general recommendation was to look into partnerships with internal/external agencies to improve data systems.

LA DOTD supplemented a contract to collect data on local roads. The agency will rely on local jurisdictions to perform data maintenance activities.

MDOT has a robust database that is populated using data from its roadside program for on state highways. MDOT emphasized the importance of communication between divisions. The agency is in the process of collecting data for SA and is planning to obtain additional funding in the next few years to assist with outreach to local agencies.

Idaho LTAP/DOT had data needs in its local system. In coordination with the DOT, LTAP started data collection efforts on local roads. In close coordination with about 290 jurisdictions, they obtained AADT information was obtained, among other data attributes. LTAP is making sure datasets are comparable and can be integrated. The bottom line is that getting local jurisdictions involved from the beginning is key.

ALDOT is studying methods to estimate AADT on local roadways based on various factors—including land use, zoning, rooftops, and parking lots. It is difficult and expensive to collect data on every road. Similarly, FDOT developed a modeling process to estimate AADT on local roads. Contact Joe Santos for obtaining additional information.

Applications – SPF Development/CMF Resource Guide

April Reinhard, LA DOTD

LA DOTD decided to move forward with calibration in addition to SPF development. The University of Alabama (Dr. Sun) developed a course curriculum for advanced highway safety for engineering students.

As part of a 2011/2012 pilot study, LA DOTD developed SPFs for two- and four-lane rural interstates. One of the objectives of developing SFPs was to replace their traditional network screening method based on average crash rates, crash types, and severities. Currently, the study team is in the process of developing SPFs for four-lane rural divided and undivided roads, four-/six-/eight-lane urban interstates, and intersections, totaling 36 different classifications. Depending on data availability, some classifications will take longer to be ready.

LA DOTD is also developing a CMF Resource Guide, primarily for HSM Part D. The target audience is local agencies that are not familiar with CMFs. It provides information about key resources (HSM, clearinghouse), key considerations for application (CMF quality, applicability), and examples.

The next steps are publishing the guide on the LA DOTD Web site, establishing a users group, and establishing a database for common countermeasures in Louisiana.

Applications – Guide for CMFs Protocols

Karen Dixon, Texas Transportation Institute

FHWA published *A Guide to Developing Quality CMFs.* NCHRP funded a project to develop a companion document for agencies, *Recommended Protocols for Developing Crash Modification Factors*;, both are available under Publications on the clearinghouse Web site. The latter publication provides a good summary of biases that may be encountered when developing CMFs.

Applications – HSM and SA Roadway Inventory Data

Jonathan Hughes, ODOT

Before implementing SA, ODOT's intersection inventory consisted of 4,259 intersections. The end goal was to get 46,000 intersections as part of the inventory for implementing SA and HSM. To achieve this goal, ODOT made some assumptions (for example, about traffic control). At the end, the data collection effort paid off, and ODOT now has a comprehensive intersection inventory.

One of the assumptions made to account for missing key inventory data elements was to use modeled traffic volumes for locations were actual data were missing.

SA is assisting ODOT with its network screening process. The district safety engineers have provided positive feedback about the locations identified using the new method.

Internal ODOT staff members and interns collected the data. They made modifications to the video log system and GIS tools, used a newly developed data capture tool in Excel to minimize the potential for data extraction errors, and conducted an extensive QA/QC review of data collected. As a reference, ODOT collected 49,000 intersections with the assistance of 15 interns in 3 months.

The new intersection inventory was integrated into SA for 2011, updating all intersection subtypes. SA SPF curves were recalibrated based on updated information. During this process, the ODOT staff reviewed SPF curves for various factors to determine if certain variables stood out as more critical than others (for example, traffic control, number of legs, AADT).

The next steps include completing the segment inventory and the ramp/interchange inventory. ODOT is also planning to use updated inventory to calibrate SPFs.

ODOT maintains a SharePoint site where implementation progress is being tracked.

Last, ODOT plans to finalize its project analysis and benefit cost tools.

Session 8: HSM Implementation Best Practices Morning Session

Incorporating HSM into Road Safety Assessments

Tracie Leix, MDOT

MDOT integrated the HSM alternative analysis into the RSA process. Sample projects are US-127, M-59 TWLTL, M-37/M-115 roundabout, and I-275/M-153. MDOT policy states that RSAs are to be conducted only on HSIP projects, with one per region, totaling a minimum of seven per FY. Also, projects valued at more than $750,000 are eligible for an RSA, and conduct additional ones when they are requested. MDOT has scheduled a total of 11 projects for RSAs this year.

Contract modifications were made to account for out-of-scope items to allow the HSM methodology to be included .

Some barriers include lack of training. Many consultants do not have enough experience applying HSM methods. Consultants are required to have HSM and RSA training. Additional HSM work requires additional funding, which might be a challenge. MDOT is dealing with scope changes every time and requesting funding increases.

The next step is to make the HSM mandatory for alternative analysis. MDOT is also considering adding RSAs into the scoping manual for mega projects.

HSM for Setting Speed Limits on Rural Expressways

Mike Curtit, Ashley Reinkemeyer, MoDOT

Missouri presented a case study on setting speed limits on expressways. Typically, speed limits are set using 85th percentile criteria or are set by law. In 1996, the Missouri legislature established uniform maximum speed limits on all roads in the state. The law includes a paragraph stating that speed limits could be raised or lowered. However, under any circumstance speed limits cannot be set higher than 70 mph.

MoDOT operates about 100 miles of roads with 70–mph limits, and the rest operate at 65 mph. Rural expressways are recommended to have 65-mph limits. The state has 140 miles of rural expressway and 1,200 miles of freeway.

MoDOT proposed criteria to raise the speed limit, which take into account the following items:

- Combined K+A must be at or below the predicted number of crashes.
- Alignment should be comparable to current freeway design.
- At least 90 percent of the corridor should have safety enhancements, such as paved shoulders with rumble strips and wet reflective pavement markings..
- Average number of median openings should be one every 2 miles.

MoDOT established the following conditions as the ideal base conditions/rural expressway.

- 12-foot lanes
- 8-foot right shoulder
- 60-foot median
- No intersection skew
- Minor road volume of 500 AADT
- Left- and right-turn lanes on major roads in both directions

- No lighting
- No automated speed
- Edge line rumble strips
- Four-leg minor-road stop control
- One intersection every 2 miles

MoDOT developed severity distributions for rural expressways. SPF regression coefficients were chosen for total crashes. This application included the average of 3 years of crash data.

MoDOT conducted visual checks by either driving the road physically or through video logs (ARAN video) and applied the same process to the two-lane rural roads and multi-lane rural roads.

To raise the speed limit above 70 mph, MoDOT recommended that all the intersections should be checked for sight distance.

Next steps include presenting the recommendations to upper management. The process has been given conceptual approval.

Lead State Discussion: HSM Best Practices Part 1

Moderator: Kim Kolody, CH2M HILL

MoDOT's 85th percentile on rural expressways ranges between 73 and 76 mph. There is a need to set a timeframe to reevaluate speed limits to avoid changing them constantly. Related to presence of pedestrians and cyclists, they do not have a complete streets policy in place. Bicyclists' accommodations include 8-foot shoulders. There is limited presence of pedestrians in rural areas.

