Data-Driven Safety Analysis

Integrating Safety Performance into All Highway Investment Decisions

Efficiency through technology and collaboration
**Introductions**

- Name
- Agency
- Position
- One way your agency has incorporated safety analysis into investment decisions
- What you would like to learn more about today
Outline

• Overview
• Methodologies and Case Studies
• State Experiences
  – Systemic Approach: Minnesota
  – Predictive Approach: Louisiana
• Resources
Overview
Integrating Safety Performance into All Highway Investment Decisions
Jerry Roche, FHWA Office of Safety

Efficiency through technology and collaboration
What is the Data-Driven Safety Analysis Initiative?

- The application of two science-based analysis approaches into two common transportation processes.
Why the Data-Driven Safety Analysis Initiative?

- **from FHWA State Data Capabilities Assessment:**
  - Use of data analysis **varies** from state-to-state
  - All states **want to improve** their data capability
  - States are **excited** about implementing the HSM and upgrading their existing analysis practices
  - Many states noted that the introduction of the HSM was a **major advance** for the transportation safety profession
What is the Key Message regarding Data-Driven Safety Analysis?

- More Informed Decision Making
- Better Targeted Investments
- Fewer Fatalities & Serious Injuries
Systemic Analysis

- Implements a **system-wide screening** of a roadway network based on the presence of **high-risk roadway features** correlated with **particular severe crash types**, rather than high crash locations.

![Table]

<table>
<thead>
<tr>
<th>Road Features</th>
<th>Traffic Volume</th>
<th>Other Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Width/Type</td>
<td>Average Daily Traffic (ADT)</td>
<td>Presence of Commercial Development</td>
</tr>
<tr>
<td>Horizontal Curvature</td>
<td></td>
<td>Proximity to Rail Crossing</td>
</tr>
<tr>
<td>Access Density</td>
<td></td>
<td>Distance from Previous Stop</td>
</tr>
<tr>
<td>Roadside Rating</td>
<td></td>
<td>Operating Speed</td>
</tr>
<tr>
<td>Intersection Skew</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: FHWA Systemic Safety Project Selection Tool
Systemic Analysis

- Particularly applicable when a significant number of severe crashes happen over a wide area:
  - Rural Roadways
  - Local Roadways
  - Specific Crash Types
    - cross-median
    - pedestrian
    - curve

- Supplements traditional site analysis
- May include treating locations that haven't experienced many crashes
Predictive Analysis

• Uses crash, roadway, and traffic volume data
• Provides reliable estimates of an existing or proposed roadway’s expected safety performance.
• Helps agencies quantify the safety impacts of transportation decisions, similar to the way agencies quantify:
  – traffic growth
  – environmental impacts
  – traffic operations
  – pavement life
  – construction costs
Predictive Analysis Tools

- Equations
- Spreadsheets
- Software Products
- Crash Modification Factors Clearinghouse
Quantitative Analysis in Other Professions

• True story about Oakland A's general manager Billy Beane who used computer-generated analysis to determine players to draft or acquire

• Competed against teams with budgets up to three times as large and made the playoffs

• Almost every professional sports team now has at least one quantitative analyst on staff

Our ultimate performance measure

Photo Source: FHWA
A Predictive Illustration...

All three of these meet design standards...

but predictive analysis tells us they would perform very differently from a safety perspective.

Source: CH2M HILL
A systemic illustration...

• You could select cable median barrier locations on fatal crash data alone... but considering other roadway characteristics would likely lead to a better risk-based solution.
Integrating Performance into Investment Decisions

• **Warren Buffet** - uses a thorough approach to determine the companies that have the greatest probability of maximizing the return of each dollar invested

  – Stock price has grown from $100 to over $200,000
  – up 177% since March 2009
  – Outpacing the S&P500 by 8 percentage points

What effect can Quantitative Analysis have on Safety?

- **Colorado** – “‘outperformed the rest of the country in reduction of fatal crashes.’”1

- **Illinois** – “has improved the sophistication of safety analyses, resulting in better decisions to allocate limited safety resources.’”2

- **Ohio** – “these higher identification rates indicate much more accurate identification of problem locations.”3

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These approaches enable users to:

• Identify factors contributing to crashes and potential mitigation measures

• Identify sites with the most potential for crash frequency or severity reduction

• Estimate the potential effect on crash frequency and severity of planning, design, operations, and policy decisions

• Evaluate the crash reduction benefits of implemented treatments
Our EDC Vision and Mission

VISION:

• **Safety Performance is integrated into all highway investment decisions.**

MISSION:

• To broaden implementation of quantitative safety analysis, so that it becomes an integral component of safety management and project development decision making, resulting in fewer fatal and serious injury crashes on our Nation’s roadways.
AASHTO Strategic Plans

