Final Report

Highway Safety Manual Lead State Peer Exchange Irvine, California

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
ADT	average daily traffic
CARE	Critical Analysis Reporting Environment
CDIP	Cost Benefit of Data Investment Program
CMF	Crash Modification Factor
CO	Central Office Core Implementation Team
CORRECT	Cost-Benefit Optimization for the Reduction of Roadway Environment Caused Tragedies
CPM	Crash Prediction Module
DCM	Design Consistency Module
DOT	Department of Transportation
DVM	Driver Vehicle Module
EB	Empirical Bayes
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HPMS	Highway Performance Monitoring System
HSM	Highway Safety Manual
HSIP	Highway Safety Improvement Program
IHSDM	Interactive Highway Safety Design Model
IRIS	Illinois Roadway Information System
IRM	Intersection Review Module
LOS	level of service
MIRE	Model Inventory of Roadway Elements
MPO	municipal planning organization
PPS	planning and programming system
PRM	Policy Review Module
PSI	Potential for Safety Improvements
RDIP	Roadway Data Improvement Program
RPO	regional planning organization
RISE	Roadway Improvement Safety Evaluation
RSA	Road Safety Audit

RSDP	Road Safety Data Partnership
SA	Safety Analyst
SMP	Safety Management Process
SPF	Safety Performance Function
SRI	Safe Roads Investment
TAM	Traffic Analysis Module
TAZ	traffic analysis zones
TRB	Transportation Research Board
usRAP	U.S. Road Assessment Program

Executive Summary

This report summarizes the presentations and discussions for the *Highway Safety Manual* (HSM) Lead State Peer Exchange held through the 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 two presentations 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) develop 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 Project 17-50, two peer exchanges were planned to bring together representatives from 13 states that are leading the path 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 10-11, 2011, in Irvine, California. This 2-day workshop 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 twenty-six short presentations followed by facilitated discussions. The topics focused on state implementation status, HSM supporting tools, data assessment, Safety Performance Function (SPF) development and calibration, regional partnerships, and resources and support. This report summarizes the proceedings from the NCHRP 17-50 HSM Lead States Peer Exchange and the evaluation comments received from the participants. See NCHRP and TRB for a complete list of participants.

*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 they can bring back to their agencies to advance HSM implementation.*

Meeting Proceedings

Session 1: Review of Available HSM and Other Safety Analysis Tools

Planning Level Tools

Safety Analyst

Darren Torbic, MRI Global

SafetyAnalyst development began in 2001 and was completed in 2010. Twenty-seven agencies were involved during the process, testing some interim tools, and providing feedback to further enhance the final product. SafetyAnalyst licensing is available through AASHTO. The software is currently licensed in 16 states and under evaluation by three agencies.

SafetyAnalyst focuses on Part B of the HSM, particularly on the six steps of the Safety Management Process (SMP). In SafetyAnalyst , those six steps are broken down into four modules: Network Screening, Diagnosis and Countermeasure Selection, Economic Analysis and Priority Ranking, and Countermeasure Evaluation. SafetyAnalyst users may work sequentially through them or pick a particular module to start with.

The purpose of Network Screening is to review highway networks, either an entire statewide or local network or any portion of it. The screening is done to identify potential sites for safety improvement by conducting analysis for a particular crash type and/or for a particular severity level. SA incorporates the most sophisticated methods in each chapter of HSM Part B (for example, peak searching, and Empirical Bayes [EB] methodologies). The Diagnosis and Countermeasure Selection tool then prioritizes the potential sites for additional evaluation on a site-by-site basis. The third module, Economic Appraisal and Priority Ranking, may be performed at a single site or across sites. First it analyzes for alternative improvements. It then ranks the alternatives by various economic measures. In the fourth module, Countermeasure Evaluation, the safety effectiveness of the countermeasures is quantified by the percent change in accident frequency or by the percent change in proportion of target accidents.

HSM Part C is intended for project-level analyses. SafetyAnalyst is intended for network-wide applications. SafetyAnalyst is a planning tool that leads to the development of projects using HSM Part C or Interactive Highway Safety Design Model (IHSDM). Both HSM Part C and SafetyAnalyst include SPFs based on negative binomial regression, account for regression to the mean with an EB approach, and include calibration procedures.

The biggest issue among the states has been getting all their data into the software. To address this issue, seven mandatory variables have been established for each data type. Additional data can also be added to the database.

Lastly, SPFs are based upon systemwide census data. An agency may supply its own SPFs to replace the default SPFs in SafetyAnalyst. Agencies may also create user-defined site subtypes and calibration factors. Calibration occurs automatically when crash data for a given year are added, and calibration is repeated any time new data are added.

PlanSAFE

Ida Van Schalkwyk, CH2M HILL

PlanSAFE is a robust, defensible, and accurate analytical set of algorithms used to forecast the safety impacts of engineering and behavioral countermeasure investments at the planning level. It is user friendly software, compatible to the extent possible with planning-level data inputs, to incorporate the analytical procedures for forecasting safety.

PlanSAFE estimates the safety performance at the traffic analysis zone (TAZ) or census block level. It is used to review future scenarios using output from long range transportation plans.

Required data inputs include georeferenced crashes, roadway and TAZ GIS shapefiles, and census data. These feed into the PlanSAFE GIS and CENSUS tools that are used for data manipulation and preparation for the PlanSAFE main tool. It can also be used to compare crash outcomes for different growth scenarios. PlanSAFE contains several built-in SPFs to predict total crashes, fatal and A-injury, bicycle, pedestrian, deer, and intersection related crashes. Users can add their own SPFs as well.

The PlanSAFE GIS tool facilitates the data preparation process. One of the main features is the creation of intersection layers. It also assigns crashes and roadways to boundaries.

The PlanSAFE CENSUS tool generates socio-demographic variables at TAZ and block group boundary levels for predictive analysis in the PlanSAFE main tool.

Some of the similarities with the HSM are that both quantify safety performance, use negative binomial and Poisson SPF models, and provide support in decision-making.

Differences with the HSM include the use of boundary-based analysis rather than segment and intersection, working with long range transportation plan scenarios, and mulitvariate SPFs.

usRAP

Doug Hardwood, MRI

The usRAP is a program sponsored by the AAA Foundation for Traffic Safety in Washington, D.C. The usRAP team includes MRIGlobal and Iowa State University. usRAP provides a method for benchmarking the safety performance of specific roadway segments in comparison to similar roadways, while complementing ongoing state highway safety planning. usRAP includes several different protocols: risk mapping, star ratings, safer roads investment plans, and performance tracking.

The presentation focused on the first three. The risk mapping provides a method for prioritizing potential improvements sites. Risk mapping has been conducted for the state highway networks in eight states and for county roads in three counties. The focus has been on fatal and serious injury crashes on rural roads, although urban roads have been considered on some states. Mapping is done for homogeneous road segments that are long enough to provide meaningful results. Several types of risk maps have been developed and are color coded to differentiate the level of risk.

Star ratings and safer roads investment plans deal with safety tools. Star ratings are assigned based on the presence or absence of road design features and traffic control features related to safety. Safer roads investment plans are developed with a safety analysis tool which includes countermeasure triggers that identify the countermeasures and benefit cost procedures.

The usRAP analysis software provides a unique tool for developing infrastructure-based safety improvement programs without the need for detailed site-specific crash data. Almost all of the safety analysis tools are very intensively crash-data driven. usRAP, however, can well be used by an agency without any crash data, or with poorly located crashes. Agencies will only need good road inventory data and/or with video coverage of its road system to participate in the usRAP program. The AAA foundation is willing to make this software available to any highway agency without charge. There is a need to sign up for a licensing agreement.

