Naturalistic Driving Studies

July 29, 2014

Andy Horosko
• Naturalistic Driving Studies (what, why and where)
• Data collection
• Data Availability
• Data Analysis
Naturalistic Driving Studies

• What are they?
  – They are simply a study where the driver is observed driving in as normal fashion as possible.

• Why are they used?
  – They provide unique and objective data on what drivers really do in their vehicles, how they drive and how they respond to the roadway, vehicle and environment.

• Where are they being conducted?
  – They are being conducted or planned in several countries including the United States, Canada, Europe, China and Australia.
Naturalistic Driving Study
Sites

United States – 6 sites
• $70 million study
• Authorized by US Congress under SHRP 2
• 3100 volunteer drivers

Canada – 1 site
• $3 million study
• Sponsored by Council of Deputy Ministers and CCMTA
• 125 passenger vehicles
• 20 large trucks
Naturalistic Driving Study Database

- Participant assessments
- Continuous driving data
- Vehicle data
- Crash investigation

Context for the NDS trips
- Base map
- Roadway inventory data
- Mobile van data
- Supplemental information

Roadway Information Database

Data

GIS

SHRP 2 Databases
Participant Assessment

- Demographics
- Driving history
- Driving knowledge
- Health and medication status
- Sleep habits
- Driving behavior
- Risk perception and risky behavior
- Sensation seeking
- Strength and mobility
- Visual perception and cognitive ability
Equipment Installed into Participant Vehicles

- Head Unit
- Front Turn Signals
- Radar Unit
- Radar Interface Box
- Fuse Box
- OBD Connector
- GPS Wi-Fi Antenna
- DAS Main Unit
- Rear Looking Camera
Equipment Installed into Participant Vehicles

- Head unit (as seen from passenger seat)
- Main Unit (mounted under passenger shelf)
- Front radar
• Video (4 camera views)
• Blurred cabin still images
• Forward Radar
• Turn signals
• Accelerometer Data
  – Braking
  – Accelerating
  – Swerving
• GPS
• Machine vision
• Illuminance sensor

• Incident push button (30 second audio channel)
• Passive alcohol sensor
• Vehicle network data
  – Accelerator
  – Brake pedal activation
  – Speed
  – Horn
  – Steering wheel angle
  – Seat Belt Information
  – Airbag deployment
  – Other as available
NDS Data Overview

• **Size: the file is huge**
  - 2 petabytes = 2,048 terabytes (1.2 PB video, 0.8 PB sensor)
  - 3,147 drivers, 5.4 million trips, 50 million miles, 3,958 data-years

• **Complexity: different data types**
  - Categorical data constant over a trip: driver age, vehicle type
  - Sampled data: collected at original resolution (once a trip up to 640 Hz during a crash): speed, acceleration, GPS position, radar, vehicle network information
  - Video data from 4 cameras (including automatic and manual reduced)
  - Acquired crash data

• **Privacy considerations:**
  - Personally identifying data such as Face video and data that have a potential when combined with other sources to identify the participant require special care including, Institutional Board review, data sharing agreements or viewing only at a secure location.
Acquired Roadway Inventory Data

Existing roadway inventory data from FHWA, State DOT’s, MPO’s and others.

- Highway performance monitoring system data
- Functional class
- Signals
- Intersections
- Access control
- Pavement condition
- Bridge locations
- Vertical alignment
- Interchanges
- Rest areas
- Terrain
- Tunnels
- FRA grade crossings
Mobile Van Data

This is new quality controlled roadway data collected by a SHRP 2 contractor using specially equipped roadway data collection vehicles on 25,000 lane miles. The data includes:

- Horizontal curvature (radius, length, start and end points, and direction)
- Grade
- Cross-slope/super elevation
- Lanes in terms of number, width, and type (turn, passing, acceleration etc.)
- Shoulder type/curb, paved width
- All Manual on Uniform Traffic Control Devices signs
- Intersection locations, number of approaches and control (uncontrolled, stop sign, yield, roundabout, etc.)
- Barriers
- Median presence (yes/no), type (depressed, raised, flushed, etc.)
- Rumble strips (yes/no), and location (centerline, edgeline or shoulder)
- Lighting (yes/no)
- VideoLog
Supplemental Data

This data provides valuable information for characterizing or analyzing operations of a roadway segment. The existing data acquired from public and private agencies varies by site and includes:

- Crash history data
- Traffic information and counts
- Aerial imagery
- Speed limit laws and data
- Cell phone and text message laws
- Automated enforcement
- Graduated driver licensing laws
- Motor cycle helmet laws
- Seat belt laws
- Local climatological data
- Cooperative weather observer/other sources
- Winter road conditions
- 511 information
- Changes to existing infrastructure
- Roadway capacity improvements
RID Data Overview