• AASHTO Strategic Plan (2009)
  – Goal 1H: promote accountability through performance-based management

• Strategic Highway Safety Plan (2005)
  – Goal Area 21: improving information and decision support systems

• SCOHTS Strategic Plan (2011)
  – Goal 2: institutionalization and further development of the HSM
  – Goal 4: developing tools that can better quantify changes in safety performance
FHWA’s Safety Strategic Plan

### Vision
Toward zero deaths and serious injuries on the Nation’s roadways

### Mission
Exercising leadership throughout the highway community to make the Nation’s roadways safer by:
- Developing, evaluating, and deploying life saving countermeasures
- Advancing the use of scientific methods and data-driven decisions
- Fostering a safety culture
- Promoting an integrated, multidisciplinary (4Es) approach to safety

| 4.1 Champion FHWA safety policies and programs to advance safety improvements |
| 4.2 Promote an emphasis on safety performance in all aspects of roadway investment and decisionmaking |
| 4.3 Embolden a culture within the highway community that embraces safety as a core value |
| 4.4 Articulate the benefits of roadway safety investments |

| 3.1 Improve **safety data** and expand capabilities for **analysis** and **evaluation** |
| 3.2 Enhance strategic highway safety planning |
| 3.3 Develop and promote roadway safety improvements |
| 3.4 Establish and implement the safety element of the Transportation Performance Management program |

| 2.1 Employ a strategic planning process to guide the safety units and align resource allocation decisions |
| 2.2 Foster a safety culture throughout FHWA |
| 2.3 Utilize effective partnerships within USDOT for the improvement of highway safety |
| 2.4 Enhance the effectiveness and efficiency of **business processes** |

| 1.1 Improve the quality of the work environment |
| 1.2 Improve career and leadership development opportunities |
| 1.3 Enhance safety knowledge of FHWA professionals |

### External Goals
3. Program and Service Delivery

### Internal Goals
1. Employee Learning and Growth

2. Business Practices/Internal Processes
FHWA’s Strategic Implementation Plan

- **System Performance** - The Nation’s highway system provides safe, reliable, effective, and sustainable mobility for all users.

  - SP 1.1 Enhance Division, State, and partner data collection and management capabilities and **use evidence-based analysis tools including the Highway Safety Manual, the Systemic Approach to Safety, and other approaches for safety project selection on all public roads** (HQ, DO, and DTS).
  
  - SP 1.2 **Provide tools and techniques** that are appropriate to each state’s needs for updating their HSIP and SHSP (HQ, DOs, and OTS).
  
  - SP 1.3 Evaluate and **enhance the States’ performance-based management approach** in implementing their HSIPs (HQ, DOs, and OTS).
HSM Lead/Support/Pooled-Fund States

- HSM Pooled Fund States (13)
- HSM Lead States (16)
- HSM Supporting States (5)

25 States
States Implementing Systemic Safety Improvements through the HSIP

Source: 2013 HSIP Reports
EDC-3 Opportunities

- **Safety Management**
  - Data-Driven Statewide Safety Program
  - Safety/Planning Performance Measures

- **Project Development**
  - NEPA Documents (especially if Safety included in Purpose and Need)
  - Design Exceptions on the expanded NHS
  - Interstate System Access Change Requests - called IAR/IJR/IMR, IOAR, IAJS (Policy Point 3)
  - Performance-Based Practical Design
Questions and Answers

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More Informed Decision Making
Better Targeted Investments
Fewer Fatalities & Serious Injuries
Methodologies & Case Studies

Integrating Safety Performance into All Highway Investment Decisions

John McFadden, FHWA Resource Center, Safety & Design TST

Efficiency through technology and collaboration
Methodologies Presentation Overview

• Nominal vs. Substantive Safety
• Data-Driven Safety Analysis
  – Predictive vs. Systemic applications
• Systemic Applications
  – Examples
• Predictive Applications
  – Examples
• Conclusions
Approaches for Considering Safety

Nominal Safety

Examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures

Substantive Safety

The expected or actual crash frequency and severity for a highway or roadway

*Adapted from Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999
Nominal vs Substantive Safety

Graph showing the relationship between Crash Risk and Design Dimension. The X-axis represents Design Dimension (Lane Width, Radius of Curve, Stopping Sight Distance, etc.), and the Y-axis represents Crash Risk. The graph illustrates that as Design Dimension increases, Crash Risk decreases. The statement "Nominal Safety is an Absolute" is highlighted, indicating that nominal safety is considered an absolute standard in comparison to substantive safety, which is described as a continuum.
Comparing Predictive and Systemic Analysis