Safety Analysis Tools

Interactive Highway Safety Design Model (IHSDM)

Mike Dimaiuta, Genex Systems

IHSDM contains six evaluation modules: Crash Prediction, Policy Review, Design Consistency, Traffic Analysis, Intersection Review, and Driver/Vehicle. These modules may be used on both the existing and proposed alternative highway geometric designs. The presentation mainly focused on the Crash Prediction Module (CPM). CPM provides a faithful implementation of the HSM Part C Predictive Method. The intention is to expand CPM to include freeways, interchanges, and other facility types and statistical procedures become available. All IHSDM modules have the ability to evaluate two-lane rural highways, but only CPM has the capability to evaluate multilane rural highways and urban/suburban arterials. The Policy Review Module (PRM) is focused on nominal safety by determining if certain design elements meet the policies specified by AASHTO and/or state agency. PRM is recommended for use in conjunction with the HSM Part C methods. The last four modules are diagnostic tools that support (not directly) the HSM Part C evaluations by providing additional highway data relating to crash experiences. The Design Consistency Module (DCM) analyzes situations where there may be operating speed inconsistencies. The Traffic Analysis Module (TAM) evaluates mean speeds and percentage vehicles—generating measures to determine the level of service (LOS). The Intersection Review Module (IRM) comprehensively reviews single intersection while the Driver Vehicle Module (DVM) looks at interaction between the driver of the vehicle and the roadway. Highway Editor and Intersection Editor are tools that allow IHSDM users to either import data from another source or to input data directly through its interface. An evaluation wizard then steps the user through the process of running the prediction. The program is capable of creating different sections and automatically calculating the estimated number of crashes for each section. The output is depicted in tabular form and also in graphics showing the expected crashes per year for the intersections and segments. The Calibration Utility is a new tool designed to help agencies with the calibration procedures by organizing all required and desired data and then calculating the Calibration Factors. It also gives the user the capability to enter their own SPFs and modify the default crash distributions. Any missing data are automatically filled in with default values. The Calibration Utility tool will be included in the next release of the IHSDM (September 2011).

Illinois HSM Tools

Dante Perez-Bravo, CH2M HILL

The presentation focused on two tools used for safety analysis in Illinois – the benefit-cost tool and the enhanced 17-38 spreadsheets. Benefit Cost calculation is the primary method of determining the most cost-effective site locations and prioritizes projects based on the greatest reduction in total number of fatalities and severe injuries. The Benefit Cost tool calculates the effectiveness of countermeasures in terms of percent reduction in crashes by type and calculates a net reduction in crashes by severity based on site-specific data. It translates this reduction into an annualized dollar benefit, and computes an annualized cost of the combination of all countermeasures applied based on their individual unit costs and their service lives.

Illinois DOT developed this tool to provide consistency in the application of benefit cost analysis and address a number of different conditions while incorporating the latest technical knowledge. The Benefit Cost tool incorporates more than 300 safety countermeasures and crash modification factors (CMFs) by peer groups from HSM part D and the FHWA clearinghouse. The benefits of using this tool include the use of statewide safety data, the ability to update default data on the basis of site-specific data, and the ability to compare low-cost improvements quickly. The tool can be made state-specific very easily by updating the statewide crash severity distribution by peer group.

The Enhanced 17-38 Spreadsheet tool was built using the original NCHRP 17-38 predictive methods spreadsheets as the starting point. The tool is intended to help HSM users understand how to apply the crash predictive methods in Part C. Apart from having a user-friendly interface, this tool has the ability to perform corridor analyses for up to 20 segment and intersection locations, and to use up to 5 years of data.

Lead States Discussion on SafetyAnalyst, IHSDM and usRAP

Questions for this session included, among others, the challenges associated with the applications and how they were overcome.

Illinois DOT mentioned the usefulness of usRAP tool for the local system. One of the challenges is obtaining traffic count data. For the Kane County pilot, video data were obtained from NAVTEQ, and post processed by graduate students. This barrier may be overcome in the near future using automated data collection vehicles.

Similarly, *SafetyAnalyst* requires different datasets for different modules, some more difficult to collect that others. However, the benefits of using the tool justify the time invested in data collection and preparation.

One of the challenges with IHSDM is data entry into the different modules. This was addressed using positive guidance from the users. They are working on how to make the data collection and preparation easier for the user.

One question related to the application of HSM Part C methods to unpaved roads. Doug Hardwood and Mike Dimaiuta stated that the predictive methods were developed for only paved roads, so neither usRAP nor IHSDM, support unpaved roads analysis.

Lastly, another question related to the use of IHSDM versus the NCHRP 17-38 spreadsheets. Mike Dimaiuta said that both tools perform similar calculations, but IHSDM has one key advantage—once the roadway is entered, the software automatically segments the roadway. It also provides graphical output reports. The recommendation was to use the tool for more complex applications.

FIGURE 2: Lead States Peer Exchange Day 1

Session 2: Safety Tools in Practice

CARE, Safety Analyst, and CORRECT Integration— Alabama DOT

Timothy Barnett, Alabama DOT

Critical Analysis Reporting Environment (CARE) uses advanced analytical and statistical techniques to generate valuable information directly from data. Its capabilities include information mining, development of collision diagrams, noncategorical and narrative data searching, hot spot determination, and GIS integration.

Cost-Benefit Optimization for the Reduction of Roadway Environment Caused Tragedies (CORRECT) is a combination of CARE data and algorithms in spreadsheet format. It is used for cost-benefit evaluation of alternate safety treatments.

Roadway Improvement Safety Evaluation (RISE) is intended to be used with maintenance resurfacing and other individual site or segment specific improvement. The idea is to develop an incremental improvement tool. RISE, with just some minor modifications, is useful for doing design exceptions evaluations. Crash pattern data are needed for RISE to run; however, crash pattern percentage for location compared to crash percentages for that particular crash pattern along the segment roadway has been an issue. It identifies crash patterns, retrieves data directly from CARE, and allows countermeasure selection.

Some Alabama DOT accomplishments include HSM implementation plan, and completion of several software analyses including SafetyAnalyst state-of-practice survey, gap analysis of CARE/CORRECT and SafetyAnalyst software, RISE, CARE, SafetyAnalyst, and CORRECT integration.

Alabama still has a fundamental need for roadway, and traffic data—although there are data for all types of average daily traffic (ADT) on the state routes and traffic counts for every ramp in the state.

Some of the barriers and challenges are related to the massive size of the implementation project. Also have challenges with the organization structural and similar impediments with sharing of data, coordination of data collection, and the data storage methods. As far as overcoming barriers and challenges, a senior level task group was formed to review data stores and collection methods. Alabama DOT is also looking at ways to collect the data at a mobile standpoint. Alabama is able to collect all of their data using the Point Cloud Data Collection.

Next for Alabama are two pilot inventory projects. One is for signalized intersections, enabling them go know where funds are needed to update traffic signals. The second is an inventory project on posted and operating speeds. This project will give them a better understanding of where the speeds need to be adjusted. Some full-scale data collection is underway— Highway Performance Monitoring System (HPMS) and Maintenance Management System. Lastly, they are also working on a traffic signing inventory.

It is anticipated that variations of the program will have many future roadway safety applications as well as general operation improvements.

Use of usRAP and Data Trees on the Local System

Kim Kolody, CH2M HILL

Some of the challenges for local municipalities have been the limited roadway and volume data, limited resources, and lack of appropriate skill sets. The usRAP and data trees have been developed to overcome these challenges and make it easier to implement highway safety projects into the local systems.

Crash data trees help to efficiently identify areas that need safety improvements in the local system. The simplified queries, VBA program in Access and Macro in Excel, shortened a process that would have taken 6 months to just over 3 weeks. Data trees have been developed for all 102 counties in Illinois.

usRAP provides complete data for the local system, analyzes the data, and then helps to identify potential projects. The potential projects are listed in the report with their respective countermeasures and benefit-cost ratio. The benefit-cost ratio calculation helps to prioritize investments and make investment decisions.

Safety Analyst—Ohio DOT

Jonathan Hughes, Ohio DOT

Ohio DOT emphasis is on applying systematic improvements (for example, rumble strips or cable rail). The key inputs for SafetyAnalyst are crash data, traffic data, safety improvement projects, and road inventory data. It is recommended for SafetyAnalyst use that various scenarios be run through the software until the meaning of the outputs are very well understood and/or until the user is certain that their results are appropriate. A key benefit of the software is that SafetyAnalyst allows the user to keep re-running iterations as many times as needed. Network screening gives the user an opportunity to make changes and tweaks to the output data (for example, change crash types, severities). The network screening report can then be exported to excel for manipulation (for example, resort, add rank factor). The information can then be extracted and exported to other systems.