ALDOT is in the process of developing a speed management manual. This will provide information on how to set speed limits.

LA DOTD has developed an automated speed enforcement manual that is is posted on the agency's website. MoDOT has an automated speed enforcement program that operates in travel safe zones, work zones, and school zones.

IDOT allows automated speed enforcement for red light running, railroad crossings, speed statewide and work zones, and for speed in school and park zones in the city of Chicago.

The HSM allowed MoDOT to compare facilities to itself, instead of comparing different roadways. MoDOT does not have enough information to evaluate whether the average number of crashes increased/decreased after raising the speed limits.

Pilot Project Case Studies

Joe Santos, FDOT

FDOT has been conducting pilot projects with districts for several years that encourage the use of the HSM. The pilot project submittal process begins with the project description and project alternative narrative submittal, including details on how the HSM can be used for analysis. The central office reviews the submittals, provides feedback that may include resource information, discussion of appropriate methodology, and so forth. This information is later shared with the districts' champions, who are the point of contact for the pilot projects.

FDOT has a core HSM Implementation Team composed of members from different divisions. The members are Joe Santos (State Safety Engineer), Alan El-Urfali (Traffic Systems Studies Engineer), Frank

Sullivan and Gregory Prytyka (Senior Transportation Engineers), Michael Shepard (State Quality Assurance Engineer), and Catherine Bradley (State Project Development Engineer).

Pilot projects have been broken down into 11 categories to be considered for analysis. As part of the accomplishments of this program, a total of 16 projects were submitted last year, but only 8 met the established requirements.

Some of the factors of the projects that did not meet the requirements include cross slope evaluation on the main line, right-turn lane on minor approach, number of lanes for left turns, projects that were already constructed, and and pavement rehabilitation projects with special features that were not part of the criteria.

Barriers and challenges include establishing what kind of improvements can be evaluated using the HSM methods; asking districts to submit projects before they had training about what can be submitted; and tracking progress and maintaining communication with HSM implementation partners.

Last, there has been a learning curve during the pilot projects process. Proper understanding and use of the HSM is important, and completing the pilot projects will be a short-term win and is key to having a successful implementation.

Tribal Use of the HSM

John Milton, WSDOT

There are 150,000 miles tribal roads in the US. There are 29 Indian nations, and a few more that are not federally recognized. Cultural practices among tribes differ. For example, tribes in the state of Washington are sovereign nations and are not always willing to share their data. Tribal police in Washington may investigate a crash and the data will not be reported to the state databases.

One way to get access to tribal crash data is through their consultants. Data can also be supplemented by verbal discussion with elders, tribal members, and police.

Tribes also differ significantly in wealth. Commercial activities include casinos, hotels, farming, and fishing.

A corridor study using SA was conducted for the confederated Tribes of the Chehalis reservation on US Highway 12. Prime activities at the reservation casinos include drinking and gambling (and related road rage), which might be the leading contributory factors for crash occurrence.

The analysis included an estimation of expected average crashes for different locations, and the calculation of benefit-cost ratios to show return investments. The Tribes wanted a four-lane highway, but the context-sensitive design was going to increase the cost.

Short-term and long-term countermeasures, as well as education and enforcement measures, were recommended.

Some of the challenges to overcome during this process were to move from beliefs to a more fact-based approach and the ability to maximize investment based on quantification.

The outcomes of this study include a better partnership between the Tribes and the state; and the state is now able to support the Tribes' planning decisions.

HSM Application in Design Exceptions

Tim Barnett, ALDOT

ALDOT has been using the HSM for a variety of projects, including establishing bridge and shoulder widths, vertical alignment, horizontal alignment, and interchanges.

Most bridges in Alabama have a 28-foot deck. Users are asking for bridges to be wider. ALDOT conducted an evaluation on a particular interstate section. The evaluation resulted on a Benefit Cost (BC) ratio of 0.003 from a purely safety point of view, with an investment return of 333 years. The conclusion was that widening bridges is not supported from a safety standpoint of view, even when there are operational benefits. Widening shoulders has a BC of 2.3 (safety standpoint)' however, it increases the construction cost significantly.

The vertical alignment project consisted of converting a county road to a state highway and evaluating the conversion from a 2-lane to 4-lane section. An environmental impact statement (EIS) was conducted in 1974 for a 70-mile roadway. A particular section had short vertical curves and limited intersection sight distance. Rebuilding this section of the roadway was going to cost $30 million. The two intersections in question had AADT volumes of 75 and 150. A safety analysis conducted at these two intersections showed that having limited sight distance increased the likelihood of having crashes by 5 percent per year. These intersections were experiencing about 1 crash every 5 years, which did not justify spending money to rebuild the roadway section just to increase the sight distance at these two intersections. Therefore ALDOT considered mitigation measures such as median acceleration lanes and indirect left turns.

The horizontal alignment project consisted of the evaluation of a 53-degree skewed intersection. AADT volumes on each road are 14,000. The upstream section is a 4-lane road with a 70 mph design speed, which drops over a length of 2,000 feet to a 30-mph turn. The skewed angle intersection project was sent for evaluation and was approved. Before approving the construction, ALDOT conducted a safety analysis. A new proposed alternative offered a crash reduction of 250 percent. ALDOT also studied rollover crashes and concluded that even with the approved final design, some rollover crashes were going to be expected. BC analyses were also conducted for the various alternatives. The proposed alternative was $3 million cheaper to build.

Alabama had five interchanges that date back to the '60s, located in very urbanized areas. Freeway-to-freeway ramp evaluations were conducted. HSM was used principally to evaluate traffic control device alternatives, with no geometric changes. Approval for suggested alternatives to improve safety was turned down.

Lessons learned during these projects—not all design exceptions are covered by existing procedures; it is difficult for a single tool to address all design exceptions; often a lot of effort is expended to get an answer that is already known. Last, ALDOT now has methods to obtain reliable crash estimates, but not all who review and approve requests for design exceptions support the HSM.

Next steps include using the HSM for evaluating design exceptions. However, these issues should have been addressed earlier in the design process. Design exceptions are typically a result of decisions that were made in early stages.

ALDOT is currently developing an RSA guidance manual that will include information from planning stages all the way to construction. It also will discuss value engineering and design exceptions, incorporating the HSM methodologies in every step of the process. Questions that will be answered include how to select projects, how to move forward through all the different stages of a project, and what safety issues to look for in particular. ALDOT is hoping to reduce the need for design exceptions by

identifying issues early in the process and selecting appropriate countermeasures to mitigate issues. The RSA manual is scheduled to be completed in 12 months.

Lead State Discussion: HSM Best Practices Part 2

Moderator: Kim Kolody, CH2M HILL

MoDOT has a design exception policy in place. However, funding issues have caused most of the funds to be reallocated to other types of projects, such as resurfacing, for which there are not many design exceptions.

MaineDOT went through a practical design approach. They ranked roadways and corridors based on customer service levels (priority level), including variables such safety, condition, and operation (six levels in total). Interstate system and major arterials are considered priority 1 roads. Minor arterials and collectors are priority 2, etc. This eliminated the use of the design exception process.

LA DOTD scopes of work are now required to add safety analysis. The LTAP representative is an effective safety champion. The agency has allocated 25 percent of its safety funds to local roads.