- Both use crash, roadway, and traffic data
- Predictive approaches provide crash frequency estimates as a function of roadway and traffic characteristics
- Systemic approaches focus on the presence of risk factors associated with higher crash frequencies of particular crash types
- Ultimately, both provide answers that can be used to make informed decisions and improve safety performance
Can be applied in Transportation Management

- System Planning
  - Long Range Transportation Plans
  - Strategic Highway Safety Plans
  - Corridor Study

- Project Planning
  - Corridor Study
  - Alternatives Evaluation
  - Designing new network connections

- Preliminary Design Final Design Construction
  - Designing a new facility
  - Widening an existing roadway
  - System upgrades

- Operations & Maintenance
  - Signal Timing & Phasing Modifications
  - Intersection Modifications
  - Traffic Impact Studies
What do we mean by “systemic safety improvement”?

• An improvement that is widely implemented based on high-risk roadway features that are correlated with particular severe crash types.
1. Systemic Approaches
Systemic Safety Project Selection Tool

Risk-Based Approach:

- Identifies roadway elements with high crash experience that have the greatest potential for safety improvement (PSI)

- SSPST uses a systemic approach looks at crash history on aggregate basis to identify high-risk roadway features
Case Study - New York State DOT

- **Intersection and Lane Departure Crashes by System**

<table>
<thead>
<tr>
<th></th>
<th>Local</th>
<th>County</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersection Crashes</td>
<td>64%</td>
<td>30%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>(18,270)</td>
<td>(1,957)</td>
<td>(5,033)</td>
</tr>
<tr>
<td>Lane Departures</td>
<td>18%</td>
<td>44%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>(5,128)</td>
<td>(2,892)</td>
<td>(5,985)</td>
</tr>
<tr>
<td>Other</td>
<td>18%</td>
<td>26%</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td>(5,199)</td>
<td>(1,723)</td>
<td>(8801)</td>
</tr>
</tbody>
</table>

*Source: New York State DOT*
Case Study - New York State DOT

• AADT
  – Crashes over represented when AADT between 3,000-5,999
  – 36.3% of crashes occur on 27.8% of the mileage

Source: New York State DOT
Benefits of Systemic Safety Planning

• Proactive program to address fatalities and serious injuries that seemingly occurred at “random” locations

• Greater knowledge regarding severe crashes, including contributing factors and location characteristics
  – Improve planning, design, and maintenance practices
  – Risk management for tort liability
2. Predictive Approaches
What is the HSM?

- A tool to improve safety analyses
- Encourages a “science-based” technical approach to safety analysis
- Accountability/Performance Measurement
  - Reduces the guesswork
  - Quantitative analyses allow safety to be evaluated alongside other transportation performance measures (capacity, environmental, ROW, and construction costs)
WHAT IS COVERED IN THE HSM?

Vol. 1 (Part A)
Introduction
Human Factors Fundamentals

Vol 1. (Part B)
Roadway Safety Management Process

Vol. 2 (Part C)
Predictive Methods

Vol 3. (Part D)
Crash Modification Factors (CMFs)
## HSM Companion Software

<table>
<thead>
<tr>
<th>HSM Part</th>
<th>Supporting Tool</th>
</tr>
</thead>
</table>
| **PART B:** Roadway Safety Management Process | AASHTO Safety Analyst  
www.safetyanalyst.org |
| **PART C:** Predictive Methods | IHSDM  
www.ihsdm.org  
HSM & ISATe Spreadsheets |
| **PART D:** Crash Modification Factors | FHWA CMF Clearinghouse  
www.cmfclearinghouse.org |

* Other commercially available tools as well
Crash Prediction Methodology

How can crash predictions be used?

**Program Level:**
- Prioritize segments or locations for selection of projects

**Project Level:**
- Assess the relative needs for a project
- Communicate the relative needs to public
- Prioritize countermeasures to keep project within budget
- Supporting documentation for design exceptions
Case Study – Monroe County, IL

HH Road S Curve
Proposed Reconstruction

Photo Source: Google Earth
Results of Right of Way Discussions

• Land owners want to minimize impacts to their adjacent property.
• Purchasing right of way for original plan will meet resistance and end up in court.
• An intermediate radius would be acceptable to the property owners.
• Does the revised radius provide adequate safety benefit?
Quantify Effect of Revised Curve Radius

<table>
<thead>
<tr>
<th>Curve Radius</th>
<th>Crash Modification Factor</th>
<th>Benefit/Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>750’ (Existing)</td>
<td>1.00 (Base)</td>
<td>N/A</td>
</tr>
<tr>
<td>1700’ (Original Proposal)</td>
<td>0.65</td>
<td>14.60</td>
</tr>
<tr>
<td>1050’ (Revised Proposal)</td>
<td>0.78</td>
<td>11.10</td>
</tr>
</tbody>
</table>