It is important to distribute resources and time based on the priority of the projects. State agencies should focus only on small number of studies of areas that need the most help. At one time, Ohio DOT was developing 600 safety studies per year. That number came down to 350 on the basis of DOT priorities. The idea is to make the most of limited resources and be able to implement the appropriate countermeasures on time.

IHSDM—Kansas DOT

Howard Lubliner, Kansas DOT

Kansas DOT recently completed HSM Part C calibration procedure for rural two-lane highways using IHSDM. In addition, results were validated to show expected accuracy of the calibration as oppose to not calibrating with and without the EB procedure. Validation was done using before and after analysis of constructed projects. To achieve this, all 300 miles of roadway segments were modeled using IHSDM, and spreadsheets were used for the more than 400 intersections.

Rural two-lane highways represent 86 percent (8,600 miles) of the state highway system. Animal crashes on the state roads represent 60 percent of the crashes. For this reason, segment locations were the focus of the study. On the basis of their experience, IHSDM presents several benefits when modeling segments. Among the benefits are the ease of performing different analyses once data are entered, breaking data into homogeneous segments, and performing EB method seamlessly.

Recommendations when modeling segments on IHSDM include entering data in smaller sections and avoiding merging roadway segments that are not homogeneous into one model. For project evaluation/validation, EB method only works if the characteristics of future segments are not significantly different than the existing segment. If differences exist, the segment should be broken into different sections and EB should only be applied at appropriate locations. Lastly, the model should not trump the analyst's common sense. Once a segment of highway has been calibrated (unless it is reconstructed) the only changes needed to get the next model calibration is to update ADT values and observed crashes.

Intersections were calibrated using spreadsheets. Given that there are fewer CMFs, and that intersections are already in homogeneous segments, applying the EB method was easier using spreadsheets.

Kansas DOT is currently developing SPFs for rural two-lane roads. They are also developing CMFs for shoulders and bypass lanes to more accurately replicate Kansas road conditions.

Another recommendation is to use an appropriate definition of rural. The HSM defines "urban" as a city of 5,000 or more. Anything less is defined as "rural."

Session 3: Where Are We Today? Implementation Status and Plans

HSM Implementation—Illinois

Priscilla Tobias, Illinois DOT

Illinois DOT currently has a zero fatality goal focused on all public roads and severe crashes.

In 2007, Illinois DOT implemented HSM Part B, and developed SPFs for all state routes and intersections. Statewide network screening is performed annually, and other methods are applied to analyze the local system. Two lists are developed annually—the 5 percent, and the 100 percent. The 100 percent list is distributed to the districts so they can determine what is performing well and what is not. GIS layers are being developed for all roadway characteristics being analyzed for system wide improvements. During the development of SPFs, different terminology was used (Potential for Safety Improvements [PSI]), but concepts were similar to the HSM. PSI represents the excess losses between the predicted average crash frequency using SPFs, and the corrected (predicted) using the EB adjustment and a weighting factor. Weighted PSI value puts more emphasis on severe crash locations.

Safety has reached across all bureaus at Illinois DOT. Institutionalization of safety involved looking into transportation and safety management, and the project development process. The framework included five critical elements: resources, data and analytical tools, training and marketing, policy, and leadership and support.

The project development process includes planning and programming, scoping, design and construction, operations and maintenance, evaluation, and performance measurement. The agency will be putting together a framework for the planning and programming. The framework includes establishing a Safe Road Investment (SRI) number that is a condition rating for pavement and bridges. They will establish performance measures, and safety performance categories where SP-1 is the lowest safety performance and SP-3 is the highest.

In terms of data and analytical tools, Illinois DOT currently has GIS layers, Illinois Roadway Information System (IRIS), Safety DataMart, and planning and programming system (PPS). They are currently establishing data gaps, and methods of capturing additional data. The PSI and a unique Highway Safety Improvement Program (HSIP) number will go into the PPS and IRIS systems to be continually tracked and used in the inventory roadway systems.

The agency coordinates with law enforcement to discuss any issues regarding speed, etc. Guides, examples, and case studies have been developed to look at different alternatives and pick the best decision. The next step is Diagnosis and Scope—establish quarterly Early Involvement Safety Meetings so that all agencies meet and share their findings and plans with their SP-1 locations.

Illinois DOT is currently using the following tools and data sources: HSIP SharePoint Site, Benefit-Cost tool, Over-Representation Tool, maps, HSM Prediction Model Tool, SafetyAnalyst, IHSDM, FHWA CMF Clearinghouse, usRAP, GIS layers, and Road Safety Audit (RSA).

HSM Implementation—Washington

John Milton, Washington DOT

Apart from trying to implement HSM, Washington DOT is also trying to create a program called Sustainable Safety. The idea behind the program is to focus on creating safety conditions within the planning and programming, project development, and traffic operation process. One of the goals that the state agency is currently working on is providing for core competencies and knowledge necessary to carry out the programs. The agency is also working on setting up safety evaluations of the work being done at all levels. In order to perform these safety assessments properly, Washington DOT will detail out

what is expected from each region as well as develop a Sustainable Highway Training Program which will include the needs from the executives to the implementation staff.

An important lesson learned is that all issues are circular and feed into other issues. For example, strategic planning will affect the design, and if a mistake is made in the design, it will affect the priority programming and so on.

Lead States Discussion on HSM Implementation

Illinois DOT and Washington DOT stress that tools and information be shared among agencies. Although every state has different needs, it is important to avoid duplicating the efforts when resources and time are limited. Both Illinois DOT and Washington DOT evaluate their projects before and after implementation over an extended period of time. One of the measurable items is the overall reduction of fatalities and serious injuries.

Both Illinois DOT and Washington DOT are working together with their planning divisions. Illinois DOT's Bureau of Safety helped them to leverage their SPR funds without development plans by sharing their collision hot spot data to identify congestion hot spots. Washington DOT pointed out that there is little knowledge transfer from safety to planning. To address that gap, they are working together on safety assessments.

One of the recommendations from the lead states is to make an overall assessment of what the program is and identify the gap areas. If it is an executive issue then it is important to quantify the program and present it in a reasonable and understandable form. The presentation needs to include a benefit-cost analysis showing the amount of money that will be saved if the projects and assessments are performed.

Session 4: Encouraging the Use of the HSM

Design Exception Policy—Missouri DOT

Jon Nelson, Missouri DOT

The agency's plan was to obtain support materials and continually work on spreading the knowledge, provide training, develop policy and guidance, and provide technical support.

Missouri DOT started using the HSM with design exceptions—mainly because it was small and manageable. The good thing about design exceptions is that in almost all the cases, when designers are doing relative comparison of their design to the standards, the same type of facility is being used. Therefore, the same SPF and calibration factor are being used. This allowed the agency to start using the manual while simultaneously started calibrating and developing SPFs.

For design exceptions the analysts are asked to conduct an HSM analysis showing the differences in expected performance using design standards versus the design with the proposed design exception. The ultimate goal is to use better information, make better decisions, and better documentation from a legal/liability standpoint of view.

The goal with the design exceptions was to quantify the effect; place numbers behind the reasoning of decisions. One of the things that had to be acknowledged with policy was that the manual was only able to address certain safety-related issues.

There is still an issue of whether training or policy comes first. There was great training in 2010 before and after the HSM came out, but before any policy was in place. The problem was that agencies had nothing in place to encourage or require their staff to start using the manual.

Pilot Program—Florida DOT

Joe Santos and Alan El-Urfali, Florida DOT

Florida DOT is working with their districts to initiate pilot projects. The pilot project concept was presented to the district staff to explain the process and request required information. The districts then submitted more than 20 projects. Currently, the Central Office Core Implementation (CO) team is in the process of reviewing those projects. After the CO completes the reviews, they will follow up with the district project manager to define the data needs. With regard to analysis with the HSM, the agency is only looking at the predicted crash methodology in HSM Part C and calibration.