WSDOT is developing a safety assessment to be implemented from Planning to Operations divisions. Design matrices are being changed to spell out the design criteria for projects to require a report to be done in every safety project they are doing.

Idaho DOT is working closely with LTAP and local highway jurisdictions to use the HSM at the local level in order to get them to be more involved with safety measures. Local jurisdictions are always looking for ways to do things outside the HSIP to improve their road systems and typically will follow what other DOTs are doing. A general recommendation was to involve LTAP programs.

In Michigan, the policy has changed to include local jurisdictions. MDOT has increased the cap to $450,000 for projects in the local system. In addition, a point system for obtaining funding has been implemented. Local jurisdictions get additional points if the HSM is used in their analyses.

Session 9: HSM Implementation Best Practices Afternoon Session

Methodology for Evaluating Small Projects: RISE Pilot Implementation

Tim Barnett, ALDOT

ALDOT needed a tool to minimize the work of design and traffic engineers. RISE is an incremental safety improvement tool that allows the analyst to run analysis in a simple way, helping to identify improvements that need to be made. The tool performs crash analysis and countermeasure effectiveness evaluation in the background. It requires limited knowledge in safety analysis.

Some of RISE key features are the ability to extract data from CARE and other databases, perform crash pattern identification, identify possible causes, and provide potential countermeasures based on patterns. It also uses single and multiple countermeasures, and performs BC analysis. Those countermeasures with BC greater than a specific set value will be approved to receive HSIP funds.

ALDOT is building its own SPFs and CMFs and will incorporate those in the future. In addition, ALDOT has a version of CARE currently under development that is almost purely GIS-based.

Large-scale Application of IHSDM

April Reinhard, LA DOTD

LA DOTD developed an EIS for a corridor from the city of Bush to Interstate 12 (I-12), a four-lane arterial with limited access. A total of five alternatives were considered for evaluation. Several variables were part of the alternative analysis, including land use, air quality, traffic and transportation, and utilities, among others. Safety was not included in the original scope, so the Highway Safety Division was asked to supplement the safety elements. The goal of the safety analysis was to quantify the perceived safety benefits from constructing the project. Due to the length of the project, IHSDM was used.

Horizontal curve data were collected by an ARAN vehicle. Cross-sectional elements and AADT were available from the travel demand model. Design speeds were assumed to be 10 mph higher than the operating speed. Aerial photography was used for intersection geometry and other elements.

Data resources included land XML files, aerial imaginary from Google Earth, and TransCAD and REMI planning models, among others.

LA DOTD has its own crash severity distributions. In addition, the agency has its own cost of crashes data set, which was developed by the Louisiana State University highway safety research group. Both data sets were included in the analysis.

IHSDM results allowed LA DOTD to rank the sites by using the predicted number of crashes. Because this was done after the draft EIS was completed, the safety results were provided for informative purposes. The selected alternative ranked as third out of five alternatives in the safety evaluation.

Implementing HSM Tools

Craig Copelan, Caltrans

The California Strategic Highway Safety Plan involves the 4Es. Caltrans has focused efforts on reducing the occurrence and consequence of leaving the roadway and head-on collisions.

Some of the actions accomplished as part of the plan are in the areas of RSAs and systemic improvements.

Some example RSAs are listed below. The first RSA was selected as part of the RSA selection process. The second one was selected as part of a large litigation project to stop a large conventional highway project.

- Project YOLO 16. This is a rural conventional two-lane road with approximately 22 miles of interstate highway. It passes a casino on an Indian reservation. Vehicles travel at high speeds, and a major contributory factor to crashes is impaired driving.
- Project Alameda 84 Nile Canyon. This rural two-lane highway connects suburbs of San Jose. It is a curvilinear commuting corridor that connects to the main freeway system. The main crash type was roadway departure. Proposed improvements included realignment, shoulder widening, and curve enhancements. The project was stopped because of community concerns. FHWA got involved in the process, helping to move the project forward. The project team developed short-, medium-, and long-term improvements that were presented to the community.

As part of the systemic improvements, Caltrans developed a statewide roadway departure plan with the assistance of FHWA. Caltrans also developed a network screening application without the use of SA. CMFs were applied for roadway departure, and their effectiveness and cost were evaluated. These CMFs included installation of rumble strips, safety edge, friction courses, tree removal, and enforcement and education programs.

As far as next steps, Caltrans has planned to implement systemic roadway departure measures, taking into consideration environmental concerns and human factors. The agency also will be considering quantifying the safety impact of roadway departure improvements, and will compare and optimize the benefits and costs of improvements.

IHSDM Calibration Module

Mike Dimauita, CTR/FHWA

The IHSDM has six modules, including a crash prediction module that incorporates the HSM methods, which was the focus of this presentation. The crash prediction module was included in the 2011 release. It comprises various model components, including safety performance functions, crash modification factors, the Empirical Bayes method, and most recently the ability to compute calibration factors. This new utility allows the user to develop calibration factors, crash distribution data sets, and model datasets.

For developing calibration factors, the IHSDM requires identification of crash distributions and models to be used. The IHSDM provides the ability to modify the default crash types and severity distributions from the HSM, and the ability to enter SPFs as long as they have the same functional form as the default ones. The calibration factors can also be input directly into the tool.

The tool can calibrate up to 18 facility types. The next version will include the freeway and interchanges chapter. The calibration input data can be added into three tables under “desired data” tab. It has a button that will populate the database with default values. Site summary tables contain years of crash data, observed number of crashes, and predicted number of crashes. Each calibration data set is linked to a crash distribution data set and a model data set.

Crash distribution data sets contain crash types and severity distributions information used to break down the overall predicted crash frequency. The default data set (HSM configuration) can be copied and modified as needed.

Model datasets contain parameters and configuration data that define SPFs and CMFs to be used in the IHSDM crash prediction module. Users can copy and edit the default HSM values to reflect SPFs developed for their specific jurisdiction.

The IHSDM Administration Tool provides a mechanism to enter required data and calculate calibration factors. It also allows agencies to enter their own SPFs and to modify default crash distributions.

The next version of the IHSDM will be released in September 2012. It will include phase 1 of the freeway prediction method.

Lead State Discussion: HSM Best Practices Part 3

Moderator: Kim Kolody, CH2M HILL

NHDOT uses BC ratios to select RSA projects. VDOT projects are ranked based on severity distributions. As a result, most of the projects are located in the state system. The next tier is typically located in the local system.

States are looking for ways to reduce noise caused by rumble strip application; MDOT has 5000 miles of centerline rumble strips and has conducted a study to assess the impact of rumble strips on driver behavior, bicyclist safety, roadside noise, and short-term pavement performance. The study is available on the MDOT website.

In Illinois, RSAs are performed when requested or a need is identified. RSA policy is soon to be released to help with guidance. Some recent RSA examples are the Illinois medical district, and several miles of freeways/interchanges.

WSDOT recommended having a group discussion on how to implement the HSM into the environmental process. This topic is coming up more often, and it would be good to get ahead of the curve

FIGURE 2: Lead States Peer Exchange Day 2

Session 10: HSM Barriers: How to Overcome Them

Moderator: John Milton, WSDOT

Most of the states have been facing challenges with HSM implementation. Some of these include lack of data, lack of financial and staff resources, getting staff members to see the benefits of using the HSM, identifying the primary user of the HSM, making the HSM methods simple and easy to use, providing a competent and well-informed staff, and keeping momentum going.
States are trying to address these challenges in different ways, some of which are outlined below.

