Data-Driven Safety Analysis
Incorporating Safety Performance into All Highway Investment Decisions

Efficiency through technology and collaboration
How many crashes on a roadway are too many crashes?
Key Message

More Informed Decision Making → Better Targeted Investments → Fewer Fatalities & Serious Injuries
What is the Data-Driven Safety Analysis Initiative?

- The application of two science-based analysis approaches into two common transportation processes.
Systemic Approach

- 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.

Source: FHWA Systemic Safety Project Selection Tool
A movement away from chasing dots...
Crashes on rural roads often account for a high percentage of severe crashes, but the density of crashes on rural roadways is typically low and may not lead to identifying crash concerns within the “traditional” site-based analysis process.

About 57% of fatal crashes are on rural roads.

A further challenge is that crashes on the local system might not have robust data to assist with identifying locations of concern.
Systemic Approach

• Supplements the traditional site analysis (i.e. “hot-spot”) approach

• Particularly applicable when a significant number of severe crashes happen over a wide area:
  – Rural Roadways
  – Local Roadways
  – May focus on specific crash types
    • Cross-median
    • Pedestrian
    • Curve

May include treating locations that haven’t experienced many crashes
Important Distinction

- **Systematic** – Deploying countermeasures at **ALL** locations

- **Systemic** – Deploying countermeasures at locations with the **greatest** risk

- Systemic Example: providing enhanced delineation on curves with radii between 500-700 feet
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.
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
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: CH2MILL
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

“Road safety management is in transition. The transition is from action based on experience, intuition, judgment, and tradition, to action based on empirical evidence, science, and technology...”
Benefits

• **Informed Decision-Making:** By quantifying the safety impacts associated with roadway planning and design, transportation professionals, elected officials, and the general public can make more informed decisions by weighing safety with other project goals.

• **Optimizing Investment:** With limited resources, agencies need to maximize the safety benefit of every transportation investment. By applying the most current analytical methods, agencies have powerful tools to optimize investments and the safety of all users.

• **Improving Safety:** State, Local, and Tribal agencies can proactively apply safety countermeasures at roadway locations identified as having the highest potential for improvement, effectively reducing fatalities and serious injuries.
Free Resources

- Crash Modification Factors Clearinghouse (FHWA)
- Systemic Safety Project Selection Tool (FHWA)
- Highway Safety Manual (AASHTO)
  - HSM Implementation Guide for Managers (FHWA)
  - Integrating the HSM into the PDP (FHWA)
  - HSM Users Guide (NCHRP 17-50)
  - Integration of Safety in the PDP and Beyond (ITE)
  - HSM 1st Edition Supplement (AASHTO, $)
New Resource:
(Free Download)

Stick Around for Next Session!

Source: ITE

http://library.ite.org/pub/e4edb88b-bafdb6c9-6a19-22e98f6a89
Tools

- AASHTO Ware Safety Analyst ($)
- HSM Spreadsheets
- Interactive Highway Safety Design Model
- Enhance Interchange Safety Analysis Tool (ISATe)
- US Roadway Assessment Program (usRAP)
- State-developed products
- Commercially Available Products ($)
Case Studies

Integrating Safety Performance into All Highway Investment Decisions
Systemic Case Study - Minnesota DOT

Local Roads Safety Plan Development

**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

### Curve Prioritization Table

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<th>ID</th>
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<th>Severe RoR</th>
<th>ADT</th>
<th>Intersection on Curve</th>
<th>Chevrons</th>
<th>Visual Trap</th>
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### Summary

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

- Projects on the system where 60% of the severe crashes were occurring
- Effective and economical project proposals
- Reduced turnaround time

- High-cost to low-cost
- Reactive to proactive
- Localized to systemic
- Events based to risk based
How can agencies 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?

• **Quantifiable safety data helps garner buy-in and support from your elected officials and the public.**
Predictive 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

Source: Arizona DOT
### Parameters for Existing & Proposed Conditions:

- Used IHSDM to perform safety analysis

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#### Predictive Case Study – Arizona DOT

<table>
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<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>
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<td>12-Foot</td>
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<td>Per survey &amp; Holbrook District turnout database</td>
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Source: Arizona DOT
Predictive Case Study – Arizona DOT

Plot of Geometric Features and Expected Crashes

EXPECTED CRASH RESULTS

Source: Arizona DOT
Predictive Case Study – Arizona DOT

Crash Prediction Results

<table>
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<tr>
<th>Alternative</th>
<th>Total Crashes</th>
<th>Fatal and Injury Crashes</th>
<th>Property Damage Only Crashes</th>
<th>Reduction in Total Crashes over Existing Conditions</th>
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- **IHSDM Safety Analysis:**
  - Model was un-calibrated as used (not necessary for comparative alternatives analysis)
  - **Alternative B** (8-ft shoulders) *would reduce crashes by 4 percent more* than Alternative A (5-ft shoulders)
**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.
Predictive 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
Predictive Case Study: I-270/US 33 Interchange

• 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.
Opportunities

Integrating Safety Performance into All Highway Investment Decisions

Efficiency through technology and collaboration
Opportunities to incorporate Safety Performance

- Identifying sites with the most potential for safety improvement
- Evaluating crash reduction benefits of treatments
- Setting safety performance measures/targets
- Evaluating design exceptions
- Evaluating project alternatives
- Interchange Access Requests/Justification Reports
- Performance-Based Practical Design

are being incorporated into agency P&Ps
What FHWA can offer

- **Technology Transfer**
  - Presentations
  - Training
  - Peer Exchanges

- **FREE Technical Assistance for each state that opts-in**
  - Safety Management & Project Development
  - Systemic and Predictive Analyses
• Within two years (Dec 2016), increase the number of states regularly using predictive and/or systemic safety analysis in their safety management process from 19 to 30 (assessment/institutionalized level).
Within two years (Dec 2016), increase the number of states regularly using predictive safety analysis in their project development process from 14 to 30 (assessment/institutionalized level).

25 States have requested DDSA assistance so far: AL, AZ, AR, CA, CO, FL, IA, ID, IL, MA, ME, MD, MI, MS, NE, NV, NJ, NY, PA, PR, TN, TX, VA, WI, WY
Stop by our booth!
Questions?

Jerry Roche, P.E.
FHWA - Office of Safety
515.233.7323
jerry.roche@dot.gov

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