Proper understanding and use of the HSM is very important because it sets the stage for further progress. Each of these projects is a short-term win, which is a key to having a successful implementation plan.

The submittal process begins with districts submitting project descriptions and narratives. Then the CO will review it, and when the pilot projects are complete, information is shared with the District Champions. The CO pilot project review steps are to determine the appropriate facility and site types based on the information provided, review the district submittals to confirm project types, follow up, and coordinate with districts on methodology to conduct analysis. The last step is to recognize district staff.

One of the barriers and challenges encountered while working on the pilot projects was in establishing the type of improvements that could be evaluated using the existing HSM methodology. The second challenge was in determining the appropriate facility and site type, as well as the time needed for the review. The third challenge was in tracking the progress of district pilot projects. A SharePoint site was developed as a tracking mechanism for submittals.

Encouraging the Use of the HSM—Florida DOT

Joe Santos and Alan El-Urfali, Florida DOT

A recommendation in implementing HSM is to use John Kotters eight-step change model. Florida DOT developed a timeline to show key implementation activities by calendar quarter. The responsibilities of the Office of Safety include maintaining the crash data and coordinating research efforts. Florida DOT worked with a university to develop a modeling process to generate local average annual daily traffic (AADT). The process is currently being refined, and AADT reevaluated.

The key components in encouraging the use of the HSM include gaining management approval, developing good district communication, and creating short-term wins by doing District Pilot Projects.

More than 20 pilot projects, intersections, and segments are underway throughout the state. The pilot projects will help to identify data needs. The main focus of the pilot is to create success stories—it's a learning session. Florida DOT is working with the project managers to perform the analysis, understand it, and document the results. These projects are going to be tied into the training programs.

One of the challenges encountered was in reviewing the district pilot projects, which has taken longer than planned. The second challenge was in determining the appropriate facility type—urban or rural. The third challenge was that it took additional time and resources. The fourth challenge was developing SPFs and updating calibration factors.

Session 5: Data Assessment and Capture

Assessing HSM Data Availability and Methods for Capturing—Louisiana DOT

Dan Magri, Louisiana DOT

The data needs project will evaluate existing data (for example, crash, roadway and traffic volume data) and compare them to what is required by the HSM. The project multidisciplinary team is comprised of professionals from different areas: highway safety, roadway design, planning, traffic engineering, among others. The available data will be assessed by how readily they can be integrated into the HSM and its applications. Common issues such as data accessibility, data manipulation, and datasets integration are going to be investigated. Lastly, the project will recommend actions and suggest time frames for attaining the additional data items needed to implement the HSM.

As part of the project process, the staff will prepare and provide a data needs document and HSM application fact sheet. Interviews will then be conducted to discuss data availability with the keepers of the data systems. The goal is to understand what is available and what is needed in the future to improve the data. Data such as highway inventory assets and HPMS state end-point feature for mapping is gathered by using the GPS enabled video-image collected by the Automatic Road Analyzer. During this collection, roads are being prioritized based on their road classifications (for example, arterials, collectors, and other high priority roads). With the project outcomes, the project team can make informed decisions and develop a plan to collect additional data to be used in HSM applications.

Data Assessment and Capture—New Hampshire DOT

Tim Harmon, New Hampshire DOT

New Hampshire DOT's existing GIS database includes roadway, nodes, routes, and crash layers. Crash data are less accurate in comparison with the other datasets. New Hampshire DOT is currently using ArcGIS to create an intersection inventory to be used for analysis in SafetyAnalyst.

The barriers and challenges in this project are the lack of traffic data collection on all routes, annual changes in the GIS route layer, and the lack of turning lanes inventory. In order to overcome these challenges, New Hampshire DOT is using HPMS data for traffic counts, assumptions, and recreating GIS intersection layer yearly.

Assembling data elements to implement SafetyAnalyst requires some effort, but once in place, it provides a robust tool for network screening, and facilitates the use of modules that will be needed for applying the processes in the HSM. New Hampshire is working with FHWA and VHB to develop an implementation plan to improve their data.

Roadway Safety Data Partnership—FHWA

Mshadoni Smith, FHWA

The Road Safety Data Partnership (RSDP) was developed to house all the different data related programs from the office of safety and help sort out the information needed. Model Inventory of Roadway Elements (MIRE), HSM, HSIP, and Strategic Highway Safety Plans are some of the current products and tools under RSDP.

MIRE is similar to an encyclopedia with roadway data elements. MIRE has more than 200 elements with its definition, attributes to describe it, priority ranking system, everything anyone could wonder about roadway data elements.

Roadway Data Improvement Program (RDIP) is a new technical assistance program intended to go out to the states and assess the type of roadway data being collected on the following elements: timeliness,

accuracy, completeness, consistency, integration, and accessibility. It is a very robust technical assistance program and specific to each state.

Cost Benefit of Data Investment Program (CDIP) was created to develop methodologies for states to compare an infrastructure improvement to a software improvement, and to quantify the benefits of data. The capability assessment is a program to get data status baselines for each of the states, including how the data is organized and maintained.

FIGURE 3: Lead States Peer Exchange Day 2

Session 6: SPF Calibration, SPF Development Experiences

HSM Customization in Virginia— Virginia DOT

Stephen W. Read, Virginia DOT

Virginia DOT is developing Part B SPFs for different facility types to use with SafetyAnalyst. Two-lane and intersection SPFs have been developed with regional models performing better than the default SafetyAnalyst SPFs. Work has started on the multilane SPF for arterials and freeways. One of the preliminary findings is the regional AADT-base models for multilane highways are fitting better than the two-lane roads. Also, one regional multilane model is not following normal form, so it will be combined with an adjacent region.

As part of the multilane SPF effort the same data set will be used to determine the Part C tables of proportions and the review methods for calibrating the base condition SPFs. There are two ways to calibrate SPFs: (1) using default SPFs and applying local calibration factors, or (2) using local SPFs and applying local calibration factors. The latter may provide more reliable estimates than calibration of Part C SPFs. It is easier to calibrate and not many data are needed. On the other hand, developing local SPFs takes more ground work to get the models calibrated. Virginia DOT will compare the developed SPFs versus the calibration technique. Specifically, rural multilane highways were chosen for the study because compared to other facility types, they have the least data requirements. Virginia DOT will then decide if they will customize the HSM Part C SPFs to fit to its local condition by updating the default values or to calibrate the SPFs using local data.

Calibration factors are used because the general level of accident frequencies may vary substantially from one jurisdiction to another and from one year to another. This variation occurs for a variety of reasons that include climate, driver populations, animal populations, and accident reporting. Calibration factors are used to adjust SPFs to account for these jurisdictional and yearly changes. HSM recommends sampling 30 to 50 sites with at least 100 crashes per year for each when developing calibration factors. A fair amount of data are to be collected from the sample sites. Then, using the equations HSM Part C, the total crash frequency can be predicted. CMF should then be applied to make the necessary adjustments, and finally be able to compute the calibration factors. The observed crash frequency can then be compared to the predicted.

HSM defines only three facility types, while Virginia DOT has defined ten facility types. In HSM, each facility type includes segments and intersections. Thus, implicitly, HSM defines six facility types. The pilot study is focused only on three site subtypes: divided segments, three-leg minor stop control, and four leg signalized intersection. They have defined a term called Safety Performance Groups (SPG) that is used for sites whose crash occurrence relationship is represented by a single SPF. SPGs are determined through statistical tests of SPFs without base condition adjustments and through a check of significance of the predicted crash frequencies by SPFs. Researchers assumed nine separate groups (one for each district), and they looked at combining using different statistical outcomes.

The next steps for Virginia DOT are to collect additional data, develop SPFs for basic conditions and corresponding calibration factors. They will also look at the tables of distributions included in the manual, and see if they can be updated using the groups they defined for the pilot. Virginia DOT is hoping that with this fundamental pilot test, they can determine how to specify calibration methods to use and to promote and the use of HSM Part C.

