TOM MAZE
TRANSPORTATION SEMINAR
IOWA STATE UNIVERSITY
APRIL 11, 2014

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ASSOCIATE ADMINISTRATOR, SAFETY
FEDERAL HIGHWAY ADMINISTRATION
Data Driven Analysis
Problem Identification

Evaluation
Performance Metrics

Investments (4E)
Systemic / Spot
CMF

TZD

Plans
Strategic – SHSP
Tactical – TIP/STIP; HSP; CVSP

Funding – HSIP, 402, 405,
MCSAP, CVISN, State, Local

RESEARCH
SHRP2
Data-Driven Safety Approach

Analysis & Stakeholder Input

Safety Decisions

Implementation of Investments / Improvements

Evaluation of Benefits / Effectiveness
Safety Analysis Tools

*Highway Safety Manual (HSM)* – uses a science-based approach that allows safety to be quantitatively evaluated alongside traffic operations, environmental impacts and construction costs ([www.highwaysafetymanual.org](http://www.highwaysafetymanual.org))

*Systemic Approach to Safety Tool*— describes approach that considers risk as well as crash history to determine improvements ([safety.fhwa.dot.gov/systemic](http://safety.fhwa.dot.gov/systemic))

*IHSDM* – software suite supporting the predictive methods and techniques represented in Part C of the HSM ([www.ihsdm.org](http://www.ihsdm.org))

*SafetyAnalyst* – AASHTOware supporting the roadway safety management process represented in Part B of the HSM ([www.safetyanalyst.org](http://www.safetyanalyst.org))

*CMF Clearinghouse* – searchable database of over 4,000 CMFs that can support an agency's roadway safety management or project development process ([cmfclearinghouse.org](http://cmfclearinghouse.org))
MIRE Fundamental Data Elements

- Consistent with State Safety Data Systems Guidance published December 26, 2012
- MIRE (Model Inventory of Roadway Elements) FDE (Fundamental Data Elements)
  - Needed to conduct enhanced safety analysis
  - Potential to support other safety and infrastructure programs
  - All public roads
- Required to comply with section 1112 of MAP-21
  - Establish a subset of the model inventory of roadway elements that are useful for the inventory of roadway safety; and
  - Ensure that States adopt and use the subset to improve data collection
FHWA’s RSDP

- Improved Data Collection & Analysis
- More Informed Decision Making
- Better Targeted Safety Investment
- TZD

http://safety.fhwa.dot.gov/rspd
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RESEARCH
SHRP2

TZD
SHSP RELATIONSHIP TO HSIP

SHSP

- Review and Incorporate SHSP Data/Analysis, Goals, & Emphasis Areas
- Demonstrate Consistency with SHSP Strategies
- Align Projects with SHSP Priorities & Action Plans
- Monitor and Track SHSP Implementation
- Use Results for SHSP Evaluation and Update

HSIP

Planning

Problem Identification

Countermeasure Identification

Project Prioritization

HSIP Project List

STIP

Implementation

Schedule and Implement projects

Evaluation

Determine Effects of Highway Safety Improvements

Data/Design Standards

Feedback

Site Analysis Approach

Systemic Approach

Demonstrate Consistency with SHSP Strategies

Align Projects with SHSP Priorities & Action Plans

Monitor and Track SHSP Implementation

Use Results for SHSP Evaluation and Update
COORDINATED TRANSPORTATION SAFETY PLANNING

1. Metropolitan Transportation Plans
2. Statewide Transportation Plan (Long-Range Plan)
3. State Strategic Highway Safety Plan (SHSP)
4. CVSP (49 U.S.C. § 31102)
5. HSP (23 U.S.C. § 402)
6. TIP (Metropolitan)
7. HSIP (23 U.S.C. § 148)
8. Statewide Transportation Improvement Program (STIP)
9. Other State Plans (e.g., Freight Plan, Ped/Bike Plan)
STRATEGIC HIGHWAY SAFETY PLAN

ANALYZE DATA
ID PROBLEMS
DEFINE EMPHASIS AREAS
SET GOALS

Highway Safety Plan

Commercial Vehicle Safety Plan

Highway Safety Improvement Program

SAVE LIVES

NHTSA approves 14 Measures

FHWA evaluates 4 Measures

Implement
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RESEARCH
SHRP2

TZD
**Crash Modification Factor (CMF) Clearinghouse**

- **Quick Search**
  - enter search term(s)
  - narrow by countermeasure category
  - narrow by crash type
  - narrow by crash severity
  - narrow by roadway type
- **Search CMFs**

**Highway Safety Manual**

The first edition of the Highway Safety Manual is now available! Find out how to order a copy and see news related to the HSM.