ALDOT's lack of roadway data has limited its ability to evaluate the statewide system. Sometimes easy tools that novice safety professionals are able to use facilitate the process of evaluating safety projects. RISE and CARE tools are examples of software tools developed to address this issue.

MoDOT is pushing its districts to use the HSM continuously. To accomplish this, MoDOT requests that each district provide an update on its use of the HSM periodically. In addition, to get new staff up-to-date with HSM methods, additional training is being offered as requested.

ODOT challenges are related to updating policies, getting tools in place, and updating legacy systems and scoring methods. To overcome these challenges, ODOT is working with various offices and

stakeholders to integrate the HSM into various processes throughout the organization. ODOT is also collecting required data elements with the assistance of interns and video logs.
UDOT is trying to identify the primary responsible person to carry out HSM analyses (designer vs. traffic engineer, region level vs. central office). UDOT is also experiencing a high turnover in key positions; this requires continual emphasis on the need for training. HSM methods are generally perceived as highly technical and require frequent application. To overcome this challenge, UDOT has formed an internal group to determine primary responsibility for HSM analyses. The agency is also providing specific training and is developing a pool of training consultants to support the central and regional staffs.

WSDOT is having difficulty with both staff and financial resources, developing HSM- competent staff, and providing expert assistance to regions and headquarters. To address these challenges, the agency is with the executive team and the technical staff to deal with issues as they arise; conducting training and developing specific training courses on HSM; and changing policies in design, traffic, planning, and programming to deal with change.

Other states highlighted the importance of getting obtaining upper management involvement and support with the implementation.

Session 10: Case Study

ISATe Freeway and Interchanges

Tim Neuman, CH2M HILL/Jim Bonneson, Kittelson and Associates

This presentation was focused on providing an overview of the HSM and its importance, and the NCHRP 17-45 research project, Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges. Case studies showing the application of the ISATe tool were discussed.

Highway engineers are used to thinking in terms of adherence to design criteria (nominal safety), such as those published in the AASHTO *Green Book*. The performance of a highway, either existing or expected, as determined by crash frequency and severity, is referred as substantive or quantitative safety. Substantive safety is a function not only of the basic characteristics of the road, but also a function of maintenance, law enforcement, and other resources that users choose to devote to its operation.

The HSM is a toolbox for assessing the quantitative safety (substantive safety) effects of decisions or actions. It provides direction on how to use each of the tools contained within it, and how to interpret and communicate the results. It also provides direction on which tools are appropriate to use in a given situation or given the amount and quality of data available. The HSM provides the user with the tools to assess different alternatives to reduce crash frequency or severity.

The HSM contains three chapters covering predictive methodologies for three types of highway facilities: two-lane rural roads, multi-lane rural roads, and urban and suburban arterials. Facilities not covered in Part C include freeways and interchanges, collector and local roads. Research is underway on freeways and interchanges.

A range of basic interchange types and also design policy for interchanges are provided in the *Green Book*. However, users ought to understand the expected safety performance of multimillion-dollar investments. Multiple interchange alternatives might have different design cost and operational results, so it might make sense that their safety performance is different. Alternatives may have different

configurations (for example , weaving segments vs. collector-distributor roads vs. ramp braids), design levels of service, and other differences.

The NCHRP 17-45 research project conducted by the Texas Transportation Institute (Jim Bonneson of Kittleson and Associates was the principal investigator) and a subcontractor (Tim Neuman, CH2M HILL) developed predictive methods for freeways and interchanges. Research was completed late 2011, and it is currently under review by AASHTO and TRB committees.

The predictive methods were incorporated into an Excel tool (ISATe) developed as part of the research project. ISATe can be used to compare predicted crashes before and after a proposed improvement, thereby assisting in purpose and need determinations and justification of an improvement. It can also be used to evaluate the effect of adding a new interchange to the interstate system, which is a major concern of FHWA, and that will be used for their Interchange/Access Justification Reports (IJR/AJR) processes. Other applications include evaluating alternative configurations (compare diamonds to partial cloverleafs), and evaluating and refining geometry, including as necessary evaluating proposed design exceptions.

The reconstruction of I-74 in Peoria, Illinois is an example of a before-and- after analysis. This analysis was conducted using the uncalibrated models for the state of Illinois. Observed crash data pre-construction were not available. Pre-construction and post-construction predicted crashes were calculated and compared to the observed crash-data post-construction. Results of the analysis indicated an overall reduction of 41 percent of total crashes and a 44 percent reduction of severe crashes. The tool over-predicted single-vehicle crashes and severe crashes in particular.

Another example is the I-70/I-75 interchange in Dayton, Ohio. Pre-construction and post-construction geometry, traffic volumes, and crashes were obtained and coded for the analysis. Results of the analysis indicated that the uncalibrated model for Ohio under-predicted the post-construction total crashes by 34 percent and the severe crashes by 17.5 percent in comparison with the observed crashes. However, when comparing the pre- versus post-construction crashes, there was a decrease of 18.4 percent in total crashes, and decrease of 30 percent in severe crashes. One important comment is that this model is uncalibrated to local conditions, so users would not expect predicted post-construction crashes with actual post-construction crashes to be similar or identical. However, a difference of 34 percent on total crashes is a good result, which implies a calibration factor of 1.3. Moreover, the severe crashes which one might expect to be more constant across states are close, with under-prediction of only 18 percent, implying a calibration factor of about 1.2. Overall crashes by location were logical and consistent with observed crashes.

A third example is the I-95 corridor in Pennsylvania. Planned corridor improvements along this corridor included auxiliary lane additions, minor ramp reallocations, and ramp diverge reconstruction, among others. Total predicted freeway crashes per year were computed for the various construction sectors. For instance, for Sector A the tool implied a 21 percent reduction in total crashes. Proposed improvements were relatively minor in nature; however, the tool predicted reductions in total numbers of crashes for all construction sectors.

ISATe provided reasonable and useful results. Case studies demonstrated instances with apparent over- and under–predictions, which can be attributed to the application of an uncalibrated model. However, trends in crashes by location were well-modeled.

Session 11: How can the HSM Support the MAP-21

MAP-21 Overview

Mike Griffith, FHWA

MAP-21 is a transformative bill. It is a 2-year bill that USDOT is working diligently to organize. Currently, guidance on interpreting the law and the safety provision are unavailable; however, mid-term guidance is expected to be available.

As the transition from SAFETEA-LU to MAP-21 continues, significant changes will include the consolidation of programs, channeling more funding into highway safety and becoming more performance-based, which will change the approaches nationwide. With the consolidation of programs, MAP-21 will allow the states to meet their targets within the performance-based framework. MAP-21 also will strengthen the link between the HSIP and National Highway Traffic Safety Administration programs.

A dramatic increase in the HSIP is about $1 billion more than the SAFETEA-LU Program, which displays the progress made over the last several years. There have been significant gains in highway safety, but whether the safety programs have influenced these changes still needs to be determined. Congress has recognized the success of these programs, however, which has led to more funding.