Modeling Crashes on Rural Two-Lane Roads in Utah— Utah DOT

Robert Hull, Scott Jones, Grant Schultz. Utah DOT

Utah DOT has undertaken a study to develop SPFs for rural two-lane roads with the ultimate goal of finding the best model for Utah DOT to use. The study approach consists of calibrating the SPFs in the HSM, and also looking for potentially new models where new SPFs can be developed. Similar to Virginia DOT, Utah DOT also took the recommendation to calibrate SPFs to fit for local conditions. The objective of data collection was to obtain as much reasonable data as possible.

Utah DOT is using RoadView, Google Earth, and Utah DOT's data collection process as data collection tools. RoadView allows the engineer to look at snapshots of all the roadways in the state and collect data. Google Earth was used to identify lane widths, shoulder widths and some other factors available. Utah DOT's collection process provided construction tables to identify sites under evaluation; eliminating those that would be under construction during the study period. Detailed crash data are also available. All of the data were combined into one spreadsheet containing variables such as grades, driveway densities, shoulder rumble strips, passing ability, speed limit, lane and shoulder width, AADT, single truck percentage, combination truck percentage, total truck percentage, and total crashes. The statistical significance of these variables in crash prediction was analyzed to determine which were to be included in the models.

As part of the modeling process, Utah DOT first looked into developing calibration factors. The calibration factor obtained during the study was 1.16—1.0 without animal crashes. Then they developed SPFs using negative binomial models. More recently, they have started developing Hierarchical Bayesian models to account for variability of the data, and also develop a model that provides a distribution rather than a single point. A hierarchical base was not used to identify the variables that were affecting crashes; instead negative binomial model was used. For the modeling, AADT and natural log AADT were used with 75 and 95 percent confidence levels. The final set of variables used included natural log AADT, segment length, combination truck percentage, and speed limit.

Some of the main challenges in all these modeling efforts are dealing with very data intensive, and time consuming processes. Utah DOT is currently working on a project to make data more accessible, and more GIS friendly. Another critical item is assembling the right team. Tools available for safety analysis may also present a challenge, if they have to be developed from scratch. The biggest lesson learned from performing the exercise is that it is a great opportunity to get into the data, see what is available, develop some SPFs and utilize that information to go into funding options to fix locations that need attention.

Lead States Discussion on SPF Experiences

The discussion focused around the development of SPFs versus HSM calibrated SPFs. Some state agencies have chosen to develop their own SPFs because they are more specific to local conditions. In many cases additional data would need to be collected to develop state specific SPFs that include all of the variables in the HSM Part C models. Research needs to be done to assess the advantages of agency specific SPFs over calibrated SPFs. The HSM recommends that if a state agency uses the SPFs from the manual, then they need to calibrate the models.

Session 7: Training

Training State and Local Agencies on HSM Principles in Michigan

Dean Kanitz, Michigan DOT and Tim Colling, Michigan Tech

A study was performed of elected officials and locals who attended a 2-year training to determine how much was learned, if there any positive attitude changes, and its effects. Surprisingly it was found that almost 50 percent of the elected officials had either started safety programs or had modified projects they had in place to incorporate new safety ideas. However, 66 percent of the elected officials interviewed stated that the class changed their likelihood to fund safety projects because they now have a better understanding of the breadth and scope of safety.The overall goal in training elected officials is to get them to realize that there may be data behind everyday decisions that they are called to make relating to traffic safety issues.

It has taken a significant amount of effort to get elected officials to attend the training. Some tactics for increasing participation has been marketing, peer advocates, co-sponsorships, scholarships, relevancy, and making funding relationships. Peer advocating has been effective as it only takes one person to encourage others to participate in the training. As for co-sponsorships, local agency groups were asked to help sponsor the training by providing mailing list for their people and placing their logo on the training. Another strategy used was promoting scholarships for the programs to provide officials with free training. Also, relevancy and making a funding relationship is important when training. This training information has been summarized in a TRB report *Assessing the Impact of Traffic Safety Training Targeted Toward Local Agency Technical Staff and Elected Officials*.

The Highway Safety Manual: An Overview for Local Agencies

John McFadden, FHWA Resource Center

Training the local agency or the technical staff is an important part of implementation. Training for locals involves trying to get them to embrace the ideas behind the HSM. This will be done by showing them the step-by-step process of data retrieval and analysis. The plan is to tie everything to the tools that are available and to try to manage the material they learn to maximize the potential use of the tools.

FHWA Resource Center has developed training materials for locals that are available for download. They are also conducting a series of pilot training. The first version of this training was done right after the HSM was released. Two more pilots will be conducted in Washington and Oregon.

HSM Practitioner's Guide Workshop

Darryl Belz, Maine DOT

The practitioner's guide workshop that took place in New Hampshire was a 1-day course for planners and a 2-day course for practitioners. The workshop was an introduction and overview of the HSM accommodating different constituents.

The outcomes of the class were that the agencies were able to identify crashes, apply the SPF equations, compare predicted safety performance to actual safety performance, identify the greatest safety shortfall, and prioritize some of the improvements. One of the benefits of the workshop was that it was an interactive, in-depth and comprehensive review. The workshop applied the methodology for Parts C and D and did real-world scenarios, making the attendees use the manual.

One of the challenges was that a significant amount of material was covered and it was overwhelming to those not familiar with the HSM. A recommendation for future workshops is to ask each person to bring a computer so that they can practice working with the HSM Part C spreadsheet tools during the class.

Next steps for Maine DOT include potential FHWA research center training sessions in Maine for practitioners, executives, and upper management. It will also look at expanding awareness to external partners (for example, municipal planning organizations (MPOs) and local agencies).

Lead States Discussion on Training

Lead states need to work on disseminating the information with other states. A good way of sharing this knowledge is through technical briefings. Technical briefing ideas include:

- training
- level of effort involved in developing SPFs versus developing calibration factors for the HSM SPFs and the benefits and challenges of each method
- data elements being collected and approach for collecting the data
- what can and cannot be done with SPF models for Part B and Part C
- What the differences are between CMFs for Part C and Part D
- Highlighting successful initiatives may provide significant value for other states because they can apply these proven efforts in their states.

Another important point is the value of having researchers involved in the implementation process and agencies may consider using university resources because they may be more affordable.

Some states stated that the main outcomes of NCHRP 17-50 Project are to have their implementation plans ready and make some progress with regard to HSM Part B and Part C. Even though full implementation may take 3 to 5 years, getting through that initial phase will be considered a success. Part of this goal is to take different states under the lead states' guidance to help them throughout the implementation process. The project has funds allocated for travel for any lead state to support other states.

States expressed their interest on having guidelines for calibration and SPF development. Development of both and similar documentation can be funded through a pool fund.

With regard to local training, Maine has the local road program. In the past, they have provided manuals such as the HCM and the *Manual on Uniform Traffic Control Devices* to locals at no cost. A similar process may be applied for the HSM.

Session 8: Partnerships

Regional Partnerships—New Hampshire DOT

Stuart Thompson, New Hampshire DOT

New Hampshire has partnered with Maine and Vermont to implement the HSM in their states. This has allowed them to pool resources and deal with common issues among the states. Currently the main focus of the three-state partnership is to get their data up-to-date. The states are working together to identify the type of improvements that are needed. Maine is focused on gathering their horizontal curve data. Vermont is more interested in their intersections and will continue to work with SafetyAnalyst. New Hampshire will continue to work with IHSDM. The states have done training for the HSM with their local agencies and consultants, but are looking forward to expand their training to include SafetyAnalyst.

Some of the barriers and challenges are lack of data, prohibitive costs, and the lack of leader and legislative support. In order to overcome these challenges, the states will be working with smaller pool fund studies, doing research projects, and using as much technology as they can.

The next step for this group is to develop a more regional implementation plan after the FHWA sends them the task list with the highway procedures of gathering data elements. The New England Transportation Consortium has identified a project. New Hampshire will soon work on developing the regional SPFs for this project.