CMF = \(\frac{1.55 L_c + 80.2/R}{1.55 L_c}\)

L (miles); R (feet)  No Spiral Transition

Source: Illinois DOT
Case Study - Arizona DOT

Use Predictive Method for Alternatives

Alternative Improvements Included:
- Widening to 5 ft shoulders
- Widening to 8 ft shoulders
- Improve superelevation
- CL & Shoulder rumble strips
- Flattening side slopes
- Install guardrail

PROJECT LOCATION
SR 264 (MP 441 to 466)
- Rural Minor Arterial
- Navajo County, Arizona
- Undivided Two-Lane, Two-Way Road
- 12-foot travel lanes
- 0-1-foot shoulders
- Intermittent right and left turn lanes
- Intermittent passing lanes

Source: Arizona DOT
Parameters for Existing & Proposed Conditions:

- Used IHSDM to perform safety analysis

<table>
<thead>
<tr>
<th>ROADWAY ELEMENT</th>
<th>HSM Base Condition</th>
<th>Existing SR 264 (1-Foot Shoulders)</th>
<th>Alternative A (5-Foot Shoulders)</th>
<th>Alternative B (8-Foot Shoulders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane width</td>
<td>12-Foot</td>
<td>12-Foot</td>
<td>12-Foot</td>
<td>12-Foot</td>
</tr>
<tr>
<td>Shoulder width</td>
<td>6-Foot</td>
<td>1-Foot</td>
<td>5-Foot</td>
<td>8-Foot</td>
</tr>
<tr>
<td>Shoulder type</td>
<td>Paved</td>
<td>Paved</td>
<td>Paved</td>
<td>Paved</td>
</tr>
<tr>
<td>Roadside hazard rating</td>
<td>3</td>
<td>Varies (6 or 7 most frequent)</td>
<td>Varies (1 or 2 most frequent)</td>
<td>Varies (1 or 2 most frequent)</td>
</tr>
<tr>
<td>Driveway density</td>
<td>≤ 5 per mile</td>
<td>Per survey &amp; Holbrook District turnout database</td>
<td>Per survey &amp; Holbrook District turnout database</td>
<td>Per survey &amp; Holbrook District turnout database</td>
</tr>
<tr>
<td>Horizontal curves: length, radius, and presence or absence of spiral transitions</td>
<td>None</td>
<td>Per best fit alignment</td>
<td>Per best fit alignment (match existing)</td>
<td>Per best fit alignment (match existing)</td>
</tr>
<tr>
<td>Horizontal curves: Super elevation</td>
<td>None</td>
<td>Per as-builds &amp; survey</td>
<td>Per as-builds &amp; survey (match existing)</td>
<td>Per as-builds &amp; survey (match existing)</td>
</tr>
<tr>
<td>Grades</td>
<td>≤ 3%</td>
<td>Per as-builds &amp; survey</td>
<td>Per as-builds &amp; survey (match existing)</td>
<td>Per as-builds &amp; survey (match existing)</td>
</tr>
<tr>
<td>Centerline rumble strips</td>
<td>None</td>
<td>None</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Passing lanes</td>
<td>None</td>
<td>Per survey</td>
<td>Per survey (match existing)</td>
<td>Per survey (match existing)</td>
</tr>
<tr>
<td>Two-way left-turn lanes</td>
<td>None</td>
<td>Per survey</td>
<td>Per survey (match existing)</td>
<td>Per survey (match existing)</td>
</tr>
<tr>
<td>Lighting</td>
<td>None</td>
<td>Present @ US 191 Intersection</td>
<td>Present @ US 191 Intersection (match existing)</td>
<td>Present @ US 191 Intersection (match existing)</td>
</tr>
<tr>
<td>Automated speed enforcement</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Source: Arizona DOT
Case Study – Arizona DOT

Plot of Geometric Features and Expected Crashes

EXPECTED CRASH RESULTS

Source: Arizona DOT
### Case Study – Arizona DOT

#### Benefit to Cost Ratio: Design Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Annual Benefit</th>
<th>Annual Cost</th>
<th>Benefit/Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative A</td>
<td>$3,873,681</td>
<td>$1,680,561</td>
<td>2.30</td>
</tr>
<tr>
<td>Alternative B</td>
<td>$5,084,207</td>
<td>$2,678,713</td>
<td>1.90</td>
</tr>
<tr>
<td>Superelevation Improvements</td>
<td>$41,807</td>
<td>$135,464</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

**Economic analysis:**

- Although Alternative B (8-ft shoulders) could provide the greater benefit in reduction in fatal and injury crashes, **Alternative A** (5-ft shoulders) would provide the greater return on investment and was selected as the preferred alternative.
Case Study: I-270/US 33 Interchange, Dublin OH