The HSIP will maintain the current structure but will have additional requirements for regular updates of the Strategic Highway Safety Plan (SHSP). Within the USDOT, a schedule will be established for the submission of the SHSP updates. It will be important to coordinate the schedule with existing planning cycles and performance recording requirements. Rail-highway grade crossings will keep a set-aside of $220 million per year, and high-risk rural roads will have no set-aside unless safety statistics worsen. The Secretary of Transportation will establish measures for the performance-based framework, and the states will set targets for the number of injuries and fatalities (and number per vehicle miles travelled).

The state HSIP will advance the capabilities of the state for safety data collection, analysis, and integration in a manner that complements a state highway safety program and commercial vehicle safety plan. The state SHIP will use that safety data system to perform safety problem identification and countermeasure analysis, which will identify hazardous locations, sections, and elements; establish relative severity of those locations; identify number of fatalities and serious injuries on all public roads by location in the state; and identify projects that maximize opportunities to advance safety. The state will have to adopt performance-based goals, which will address highway safety issues—not only infrastructure solutions but also behavioral solutions—and opportunities on all public roads. This too will have to be coordinated with the other programs the state is managing. The state will establish and implement a schedule of the highway safety improvement projects and continue to follow up with an evaluation process.

The SHSP is the core of this entire program and requires regular updates. The Secretary of Transportation will set a schedule and have the content updated by October 1, 2013. The list of participants, which includes county transportation officials, state representatives of non-motorized users, and other major federal, state, tribal, and local safety stakeholders, will be expanded in MAP-21.

MAP-21 will continue to present the strategies, activities, and projects for public roads that are consistent with a state strategic highway safety plan and correct or improve a hazardous road location or feature, or address a highway safety problem. Funds may be obligated to carry out any highway safety improvement project on any public road or publicly owned bicycle or pedestrian pathway or trail. A list of examples will be included in MAP-21.

Improvement of safety data is defined as a project/activity that will further the capacity for the state to make-informed decisions and make better safety infrastructure investments for the citizens. The following activities are eligible: create a highway base map of all public roads, collect safety data, store and maintain safety data, develop analytical processes for safety data elements, develop roadway safety analysis tools, and make analytical use of safety data. The Secretary of Transportation shall establish a subset of the model inventory of roadway elements that are useful for inventorying roadway safety.

Coordination with National Highway Traffic Safety Administration programs will ensure that the state coordinates the HSIP with the SHSP, coordinates data collection and information systems with the state SHSP, and aligns performance measures between the SHSP and HSIP.

MAP-21 identifies safety as a national goal area. USDOT will have measures in place by April 2014 regarding reduction of serious injuries and fatalities per vehicle miles travelled and reduction of the number of serious injuries and fatalities. States will set safety targets 1 year after these measures are established and will have the opportunity to adjust targets for urban or rural areas/state, and metro plans will describe how programs and projects will achieve these targets. If a state has not met or made significant progress toward meeting safety targets in 2 years, funds may be obligated to carry out any highway safety improvement project on any public road or publicly owned bicycle or pedestrian pathway or trail.

Other targets include HRRR safety, which requires that if the fatality rate on rural roads increases over 2-year period, the state must obligate at least 200 percent of its FY 2009 HRRR program for projects on HRRRs. For older drivers, if the fatalities and serious injuries per capita for road users over 65 increases during 2-year period, the state must include strategies in its subsequent SHSP and consider *Older Driver Handbook* recommendations.

The study team for HRRR best practices will issue a report by October 1, 2013, which will include a survey of the current practices of DOTs and local units of government, and a Best Practices Manual will be due 180 days after the report. The report will also include list of cost-effective roadway safety infrastructure improvements and best practices. The use of the manual shall be voluntary.

From a state's perspective, what is really important is that they are now better prepared than they were 7 years ago to meet the MAP-21 requirements and have better tools. However, there are some challenges, such as the quality and quantity of data in the local system. Also, states will still be focused on the frequency of fatal and serious injuries.

Some of the key elements that are different from SAFETEA-LU include the type of data available. In addition to safety data, there are other items such as geometric elements, as well as performance measures and targets.

Lead State Discussion: How can the HSM Support the MAP-21

Moderator: Priscilla Tobias, IDOT

MAP-21 will still encounter challenges with data collection for some states in categories such as fatal/serious injuries. The HSM, roadway safety assessments, and data systems are all tools that will create progress in safety.

The questions presented to the group were the following:

- Has the implementation of the HSM and/or the efforts for implementing the HSM helping the states move forward in safety compared to a year ago?

- Are the states are getting farther along with the data requirements with the analysis on a national level? What do we need as resources/tools?
- Do we have them? Do we need more?

The group was also asked to present Mike Griffith, FHWA, with questions or ideas that FHWA can reflect on and investigate to incorporate into MAP-21.

Some questions were about HRRRs— "Which 2 years of data will be used to measure? If there is a 5-year moving average, will the 2 years be consecutive to those five?" On the national performance matrix, 5 years of data are being used.

Other discussion items were as follows:

- MAP-21 mentions the SHSP, but it does not appear to include the behavioral plans and flexing included in the SHSPs. It also does appear to illustrate what qualifies for HSIP. Congress will be reaching out to the USDOT and possibly providing clarification regarding flexing and HSIP.
- A very important provision in MAP-21, there is a team looking into expanding the abilities in the HSIP program. There will be more guidance provided in the near future. Non-infrastructure improvements are still within the scope of the HSIP.
- The bill now requires states to provide performance management measures.
- Under the "Performance and Management" section of the code, it mentions reporting on the national highway system versus off the national highway system, and in regards to HSIP, it covers ownership in terms of state versus local. To report on all these areas can be challenging for the states. We will need more direction.
- The MAP-21 Web site has resources available to help with guidance.
- The next steps for HSM implementation will go into fruition January 2013: (1) FHWA HSM Implementation Pool Fund Study – a decision tree document and SPF guide book will be developed; (2) TRB Safety Performance Committee – to reach out to users to identify needs and gaps and work with various entities to get those items developed and out to the users; and (3) proposal to continue an expansion of the current project, which will include adding support states, having another Peer Exchange, and developing a matrix for guide books.

NCHRP 17-50 Recap and Next Steps

Priscilla Tobias, IDOT

At the annual LTAP meeting next summer, there will be a discussion on how to get the local jurisdictions involved. Recognizing the need to get the local jurisdictions engaged is critical for states.

Idaho DOT has encouraged other states to use FHWA funds to conduct local safety peer exchanges or meetings. FHWA has allocated these funds for this specific purpose. Contact Esther Strawder or Ray Krammes for additional information.

The states agreed on supporting the submittal of a research statement to get a continuation of time and funds for the NCHRP 17-50. That way additional support states can be included, and another peer exchange can be held next year.

FIGURE 3: NCHRP 17-50 Participants Group Picture

Survey Feedback

At the end of the peer exchange, attendees were asked to complete a survey that provided valuable feedback to the organizers. A total of 23 responses were received and summarized. Appendix C contains the attendee summary survey.

Attendees were asked about their satisfaction with key aspects of the peer exchange. Table 1 shows that most attendees were very satisfied with the registration process, speakers and presenters, and venue/facility.