Working with Locals and MPOs— Alabama DOT

Dan Turner, Alabama DOT

County roads in Alabama represent two-thirds of the state mileage and carry 25 percent of the traffic. A majority of crashes in Alabama are lane departure, and approximately 50 percent occurred on county roads. Alabama has been able to provide many training opportunities (for example, Safety Short Course for County Engineers, CARE training, Low-Cost Safety Improvements, Road Safety Audits, Safety Effects of Geometric Design Elements, and HSM). Alabama DOT is currently coordinating training activities with MPOs, units of local governments, and external agencies.

Funding is a struggle for local municipalities since counties in Alabama cannot charge taxes. Alabama DOT has helped by providing safety expertise from highly trained people from the Central Office. Alabama DOT is adding a Local Engineering Assistance Program to assist these smaller communities by helping them identify funding sources for improvements. Data needs are problematic for local governments because of their busy schedule and lack of knowledge to review and screen the data. The County Transportation Bureau is assisting them with this effort. This gives Alabama DOT the opportunity to recommend that locals make the HSM a mandated portion of the program.

Barriers and challenges that have been encountered include funding and participation by local elected officials. The amount and quality of data are other challenges. It has been hard to get the data in the right form and then manipulate and convert the data to make it useable. Other challenges are that MPOs and regional planning organizations (RPOs) tend to be independent and see safety as a lower priority. Some of the actions taken to overcome these barriers are education and training of the HSM, providing support to those who use it, and mandating the use of the HSM.

Next steps are to continue training, complete the HSM implementation scoping study and implement HSM components.

Lead States Discussion on Partnerships

One of the objectives of the lead states initiative is to create partnerships with other states interested in implementing the HSM. Some states have started contacting lead states for assistance with information, training, etc. Lead states can help other lead states, not just the support states.

Suggestions on how to share the knowledge with other states include (1) developing a document that summarizes each lead state implementation efforts to allow other states to understand who to contact for assistance on specific topics, and (2) developing strong partnerships with neighbors and others. The NCHRP 17-50 Project has travel funds available to help with support between states. Another suggestion was to organize academic round tables. Having researchers involved in partnerships will add value to the process. They can provide assistance with SPF development or states could sponsor graduate students to assist developing implementation plans.

Session 9: Resources and Support

FHWA Support of HSM Implementation Efforts

Mike Griffith, FHWA Office of Safety Technology

FHWA is currently developing a number of products to support implementation.

The *HSM National Implementation Roadmap* is a detailed plan describing how national partners can support the goals of HSM implementation. It is completed.

The *HSM Training Guide* was delivered at the peer exchange. It lists all available HSM training that a state may need for different target audiences (for example, planners, designers, traffic engineers, and safety engineers). It includes National Highway Institute and Institute of Transportation Engineers course offerings with descriptions of each course and what level needs to take it (beginner, intermediate or advanced). It is completed.

The *HSM Application Guide* will include specific FHWA guidance on integrating the HSM into identified processes and programs within select disciplines such as safety (Roadway Safety Management Process and Highway Safety Improvement Program), planning and environment (Transportation Safety Planning, Context Sensitive Solutions, and Alternative Selection), and design (Design Exceptions and Value Engineering). The applications guide will serve as a precursor to the HSM User Guide that will be developed by the Lead State Initiative Project. It will be available in the fall of 2011.

The *HSM Implementation Guide for Managers* is intended for managers of DOTs charged with leading and managing various programs related to the project development process and safety programs. It outlines what the HSM is, how it fits with other core technical documents and policies, and the potential benefits of its use. The implementation guide will give insights into the organizational needs, policies, data systems, and training that should be considered to fully implement the HSM. In addition, it offers guidance to senior management in identifying and overcoming barriers to implementation and integration of the HSM from both within and outside their agency. It will be available in the fall of 2011.

The *HSM Case Studies* presents examples of how partner agencies have used various elements of HSM. Four out of five case studies are finalized or near delivery. The fifth case study will be focused on implementation plan development.

The ultimate home for these products is the HSM website. FHWA is currently working on getting everything on the one website to avoid confusion. It is important for everybody to voice what they need so that appropriate resources and support may be provided.

FHWA also has the following ongoing research efforts:

- Practical Guidance on the application of CMFs. White Paper*: Investigation of Existing and Alternative methods of combining multiple CMFs.*
- Evaluation of Low-Cost Safety Improvements.
- Interactive Highway Safety Design Model.
- Advancing Highway Crash Data Modeling Concepts and Methods.

Also coordination efforts are ongoing with partners, within FHWA, and with safety programs. FHWA is committed to delivering products to ensure that the HSM is successfully implemented.

Summary

Session 1: Review of Available HSM and other Safety Tools

Several advantages are associated with the different software tools shown during this session (for example, IHSDM and SafetyAnalyst). Many states have expressed their concern about the data collection and data manipulation required to run such software platforms. However, the robustness of the different platforms, and the different analysis options and output compensate for these data-related efforts.

Session 2: Safety Tools in Practice

States are investing significant resources and money developing their own tools for analysis. During the workshop, states discussed the idea of consolidating these efforts, and investing in a new set of tools, or modifying existing ones by using a pool fund.

Session 3: Where Are We today? Implementation Status and Plans

Illinois DOT has established a framework that includes five critical elements: resources, data and analytical tools, training and marketing, policy, and leadership and support. They have incorporated other bureaus by providing them with tools to make decisions based on diagnosis (for example, Five percent list, Safety Road Investment (SRI) number).

Illinois DOT has a robust database system, but still are working on establishing data gaps, and methods to capture additional data. Illinois DOT has also developed several supporting tools for data analysis.

Washington DOT is working on implementing a program called Sustainable Safety. The focus is creating safety conditions within the planning and programming, project development, and traffic operations processes.

Incorporating other bureaus is critical in implementation. Safety calls for analysts to make decisions based on diagnosis. Lack of knowledge can results in poor decisions and will solely rely on standards.

During the research portion, agencies have realized that the issues are not necessarily coming from the safety staff but from the operations and design staff. Therefore, lead states are encouraged to schedule meetings inviting all staff members to discuss the HSM and the ultimate goals of the project. Lead states are also encouraged to start using SharePoint site as a way to collaborate and share information among each other.

Session 4: Encouraging the Use of the HSM

A number of policy-related and pilot efforts are focused on implementing the HSM. Missouri DOT shared their experience with design exceptions. Florida DOT provided a summary of their districts pilot projects. It is planned to use successful experiences within the states, or with other states that are interested in implementing the HSM.

Session 5: Data Assessment and Capture

Assessing data gaps and establishing methods for data collection is critical for implementation. Louisiana DOT and New Hampshire DOT shared their experiences in their ongoing data collection efforts.

FHWA highlighted a new resource that will house all the different data-related efforts from the office of safety under one roof. RSDP will contain information from MIRE, HSM, HSIP, Strategic Highway Safety Plans, etc.

Session 6: SPF Calibration, SPF Development Experiences

It is important to study the benefits and level of effort of state agencies developing their own SPFs versus calibrating existing SPFs before states begin to spend their funds on collecting data. Lead states are trying different approaches, and assessing differences between such methods. Information related to the cost, benefits, and challenges of both methods is important for states who are trying to get started on HSM implementation so that they make cost effective decisions based on available data and resources.

Session 7: Training

FHWA has developed training materials for locals free for download. States expressed their interest on having training as a technical briefing or webinar to share their experiences with other states.

Training efforts need to be planned strategically, not everyone needs to be trained at once, and have the same in-depth knowledge. Consider customizing different training for different staff within the agency, as well as encourage senior leadership participation.

Session 8: Partnerships

One of the main objectives of the project is to provide assistance with implementation to other state (for example, neighboring and support states). One of the ideas for sharing the knowledge was developing a document summarizing each state's status and efforts associated with implementation to allow others to understand who to talk to about specific topics.

Session 9: Resources and Support

FHWA is currently developing a number of products to support implementation. The *National Roadmap*, and the *HSM Training Guide* are ready and available. The *HSM Application Guidebook*, *Implementation Guide for Managers*, and *Case Studies* will be ready in the months to come. All products will be housed under the HSM website.