• Size: the file is manageable
  – 50-60 GB without video, 6-8 TB with video

• Complexity: different data sources all referenced to a common basemap
  – ESRI: baseline data for entire country
  – State roadway inventory data: from 6 study States; data vary by State
  – Mobile van data: very detailed, about 12,500 centerline miles; 43,195 intersections, 518,570 MUTCD signs; includes forward video
  – Supplemental data: from 6 study States, data vary by State

• Privacy considerations: should be none
  – Video data may require IRB to determine exemption from IRB review
Linking NDS and RID

The databases are being linked to match trip IDs and road segment IDs. This will allow researchers to:

- Identify all trips passing over a given roadway segment
- Identify all roadway segments over which a given trip travels
- More easily create specific datasets based on driver, road and vehicle variables

The database linking will be complete by December 31, 2014.
Data Status and Availability

• NDS data
  – Data collection is complete
  – April 2014 update - 4.7 million trips through quality control
  – Quality control rest of trips; add radar, cell phone data by December 31, 2014

• RID data
  – Data collection is complete
  – Complete quality control, add supplementary data by October 31, 2014

• Trip summary files
  – April 2014 update - 1,143,033 trips, not all variables
  – Complete by December 31, 2014

• Crash, near-crash, and baseline event and epoch files
  – April 2014 update - 113 crashes and near-crashes
  – Complete all crash, near-crash, and baseline files by December 31, 2014. Approximately 700 crash, 7,000 near-crash and 30,000 baseline files are expected.
Available information includes
- 3,100+ driver assessment and vehicle data
- Data collection and processing progress
- Project and data background
- 1,100,000 trip summary records
- 100+ crash and near crash driving events (more soon)
- Discussion forum

User access levels
- Guest
- Registered user – fill out registration form and agree to online terms of service and privacy policy
- Qualified researcher - apply for qualified researcher and upload a valid IRB training certificate

Visit Insight to:
- Query the database,
- create cross tabulations
- assess NDS database content.
SHRP 2: Pilot projects

- Road departure on rural 2-lane curves – Iowa State University
- Offset left-turn bays – MRI Global
- Driver inattention when following a vehicle – SAFER, Chalmers University, Sweden

NHTSA

- Project on speeding behavior, which is looking at gender, situational, and environmental factors in order to develop enforcement and training guidance and possibly guidance for vehicle crash avoidance.
- Project on seat belt use (advertised but not yet awarded)

State DOTs/AASHTO/FHWA

- Numerous concept to countermeasure proposals under the Implementation Assistance Program
For the NDS

- InSight website https://insight.shrp2nds.us/
- Safety project reports at SHRP 2 Naturalistic Driving Study http://www.trb.org/Publications/PubsSHRP2ResearchReportsSafety.aspx
- Recorded NDS webinar www.trb.org/StrategicHighwayResearchProgram2Shrp2/SafetyWebinars.aspx

For the RID

- Recorded NDS webinar www.trb.org/StrategicHighwayResearchProgram2Shrp2/SafetyWebinars.aspx

For the three SHRP 2 analysis pilot projects

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Vehicle telematics: a key element to fleet operations

Benoit Vincent, P.Eng.

July 29, 2014
# Outline

1. Introduction to FPInnovations’ PIT group
2. Our expertise
3. EOBR projects and lessons learned
4. Benefits of vehicle telematics
5. Questions
Introduction to FPInnovations’ PIT group
What is FPInnovations?

- Research Consortium
- $100 million budget
- Over 500 employees
- 11 research programs

FPInnovations

PIT: Performance Innovation Transport
- Resource Assessment
- Forest Operations
- Wildfire Operations
- Primary Wood Products Manufacturing
- Secondary Wood Products Manufacturing
- Advanced Building Systems
- Market Pulp
- Paper, Packaging and Consumer Products
- Biochemicals and Energy
- Biomaterials
What is PIT?

- Technology testing (Energotest™)
- Not-for-profit, membership-driven
- Mission: solutions for better efficiency
  - Fuel consumption
  - Operational efficiency
  - Safety and security
- Over 50 fleet members and other affiliates
Our expertise
What do we do?