TABLE 1
Attendee Overall Satisfaction

Overall Satisfaction	Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied	Total
Registration Process	19	3	1	0	0	23
Materials and Handouts	17	5	1	0	0	23
Speakers and Presenters	19	4	0	0	0	23
Venue/Facility	18	5	0	0	0	23

Some of the attendees suggested that providing lined sheets in binders for note taking would have been helpful, and many indicated they liked receiving the presentations and tools on the flash drive. When asked about the most important gain from the Peer Exchange, most responses centered on “great exchange of information, learned about different ways to apply the HSM, being able to interact and discuss similar issues,” “networking,” and “progress that everyone is making” Respondents indicated that they would like to learn more about how to incorporate the HSM into policy and processes; the use of tools such as SA, IHSDM, ISATe; and case studies of successful applications of the HSM. Attendees also indicated they would like guidance on best practices, periodic webinars to share progress, and receive data expert support from FHWA.

All attendees who responded to the survey said they are interested in attending similar exchange sessions in the near future.

Overall, the survey feedback demonstrates that the second NCHRP 17-50 achieved its objectives. Attendees were very satisfied with the information shared and are looking forward to participating in future workshops and continued exchanging information and experiences with other lead states.

Appendix A: Peer Exchange Agenda

NCHRP 17-50: Lead State Initiative for Implementing the Highway Safety Manual Peer Exchange Agenda

Baltimore Marriott Inner Harbor at Camden Yards. Stadium Ballroom 1 and 2

	Monday August 27th	Tuesday August 28th	Wednesday August 29th
7:15 AM		Continental Breakfast	Continental Breakfast
7:30 AM			
7:45 AM			
8:00 AM	Continental Breakfast	Calibration Efforts: National & State	HSM Barriers: How to Overcome Them
8:15 AM			
8:30 AM			Case Study: ISATe Freeway and Interchanges
8:45 AM			
9:00 AM	Welcome		
9:15 AM	States Progress		How can the HSM support MAP-21
9:30 AM			
9:45 AM			NCHRP 17-50 Next Steps
10:00 AM		Break	
10:15 AM		Data: Challenges, Methodology and Approaches	Wrap-up
10:30 AM			
10:45 AM			
11:00 AM		Break	
11:15 AM	Break	Data: Challenges, Methodology and Approaches	
11:30 AM	National Efforts		
11:45 AM			
12:00 PM			
12:15 PM		Lunch	
12:30 PM	Lunch		
12:45 PM			
1:00 PM			
1:15 PM		HSM Implementation Best Practices - Part 1	
1:30 PM	HSM implementation - Fact or Fiction: How is the HSM being used or misused?		
1:45 PM			
2:00 PM		Break	
2:15 PM	Capacity Building	HSM Implementation Best Practices - Part 1	
2:30 PM			
2:45 PM	Break		
3:00 PM	User Guide Comments and Discussion		
3:15 PM		Break	
3:30 PM		HSM Implementation Best Practices - Part 2	
3:45 PM			
4:00 PM			
4:15 PM			
4:30 PM			
4:45 PM			

Continental breakfast and lunch will be provided

Peer Exchange Program

Monday, 9:00 am – 9:15 am
Welcome to participants

Monday, 9:15 am – 11:15 am
States Progress

States implementation status updates
States to provide an update on actions, progress and challenges to date
(5 min/state)

Monday, 11:30 am - 12:30 pm
National Efforts

Mshadoni Smith, FHWA
Resources, training, guides and support (20 min)

Priscilla Tobias, IDOT
Kelly Hardy, AASHTO
AASHTOs strategic plan and website updates (20 min)

Mark Bush, National Academies
NCHRP HSM related projects (20 min)

Monday, 1:30 pm - 2:15 pm
How is the HSM being used or misused?

Karen Dixon, Texas Transportation Institute
TRB common use and misuse of the HSM (10 min)

Moderator: Mshadoni Smith, FHWA
States round table discussion (35 min)

Monday, 2:15 pm - 2:45 pm
Capacity Building

Moderator: Scott Jones, Utah DOT
Capacity Building (30 min)

Monday, 3:00 pm – 5:00 pm
HSM Users Guide & Wrap - Up

Moderator: Kim Kolody, CH2M HILL

Tuesday, 8:00 am – 10:00 am
Calibration Efforts: National & State

Moderators:
Geni Bahar, NAVIGATS
Karen Dixon, Texas Transportation Institute

- Introduction (5 min)
- Session purpose and objectives (5 min)
- Overview of 1) what calibration and SPF developing mean and how they differ; 2) SPF in the context of SafetyAnalyst (Pt B) and IHSDM (Pt C) (15 min)
- Overview of NCHRP 20-7 (332) – User's Guide: Calibration of HSM SPFs (5 min)
- State-of-Practice Survey (5 min)
- Lessons Learned – States round table discussion (70 min)
- Conclusions and Final Remarks (15 min)

Tuesday, 10:15 am – 12:15 am
Data: Challenges, Methods and Approaches

Collection
Priscilla Tobias, Illinois DOT
Illinois data research project (10 min)

Stuart Thompson, New Hampshire DOT
MIRE MIS - Intersection Data Collection Tool (10 min)

Systems Integration
Stephen Read, Virginia DOT
Transportation Data Systems Integration (10 min)

Moderator: Kim Kolody, CH2M HILL
States round table discussion (20 min)

Applications
April Renard, Louisiana DOT
SPF development/CMF Resource Guide (10 min)

Karen Dixon, Texas Transportation Institute
Guide for CMFs protocols (10 min)

Jonathan Hughes, Ohio DOT
HSM & *SafetyAnalyst* roadway inventory data improvements (10 min)

Moderator: Kim Kolody, CH2M HILL
States round table discussion (25 min)

Tuesday, 1:15 pm – 3:15 pm

HSM Implementation Best Practices - Part 1

Tracie Leix, Michigan DOT
Incorporating HSM into Road Safety Assessments (10 min)

Mike Curtit, Missouri DOT
HSM for setting speed limits on rural expressways (10 min)

Joe Santos, Florida DOT
Pilot project case studies (10 min)

Moderator: Kim Kolody, CH2M HILL
States round table discussion (25 min)

John Milton, Washington DOT
Tribal use of the HSM (10 min)

Tim Barnett, Alabama DOT
HSM application in design exceptions (10 min)

Moderator: Kim Kolody, CH2M HILL
States round table discussion (30 min)

Tuesday, 3:30 pm – 5:00 pm

HSM Implementation Best Practices - Part 2 & Wrap - Up

Tim Barnett, Alabama DOT
Methodology for evaluating small projects. (10 min)

April Renard, Louisiana DOT
Large scale application of IHSDM (10 min)

Craig Copelan, California DOT
Implementing HSM Tools (10 min)

Mike Dimaiuta, CTR
IHSDM Calibration Module (10 min)

Moderator: Kim Kolody, CH2M HILL
States round table discussion (50 min)

Wednesday, 8:00 am – 8:30 am

HSM Barriers: How to Overcome Them

Moderator: John Milton, Washington DOT

Wednesday, 8:30 am – 9:15 am

Case Study

Jim Bonneson, Kittelson and Associates
Tim Neuman, CH2M HILL
ISATe Freeway and Interchanges (45 min)

Wednesday, 9:15 am – 9:45 am

How can the HSM support the MAP-21

Mike Griffith, FHWA
MAP-21 Overview (10 min)