Survey Feedback

At the end of the peer exchange, attendees were asked to complete a survey which provided valuable feedback to the organizers. A total of 28 responses were received and summarized. Appendix B contains the attendee summary survey.

Attendees were asked about their satisfaction with a few 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	22	3	2	0	0	27
Materials and Handouts	14	7	4	2	0	27
Speakers and Presenters	23	4	0	0	0	27
Venue/Facility	26	1	0	0	0	27

Some of the attendees suggested that providing materials/handouts in advance would be 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, the majority of responses centered on “learning what others are doing and accomplishing, challenges, etc,” “networking,” and “discussion of supporting tools”. Respondents indicated that they would like more time for open group discussion, fewer topics/more in-depth knowledge, and case studies of successful applications of the HSM. States also indicated they would like sample training materials, conference calls on specific topics, and webinars.

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

Overall, the survey feedback demonstrates that the first NCHRP 17-50 achieved its objectives. Attendees were very satisfied with the information shared and are looking forward to participating in future workshops.

SECTION II

Appendix

Appendix A: Peer Exchange Agenda

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

Peer Exchange Preliminary Agenda

Wednesday, August 10, 2011

10:00 a.m. to Noon	**Session 1** (In conjunction with the TRB Safety Performance Committee): **Review of available HSM and other safety analysis tools** Planning level tools: • Safety Analyst (45 minutes) • PlanSafe (30 minutes) • usRAP (30 minutes) • Discussion (15 minutes) TRB Adjourns
Noon to 1:00 p.m.	**Lunch at the Beckman Center**
1:00 p.m. to 2:30 p.m.	Safety analysis tools: • IHSDM (30 minutes) • Illinois SPFs (20 minutes) Basic tools that cover the HSM predictive methods: • 17-38 spreadsheets, Illinois HSM tools (20 minutes)
2:30 p.m. to 2:45 p.m.	**Break**
2:45 p.m. to 4:45 p.m.	**Session 2: Safety Tools in Practice** The use of safety analysis tools in practice • Basic tools (California) (15 minutes) • IHSDM (Kansas) (25 minutes) • Safety Analyst (Ohio) (20 minutes) • Selection of tools vs adapting (Alabama) (15 minutes) • Use of usRAP and data trees on the local system (Illinois) (15 minutes) • Discussion (30 minutes)
4:45 p.m. to 5:00 p.m.	**Closing comments for the day**

Thursday, August 11, 2011	
7:00 a.m. to 8:00 a.m.	**Breakfast at the Beckman Center**
8:00 a.m. to 8:15 a.m.	**Opening comments**
8:15 a.m. to 9:35 a.m.	**Session 3: Where are we today? Implementation status and plans** • HSM Lead States 17-50 (15 minutes) • Illinois (20 minutes) • Washington (20 minutes) • Discussion (25 minutes)
9:35 a.m. to 9:50 a.m.	**Break**
9:50 a.m. to 10:55 a.m.	**Session 4: Encouraging the use of the HSM** • Design exception policy, Missouri (15 minutes) • Pilot Program, Florida (15 minutes) • Example project using the HSM, Florida (15 minutes) • Discussion (20 minutes)
10:55 a.m. to 12:05 p.m.	**Session 5: Data Assessment and Capture** • Louisiana (15 minutes) • New Hampshire (15 minutes) • Roadway Safety Data Assessment, FHWA (20 minutes) • Discussion (20 minutes)
12:05 p.m. to 1:05 p.m.	**Lunch at the Beckman Center**
1:05 p.m. to 2:05 p.m.	**Session 6: SPF Calibration, SPF Development Experiences** • Virginia (15 minutes) • Utah (15 minutes) • Discussion (30 minutes)
2:05 p.m. to 3:20 p.m.	**Session 7: Training** •Training elected officials, Michigan (15 minutes) • HSM Lite for locals, LTAP (15 minutes) • FHWA practitioners course recommendations, Maine (15 minutes) • Discussion (30 minutes)
3:20 p.m. to 3:35 p.m.	**Break**
3:35 p.m. to 4:25 p.m.	**Session 8: Partnerships** • Regional partnerships, New Hampshire (15 minutes) • Working with locals and MPOs, Alabama (15 minutes) • Discussion (20 minutes)
4:25 p.m. to 4:35 p.m.	**Break**
4:35 p.m. to 6:00 p.m.	**Session 9: Resources and Support** • FHWA (20 minutes) • AASHTO (20 minutes) • NCHRP 17-50 (45 minutes)
6:00 p.m. to 6:15 p.m.	**Closing comments, Adjourn**

Appendix B: Lead State Attendee Survey Summary

Highway Safety Manual Lead State Peer Exchange										
Item	Overall Satisfaction				In what ways could the workshop be improved?	What did you like most and what is your most important gain from it?	Interested in attending similar exchange sessions in the near future (e.g., next year)?	What kinds of sessions would you like to see included at the exchange meetings?	What kinds of resources and support would you like to have between now and future meetings within our state, regionally, and nationally?	Additional comments or feedback on this workshop
	Registration Process	Materials/ Handouts	Speakers/ Presenters	Venue/ Facility						
1	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	Encourage presenters to use more examples with less "we did that, we did this" in their presentation. Consider holding HSM Poor Exchange on the first or second day. The Poor Exchange seemed to lag, perhaps it was because it was day 4 of meeting for many.	I liked the state's examples of what is working for them. I will recommend that our local agency group look at USRAP to help local agencies identify potential locations for safety improvements.	Yes	Frank evaluation and discussion of HSM implementation would be good. A meeting in spring/summer of 2012 (18 months after our first meeting) will be a great opportunity to really look at HSM implementation, the road blocks and from there create implementation plans and timelines for other states.	Conference calls to share emerging successes or problems.	Kim did a great job juggling the schedule and trying to keep things on schedule!
2	Very Satisfied	Satisfied	Satisfied	Very Satisfied		Good atmosphere for sharing information. Knowledge of tools other states have developed and are using.	Yes	Implementation states updates, more pilot programs.	Training materials, tools other states have developed.	
3	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Listening and learning what other states have accomplished.	Yes		Training and conference calls.	Good job!
4		Somewhat Dissatisfied	Very Satisfied	Very Satisfied	Would have liked to have thumb drive ahead of time or handouts to make notes	Very much enjoyed state interation and discussion.	Yes	Where are we now. Recap of this sessions major themes. How the takeaways were used.		Great job!
5	Very Satisfied					Broad variety of state activity in implementing the HSM and related tools. Taken together the level of activity is very impressive, more than expected.	Yes			In the futre, it would be desirable to involve other states so they can see what the lead states are doing.
6	Somewhat Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Learning from others' experiences.				
7	Neutral	Neutral	Very Satisfied	Very Satisfied		Discussion sessions were best. Would be valuable to get support state to hear lessons learned.	Yes			
8	Very Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied		Very helpful to hear what the states are doing and why, what they are considering, what issues they are struggling with, what questions they had for other states.	Yes	I'd like more of the same far enough in the future for them to be able to give meaningful reports, i.e., new stuff.	N/A	
9	Very Satisfied	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied	Consider break at discussion sessions to provide discussion/feedback.	Great mix of theory and practice, got good contacts/peer-to-peer exchange.	Yes	Sessions that address choice between two similar topics.	Looking for more examples of success.	Thanks for the invite. I learned a ton.
10	Somewhat Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied	Responding to the forms (requesting our feedback, questions and issues) is just hard to do. We can never remember those things. Why not have a chat board for us to ask each other questions online?	Great swap of information, very good at helping us get a better handle on SA and IHSDM. Great idea to meet with or just after the HSPC. But the days/sessions were just too much. We need longer breaks to recharge.	Yes	More open gorup discussion on confusing and different issues. Discuss which states have used commercial projects other than IHSDM and Safety Analyst.		Fun, sometimes we just need a relaxing time. We, who have started implementation are way out on a limb (high risk) and just need to talk with others to make sure I am not going in the wrong direction.
11	Very Satisfied	Neutral	Somewhat Satisfied	Somewhat Satisfied	Electronic copies of the presentation/handouts before the presentation would have been helpful to make notes on (microsoft one note).	Just seeing implementation challenges and successes makes me motivated to keep pushing forward in our own program.	Yes	Fewer topics, more depth. Possibly separate tracks for different topics.		

