Crash Avoidance Technologies: Assessing The Building Blocks For Tomorrow's Driverless Vehicles

I-95 Corridor Coalition Connected & Automated Vehicles Conference: What States Need to Know

June 22, 2016

David Zuby, EVP & Chief Research Officer
IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from crashes on the nation’s roads.

HLDI shares this mission by analyzing insurance data representing human and economic losses from crashes and other events related to vehicle ownership.

Both organizations are wholly supported by auto insurers.
Where are we?

- Washington, DC
- Arlington, VA
- Ruckersville, VA
Driver assistance features

Velodyne LIDAR used by Google Self-Driving Car
325 ft range with 360º rotation

Ultrasonic sensors
15 ft range

Short-range radar
100 ft range
80º opening angle

Mid-range radar
260 ft range,
16º opening angle

LIDAR
45 ft range,
27º opening angle

Mid-range radar
200 ft range,
60º opening angle

Mono/stereo cameras
325 ft range, 45º opening angle

Infrared
525 ft range
20º opening angle

Long-range radar
650 ft range,
18-20º opening angle
Crashes relevant to 4 crash avoidance systems
FARS and GES, 2004-08

<table>
<thead>
<tr>
<th>System</th>
<th>All</th>
<th>Injury</th>
<th>Fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front crash prevention</td>
<td>1,165,000</td>
<td>66,000</td>
<td>879</td>
</tr>
<tr>
<td>Lane departure prevention</td>
<td>179,000</td>
<td>37,000</td>
<td>7,529</td>
</tr>
<tr>
<td>Side view assist</td>
<td>395,000</td>
<td>20,000</td>
<td>393</td>
</tr>
<tr>
<td>Adaptive headlights</td>
<td>142,000</td>
<td>29,000</td>
<td>2,484</td>
</tr>
<tr>
<td>Total unique crashes</td>
<td>1,866,000</td>
<td>149,000</td>
<td>10,238</td>
</tr>
</tbody>
</table>
Crash avoidance technology effects on insurance claims
Front crash prevention systems
Change in claim frequency

-30%
-20%
-10%
0%
10%
low speed
warning only
warning with autobrake

Mazda (smart city brake support)
Mazda (smart city brake support & FOW)
Volvo City Safety
Chrysler (with ACC, BSM & RCTA)
Honda Accord (with LDW)
Honda Accord (with LDW + ACC)
Mercedes-Benz
Volvo
Acura
Mercedes-Benz
Subaru (with LDW)
Volvo (with LDW)

PDL
Collision

low speed
warning only
warning with autobrake

-30%
-20%
-10%
0%
10%
Front crash prevention systems
Change in claim frequency

![Bar chart showing change in claim frequency for various vehicles with different safety features.](chart.png)
### Speed reduction in 12 and 24 mph tests

<table>
<thead>
<tr>
<th>Volvo S60</th>
<th>Dodge Durango</th>
<th>Subaru Outback</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 point advanced</td>
<td>3 point advanced</td>
<td>6 point superior</td>
</tr>
</tbody>
</table>
Summary of technology effects on insurance claim frequency
Results pooled across automakers

<table>
<thead>
<tr>
<th>Technology</th>
<th>Collision</th>
<th>Property Damage Liability</th>
<th>Bodily Injury Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Collision Warning</td>
<td>-20%</td>
<td>-15%</td>
<td>-10%</td>
</tr>
<tr>
<td>Fcw with Autobrake</td>
<td>-10%</td>
<td>-5%</td>
<td>0%</td>
</tr>
<tr>
<td>Adaptive Headlights</td>
<td>-15%</td>
<td>-5%</td>
<td>0%</td>
</tr>
<tr>
<td>Lane Departure Warning</td>
<td>-10%</td>
<td>-5%</td>
<td>0%</td>
</tr>
<tr>
<td>Side-view Assist (blind spot)</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
</tr>
</tbody>
</table>
Effectiveness of collision avoidance systems in police-reported crash data
Effects of systems on police-reported crashes

- 2009-14 data on police-reported crashes from states with VINs
  - Analyses include data from 19-26 states, depending on crash type
- Compared crash rates for vehicles with systems and same make/model/year vehicles without systems in most analyses
- In analyses of Volvo’s standard City Safety system, compared vehicles with system to similar vehicles in same class
- HLDI data
  - Insured vehicle years as exposure measure
  - Covariates: other collision avoidance technologies, calendar year, vehicle series/model year, state, vehicle density, rated driver age group, gender, marital status, insurance policy characteristics
Effects of front crash prevention systems on rear-end strikes with third-party injuries

Percent difference in crash rates

<table>
<thead>
<tr>
<th>System</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCA (w/BSM + RCP)</td>
<td>-80%</td>
</tr>
<tr>
<td>Honda Accord camera (w/LDW)</td>
<td>-60%</td>
</tr>
<tr>
<td>Honda Accord radar (w/LDW + ACC)</td>
<td>-40%</td>
</tr>
<tr>
<td>Mercedes-Benz (w/Warning)</td>
<td>-20%</td>
</tr>
<tr>
<td>Volvo (w/LDW)</td>
<td>0%</td>
</tr>
<tr>
<td>Acura (w/Warning only)</td>
<td>20%</td>
</tr>
<tr>
<td>Mercedes-Benz (w/Warning with autobrake)</td>
<td>40%</td>
</tr>
<tr>
<td>Subaru (w/LDW)</td>
<td>60%</td>
</tr>
<tr>
<td>Volvo (w/LDW)</td>
<td>80%</td>
</tr>
<tr>
<td>Autobrake pooled</td>
<td>100%</td>
</tr>
</tbody>
</table>
Effects of lane departure warning systems on single-vehicle run-off-road and head-on injury crashes
Percent difference in crash rates

- Honda Accord (w/FCW)
- Mercedes-Benz (w/FCW + AEB)
- Subaru (w/FCW + AEB)
- Volvo (w/FCW + AEB)
- Lane departure warning pooled
- Buick Lucerne (w/ESC + blind spot)
Effects of lane departure warning systems on sideswipe injury crashes, with no prior lane change

Percent difference in crash rates

- Honda Accord (w/FCW)
- Mercedes-Benz (w/FCW + AEB)
- Subaru (w/FCW + AEB)
- Lane departure warning pooled
- Buick Lucerne (w/ESC + blind spot)
Spread of technology through the fleet
New vehicle series with electronic stability control

By model year
Registered vehicles with electronic stability control
By calendar year

- Green: standard
- Yellow: optional
- Red: not available
Registered vehicles with available electronic stability control, actual and predicted
By calendar year
Registered vehicles with front crash prevention
By calendar year

- Standard
- Optional
- Not available
Year available features reach 95% of registered vehicles with and without hypothetical mandate

- **Front crash prevention**
- **Lane departure warning**
- **Adaptive headlights**
- **Blind spot warning**
- **Rear camera* (mandate)**
- **Rear parking sensors**

* rear camera mandate  
May 1, 2018
...I AM APPROACHING FROM YOUR LEFT AND AM MAKING PRECAUTIONARY ADJUSTMENTS...

ACKNOWLEDGED. NOT A PROBLEM UNLESS THE SLAB OF MEAT IN HERE INTERFERES...

Intermediate stage en route to driverless cars.
More information and links to our YouTube channel and Twitter feed at iihs.org

David S Zuby
EVP & Chief Research Officer
dzubby@iihs.org