• **Goals and Objectives:**
  – Improve Safety
  – Address Traffic Congestion
  – Resolve Obsolete Geometrics
  – Minimize Environmental Impacts
  – Enhance Economy & Community
  – Improve Quality of Life
  – Fiscal Responsibility
  – Constructability

Source: CH2M HILL

Source: Ohio DOT
Case Study: I-270/US 33 Interchange, Dublin OH

• Three of eight interchange alternatives were developed and analyzed based on a list of criteria:
  – Traffic Operations
  – Design & Construction
  – Environmental Impacts
  – Right-of-Way Needs
  – Capital Costs
  – Safety Performance
Case Study: I-270/US 33 Interchange, Dublin OH

- ISATe used for safety analysis:
  - Model was un-calibrated as used
  - Results used for comparisons are relative
  - Focused on KAB type crashes from 2015-2035

- Alternative 8 predicted to have lowest KAB crash frequency and lowest expected societal cost

- City of Dublin and ODOT selected Alternative 8 as the preferred alternative based on all of the criteria.

<table>
<thead>
<tr>
<th>Predicted Crashes and Societal Costs: 2015–2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAB Crashes</td>
</tr>
<tr>
<td>No Build</td>
</tr>
<tr>
<td>Alternative 4</td>
</tr>
<tr>
<td>Alternative 7</td>
</tr>
<tr>
<td>Alternative 8</td>
</tr>
</tbody>
</table>

Source: CH2M HILL.
Questions & Answers

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More Informed Decision Making
Better Targeted Investments
Fewer Fatalities & Serious Injuries
Systemic Approach: Minnesota’s Experience

Integrating Safety Performance into All Highway Investment Decisions

Will Stein, FHWA - Minnesota Division
Mark Vizecky, Minnesota DOT

Efficiency through technology and collaboration
How did Minnesota embrace the systemic approach?

- A change in mindset that occurred over time. Sustained effort.
- Champions/influencers/educators in key positions.
- Hard look at the data made it clear:
  - only treating high crash locations would not achieve goals.
  - only treating State system would not achieve goals.
- Ongoing education process. Some are still skeptical.
Formalized in 2007 SHSP.

• **Non-metro Districts**
  - Severe crashes widely scattered across rural highways.
  - Target: 70% systemic projects; 30% high crash locations.

• **Metro District**
  - Much higher crash densities.
  - Target: 70% high crash locations; 30% systemic projects.
How did Minnesota embrace the systemic approach?

• Another change in mindset: the local (non-State DOT) system had to be addressed.

“(2) PURPOSE.—The purpose of the highway safety improvement program shall be to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal land.
The local system challenge

Severe crashes

Local

State
Funding alignment

Severe crashes
- State
- Local

Safety funding
- State
- Local
How can States embrace the systemic approach?

• Check projects against your data.
  – Are they mostly high-cost projects at high-crash locations?
  – Do you have many severe crashes widely scattered across rural and local highways?
• Help influence and educate. Use data to make your case.
• Make sure local system is addressed. May need to push for sharing of funds.
• Help educate local agencies on the Federal process/requirements.
County Roads
- 2,089 Severe Crashes
- 45,000 miles of road
- 0.05 severe crashes per mile

State Highway
- 2,168 Severe Crashes
- 12,000 miles of road
- 0.18 severe crashes per mile
GREATER MN PROACTIVE SPECTRUM

Examples of HSIP Intersection Proactive/Systematic Strategy Deployments

> 70%
- Pavement Markings (Stop Bars)
- Lighting
- Curb Extensions
- Sign Enhancements
- Active Warning Systems
- Sight Distance Improvements (Sign relocations, etc.)

> 70%

Low Cost
- Right Turn Lanes
- Left Turn Lanes
- Acceleration/Deceleration Lanes
- Access Management
- Traffic control (Signals, Roundabouts, etc.)

< 30%

High Cost
- Interchanges

Low HSIP Priority

More Reactive

Examples of HSIP Lane Departure Proactive/Systematic Strategy Deployments

High HSIP Priority

- Wider Shoulders
- Full Shoulders
- Roadway Realignment
- Divided Roadway

Pure Proactive

Low Cost

NOTE: The Proactive Spectrum is not all inclusive of all safety strategies. Additional strategies may be appropriate for some roadways.
Typical HSIP Strategies

Segments

Curves

Intersections
HSIP Implementation

- Roadway Safety Plans using the systemic approach
- Based on data driven risk factors
- Recommends safety projects for each at-risk location

- Reactive to proactive
- Localized to systemic
- Events based to risk based
What Are the Concerns of Implementing the Systemic Approach?

