Federal Motor Carrier Safety Administration's Advanced System Testing Utilizing a Data Acquisition System on the Highways (FAST DASH) Safety Technology Evaluation Project #1: Blind-Spot Warning, 2012

PURPOSE

The Federal Motor Carrier Safety Administration (FMCSA) provides leadership in evaluating promising safety technologies developed for commercial motor vehicles (CMVs) by identifying their in-service benefits in a naturalistic driving environment. By identifying, quantifying, and documenting safety benefits of promising technologies, FMCSA encourages the voluntary adoption of proven technologies by motor carriers. FMCSA's FAST DASH program conducts efficient, independent evaluations of promising safety technologies aimed at commercial vehicle operations (CVO) to serve this goal. This report is the first of three technology evaluations that the FAST DASH program will complete over a period of 5 years. The safety technology evaluated in this study was a blindspot object detection and warning (BSW) system.

TECHNOLOGY

The BSW system uses sensors to monitor areas on either side of the truck and provides drivers with a visual alert when vehicles or objects are detected in their blind spots. The subject BSW technology uses an array of infrared laser beams to create a three-dimensional detection zone on both the driver and passenger sides of a CMV. A driver is alerted to vehicles in the blindspot via activation of amber light-emitting diodes (LEDs) mounted on the side-view mirrors.

PROCESS

This study represents a comprehensive evaluation of the tested BSW system. The FAST DASH study process included the following steps:

- **Controlled Performance Testing—**The research team performed preliminary "shake-down testing" of the technology in a control environment to exercise and assess the performance capabilities reported by the vendor. Performance capabilities of initial interest included: the object detection region for the driver- and passenger-side adjacent lanes, the object detection sensitivity, and performance in unfavorable driving conditions.
- **Field Study—**The intent of the field study was to implement the BSW system within a revenue-producing fleet and exercise the system on public roadways to gain an understanding of the system's potential safety benefits, system performance under real-world conditions, unintended consequences from the use of the system, and drivers' impressions of the technology.

RATIONALE AND BACKGROUND

Large trucks, because of their size and design, have extensive areas around the truck that are obscured from the driver's direct and indirect vision (as shown in Figure 1). These blind-spot areas have the potential to hide other road users from the driver's field of view, contributing to safety conflicts and crashes during maneuvers such as lane changes and merges.

In an analysis of 2004–08 crash data, the Insurance Institute of Highway Safety (IIHS) stated that 39,000 heavy truck crashes were relevant to today's BSW systems and indicated that BSW technology offers the greatest potential in mitigating the largest number of large-truck crashes during the study time period (approximately 10 percent of the 384,000 crashes involving large trucks reported during the study time period).