Highway Safety Manual Lead State Peer Exchange										
Item	Overall Satisfaction				In what ways could the workshop be improved?	What did you like most and what is your most important gain from it?	Interested in attending similar exchange sessions in the near future (e.g., next year)?	What kinds of sessions would you like to see included at the exchange meetings?	What kinds of resources and support would you like to have between now and future meetings within our state, regionally, and nationally?	Additional comments or feedback on this workshop
	Registration Process	Materials/ Handouts	Speakers/ Presenters	Venue/ Facility						
12	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	Overall the workshop was very good, but perhaps we tried to cram too much into the allotted time considering it was tacked onto the HSPC meeting.	Calibration of SPFs vs. development of SPFs. Discussion of the various tools.	Yes	Not sure how this can be accomplished, but we would like to have an open discussion of the tools, i.e. the good, the bad and the ugly.	Regional peer exchange or meeting with an invitation extended to non-lead states to attend. Template for implementation plan.	Keep up the excellent work!
13	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Appreciate the combination of TRB (reseracher) and AASHTO (practioner) meeting into one trip. It helps to justify the travel. The content/program is great. Thanks!	Yes	Future direction/research needs. AASHTO's implementation status/challenges/success stories.		
14	Neutral	Somewhat Dissatisfied	Very Satisfied	Very Satisfied	The workshop could have been improved by providing an Attendee List similar to what was done for the HSPC mid-year meeting.	Opportunity for folks to ask questions. Great discussions concerning HSM topics. Most important call was the IHSDM discussion.	Yes	Partnerships and sharing HSM practices with neighbor states. Researchers round table.	Opportunity to assist with regional session (southeast, CA, MS, AL, FL,GA, etc.)	Post all material on Sharepoint site and share link/code to access. Follow up webinars.
15	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Hearing what other states have accomplished. Meeting/networking with others trying to implement HSM. Discussion of SPFs vs Calibration.	Yes	What have we accomplished since this meeting.	Conference calls on topics (i.e. SA, Calibration, SPF development, etc.)	Great meeting!
16	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		It's always a benefit to network and hear from safety leaders in other states and agencies. I also benefited greatly from sitting in the TRB portion and hearing more perspective from the academics in attendance. This certainty benefited my understanding of SPFs/CMFs, HSM vs. Safety Analyst, etc. I hope these meetings continue in the future. I have many take home "notes."	Yes	Greatly benefited from having researchers/academics at the first part of the week to answer "proper use" questions. Follow-up on Calibration/SPF development and the use of SA and IHSDM. Future research on Calibration vs. SPF development. Pros/Cons.	Performance measurement of HSM/Safety Analyst use. Tracking use and effectiveness of quantitative safety. Common challenges/barriers in calibration and SPF development and ways to overcome them. Shared resources/tools among states (spreadsheet interfaces, SA user guides, policy documents, data collection tools, etc.)	Excellent workshop. Great benefit to the states!
17	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		I enjoyed the discussions of each of the topics and the opportunity to meet and talk with respresentatives of each of the lead states.	Yes	Local agency HSM applications.	Resources to purchase HSM manuals and free training opportunities provided online to individualize travel costs.	Well done!
18	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	None	I was glad to meet others working on safety projects, as this is the first time I have worked out of our state on safety. I will go back and use SPF calibration and comparison to assess our data in SA. We will experiment more with IHSDM.	Yes	Not sure, potentially case studies of countermeasurements (choice and effectiveness) that have been chosen and implemented using HSM or Safety Analyst.	Stuart spoke to this in his regional presentation.	It was a great experience. Thank you for having me and I was glad to be able to contribute.
19	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	I hope that this group does not become a venue for Michigan LTAP to market their software?	The presentations and experiences that were shared were very good. The review of SA and IHSDM were very informative.	Yes	A presentation and steps for preparing data to develop SPF's. Possibly hold a users group conference for SA.	National users group for SA. More sharing of success for implementation of IHSDM. IHSDM training.	Good job! Kim did a great job keeping things under control, although a few speakers were long winded without substance.
20	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		Perfect amount of information. Good cross-section of topics.	Yes	Use of GIS in safety analysis.	Webinar on software tools.	
21	Very Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied		Finding out what other states are doing (barriers, successes). How to work with local officials. Networking, sharing info/spreadsheets/software .	Yes	Policies/standards/initiatives states have taken. Training, what is working well and what isn't. More on barriers and successes. Lessons learned.	Software/spreadsheet/tools to use. Export resource to bounce ideas off of. Names/contact information (who is willing to share for different topics).	Great job setting up and coordinating.

Highway Safety Manual Lead State Peer Exchange										
Item	Overall Satisfaction				In what ways could the workshop be improved?	What did you like most and what is your most important gain from it?	Interested in attending similar exchange sessions in the near future (e.g., next year)?	What kinds of sessions would you like to see included at the exchange meetings?	What kinds of resources and support would you like to have between now and future meetings within our state, regionally, and nationally?	Additional comments or feedback on this workshop
	Registration Process	Materials/ Handouts	Speakers/ Presenters	Venue/ Facility						
22	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied		State presentations. Discussion on Safety Analyst and what other state tools used.	Not		N/A	It was great. Enjoyed being here!
23	Very Satisfied	Very Satisfied	Somewhat Satisfied	Very Satisfied		Great idea to provide presentations and resources on a jump-drive to take back home. Key to see what other states are doing, talking to them, sharing best practices and key learnings. Contacts at other states and learned some new developments with software for safety analysis.	Yes	Differences states have seen by calibrating SPFs vs. developing from scratch. Methodologies use to develop curve and grade characteristics.	Training information and materials, powerpoints, webinars, etc.	It might be nice to have some work stations set up with different software set up to test and walk through. Safety Analyst, IHSDM, 17-38 spreadsheets.
24	Somewhat Satisfied	Neutral	Very Satisfied	Very Satisfied	Would have been great to have the powerpoint prior to each so that notes could have been taken electronically.	Gaining the understanding of others perspective on the HSM.	Yes	Performance measurement with HSM. Alternative uses of Safety Analyst. Live Demo of available softwares/tools. Bring in a local to speak about their perspective.	Process support, actual examples that have worked.	
25	Very Satisfied	Neutral	Very Satisfied	Very Satisfied	No real hand-outs were handed out. Good to get flash drive of all presentations at end.	Good to hear what other states are doing to implement the HSM and to hear of the computer programs they are using. Also, good to hear of the challenges others are encountering, makes one feel that my state is alone on an island.	Yes	I would be interested in hearing in the future how other states are actually applying the HSM process in the selection process of a state's HSM and HRRR programs.	Information regarding when an HSM analysis when used for Design Exception approval/rejection, what threasholds should be used in making a D.E determination.	
26	Very Satisfied	Somewhat Satisfied	Very Satisfied	Very Satisfied	PDF's of presentation will be most helpful, maybe "very satisfied."	Informal exchange of information. Good participation by all. Good presentations on "written" plans. Good presentations and discussion on IHSDM.	Yes	Written plans and modifications made while "Enroute." Improvements in training materials e.g Intermediate to Advanced audiences.	Using consultants to work/unite plan, so getting copies of other state's "scope" would be helpful. Yes, to sharepoint.	Could have "quarterly or bi-monthly" web/conf. calls for discussions on topics.
27	Very Satisfied	Very Satisfied	Very Satisfied	Very Satisfied	N/A	N/A	Yes			
28	Very Satisfied	Satisfied	Very Satisfied	Very Satisfied		Congratulations to the lead states. I am very impressed with the progress made in implementation efforts that have occurred over the past year. Please let us know what additional support FHWA can provide.	Yes	Case Studies of succesful applications of the HSM		Thank you very much to Rick Pain and Chuck Niessner for their strong support. Congratulations to Chuck on his retirement.

Appendix C: 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