- Agency’s priority vs safety plan priority
- Limits engineering judgment
- Lack of political support
How Did We Overcome These Concerns?

• Not everyone will support a new approach
• Include all stakeholders
• Find agency champions to “carry the banner”
• Demonstrate the benefits in practical terms
• Partnership between State DOT and local agency
Project Vitals

• Project Timeline
  • Total Project 3.5 years
  • Approx. 7 months/plan
• Project Location
  • 87 Counties (All)
  • 8 MnDOT Districts (All)
• Project Cost
  • Counties $3.5 Million
    – Approx. $40,000 (Rural)
    – Approx. $100,000 (Metro)
  • MnDOT Districts $500,000
    – Approx. $55,000 (Rural)
    – Approx. $100,000 (Metro)
Project Approach

Month 1
Analyze Crash Data

Month 2
Select Safety Emphasis Areas

Month 3
Identify Safety Projects

Month 4
Develop List of Safety Strategies

Month 5
Conduct Safety Workshop

Month 6
Identify Short-List of Critical Strategies

Month 7
Review MTG WICOUNTIES

Critical Strategies
- Education
- Enforcement
- Engineering
- Operation
- Information

NCHRP

Risk Factors

Curves
- ADT Range
- Radius Range
- Visual Trap on Curve
- Intersection on Curve
- Severe Crash on Curve

Intersection
- Geometry
  - Skewed minor leg approach
  - Intersection on/near horizontal curve
- Volume
  - Minor ADT/Major ADT ratio
- Proximity
  - Previous STOP sign
  - Railroad crossing
- Intersection Related Crashes
- Commercial Development in quadrants

Segments
- Traffic Volume
- Density of Road Departure
- Crashes
- Curve (Critical Radius)
- Density
- Edge Risk Assessment
- Access Density
The majority of severe crashes occurred on curves with 500’-1,500’ ADT.
The majority of severe crashes occurred on curves with 500’-1,500’ radii.
Curve - Visual Trap

★
Intersection on Curve
## Curve Prioritization

- Complete census of 504 curves
- 32 High Priority Curves (6%)

<table>
<thead>
<tr>
<th>Curve Count</th>
<th>ID</th>
<th>Corridor</th>
<th>Segment</th>
<th>Total</th>
<th>Severe</th>
<th>K</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>PDO</th>
<th>K</th>
<th>A</th>
<th>Radius (ft)</th>
<th>Length Curve (ft)</th>
<th>ADT</th>
<th>Intersection on Curve</th>
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| 504 | 100% | 14 | 3% |
### Project Sheets

#### Curves on CSAH 4 from CR-98 to CSAH-40

**Agency:** Kandiyohi County

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*Curve numbering may not be consecutive, as some curves may have been removed from further analysis because a large radius, located on a gravel road, etc.*

#### Ranking Factors

Curves are selected for project if:

- ≥ 3 Crashes
- ≥ 6 Severe Crashes
- Radius 500 to 1200
- ADT 400 to 1400
- Intersection on Curve
- Visual Trap

#### Short List of Strategies Considered

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#### Implementation Cost

- **Federal Funds:** $14,850
- **Local Match (10% of Total Project Cost):** $1,650
- **Total Project Cost:** $16,500

Page: 10  
Segment ID: 4.04  
Date: 2/23/2011

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Every Day Counts
### Summary of Suggested Safety Projects

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Minnesota Roadway Fatalities
Source: MnDOT 6/9/2014

Toward Zero Deaths
Established 2003

Goal for 2008
500

Goal for 2010
400

Goal for 2014
350

Persons Killed

TZD Goal
Persons Killed
2003 Trendline
2003 Trendline
Questions and Answers

Will Stein, P.E.
FHWA - Minnesota Division
651.291.6122
william.stein@dot.gov

Mark Vizecky, P.E.
Minnesota DOT
651.366.3839
mark.vizecky@state.mn.us

More Informed Decision Making
Better Targeted Investments
Fewer Fatalities & Serious Injuries
Efficiency through technology and collaboration

Predictive Approach: Louisiana’s Experience
Integrating Safety Performance into All Highway Investment Decisions

Betsey W. Tramonte, FHWA - Louisiana Division

Efficiency through technology and collaboration

Every Day Counts

DOTD

U.S. Department of Transportation
Federal Highway Administration
Louisiana HSM Implementation Overview

- HSM Implementation Milestones
- HSM Applications in Project Delivery
- HSM Applications in LDOTD Business Practices
- Benefits of Implementation
- Keys to Successful Implementation
- Lessons Learned
Louisiana HSM Implementation Overview

- HSM Implementation Milestones
- HSM Applications in Project Delivery
- HSM Applications in LDOTD Business Practices
- Benefits of Implementation
- Keys to Successful Implementation
- Lessons Learned
HSM Implementation Milestones