- **Recently Added CMFs**
  - **Widen paved shoulder from 3 ft to 6 ft**
    - CMF: 0.93
  - **Provide static combination horizontal alignment/auxiliary guide lines**
    - CMF: 0.25
  - **Install chevron signs on horizontal curves**
    - CMF: 0.35

(www.cmfclearinghouse.org)
CRASH MODIFICATION FACTORS

- CMF Clearinghouse 2013 Statistics
  - 698 CMFs added from 59 studies
  - Total: 3,207 star-rated CMFs; 1,140 CMFs with no star rating
- CMF CH Webinar (12/16)
  - Research Meets Practice: Identifying and Applying CMFs
  - ~200 participants
  - Recording, PPTs and Q&As available on CMF CH website
- CMF in practice series available
PROVEN SAFETY COUNTERMEASURES

- Roundabouts
- Road Diet
- Corridor Access Management
- Backplates with Retroreflective Borders
- Safety Edge
- Medians & Pedestrian Crossing Islands
- Enhanced Delineation & Friction for Horizontal Curves
- Pedestrian Hybrid Beacon
- Longitudinal Rumble Strips / Stripes on 2 Lane Roads
Systemic Approach to Safety

- Systemic Safety Improvement
  - An improvement that is widely implemented based on high-risk roadway features that are correlated with particular crash types, rather than crash frequency.

- Systemic Problem Identification
  - System-wide crash analysis
  - Crash characteristics at the system level

http://safety.fhwa.dot.gov/systemic
Launched in 2010, EDC is designed to encourage the rapid deployment of existing, proven technologies to shorten project delivery, enhance highway safety, protect the environment, and reduce congestion.

The two safety initiatives in EDC 2 are:

- High Friction Surface Treatments
- Intersection and Interchange Geometrics
**High Friction Surface Treatment**

High Friction Surface Treatments (HFST) are resin-based pavement surfacing overlay systems:

- exceptional skid-resistant properties
- retains the higher friction property for a much longer time.

Commercially available.
Generally applied in short sections to improve spot locations where friction demand is critical.

It is not used for pavement maintenance or continuous resurfacing, it is for spot treatment at specific (high crashes) locations, including urban, rural, and non-motorized locations.
INTERSECTION AND INTERCHANGE GEOMETRICS

Displaced Left Turn (DLT)

U-Turn Intersections

These proven innovative designs enhance safety and traffic by relocating or eliminating certain turning conflict points.

Roundabouts

Diverging Diamond Interchange

Source: FHWA
Data Driven Analysis
Problem Identification

(RESEARCH
SHRP2)

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Performance Based Metrics

**SMOKESTACK**
- Acid Rain

**BILGE PIPING**
- Hard-piped / crushed

**MARITIME SECURITY**
- Perimeter Security

**SAFETY MANAGEMENT SYSTEMS (SMS)**
- Process – audits
- Vertical Alignment
- Corporate / On-the-ground
What performance are you measuring?
- system / process / personnel
- output / outcome

How will you use the measure in decision making or problem solving?

Are the metrics an immediate need for operational decision making or longer term - planning?

What is the measure you really need v. what you can currently measure? Proxy?
Performance Measurement

What data to collect, how much to collect, and what type of analysis to perform?

Relationship of outcome to your ability to influence? Or do you control enough of the variables to affect the outcome?

- Dynamic / fluid environment
  - Outcome = $f(X) + f(Y) + \ldots$
- Correlational / Causal

How do you set targets? What methodology?
Two NPRMs, Different But Related

- Highway Safety Improvement Program NPRM
  - Revises existing regulation (23 CFR 924)

- Safety Performance Measures NPRM
  - Establishes new regulation (23 CFR 490) to implement MAP-21 Performance Management Requirements
  - Defines safety performance measure requirements
**MAP-21 Changes For HSIP**

- **Items Removed** *(no longer exist under MAP-21)*
  - Transparency Report
  - High Risk Rural Roads set-aside and reporting requirements
  - 10% flexibility provision for States to use safety funding per 23 U.S.C. 148(e)

- **Items Added**
  - State Strategic Highway Safety Plan update requirements
  - Subset of model roadway elements
  - HSIP reporting content and schedule
Performance Measures

Focus the Federal-aid program on the following national goals:

1) SAFETY; (1)
2) INFRASTRUCTURE CONDITION; (2)
3) CONGESTION REDUCTION; (3)
4) SYSTEM RELIABILITY; (3)
5) FREIGHT MOVEMENT AND ECONOMIC VITALITY; (3)
6) ENVIRONMENTAL SUSTAINABILITY; (3)
7) REDUCED PROJECT DELIVERY DELAYS (3)
SAFETY TPM

- Proposes measures for safety
  - Fatalities / Serious Injuries
  - Numbers and Rates
- Proposes method for States and MPOs to report targets and progress
- Proposes FHWA method to evaluate State target achievement
- Proposes requirements if targets are not achieved
## USDOT Implementation of MAP-21 Performance Provisions:
### Ten Interrelated Rules

