Safety Technology Review

Active Safety Technology Basics & Best Practices

Conference

“Back to the Basics—Reducing Workforce Turnover”

Oct 22–23, 2015
MeadowView Marriott Conference Center & Resort
Kingsport, TN

Sam Mask – Meritor
Mike Gracey - Bendix
Accidents Happen......
The Cost of Accidents....

The Goal is to help fleets “move over” a category.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Near Miss</th>
<th>Property Damage</th>
<th>Injury</th>
<th>Fatality</th>
</tr>
</thead>
<tbody>
<tr>
<td>All large trucks¹</td>
<td>$0</td>
<td>$26k</td>
<td>$392k</td>
<td>$7.7m</td>
</tr>
<tr>
<td>2004²</td>
<td>???</td>
<td>232,000</td>
<td>56,000</td>
<td>3,261</td>
</tr>
</tbody>
</table>

1- “Commercial Motor Vehicle Facts, Nov 2011”
2- “Large Truck Crash Facts 2010”
Integrated Safety Systems

- An “ACTIVE” system assists the driver to gain & maintain control
- Camera’s and Data Monitoring systems help coach drivers & explain what happens
What Systems Are Available?

- ABS
- ATC
- RSC & ESC
- Trailer Roll Stability Support
- Collision Mitigation
- Side Detection
- Lane Departure Warning
- OnBoard Camera’s Vehicle Monitoring/Driver Analytics
Rollover Statistics

- **Frequency**
  - ≈13,000 Rollovers (and Loss of Control Accidents) occur annually (1)
  - Of 275 cases, 47% were related to vehicle stability

- **Property Damage cost:**
  - Roll over accidents are among the costliest (2,3)
  - A typical rollover crash can easily total the entire truck, trailer and load.

<table>
<thead>
<tr>
<th>PDO</th>
<th>Injury</th>
<th>Fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Accident Costs (2)</td>
<td>$197,000</td>
<td>$462,000</td>
</tr>
</tbody>
</table>

- **Cost in Lives:**
  - Rollover accidents are the most deadly type of crash for commercial drivers (2,3)
  - Single vehicle rollover crashes claim more professional driver lives than any other type of accident (3)

- **Prevention (4)**

<table>
<thead>
<tr>
<th>System</th>
<th>Rollover and Loss of Control Accidents Prevented per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PDO</td>
</tr>
<tr>
<td>ESC</td>
<td>42%</td>
</tr>
<tr>
<td>RSC</td>
<td>31%</td>
</tr>
</tbody>
</table>

1. Large Truck Crash Causation Study (March 2006)
2009 UMTRI STUDY

Stability Control

• Funded but not conducted by NHTSA under cooperative agreement with Meritor WABCO
• 178K semi truck crashes annually – 3,330 fatalities
• Approximately 6,900 rollovers – 200 fatalities
• Study determined RSC could have eliminated 48% of rollover crashes
• Study determined ESC could have eliminated 25% of loss of control crashes (Plus RSC rollover crash elimination)
• Total economic benefit if stability control were on all trucks:
  • RSC $1.46 Billion
  • ESC $1.74 Billion

Note: RSC is integral to ESC. ESC has added Yaw Control
### Electronic Stability Program (ESP)

#### Driving Scenario Example

<table>
<thead>
<tr>
<th>Road Surface Coefficient of Friction</th>
<th>Ice</th>
<th>Wet Asphalt</th>
<th>Dry concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

- **Ice (Low Coefficient of Friction):**
  - Driving speed exceeds the threshold
  - Lateral force exceeds surface friction
  - Vehicle begins to *slide/jackknife*

- **Wet Asphalt:**
  - Driving speed exceeds the threshold
  - Surface friction sufficient to resist
  - Vehicle prone to *roll over*

- **Dry concrete (High Coefficient of Friction):**
  - System applies all brakes to:
    - Reduce speed
    - Reducing tendency to roll over
  - System applies individual brakes to:
    - Reduce speed / correct orientation
    - Reducing tendency to jackknife/slide