• **Strong Support from State DOT Leadership**
  – FHWA Resource Center presented HSM to Louisiana DOTD (LDOTD) Leadership, Fall 2010
  – Early and comprehensive training
  – HSM Lead States Initiative
  – HSM Pooled Fund Study
HSM Implementation Milestones

• 2011 Louisiana Strategic Highway Safety Plan
  – Strategy in Infrastructure Emphasis Area
• HSM Implementation Plan Developed, June 2012
  – 5-year plan 2012-2017
## HSM Implementation Milestones

- **HSM Implementation Team Formed**

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HSM Implementation Milestones

• HSM Training Plan
  – LDOTD **mandatory training** requirement for **consultant contracts and task orders** beginning in 2013
  – Implementation Team trained on HSM including LTAP and FHWA Division office staff

\[ C_r = \frac{\sum \text{Observed}}{\sum \text{Predicted}} \]
Louisiana HSM Implementation Overview

- HSM Implementation Milestones
- **HSM Applications in Project Delivery**
- HSM Applications in LDOTD Business Practices
- Benefits of Implementation
- Keys to Successful Implementation
- Lessons Learned
HSM Applications in Project Delivery

- Seven stages of LDOTD project development
  - Stage 0, Feasibility
  - Stage 1, Planning and Environment
  - Stage 2, Funding Project Prioritization
  - Stage 3, Final Design
  - Stage 4, Letting
  - Stage 5, Construction
  - Stage 6, Operation
HSM Applications in Project Delivery

- **Stage 0, Feasibility**
  - Use CMFs and predictive method to evaluate safety of various design elements or alternatives
  - Use CMFs and predictive method to diagnose a location for inclusion in the Safety program
HSM Applications in Project Delivery

• Stage 1, Planning and Environment
  – Use CMFs and predictive method to evaluate safety impacts of various design alternatives
  – I-12 to Bush, LA Realignment project (IHSDM)
HSM Applications in Project Delivery

• I-12 to Bush Case Study
  – Four alternatives were considered to replace a two-lane, un-divided roadway with a four-lane, divided roadway with controlled access
  – All four alignments predicted a reduction in crashes from the No Build alternative
HSM Applications in Project Delivery

• I-12 to Bush Case Study Overall Comparison

<table>
<thead>
<tr>
<th>Rank</th>
<th>Alternative</th>
<th>Total Crashes</th>
<th>Crashes Reduced</th>
<th>Total Cost of Crashes</th>
<th>Potential Reduction</th>
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</table>
HSM Applications in Project Delivery

- Benefits from use of IHSDM
  - Quantify safety costs and benefits
  - Safety given equal weight in comparative analysis

- Corps of Engineers selected Alternative Q, which had a predicted crash reduction of 6% and a $1.5M cost savings to society
HSM Applications in Project Delivery

- **Stage 3, Final Design**
  - Use CMFs in **Design Exceptions** to determine safety impacts
  - Use CMFs in **Transportation Management Plans** to analyze safety impacts of temporary traffic control
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HSM Applications in LDOTD Business Practices

- Highway Safety
- Transportation Planning
- Environmental
- Road Design
HSM Applications in LDOTD Business Practices

• Highway Safety
  – Calibration of HSM Safety Performance Functions (SPFs) for segments
  – Development of five LA specific SPFs
  – Procurement of software tool to use SPFs in predictive safety analysis
  – Development of LA specific CMFs
  – Development of guidelines for safety analysis
HSM Applications in LDOTD Business Practices

• Transportation Planning
  – Development of guidelines for conducting safety analysis in Stage 0 Feasibility Studies

• Environmental
  – Expansion of scope and man hours for the analysis of safety impacts

• Road Design
  – Use of predictive method in design exceptions
  – Training on IHSDM and ISATe
Louisiana HSM Implementation Overview

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Benefits of Implementation

• Ability to quantitatively evaluate safety impacts for various design alternatives
• Improved decision making
• Use of effective safety countermeasures
• Integrates safety elements in the most cost-effective manner in the project development process
Louisiana HSM Implementation Overview

• HSM Implementation Milestones
• HSM Applications in Project Delivery
• HSM Applications in LDOTD Business Practices
• Benefits of Implementation
• Keys to Successful Implementation
• Lessons Learned
Keys to Successful Implementation

- Identify a Champion and establish an Implementation Team
- Develop and execute an Implementation Plan
- Revise/develop agency policies and resources
- Examine risk management and legal issues
- Assess data, information technology, and analytical tools
- Develop budget and phased approach
- Identify technical assistance needs
- Consider organizational needs and issues
Keys to Successful Implementation