Help fleets adopt the best practices and technologies

- Eliminate guess work
  - Testing to identify the best technologies
  - Solutions with the best ROI
  - Support fleets to reap the benefits

- Our activities are conducted through:
  - Test campaigns (Energotest)
  - Technology implementation
Our expertise in vehicle telemetry

20 years experience in vehicle telemetry & telematics

- Technology evaluation (selecting the best technology)
- Technology implementation and operation
- Industry support through pilot projects
EOBR projects
Mandate: evaluate EOBRs based on performance specifications

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<thead>
<tr>
<th>Stage 1</th>
<th>Operational trials at control stations (Ontario &amp; Quebec)</th>
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<tbody>
<tr>
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<td>- Expose enforcement officers to various EOBR technologies</td>
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<td>- Evaluate EOBR technologies vs enforcement needs &amp; HoS reg.</td>
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<th>Stage 2</th>
<th>Technology testing</th>
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<td>- EOBR evaluation vs driver and carrier obligations (HoS)</td>
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<td>- Portrait of EOBR capabilities and limitations</td>
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<th>Stage 3</th>
<th>Stakeholder surveys</th>
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<td>- Survey stakeholders</td>
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<td>- Identify operational and EOBR technology issues, benefits, etc.</td>
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EOBR testing – Outcomes

- EOBR technologies can meet regulatory requirements
- Technological developments offer adaptable functionalities and solutions
- Automated collection of data:
  - Improves operational efficiency
  - Helps monitor compliance
- Major concern: roadside inspection
Increasing number of technologies with HoS feature
New EOBR technologies

New applications for smartphones and tablets
Objective: improve and simplify HoS compliance
eLogs benefits

**Primary benefits for the driver**

- Records duty status hours (on-duty, driving, etc.)
- Daily logs format compatible with HoS reg.
- Automatically calculates available hours
- Automatically transmits HoS information to the carrier
- eLogs available for the last 14 days
- Roadside inspection feature
**Primary benefits for the carrier**

- Access to driver elogs in real time
- HoS information summary and daily log compliance for all drivers
- Reduction in administrative duties
- Web portal enables the management of multiple driver groups
- Archived daily logs in pdf format for the previous 6 months

*Benefits are not limited only to the production of electronic logs.*
Canadian EOBR Standard

- Objectives:
  - Comply with HoS regulations
  - Allow enforcement personnel to verify driver compliance
- Nov 2011: preliminary version
- Aug 2012: revised version
- PIT’s approach: ensure consistency and interoperability with the U.S. regulation
Canadian EOBR Standard

Key elements

- Technical performance-based standard
- Aligned with Canadian HoS regulations
- Must be synchronized with ECM (vehicle speed and odometer)
- GPS sensor for location
- No requirement for cellular network
- Grandfathering options for existing EOBR units
- The certification process → later date
- No time frame for implementation
Benefits of vehicle telematics
Benefits of vehicle telematics

Telematics permits driver monitoring

- Consumption could vary up to 35% between drivers
- Real-time coaching and periodic feedback to improve driver behaviour
- Avenue for incentive programs to improve performance and safety
Training is not enough

Using telematics to evaluate, monitor and provide periodic feedback to the drivers

- Greater impact on vehicle fuel consumption (8-15%)
- Impact on driving habits is also more important
- The application rate is higher among the drivers
- Benefits are maintained for a longer period of time
Why vehicle telematics?

Fuel consumption evolution (before and after training)

- Phase 1: Pre-training
- Phase 2: Without intervention
- Post-training: With personalized follow-up
Questions?
Thank you

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Connecting for Safety
Tuesday July 29, 2014
Bob Burrows
Objectives

- Safety
- Sustainability
- Mobility
- Efficiency
Connectivity Types

- Entertainment
- Telematics
- Driver Assistance
- Safety

Autonomous Vehicles
APMA Connected Vehicle

- LTE Connected
- Robust Connections
- Heads Up Display
- Gesture Control
- Alcohol Lock Out
- Remote Authentication Lock Out
- Phone Lock In
- Ambient Lighting
- Exterior Lighting
- Weather Telematics
- Cameras – Local, remote
- Emergency Vehicle Warning
Making it Work: Regulations, Standards, Data

- Lane level maps
- Assets
- Zones
- Standards

- Traffic signals, Traffic Management Systems
- Standards
- Evolution – technology, equipment, areas
- Programs, coordination

- Driver attention/distraction – aftermarket, carry in
- Driver training, ….certification
- Law enforcement – enforceability, training
- Standards, coordination

- Privacy regulation, verification
- Certificate authority
- Violations, enforcement
Making it Work: Building Participation

- Safety
- Mobility
- Sustainability
- Efficiency

Coverage

Level of Participation
- Personal
- Commercial
- Transit
- Government

Regulation
- OEM Embedded
- Aftermarket
- Carry In
**Driver Distraction: NHTSA Guidelines**

- Look forward to audio-vocal interface
- Embrace use of smart phones used appropriately

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<tr>
<th>Device Type</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
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<td><img src="Auditory-Vocal_icon.png" alt="" /></td>
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<tr>
<td>Embedded</td>
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<tr>
<td>Aftermarket</td>
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<tr>
<td>Carry In</td>
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“Given that for some device types the only substantial difference between an integrated and a portable version of the device will be the device location (fixed or variable), most of the NHTSA visual-manual Driver Distraction Guideline criteria are expected to also be appropriate for aftermarket and portable devices with visual-manual driver interfaces.”