Moderated Session

- Safety data system, collection, integration
- Evaluation of improvement efforts
- SPF screening
- Safety performance for locals
- Safety analysis tools

Wednesday, 9:45 am – 10:15 am

NCHRP 17-50 Recap & Next Steps

Priscilla Tobias, Illinois DOT

- NCHRP 17-50 Deliverables
- User Guide
- Peer Exchange report
- Shared materials
- HSM implementation pooled fund
- TRB user liaison

Appendix B: List of Participants

NCHRP 17-50 Peer Exchange 2. List of Participants

No	Full Name	Last Name	First Name	Email	Organization
1	Jian Afshin	Afshin	Jian	afshin.jian@state.nm.us	New Mexico DOT
2	Gene Amparano	Amparano	Gene	Gene.Amparano@dot.gov	FHWA
3	Geni Bahar	Bahar	Geni	genibahar@navigats.com	NAVIGATS
4	Timothy E. Barnett	Barnett	Timothy E.	barnettt@dot.state.al.us	Alabama DOT
5	Darryl Belz	Belz	Darryl	darryl.belz@maine.gov	Maine DOT
6	James Bonneson	Bonneson	James	jbonneson@kittelson.com	KAI
7	Cheryl Bornheimer	Bornheimer	Cheryl	cherylb@ksdot.org	Kansas DOT
8	Mark S. Bush	Bush	Mark S.	mbush@nas.edu	TRB
9	Clayton Chen	Chen	Clayton	clayton.chen@dot.gov	FHWA
10	Mike Colety	Colety	Mike	Mike.Colety@Kimley-Horn.com	Kimley-Horn
11	Craig A. Copelan	Copelan	Craig A.	craig.copelan@dot.ca.gov	California DOT
12	Sean Coyle	Coyle	Sean	Sean.coyle@illinois.gov	Illinois DOT
13	Michael Curtit	Curtit	Michael	Michael.Curtit@modot.mo.gov	Missouri DOT
14	Michael Dimaiuta	Dimaiuta	Michael	Michael.Dimaiuta.CTR@dot.gov	FHWA/CTR
15	Karen Dixon	Dixon	Karen	Karen.Dixon@oregonstate.edu	OSU
16	Michael Dornfeld	Dornfeld	Michael	dornfem@wsdot.wa.gov	Washington DOT
17	Bruce Drewes	Drewes	Bruce	BDrewes@lhtac.org	Idaho DOT
18	Alan El-Urfali	El-Urfali	Alan	Alan.El-Urfali@dot.state.fl.us	Florida DOT
19	Dennis Emidy	Emidy	Dennis	Dennis.Emidy@maine.gov	Maine DOT
20	Mike Griffith	Griffith	Mike	Mike.Griffith@dot.gov	FHWA
21	Sally Gunn	Gunn	Sally	sgunn@dot.state.nh.us	New Hampshire DOT
22	Kelly Hardy	Hardy	Kelly	khardy@aashto.org	AASHTO
23	Jonathan Hughes	Hughes	Jonathan	jonathan.hughes@dot.state.oh.us	Ohio DOT
24	Scott Jones	Jones	Scott	wsjones@utah.gov	Utah DOT
25	Dean Kanitz	Kanitz	Dean	KanitzD@michigan.gov	Michigan DOT
26	Kim Kolody	Kolody	Kim	kkolody@ch2m.com	CH2M HILL
27	Ray Krammes	Krammes	Ray	Ray.Krammes@dot.gov	FHWA
28	Nancy Lefler	Lefler	Nancy	nlefler@vhb.com	VHB
29	Tracie Leix	Leix	Tracie	leixt@michigan.gov	Michigan DOT
30	Yingyan Lou	Lou	Yingyan	ylou@eng.ua.edu	ALDOT/University of Alabama
31	Gaurav Mehta	Mehta	Gaurav		
32	John C. Milton	Milton	John C.	miltonj@wsdot.wa.gov	Washington DOT
33	Girish Modi	Modi	Girish	gmodi@pa.gov	Pennsylvania DOT
34	Tim Neuman	Neuman	Tim	tneuman@ch2m.com	CH2M HILL
35	Jeffrey Oser	Oser	Jeffrey	JOser@nas.edu	TRB
36	Richard Pain	Pain	Richard	rpain@nas.edu	TRB
37	Perez-Bravo, Dante	Perez-Bravo	Dante	dperezbr@ch2m.com	CH2M HILL
38	Mark Poppe	Poppe	Mark	mpoppe@azdot.gov	Arizona DOT
39	Stephen W. Read	Read	Stephen W.	stephen.read@vdot.virginia.gov	Virginia DOT
40	Chuck Reider	Reider	Chuck	creider@dot.state.nv.us	Nevada DOT
41	Ashley Reinkemeyer	Reinkemeyer	Ashley	ashley.reinkemeyer@modot.mo.gov	Missouri DOT
42	April Renard	Renard	April	april.renard@la.gov	Louisiana DOT
43	Joseph B. Santos	Santos	Joseph B.	joseph.santos@dot.state.fl.us	Florida DOT
44	Wayne Schoonover	Schoonover	Wayne	wayne@ioniacountyroads.org	Ionia County Road Commision
45	Mshadoni Smith	Smith	Mshadoni	mshadoni.smith@dot.gov	FHWA
46	Ruihua Tao	Tao	Ruihua	rtao@sha.state.md.us	Maryland DOT
47	Stuart Thompson	Thompson	Stuart	gthompson@dot.state.nh.us	New Hampshire DOT
48	Priscilla A. Tobias	Tobias	Priscilla A.	priscilla.tobias@illinois.gov	Illinois DOT
49	Derek Troyer	Troyer	Derek	Derek.Troyer@dot.state.oh.us	Ohio DOT
50	Daniel Turner	Turner	Daniel	dturner@eng.ua.edu	ALDOT/University of Alabama
51	Jiguang Zhao	Zhao	Jiguang	jiguang.zhao@ch2m.com	CH2M HILL