• Use of HSM Resources
  – NCHRP 17-50 HSM Lead-States Initiative for Implementing the HSM
  – HSM Implementation Guide for Managers (FHWA)
  – Integrating the HSM into the PDP (FHWA)
  – HSM Users Guide Integrating Safety into the PDP (ITE, coming soon)
Louisiana HSM Implementation Overview

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Lessons Learned

- **Employ a Consistent Technical Approach**
  - Predictive methods, assumptions, CMFs, B/C calculations need to be uniform

- **Encourage Gradual Changes**
  - Policies, use of predictive methods, and training should not outpace the capability of the data and decision-support systems

- **Anticipate and Champion Culture Change**
  - Explain new concepts (substantive safety)

- **Manage Training**
  - Consider how HSM will be used and what level of understanding each person needs
Questions and Answers

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More Informed Decision Making
Better Targeted Investments
Fewer Fatalities & Serious Injuries
Resources

Integrating Safety Performance into All Highway Investment Decisions

Jerry Roche, FHWA Office of Safety

Efficiency through technology and collaboration
STIC Incentive Program

• Up to $100,000 available to each STIC per year

• Fund activities which will have a statewide impact on making an innovation a standard practice

• Example activities include: developing standards and specifications, preparing SOPs or technical guidance, developing/delivering training, etc.
Accelerate Innovation Deployment (AID) Demonstration Program

- Notice of Funding Availability published in Federal Register on February 19, 2014
- Incentive funding to offset risk of using an innovation on a project
- Award amount may be full cost of innovation on project, up to a maximum of $1,000,000
- Eligible projects may be in any aspect of highway transportation including:
  - planning, financing, operation, structures, materials, pavements, environment, and construction
Incentive is an increase of federal share on a project by up to 5%

Restricted to NHPP, STP and PL funding categories

Technologies and practices should be truly innovative to the State

Reference: 23 U.S.C. 120(c)(3)
What we can offer

• **Technology Transfer**
  – Presentations
  – Training
  – Peer Exchange

• **FREE Technical Assistance for each state that opts-in**
  – Safety Management & Project Development
  – Predictive & Systemic Analyses
Questions and Answers

Jerry Roche, P.E.
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More Informed Decision Making
Better Targeted Investments
Fewer Fatalities & Serious Injuries
# Our Team

<table>
<thead>
<tr>
<th>Position</th>
<th>Team Member(s)</th>
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<tbody>
<tr>
<td><strong>Team Lead</strong></td>
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<tr>
<td></td>
<td>Jerry Roche, Office of Safety</td>
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<tr>
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<td>John McFadden, RC Safety &amp; Design</td>
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<tr>
<td><strong>Co-Team Lead</strong></td>
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<td><strong>FHWA Subject Matter Experts</strong></td>
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<td></td>
<td>Ray Krammes, Office of Safety</td>
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<td></td>
<td>Karen Scurry, Office of Safety</td>
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<td>Clayton Chen, Safety Research &amp; Development</td>
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<td>Mick Matzke, Office of Infrastructure</td>
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<td>Gene Amparano, RC Safety &amp; Design</td>
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<td>Dave Engstrom, RC Safety &amp; Design</td>
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<td>Hillary Isebrands, RC Safety &amp; Design</td>
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<tr>
<td><strong>State DOT Representatives</strong></td>
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<tr>
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<td>Tim Harmon, New Hampshire DOT</td>
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<td>John Miller, Missouri DOT</td>
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<td>Stephen Read, Virginia DOT</td>
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<td>Derek Troyer, Ohio DOT</td>
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<td>Jeremey Vortherms, Iowa DOT</td>
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<td><strong>FHWA Division Representatives</strong></td>
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<tr>
<td></td>
<td>Linda Guin, Alabama Division</td>
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<td>Don Petersen, Washington Division</td>
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<td>Will Stein, Minnesota Division</td>
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<td>Betsey Tramonte, Louisiana Division</td>
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<td><strong>Marketing</strong></td>
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<td>Judith Johnson, FHWA Office of Technical Services</td>
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<td><strong>Coordination with AASHTO/TRB</strong></td>
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<td>Kelly Hardy, AASHTO</td>
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<td>John Milton, Washington State DOT</td>
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<td>Priscilla Tobias, Illinois DOT</td>
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<td>Matt Enders, Washington State LTAP</td>
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<td>Kevin Murphy, Delaware Valley Regional Planning Commission</td>
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<td>Mark Vizecky, Minnesota DOT</td>
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<td><strong>FLH, Parks and Tribal Outreach</strong></td>
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<td>Victoria Brinkly, Western Federal Lands</td>
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</table>
Thank You!

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*FHWA cites specific tools as examples of ways to implement safety analysis approaches, not as an endorsement of these tools over others.