SHRP2 Safety Data Application and Training Opportunities

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SHRP2 Safety Program

Phase 1: Proof of Concept
Phase 2: In-Depth Research
Phase 3: Deployment

TRB Research Phase
NDS
RID

FHWA/AASHTO Implementation Phase

Locations:
- Seattle, WA
- Bloomington, IN
- Buffalo, NY
- State College, PA
- Durham, NC
- Tampa, FL
**SHRP2 Safety Program**

**Consists of Two Large Databases:**
- Naturalistic Driving Study (NDS) database
- Roadway Information Database (RID)

**Naturalistic Driving Study (NDS):**
- Crash, pre-crash, near-crash, and normal driving data
- 3,500+ drivers, six sites, people of all ages

**Roadway Information Database (RID):**
- NDS trip data can be linked to roadway data such as roadway location, curvature, grade, lane widths, and intersection characteristics
- These two databases will support innovative research leading to new insights about crash causation
Phase 1 – Proof of Concept

- 9 months
- Reduced set of NDS and RID data
- 10 states/11 projects
- Teams presented to STF – October 19th and 20th
- FHWA to selected Phase 2 projects with input from STF

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Phase 1 – Proof of Concept

- NDS
- RID
- SHRP2 (Safety)

Phase 1

- Phase 1
- Phase 2
- Phase 3

TRB Research Phase

FHWA/AASHTO Implementation Phase
Phase 1 Results - Summary

- All teams excited with potential research findings
- No fatal flaws in research or ability to use NDS data
- Sample of potential outcomes through POC:
  - New data processing tools
  - New highway lighting standards
  - New crash modification factors
  - New methods for establishing speed limits and advisory speeds
  - New understanding about effectiveness of work zone devices/messaging/campaigns
- 2-year, in-depth research proposals
- Lower-than-expected Phase 2 cost proposals
Phase 2 – In-Depth Analysis

- Selections were announced in December 2015
- Phase 2 began January 2016
- Conduct in-depth research and analysis
- Countermeasure identification and refinement
### Phase 2 In-Depth Research and Analysis Projects

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Phase 3 - Implementation

• Adopt, champion, and implement countermeasures

• Integrate findings into Manuals, Guidelines, Policies

• Conduct pilot testing
Concept to Countermeasure Research to Deployment Using the SHRP2 Safety Databases

Tim McDowell, P.E.
Wyoming Department of Transportation
Wyoming initially was not interested in participating in SHRP2 studies. The reason: We felt most of it was very urban centric and not applicable to Wyoming.

AASHTO convinced WYDOT to consider looking at the NDS database to see if we could extract safety data that could apply.

With great resistance on our part we reluctantly agreed. We contacted our University partner and wanted to see if there was data that could be applied.

With their suggestions we decided to look at driver behavior in adverse weather conditions. This is a problem in most states.
Driver Performance and Behavior in Adverse Weather Conditions: An Investigation Using the SHRP2 NDS Data

Wyoming Department of Transportation

I-80 Summit
Wyoming, Dec. 2014

Photo Courtesy: Dr. Mohamed Ahmed, P.E. – University of Wyoming
Weather Impact: Framing the Research

- Northern tier states face extreme natural weather all the time (snow, ice, wind), and statistics show:
  - Fog, snow, rain, strong wind, etc. affect:
    - Pavement conditions, vehicle performances, visibility, and drivers' behavior and performance.
  - Weather contributed to > 24% of total crashes, 1995-2008 (NHTSA)
  - Inclement weather → 31,514 Fatal Crashes, 2000-2007 (NHTSA)
  - On average, 6,250 people are killed and over 480,000 people are injured in weather-related crashes every year in the US.
The Role of Driver Behavior and Performance

• Naturalistic Drivers’ Performance and Behavior are Absent in Traffic Safety Studies!

• If the comprehensive SHRP2 Naturalistic Study Data has the proper data it should help to better understand driver behavior and performance in Adverse Weather Conditions.

• Mitigating impacts of adverse weather by applying to driver behavior does reduce crashes.
1. Can inclement weather trips be identified effectively using the NDS and RID data?

2. Can driver responses (i.e., speed and headway adaptation, and lane wandering) during inclement weather be characterized efficiently and effectively from the NDS data?

3. What are the best surrogate measures for weather related crashes that can be identified using the NDS data?

4. What type of analysis can be performed and conclusions be drawn from the resulting dataset?
The only study dealing exclusively with safety and driver behavior in adverse weather conditions:

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After a lengthy contract process were able to request data.