### Roll Stability Program (RSP)

- **Heavy Truck Stability Systems**
- **NHTSA ESC Mandate - August of 2017**

- **Stability System Action**
  - System applies individual brakes to:
    - Reduce speed / correct orientation
    - Reducing tendency to jackknife/slide
  - System applies all brakes to:
    - Reduce speed
    - Reducing tendency to roll over
2013 UMTRI STUDY
Collision Mitigation

- Funded but not conducted by NHTSA under cooperative agreement with Meritor WABCO and UMTRI
- Study Goal: Estimate the safety benefits of F-CAM (FCW & CMS) technology installed on tractor-semitrailers and single trucks.
- Fleet Analysis - 2 fleets in study, trucks without the F-CAM *(Forward Collision Avoidance & Mitigation)* system were 2.26 and 1.96 times more likely to be the striking vehicle in a rear-end crash than trucks with the system.
- Total economic benefits of CMS for Tractor Semitrailer and Straight Trucks
  - Current Gen – $1.3 Billion
  - Next Gent – $2.5 Billion
  - Future Generation – $3.1 Billion
How does today’s forward radar work?

**Forward Collision Warning**
- Audible & visual warnings provides detection of developing rear end collisions and alerts driver
- Stationary object warning

**Adaptive Cruise Control w/Active Braking**
- Provides adaptive cruise for both deceleration and automatic resume
- Assists driver in attempt to maintain safe following distance
- Provides sequential deceleration activation:
  - Torque reduction
  - Retarder control
  - Foundation braking
- Max decel predetermined % of full brake application

**Collision Mitigation**
- “Always on” emergency activation
- Calculates to determine impending collision
- Predetermined % of full brake application
- Functions at speeds > 15mph
- Auto disengage if driver takes appropriate action
Side Radar Detection

- **Volume Control Button**
- **Red LED**: Alert
- **Ambient Light Sensor** (Automatically Dims LEDs)
- **Yellow LED**: Standby; No Object Detected

<table>
<thead>
<tr>
<th>LED</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Indicator</td>
<td>Object Detected</td>
</tr>
<tr>
<td>Yellow Indicator</td>
<td>No Object Detected</td>
</tr>
<tr>
<td>Red and Yellow (at power-up)</td>
<td>Self-Test</td>
</tr>
<tr>
<td>Red and Yellow (constant)</td>
<td>Sensor Diagnostic Trouble Code (DTC)</td>
</tr>
</tbody>
</table>

**WARNING**

The driver is always responsible for the control and safe operation of the vehicle at all times. The Bendix™ BlindSpotter® Radar system does not replace the need for a skilled, alert professional driver, reacting appropriately and in a timely manner, and using safe driving practices.
LANE DEPARTURE WARNING SYSTEMS

Lane Departure Warning Accidents

• Accident Predominance¹
  • 42% of total fatalities in 2006
  • 20% of all crashes
  • One occurs every 21 minutes in the US²

• Cost of Accidents³

<table>
<thead>
<tr>
<th>Accident Severity</th>
<th>Range of Costs (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Damage Only (PDO)</td>
<td>$100K – $196K</td>
</tr>
<tr>
<td>Injury</td>
<td>$135K – $456K</td>
</tr>
<tr>
<td>Fatal</td>
<td>$885K – $1.3M</td>
</tr>
</tbody>
</table>

• Cause of Accidents
  • Inattention
  • Distraction
  • Fatigue

1) Neuman 2003 UMTRI 2006
2) AASHTO Driving down lane departure crashes 2008.04 PLD-1.pdf
3) FMCSA-RRT-09-022 Analysis of Benefits & Costs of LDWS for the Trucking Industry, ATRI, 2009.02
4) Dependent upon Crash Type, i.e. Rollover, Head-on, Sideswipe, Single Vehicle Collision
Operating Conditions

Typical Interstate

Night Driving

Night with only retroreflectors

Rain

Snow

No lane markings
Lane Departure Warning Systems

FIGURE 1 - AUTOVUE® LDW SYSTEM (BOXES ADDED TO ILLUSTRATE ACTIVE LANE DETECTION)
**Driving Scenario:**
A vehicle enters a curve too fast, on high friction pavement, resulting in high lateral (side) forces acting at the trailer’s center of gravity (CG). The high friction between the wheels and the pavement create a "hinge" effect and the side forces at the CG push the vehicle over.