Appendix C: Lead State Attendee Survey Summary

Highway Safety Manual Lead State Peer Exchange

Item	Overall Satisfaction				Additional details for unsatisfaction, if any	What did you like most and what is your most important gain from it?	Interested in learning more about any specific topic discussed at the peer exchange	In a scale from 1% to 100%, where do you think you are with HSM implementation efforts in your state?	While developing and implementing HSM in your organization, what kinds of resources and support would you like to have within our state, regionally, and nationally to continue to support your efforts?	Additional comments or feedback on this workshop
	Registration Process	Materials/ Handouts	Speakers/ Presenters	Venue/ Facility						
1	Very Satisfied	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied		I most liked the change of attitude of attendees. It is clear that almost all have taken ownership of implementation in their home states. They have transitioned from questions like "How do I get started", "How do I do that", to questions of a positive advanced implementation point of view.	I think the program touched the important issues. The face-to-face lead state issues have provided contact persons to whom we can go directing for specific information. (so my answer is "no", we don't need more information on specific issues)	Alabama-33%-The plan is in place and it appears that resources are available, but it will take five years(?) to build all the systems, train people, convert attitudes and prepare policies.	I would like to see a good way for the lead state to remain in contact with each other, periodic webinars to share progress? Conference call? Others?	This was a very encouraging conference. It was great to first have reports of HSM progress in so many states in so many different ways.
2	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied			MIRE MIS Intersection data collection; Using HSM for setting speed limits	40%	Regional meetings; webinars	
3	Very Satisfied	Very Satisfied	Very Satisfied	Somewhat Satisfied		Progress everyone is making; Specific processes implemented that we can take back and adapt/implement for ourselves	Continued development and availability of tools and data	55%. Groundwork is layed, now the fun begins.	This kind of efforts/collaboration; FHWA promoting the HSM and HSM-type processes and data with multiple disciplines within the DOTs.	Enjoyed it-thanks!
4	Very Satisfied	Very Satisfied	Very Satisfied	Somewhat Satisfied		Exchange of ideas and process: it would be good to have online for agencies just starting.		20% to 30%. A lot of work on calibration and SPF with education of state and local.	Examples of experience and organization structure use	Again
5	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied		The exchange of ideas were great!	Yes, I like to learn more about SafetyAnalyst implementation and data gathering methods.	5%. We have started initial training.	All the forementioned training would be helpful.	Great workhsop! For a state that is starting the process, this was a great source. I will be reaching out to others for help!
6	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Just being able to hear/see what other states are doing and how they are using the HSM. This can only benefit us.		45%. Just getting users to continue using the HSM is our challenge.		
7	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Very good state presentation and discussion				
8	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Short presentations with discussions; Lots of good work shared (i.e. more real application)	Use of Part C and IHSDM for analysis	50% on Part B; 10%-20% on Part C	Detailed analytical training for Part C (more case studies and use of spreadsheets); Plan to get management support and direction.	
9	Very Satisfied	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied						
10	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	All areas were great; Maybe include lined sheets in binder for note taking (especially for presentation not in binder)	Opportunity to hear what states are doing to implement HSM. Specific items of interest included data and applications in the project development process.	Marketing of HSM to both engineers (state and local) and others.	60%-Next primary steps are development of policies and procedures.	Matrix of available tools/products; Data expert support from FHWA	Good work overall. One word of caution is as we move forward and expand our user base that there will be more challenges with focused efforts.
11	Very Satisfied	Somewhat Satisfied	Somewhat Satisfied	Somewhat Satisfied		New development in HSM; Discussion on HSM SPF/Calibration, data; Update of NCHRP projects and FHWA/TRB committees activities; Guided discussions.	It seems, at current stage, most applications/studies of HSM focus on design or planning engineering practices. Are there any states use HSM in operation?	50%. Completed activities include training/education. Ongoing activities include development of SPF, agency-wide policy of using HSM. Next step will be pilot study.	Funding for initial study for developing HSM SPF (resource); Peer exchange/workshops.	It's a great workshop, helpful, informative. Hope to see it regularly. Kim, great job!
12	Somewhat Satisfied	Very Satisfied	Very Satisfied	Very Satisfied						
13	Very Satisfied	Very Satisfied	Very Satisfied	Somewhat Satisfied		Being able to interact and discuss similar issues/challenges and solutions with other state DOTs.	Specific examples on project alternatives analysis using HSM methods; Using HSM for design exception analysis and documentation.	63.5%. Working on SPF development. Slow going on that front.	Training materials, sample problems and project examples to share with districts staff to show how the analysis can be performed.	Holding periodic webinars to get the states together on various topics would be cheap and useful to keep things moving.

Highway Safety Manual Lead State Peer Exchange

Item	Overall Satisfaction				Additional details for unsatisfaction, if any	What did you like most and what is your most important gain from it?	Interested in learning more about any specific topic discussed at the peer exchange	In a scale from 1% to 100%, where do you think you are with HSM implementation efforts in your state?	While developing and implementing HSM in your organization, what kinds of resources and support would you like to have within our state, regionally, and nationally to continue to support your efforts?	Additional comments or feedback on this workshop
	Registration Process	Materials/ Handouts	Speakers/ Presenters	Venue/ Facility						
14	Very Satisfied	Very Satisfied	Somewhat Satisfied	Very Satisfied		Hear what other states are doing and try to take these experiments and use them in our state.	Tools states are using; Public interaction experiences.	67%	Maybe guidance on best practice. Example: 30-50 sites, and how many miles it could be. Describing the best practices for creating homogeneous segments, intersections.	
15	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		I gained a greta deal from everything. The sample project is very benefitial. Great discussion as well.	Post analysis on safety projects. Improving database for SPF and CMF development.	10%. I see that greater use of HSM and predictive will be a continous improvement process	Conference are good. Case studies are great.	Great jobs.
16	Neutral	Neutral	Very Satisfied	Somewhat Satisfied		Examples of implementing the HSM in the project development process were very valuable. These types of examples should be incorporated into the HSM user guide. I also enjoyed hearing what all states are doing.	How to incorporate HSM (and ISATe, IHSDM, etc) into policy.	Efforts? 100%. Progress? 40%.	We've had lots of training, but not widespread use. I think incorporating it into policy is an important step LA needs to take.	
17	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Learning about what other states are doing, current problems and how they are dealing with them. Really enjoying learning about ISATe, the future of interchange and freeway design.	ISATe	35%. Consult in design problems, design to a budget, using to help distribute HSIP funding.	Nationally, these types of meetings/conferences are very benefitial to learn about what other states are doing. Within state, training to make otheres more aware.	
18	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied				50%	Working on introducing training and will continue.	Very imformative.
19	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Good presentation for states; Good overview on current research/projects; Good presenters.	SPF; CMF; SafetyAnalyst, IHSDM	20%. Leadership awareness, 90%. To be done, process change, contract for SPF, roadway data improvement.	Training, tutorial, meeting.	Very good meeting, Lots of knowledge sharing.
20	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Great exchange of information and examples of HSM application. Great relationships developed for future questions.	Yes. HSM incorporation into process		Training	Great meeting
21	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Examples-It's amazing how many ways the HSM is being applied! I have lots of new ideas.	Yes, ISATe.		Training, tutorials, meetings. Others within my state to help working on this.	Good jobs!
22	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	This program was well established and covered the needs of the group. Good job with the agenda. Move forward to talk and ask questions.	A meeting of the lead states and the partners that are helping move the HSM and safety forward need to meet, this help those partnership grow and moves the activities forward.	Yes, how are other DOTs linking the HSIP, SHSP and the data elements, and what tools are they using when looking at their program and the local programs.			Having this meeting in conjunction with GHSA and SMS helps with travel but spends the limited staff resources.
23	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Calibration discussion; State reports from states, success, challenges; New materials available.			We need to review what is available and are currently identifying needs.	

Appendix D: References

- *Highway Safety Manual* website: www.highwaysafetymanual.org
- Purchase the HSM: http://bookstore.transportation.org Search under code HSM-1
- IHSDM website: http://www.tfhrc.gov/safety/ihsdm/ihsdm.htm
- SafetyAnalyst website: http://www.safetyanalyst.org
- Crash Modification Factors Clearinghouse: http://www.cmfclearinghouse.org
- NCHRP Research Results Digest 329: www.trb.org/Publications/Blurbs/Highway_Safety_Manual_Data_Needs_Guide_159984.aspx
- Training courses available at http://nhi.fhwa.dot.gov