**Requested NDS Data**

- **50 NDS Freeway Trips**
  - Heavy Rain > 10 min.
- **100 NDS Freeway Trips**
  - Clear Weather

**Locations**
- Florida
- Washington
Traffic Condition / Level of Service

Traffic Condition

- Free Flow Operation
- Congested
- Mixed Traffic (FFO/ Congested)

Driver Behavior due to Adverse Weather (Heavy Rain) only
Data Visualization and Reduction

This diagram illustrates a software tool for data visualization and reduction, featuring:

- Front and rear cameras
- Time series
- Variable Selection
- Image Histogram
- Visibility Index
- Radar map with color coded distance
- Clear display
- Smooth signal
- Up to three channels
- Edges detected
- Values at marker
- Readings per second
- Video Duration
- Play/Pause
- Time Marker
- Play
- Reset Display
- Smooth Data
- Grab Frame
- System Time Stamp
- vtt.accel_x
- vtt.accel_y
- vtt.accel_z
- vtt.esc
- vtt.file_id
- vtt.gyro_x
- vtt.gyro_y
- vtt.gyro_z
- vtt.object_id_10
- vtt.object_id_11
- vtt.range_rate_x_10
- vtt.range_rate_y_10
- vtt.range_rate_z_10
- vtt.left_line_right_distance
- vtt.left_line_left_distance
- vtt.left_marker_probability
- vtt.light_level
- vtt.longitude
- vtt.getLatitude
- vtt.object_id_10
- vtt.object_id_11
- vtt.range_rate_x_10
- vtt.range_rate_y_10
- vtt.range_rate_z_10
- vtt.accel_x

The tool allows for the selection of variables, visualization of time series, and display of histogram and visibility index, among other features.
NDS Events Analysis

Timeline Snapshots for Incident

1. Leading Vehicle
   21.50m

2. Leading Vehicle
   12.10m

3. Leading Vehicle
   8.80m

4. Leading Vehicle
   8.20m

5. Leading Vehicle
   5.20m

6. Leading Vehicle

Video timestamp:
- 1: 828148
- 2: 836823
- 3: 837891
- 4: 838892
- 5: 839826
- 6: 841094
Phase 1 - Conclusions

• All research questions proposed in Phase 1 were adequately addressed.

• The NDS and RID datasets utilized in Phase 1 revealed that modeling drivers’ behavior in adverse weather conditions using vehicle time series data is realizable.

• Heavy and light rain trips were identified effectively using the NDS data.

• A visualization and reduction software was developed.

• The driving variables such as speed selection, acceleration/deceleration, lane change/keeping, and headway were efficiently characterized.
Phase 1 - Conclusions

• The preliminary analysis showed significant behavior and performance differences between driving in adverse (i.e., heavy rain) and clear weather conditions under free-flow and heavy traffic conditions.

• An analysis for the trajectories and time series vehicle data indicated that surrogate measures for weather-related crashes could be identified using the NDS data.

• Preliminary analysis and Ordered Probit Logistic regression models were useful to help in understanding driver behavior under various rain and traffic conditions.
Phase 2

- All 6 NDS States.
- All adverse weather conditions.
- Improve the Visualization and Red. Tool.
- Expected 1,500 to 2,500 trips.
- 4:1 Matching Ratio.
- External Data to leverage NDS data.
Countermeasures - Phase 3

Weather/ Driver Behavior & Performance - Based Variable Speed Limit

Advanced Traveler Information Systems

Connected Vehicle Weather Application

5th Research Question: Can the NDS data be extrapolated to provide real-time weather information in the context of the Road Weather Connected Vehicle Applications?
Countermeasures - Phase 3

Wyoming I-80 Corridor - Connected Vehicle Map

- RSEs at key decision points throughout the Corridor broadcast advisories to equipped trucks including alerts, parking and route guidance.
- In this zone, connected vehicle data from snow plows and trucks will be used to set and broadcast Variable Speed Limits. During summer, this zone will be used to test work zone alerts.
- In this zone, all proposed CV applications are included. V2V applications such as do not pass, situational awareness will be demonstrated here.

Throughout the corridor, equipped vehicles will provide road condition data over the WYOLINK system. Processed data will be shared through the traveler information systems especially through the Commercial Vehicle Portal.

Legend:
- High Profile Wind Warning Area
- AVL/Tablet
- Snow Plows
- STIP Areas 2015-2018
- WyoLink - Signal Strength: Good, Spotty, Unreliable
- I-80, Wyoming
- WiFi Locations (9 within 500 ft of I-80)
- Possible Locations Roadside DSRC (Going into/out of town off I-80 for supporting VSL Application. These include locations with mm labels)
- VSL Devices (122 on I-80)
- Truck Parking (55 on I-80)

Map Extent
Phase 1 – Lessons Learned

• If Wyoming can use this data base, most certainly others can to.

• Frame the issue before proceeding. Has it already been done? If not, what are you really looking for?

• RID data is quite easy to get to and their organization is easy to work with.

• NDS data is a different story. Due to PII, etc., privacy is extreme. Build in a lot of extra time to get the contracts, Data User Agreements, etc., completed. It is a very onerous process and is not really easy. A big headache.
Phase 1 – Lessons Learned

- We feel the benefits will far outweigh the contract issues.

- The information we are already getting will be applied to our I-80 corridor and will reduce crashes over time.

- Before venturing into the NDS data, talk to the states that have used it to learn from them.

- Use your legal system ahead of time to avoid last minute detail pitfalls.

JUST DO IT!
Questions?

I-80 VSL System
Wyoming, Dec. 2014

Photo Courtesy: Dr. Mohamed Ahmed, P.E. – University of Wyoming

Wyoming Department of Transportation

Dr. Mohamed M. Ahmed, PE