**How the Bendix® TABS-6 Advanced MC™ Trailer Stability System responds:**
The Bendix® TABS-6 Advanced MC™ roll stability system applies pressure to the trailer brakes to reduce vehicle speed and mitigate the tendency of the vehicle to roll over.
OnGuard™ Radar Sensor & Features

Current Generation

77 GHZ Long Range Bimodal Radar

Features
- FCW
- Haptic Warning
- ACC
- CMS
- Stationary Object Warning
- Evasive Maneuver Check
- EOL Self Alignment
- Continuous Self Alignment
- Improved Object Tracking
- Improved Object Resolution

OnGuardACTIVE
- Same as above plus active braking on stationary objects
- System readiness end of 2015
UP AND COMING NEXT GENERATION SYSTEM

Introducing Bendix® Wingman® Fusion™

Benefits

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary vehicle braking</td>
<td>Provides alert and braking when system definitively identifies stationary car in lane</td>
</tr>
<tr>
<td>Collision mitigation</td>
<td>Helps reduce the frequency and severity of rear-end collisions</td>
</tr>
<tr>
<td>Active Cruise w/ Braking</td>
<td>Holds gap with forward vehicle</td>
</tr>
<tr>
<td>Overspeed alert &amp; action</td>
<td>Warns driver when speeding</td>
</tr>
<tr>
<td>Lane departure warning</td>
<td>Alerts the driver to unintended lane change – helps drowsy drivers</td>
</tr>
<tr>
<td>Following distance alerts</td>
<td>Helps reinforce a safer distance gap between host &amp; forward vehicle</td>
</tr>
<tr>
<td>Stationary object alert</td>
<td>Helps reduce the likelihood of hitting a stationary object</td>
</tr>
</tbody>
</table>
Con-way Findings

DriveSafe System Equipped Tractors vs. Non-DSS Equipped Tractors:
January 2011 - December 2012

- Lane departure: No DSS 0.17, DSS Equipped 0.12, decrease of 25%
- Improper lane change: No DSS 0.13, DSS Equipped 0.07, decrease of 46%
- Unsafe speed: No DSS 0.13, DSS Equipped 0.06, decrease of 53%
- Unsafe following distance: No DSS 0.11, DSS Equipped 0.04, decrease of 63%
- Rollover: No DSS 0.13, DSS Equipped 0.05, decrease of 63%
- Front-end collision: No DSS 0.08, DSS Equipped 0.01, decrease of 87%
Best Practices for technology launches
...before you say “I do”...... are you ready??

• **Management Involvement is a must**
  • Operations, Safety, Maintenance and Driver Managers/Trainers.
    • Have you taken a ride?
    • Pre-launch meetings, training & orientation is essential

• **Plan Ahead – Company and Driver Orientation**
  • Use training resources – video and literature *BEFORE they get the trucks!*
    • Technician Training & Orientation
      – They handle most drivability questions with drivers

• **THESE SYSTEMS DON’T REPLACE A GOOD TRAINED DRIVER, DRIVERS ARE ALWAYS IN CONTROL......**
Thank you for your time and attention today! For more information please contact us;

Meritor
Sam Mask
District Manager – Eastern Region
Cell: 828-234-6961
Sam.mask@meritor.com

Bendix
Mike Gracey
National Fleet Account Manager
Cell: 980-275-9133
Michael.gracey@bendix.com