<table>
<thead>
<tr>
<th>Planning</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metropolitan and Statewide Planning Rule</strong></td>
<td>- Establish a performance-based planning process at metropolitan and state level.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Highway Safety</strong></td>
<td>- Propose and define fatalities and serious injuries measures, along with target establishment, progress assessment and reporting requirements.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Safety Performance Measure Rule</strong></td>
<td>- Discuss the implementation of MAP-21 performance requirements.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Highway Safety Improvement Program (HSIP) Rule</strong></td>
<td>- Integration of performance measures, targets, and reporting requirements into the HSIP.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Highway Safety Program Grants Rule</strong>*</td>
<td>- Strategic Highway Safety Plan updates.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>*Interim Final Rule issued by NHTSA in January 2013.</td>
<td></td>
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</tr>
</tbody>
</table>

### Highway Conditions

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement and Bridge Performance Measure Rule</strong></td>
<td>- Propose and define pavement and bridge condition measures, along with minimum condition standards, target establishment, progress assessment and reporting requirements.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Asset Management Plan Rule</strong></td>
<td>- Contents and development process for asset management plan.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Congestion/System Performance</strong></td>
<td>- Minimum standards for pavement and bridge management systems.</td>
<td>-</td>
</tr>
<tr>
<td><strong>System Performance Measure Rule</strong></td>
<td>- Define performance of the interstate system, non-interstate national highway system, and freight movement on the interstate system.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Anticipated Coordinated Performance Measure Effective Date</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Transit Performance

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transit Asset Management Rule</strong></td>
<td>- Define state of good repair and establish state of good repair performance measures</td>
<td>-</td>
</tr>
<tr>
<td><strong>National Transit Safety Program Rule</strong></td>
<td>- Require transit providers to set targets and report on progress</td>
<td>-</td>
</tr>
<tr>
<td><strong>Transit Agency Safety Plan Rule</strong></td>
<td>- Transit asset management plans</td>
<td>-</td>
</tr>
<tr>
<td><strong>Transit Safety Plan Content and Reporting Requirements</strong></td>
<td>- Define transit safety criteria and standards</td>
<td>-</td>
</tr>
<tr>
<td><strong>Target Setting Requirements for Transit Agencies and States</strong></td>
<td>- Include definition of state of good repair</td>
<td>-</td>
</tr>
</tbody>
</table>

*Indicates the comment period*
Highway Safety Improvement Program (23 U.S.C. 148)

National Goals and Performance Management Measures (23 U.S.C. 150)

HSIP Program Requirements (23 CFR 924)

National Performance Management Measures (23 CFR 490)

Safety Performance Measures

Other Performance Measures (e.g. CMAQ, Pavement & Bridge Condition)
MAP-21 SAFETY RULEMAKINGS

- **HSIP** (23 U.S.C. 148; MAP-21 Section 1112)
  - Published NPRM on: March 28, 2014.
  - Comment period closes on: **May 27, 2014**
  - Docket Number: FHWA-2013-0019

- **Safety PM** (23 U.S.C. 150; MAP-21 Section 1203)
  - Published NPRM on March 11, 2014.
  - Comment period closes on: **June 9, 2014**
  - Docket Number: FHWA-2013-0020

www. regulations.gov
Problem Identification
Behavioral Countermeasures
Vehicle Countermeasures
Infrastructure Countermeasures
Potential changes to:
  AASHTO Green Book
  Roadside Design Guide
  Highway Safety Manual
  MUTCD

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Tzd
The Vision: to make a revolutionary improvement in highway – saving thousands of lives

This is the high-risk, high-payoff part of the overall SHRP 2 portfolio
SHRP2 Study Design

• Two linked databases providing unprecedented detail on driver behavior and driver interaction with roadway features

• Naturalistic Driving Study (NDS) data – VTTI, Virginia Tech
  • record of every trip by volunteer drivers over 12-24 months
  • 2,800 drivers, male and female, all ages
  • 1,900 vehicles on the road at any time

• Roadway (RID) data – CTRE, Iowa State
  • from mobile van data collection in study areas
  • from state data and other sources
Largest Naturalistic Driving Study Ever Undertaken
- 2,900 primary drivers, all age/gender groups.
- 3,900 data years; 5 M trip files; 32 M vehicle miles
- 2 years of data collection
  - Most participants 1 to 2 years
- Vehicle Types: All light vehicles including
  - Passenger Cars
  - Minivans
  - SUVs
  - Pickup Trucks
- Six data collection sites
- Integration w/ detailed roadway information
- Data useful for next generation of researchers
**Roadway Data Overview**

