V2V Safety Research for Heavy Commercial Vehicles

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Washington, D.C.
Outline

- Analysis Framework for V2V Safety for Commercial Vehicles
- Connected Commercial Vehicle Project Team
- CV Driver Acceptance Clinics
- Heavy Trucks in Model Deployment
- Current Research Areas
Analysis Framework for V2V Safety for Commercial Vehicles

- Preliminary V2V Research
  - Initial Crash Problems
  - Performance Measures
  - Interoperability Requirements
  - Driver Vehicle Interface Guidance
  - Integrated Heavy Trucks
  - Retrofit Safety Devices

- Test Track and Field Experience
  - Experimental Design
  - Driver Clinics
  - Performance Testing
  - Model Deployment
  - Benefits Framework

- Evaluation
  - Evaluation Plan
  - Data
  - Conduct Evaluation
  - Run Simulations

- Policy Elements
  - Implementation
  - Technical
  - Legal

- Moving Towards 2014 Decision
  - Safety Benefits
  - Performance Requirements
  - Test Procedures
  - Driver Acceptance
Connected Commercial Vehicle Project Team

Battelle
The Business of Innovation

Mercedes-Benz
Research & Development North America, Inc.

Daimler Trucks North America

UMTRI

MERITOR WABCO

DENSO North America

TRANSPORTATION RESEARCH CENTER INC.

AUTOMOTIVE EVENTS
Vehicle Builds and Application Development

- Connected Commercial Vehicle - Integrated Trucks Project (CCV-IT)
- Heavy truck tractors were developed with Connected Vehicle safety applications in December 2011
Retrofit Safety Devices (Battelle-RSD)

- Complete hardware and software retrofit kits for commercial vehicles
  - Denso Mini-WSU Platform used for ASDs
  - Applications:
    - FCW, IMA, EEBL, BSW/LCW, CSW, BHI
  - RSDs are designed to be used in various brands and models of heavy trucks
Retrofit Safety Devices (Cambridge/SWRI-RSD)

- Complete hardware and software retrofit kits for commercial vehicles
- Team: Cambridge Systematics, Southwest Research Institute, and Volvo Technology North America
  - Cohda Platform similar to ASDs
  - Applications: FCW, EEBL, Curve Speed Warning (CSW)
Application Development

V2V and V2I Application development for heavy truck platforms:
- Forward Collision Warning (FCW)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Intersection Movement Assist (IMA)
- Emergency Electronic Brake Lights (EEBL)
- V2I – Curve Speed Warning (CSW)
- V2I – Bridge Height Inform (BHI)
V2V Safety Applications

Intersection Movement Assist (IMA)

Forward Collision Warning (FCW)

Emergency Electronic Brake Lights (EEBL)

Blind Spot/Lane Change Warning (BSW/LCW)
CV Driver Acceptance Clinics (CV DAC)

- Evaluate Driver Acceptance of V2V applications on Heavy Trucks
  - Surveys and direct observation of driver responses to warnings
  - Recruited 112 drivers with valid CDL from local fleets and independents (109 male, 3 female)
  - 61 In-depth interviews of drivers
  - Age range similar to drivers in U.S. fleet (20s-60s)
- Coordinated with the Light Vehicle Clinics and Independent Evaluator (Volpe)

Ohio - July 10-26, 2012
Transportation Research Center, Inc.
East Liberty, Ohio

California - August 22-23, 2012
Former Alameda Naval Air Station
CV DAC Results

"How effective was the warning to you?"

<table>
<thead>
<tr>
<th>Group</th>
<th>Not at all</th>
<th>Moderately</th>
<th>Very</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSW/LCW</td>
<td>2</td>
<td>6</td>
<td>104</td>
<td>112</td>
</tr>
<tr>
<td>EEBL</td>
<td>1</td>
<td>10</td>
<td>101</td>
<td>112</td>
</tr>
<tr>
<td>FCW</td>
<td>1</td>
<td>16</td>
<td>92</td>
<td>108</td>
</tr>
<tr>
<td>IMA</td>
<td>1</td>
<td>20</td>
<td>91</td>
<td>112</td>
</tr>
</tbody>
</table>
CV DAC Results (cont.)

"How useful do you think [this] would be in the real world?"

<table>
<thead>
<tr>
<th>Program</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSW/LCW</td>
<td>123</td>
</tr>
<tr>
<td>EEBL</td>
<td>106</td>
</tr>
<tr>
<td>FCW</td>
<td>90</td>
</tr>
<tr>
<td>IMA</td>
<td>95</td>
</tr>
</tbody>
</table>

- Not at all
- Moderately
- Very
CV DAC Results (cont.)

"I would like to have this Vehicle-to-Vehicle Communication safety feature on my truck"

<table>
<thead>
<tr>
<th>All Apps</th>
<th>6</th>
<th>106</th>
</tr>
</thead>
</table>

- Disagree
- Neither
- Agree
# Heavy Trucks in Model Deployment

- 3 - Integrated CVs – driven by participating fleets
- 16 - Retrofit of existing fleet vehicles
- 76 – CVs with Vehicle Awareness Devices

<table>
<thead>
<tr>
<th></th>
<th>Integrated V2V Systems</th>
<th>Retrofit Safety Devices</th>
<th>Vehicle Awareness Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcasts Basic Safety Message (BSM – SAE J2735)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Receives BSMs, Assess Threats, Issue Alerts to Drivers</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Integrated with vehicle data bus &amp; systems for BSM &amp; alert decisions</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Data Logging</td>
<td>Full data acquisition system (DAS)</td>
<td>DAS for 12 vehicles, Device log files</td>
<td>Device log files only</td>
</tr>
</tbody>
</table>
Current Research: V2V Objective Test Development

- Develop Test procedures and performance criteria for heavy trucks with V2V safety applications

- NHTSA Vehicle Research and Test Center in East Liberty, Ohio.

- Supports Compliance test procedures for possible future rulemaking in this area.
On a straight path a single, simple BSM adequately describes the vehicle.

On a highway curve or ramp at low to moderate speed, the trailer tracks inside the tractor.

CAMP/MBRDNA is studying modifications to BSM to more accurately represent trailers.

Demonstrate in mid 2014 on tractor-trailer.

Recommendations for SAE J2735 and J2945.
Contact Information

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For more information on the U.S. DOT Connected Vehicles Program, visit the website:

http://www.its.dot.gov

Thank you!