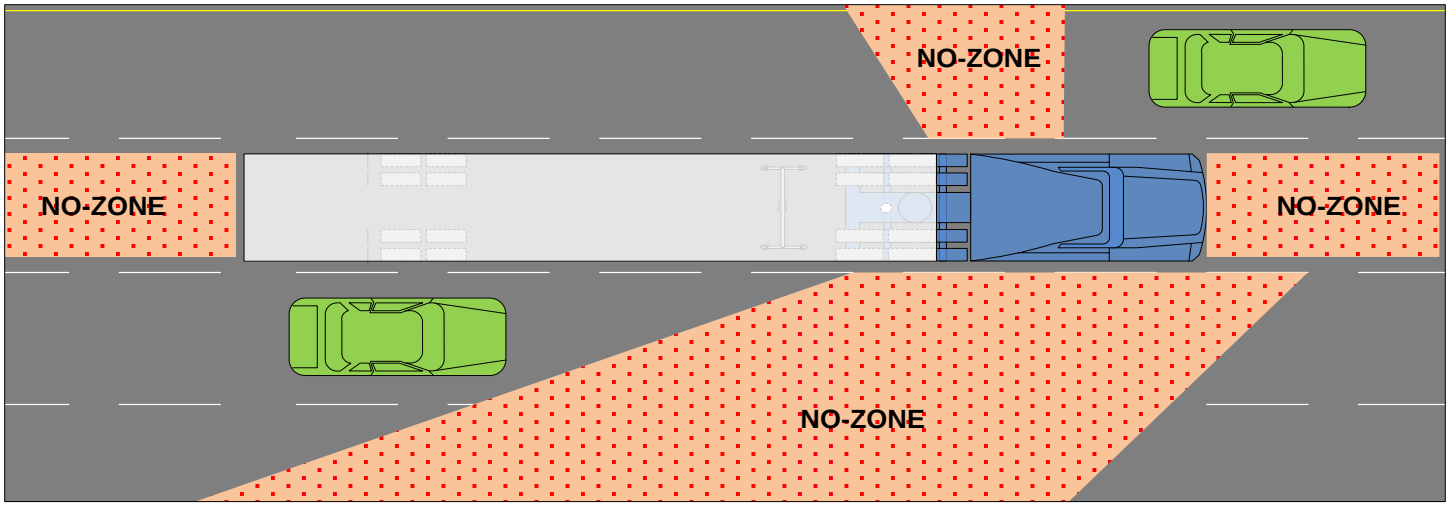

Figure 1. Diagram. Tractor-trailer blind spots ("No-Zones") adapted from the FMCSA NO-ZONE Campaign.

STUDY FINDINGS

System testing in controlled experiments on a test track showed that the system performed well at correctly detecting vehicles inside the detection zones (no-zones) and correctly ignoring vehicles outside the no-zones (see Table 1). Two areas where the system's coverage could have been improved were discovered. The driver-side sensor unit leaves an area directly adjacent to the tractor uncovered for high-sitting, eye-height positions. Also, on both the driver and passenger sides, the BSW system detectors do not provide coverage for the rear two-thirds of the trailer for about half of the adjacent lanes.

Table 1. Summary of BSW system performance in controlled performance tests.

System Function	Performance Level
Detection of vehicles inside the no-zone and ignoring vehicles outside the no-zone	System performed this function well.
Driver-side sensor unit	The sensor left an area directly adjacent to the tractor uncovered for high-sitting, eye-height positions.
Blindspot warning coverage for driver and passenger sides	The BSW system detectors did not provide coverage for the rear two-thirds of the trailer for about half of the adjacent lanes.
Blindspot warning system performance during CMV passing and merging	BSW system performed suitably in detecting light vehicles under varying conditions, although rain spray denigrated performance.

During passing and merging testing, the BSW system performed suitably in detecting light vehicles of different types and sizes under varying conditions. Rain spray from the equipped vehicle and small vehicle approach angles appeared to result in some false positives and false negatives, respectively.

The effectiveness of the subject BSW system was also investigated under naturalistic driving scenarios in a 20 vehicle field study. Within this study, two analyses were performed to investigate whether operators' driving behaviors, as measured by the rate of involvement in safety-critical events (SCEs), changed when the BSW system was introduced. SCEs consisted of all valid events which can be classified into five basic event types: crashes, tire strikes, near-crashes, crash-relevant conflicts, and unintentional lane deviations.

First, an analysis was performed comparing all baseline SCEs to all intervention SCEs. Next, SCEs were filtered for inclusion of only lane change/merge conflicts, again comparing baseline to intervention conditions. There were 99 SCEs identified over 283,235 miles in the baseline condition (before the BSW system was introduced), and 112 SCEs identified over 439,404 miles in the intervention condition (after the BSW system was introduced).

In the overall comparison of baseline SCEs to intervention SCEs, the mean reduction was 0.66 SCEs per 10,000 miles ($p=0.0539$). In the filtered baseline to intervention comparison, where only lane change and merge conflicts were compared, the mean reduction was 0.37 SCEs per 10,000 miles ($p=0.0824$).

Results from a sample of participants surveyed after the field study indicated that the BSW system was easy to use, met performance expectations, and helped to improve driving performance and eliminate blindspots. Although the majority of the findings were positive, some results showed opportunities to further improve the BSW system's overall performance.

To view the full report, please visit: http://www.fmcsa.dot.gov/facts-research/art-public-reports.aspx