- **New data:** collected at highway speed, about 12,500 centerline miles (both directions)
  - focus on data needed for lane departure and intersections
  - curvature location, length, radius; grade; cross-slope; lane number, width, type; shoulder type (width if paved); speed limit signs; medians; rumble strips; lighting; intersection location, number of approaches, and control type; videolog

- **Existing data from state inventory:** any available roadway information – varies by site

- **Supplemental data:** traffic, weather; work zones; crashes; roadway improvements; laws; safety campaigns
BUFFALO, NEW YORK

Blue: Collected in 2011
Red: Collected in 2012

520 miles in 2011
3,300 miles in 2012
30% Urban
70% Rural
Multiple Videos
Machine Vision
  Eyes Forward Monitor
  Lane Tracker
Speed
Accelerator
Accelerometer Data (3 axis)
Rate Sensors (3 axis)
GPS
Time
Forward Radar
Cellular Phone Records
Illuminance sensor
Infrared illumination
Passive alcohol sensor
Incident push button
Audio (only on incident push button)
Turn signals
Vehicle network data
  Brake pedal activation
  ABS
  Gear position
  Steering wheel angle
  Seat Belt Information
  Airbag deployment
Crash Data
  AADT
  Work Zone
  Winter Road Conditions
  Local Climatological Data NOAA
  Cooperative Weather Observer/Other Sources
  Nonrecurring Congestion
  Recurring Congestion
  Travel Time Data Reliability
  Aerial Imagery
  Speed Limit Data
  Speed Limit Laws
  Cell phone and text messaging laws
  Automated enforcement laws
  Alcohol-Impaired / Drugged Drivers laws
  Graduated driver licensing (GDL) laws
  State motorcycle helmet use laws
  Seat Belt Use laws
  Automated Enforcement
  Traffic Data - Continuous Counts (ATR)
  Traffic Data - Short Duration Counts
  Changes to existing infrastructure condition
  Roadway Capacity Improvements
  Innovative Treatments
  511 Information
Curvature Length
Curvature Radius
Grade (+ or -)
Cross Slope/Super Elevation
Lane Width/Type
Paved Shoulder Width/Type
Nonrecurring Congestion
Recurring Congestion
Travel Time Data Reliability
Aerial Imagery
Speed Limit Data
Speed Limit Laws
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Traffic Data - Short Duration Counts
Changes to existing infrastructure condition
Roadway Capacity Improvements
Innovative Treatments
511 Information

Laws Data
Behavioral Data
Weather Data
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<tr>
<th>Paved Shoulder</th>
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<td>Lanes</td>
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<td>Thru Lane: 1 (11’</td>
<td>Thru Lane: 1 (21’)</td>
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<tr>
<td></td>
<td>Right Turn: 1</td>
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<td>2’ Mix/Combo</td>
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<td>3’ Mix/Combo</td>
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<td>Flush (Painted)</td>
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<tr>
<td>Paved Shoulder</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Unpaved Shoulder</td>
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<td></td>
</tr>
<tr>
<td>Rumble Strips: N/A</td>
<td></td>
<td></td>
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</tbody>
</table>
The BIG Picture

- **Size: the file is huge**
  - 4 petabytes = kilo, mega, giga, tera, peta 4,000,000,000,000,000
  - 5 M trips; 32 M miles of driving

- **Complexity: different data types**
  - Categorical data constant over a trip: driver age, vehicle type
  - Sampled data: collected at different rates (once a trip up to 640 Hz during a crash): speed, acceleration, GPS position, radar, ...
  - Video data from 4 cameras; must be interpreted and reduced
    - Automated reduction: lane tracker, head tracker
    - Manual reduction: all other items for specific analyses
  - Roadway data linked to trip data via GPS

- **Privacy considerations: personally-identifying data**
**Near Term Activity**

- Intent is to:
  - Create an accelerated path to implementation that helps drives down crash numbers
  - Ingrain the NDS research into AASHTO committee activities, considerations
  - Patterned after current NDS pilot projects
  - Demonstrate full spectrum of implementation process - *concept to countermeasure*
- Utilize $5.8M of implementation funds
- This activity will not delay the overall completion of the NDS database
- Vetted and recommended by the AASHTO Implementation Task Force
FHWA (STAC)
Safety Training and Analysis Center

- To enable and accelerate the use of SHRP2 Safety Data in the research community, especially as it relates to the design and operations of roadways. It will serve as an incubator for new ideas and a training ground for practitioners and researchers to help increase the demand for services from the broader research community.

- The STAC will focus primarily on:
  - providing a learning and training opportunity for State DOTs to help them develop greater understanding of the data and its potential uses.
  - providing the opportunity for researchers, graduate students and fellows to experiment and work with SHRP2 safety data so that they can take that experience back to their work environment.

- Will be hiring 2 positions to staff the STAC – job announcements will be posted to USA jobs shortly.
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