



Onboard Safety System Effectiveness Evaluation

This research study evaluated three vehicle-based driver assistance technologies that aim to improve the safety of in-service commercial motor vehicle (CMV) operations. These commonly deployed onboard safety systems (OBSS)—lane departure warning (LDW), roll stability control (RSC), and forward collision warning (FCW)—were examined using existing crash data acquired directly from participating motor carriers. The OBSSs were installed on Class 7 and 8 trucks and the data were collected while drivers operated their normal revenue-producing routes.

The crash data collected from participating carriers included U.S. Department of Transportation (USDOT) reportable crashes, as well as non-USDOT-reportable minor incidents for which the carriers kept detailed records. This study explored answers to three specific research questions:

- What are the safety benefits (i.e., reduction in the number of OBSS-related crashes) of LDW, RSC, and FCW regarding the crash types associated with each OBSS type?
- Are these OBSSs cost-effective investments (e.g., what are the economic costs and benefits associated with the adoption of each OBSS)?
- What are the drivers’ and safety managers’ opinions and perceptions regarding each OBSS?

OBSS Effectiveness and Benefit-Cost in CMVs

The data used in the study were divided into two cohorts: trucks with an OBSS and trucks without an OBSS. The crash data were also arranged into two groups: crashes that were OBSS-related, and crashes that were not OBSS-related. The statistical approach accounted for the existence of multiple OBSS types on some trucks and also adjusted for exposure based on mileage. The analyses indicated a strong positive safety benefit for LDW and RSC.

The benefit-cost analyses also showed the estimated

Observed Safety and Cost Effectiveness of Selected Safety Systems

Onboard Safety System	OBSS-Related Crash Rate Reduction (per MVMT)	Benefits Exceed Costs? Benefit Cost Ratio (BCR)
Lane Departure Warning	Yes 47.8% Difference	Yes Up to 15:1 BCR
Roll Stability Control	Yes 35.7% Difference	Yes Up to 13:1 BCR
Forward Collision Warning	Not Enough Data for Assessment	N/A

benefits of LDW and RSC systems deployed at participating fleets outweighed the estimated costs. The study did not contain enough trucks with an FCW system to be able to detect safety benefits with statistical significance.

I. Lane Departure Warning System Effectiveness

LDW system effectiveness analysis had sufficient statistical power in the analyzed dataset. Approximately 6 percent (780 million) of the 13 billion vehicle miles accumulated were with an LDW system installed on the carrier vehicles.

The LDW system effectiveness analysis resulted in a statistically significant finding whereby trucks without LDW systems had an LDW-related crash rate per million vehicle miles traveled (MVMT) 1.917 times higher than trucks with such a system. This reduction translates to a 47.8 percent crash rate reduction per MVMT in LDW-related crashes with the use of a LDW system, and this finding is on the high end of the range (23 percent to 50 percent) predicted in previous research studies that also assessed the effectiveness of LDW systems. (Note that past studies reported reductions in the number of OBSS-related crashes and not the crash rate reduction per MVMT.)

A followup benefit-cost analysis showed the following:

- LDW system benefits to the carriers outweighed the costs by a factor (benefit-to-cost ratio, or BCR) of 14.69:1 or 4.95:1 (depending on annual vehicle miles traveled [VMT]) implying a payback period of 4 to 12 months.
- LDW system benefits to society would outweigh the costs by a factor of 5.7:1 or 1.9:1 (depending on annual VMT) implying a payback period of 11 to 32 months.

II. Roll Stability Control Effectiveness

RSC effectiveness analysis had very strong statistical power in the analyzed dataset in comparison to all OBSS systems deployed at the participating carriers. Approximately 49 percent (6.4 billion) of the 13 billion vehicle-miles accumulated were with a stability system installed on the carrier vehicles. Among the participating fleets, an overwhelming majority of the deployed stability control systems were RSC systems and a smaller subset were Electronic Stability Control (ESC) systems, which was due to the nature of the supplier and system choice among the participating fleets. The ESC subgroup alone did not have sufficient data to lend itself to a standalone statistical analysis. As a result, this study only examined the RSC effectiveness.

The RSC effectiveness analysis resulted in a statistically significant finding whereby trucks without RSC systems had an RSC-related crash rate 1.555 times higher than trucks with RSC. This reduction translates into a 35.7 percent crash rate reduction per MVMT in RSC-related crashes with RSC. This finding is on the lower half of the range (26 to 64 percent) predicted in previous research studies.

A followup benefit-cost analysis showed the following:

- RSC system benefits to the carriers outweigh the costs by a factor of 12.50:1 to 4.17:1 (depending on VMT) implying a payback period of 5 to 14 months.
- RSC system benefits to society outweigh the costs by a factor of 4.2:1 to 1.4:1 (depending on VMT) implying a payback period of 14 to 43

months.

III. Forward Collision Warning Effectiveness

This study did not collect a sufficient amount of data to detect statistically significant differences between trucks with an FCW and those without.

Driver and Safety Manager Opinions and Perceptions of OBSSs

Drivers' and safety managers' opinions and perceptions of each OBSS type were generally positive. Overall, drivers and carrier staff liked having the OBSSs on their trucks; they believed the systems were beneficial and increased safety. Both drivers and carrier staff recognized the relationship between safety, job retention, and company reputation; they appreciated how the OBSSs reflected their company's safety culture.

Recommendations from focus groups:

- **OBSS training needs.** Drivers should be given an opportunity to experience these systems in a simulator or controlled practice environment prior to deploying in a revenue-producing operation.
- **Obsolescence of each OBSS.** Manufacturers should consider building scalable hardware devices that allow software upgrades rather than new hardware purchases.
- **Easier access to the OBSS data.** Enabling wireless downloads from the OBSS, rather than manual downloads, will allow more convenient access to data, which would enable carrier staff to monitor drivers more closely, provide feedback on their driving behavior, and implement targeted training to drivers, if needed.
- **Include features to allow drivers to control the sensitivity of OBSSs in certain situations, i.e., wet or icy conditions.** However, carrier staff expressed concern that drivers may override the systems to the degree that these systems become ineffective.

For more information, please visit:

<http://www.fmcsa.dot.gov/facts-research/art-public-reports.aspx>.