Tech Brief

Programs of the Federal Motor Carrier Safety Administration (FMCSA) encompass a range of issues and disciplines related to motor carrier safety and security. FMCSA's Office of Analysis, Research, and Technology defines a "research program" as any systematic study directed toward fuller scientific discovery, knowledge, or understanding that will improve safety, and reduce the number and severity of commercial motor vehicle crashes. Similarly, a "technology program" is a program that adopts, develops, tests, and/or deploys innovative driver and/or vehicle best safety practices and technologies that will improve safety and reduce the number and severity of commercial motor vehicle crashes. An "analysis program" is defined as economic and environmental analyses done for agency rulemakings, as well as program effectiveness studies, state-reported data quality initiatives, and special crash and other motor carrier safety performance-related analyses. A "large truck" is any truck with a Gross Vehicle Weight rating or Gross Combination Weight rating of more than10,000 pounds.

Currently, the FMCSA Office of Analysis, Research, and Technology is conducting programs in order to produce safer drivers, improve safety of commercial motor vehicles, produce safer carriers, advance safety through information-based initiatives, and improve security through safety initiatives. The study described in this Tech Brief was designed and developed to support the strategic objective to produce safer drivers. The primary goals of this initiative are to ensure that commercial drivers are physically qualified, trained to perform safely, and mentally alert.

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Entry-Level Training of Commercial Motor Vehicle Drivers

Background

Earlier research has indicated that entry-level commercial motor vehicle (CMV) drivers were not receiving adequate training prior to beginning their professional driving careers (Dueker, 1995). Further evidence of this is provided by the large number of in-house training programs for newly licensed CMV drivers (commonly known as "driver finishing" programs) operated by approximately 75 percent of carriers (Stock, 2001). These programs provide newly licensed CMV drivers with additional training and/or supervised driving time to ensure that a minimum operational skill level is met, even though the participating drivers already hold valid Class-A commercial driver's licenses (CDLs).

Although there are standards for testing and issuing Class A CDLs, there is no current Federal requirement for training CMV drivers. CMV driver trainers have noted the need for more effective training strategies to increase the retention rate and skills of new drivers (Dugan, 2008). Some industry groups have created independent training standards for use in CMV driver training (Professional Truck Driver Institute [PTDI], 1999). A number of entry-level, driver finishing, and CMV driver training programs currently use PTDI standards. As truck simulators could be a useful tool for increasing the efficiency and quality of novice CMV driver training, there is interest in examining their use in CMV driver training programs.

Fortunately, many of the unique skill requirements for operating large trucks can be addressed through the use of advanced simulation technology, which is continually becoming more capable, reliable, and affordable. Over the past decade or more, high-fidelity, "full mission" truck driving simulators have become commercially available at steadily decreasing prices. Hartman et al., (2000), report that many European countries have successfully included simulators in CMV driver training programs. In a public/private partnership, a French training program (the Association for the Development of Professional Training in Transport—Institute of Training and Warehousing Techniques, or AFT-IFTIM) offers a curriculum combining simulator- and computer-based training in addition to behind-the-wheel (BTW) training, with a program to track individuals' training hours. The Stora Holm vocational center in Sweden uses a similar combination of simulator-, computer-, and BTW-based training for entry-level CMV drivers. In both the AFT-IFTIM and Stora Holm experience with CMV simulators, results have suggested that there are benefits to simulation-based training. In particular, the AFT-IFTIM program considers 1 hour of simulated driving and 4 hours of BTW driving to be more effective than 8 hours of BTW driving (Hartman et al., 2000).

Findings such as these have led some training programs and motor carriers within the United States and Canada to begin implementing simulator-based CMV training programs (Robin et al., 2005a). However, many questions

remain about how these programs would work in the considerably different CMV driver training and testing environment of the United States. In order to better explore the potential advantages of simulation training, the Federal Motor Carrier Safety Administration (FMCSA) has established and sponsored a CMV Driving Simulator Validation (SimVal) research program. This study represents the second phase of this research program, tasked with exploring the use of simulators in entry-level CMV driver training and testing.

Figure 1. Simulator overhead view, intersection, and driver training.

The Simulator

An FAAC, Inc. model TT-2000-V7 + 3 DOF tractor-trailer simulator was used (Figure 1). Computer-generated imagery is displayed on five 60-inch screens through projectors surrounding a generic truck cab to provide a seamless 225 degree forward field of view. Actual flat mirrors reflect images from plasma monitors mounted behind the cab in order to provide parallax for the driver. The cab has original equipment manufacturer working gauges, indicator and warning lights, pedals, and shifter with range selector. The seat provides heave, pitch, and roll based on environmental conditions and driver inputs to the vehicle controls. Force feedback steering is used to provide tactile feedback for different road surfaces, resistance at different road speeds, and curb strikes. Tractor and trailer characteristics and dynamics, along with the driving environment, can be manipulated to create specific, customized scenarios. A library of automobiles, trucks, buses, pedestrians, signs, buildings, and other objects is available to further enhance scenarios. In addition, the simulator provides the ability to give overhead views and instantly halt the driving scenario, as well as replay or re-drive the prior 30 seconds of the scenario.

Scope

This project examined the effectiveness of simulation training by comparing the research results of four different types of entry-level CMV driver training:

- Conventional Training: Conventional entry-level training occurs in both classroom and BTW settings. Students receive instruction on concepts, techniques, and fleet safety. In addition to the classroom, students practice range driving (for skills maneuvers) and road driving (which includes learning proper shifting, making turns, and responding to situations while driving actual trucks on the road under the supervision of trainers). In order to obtain PTDI certification, these courses must include a minimum of 104 hours of classroom time and 44 hours of BTW training per student (using 60-minute hours; PTDI, 1999). It should be noted that some carriers offer PTDI-certified conventional training; however, no entry-level drivers in the present study were trained in their courses.

- Simulator Training: Simulator training is similar to Conventional entry-level training in that both a classroom and a BTW component is present. However, with Simulator training, a portion of the BTW training occurs in a driving simulator. For the present study, students received approximately 60 percent of their BTW training in a simulator.

- Informal Training: Informal training occurs when a driver receives training in an informal or non-structured setting. No requirements for classroom or BTW time are present and the trainer may not necessarily be certified. A friend or family member may provide informal training.

- CDL-focused Training: CDL-focused training mimics some of the features of conventional training (including classroom and BTW training), though on a compressed schedule. CDL-focused training typically lasts less than four weeks and involves drivers learning only the basic information needed to obtain a CDL instruction permit (i.e., a learner's permit), followed by BTW training for the specific vehicle skills needed to pass the Division of Motor Vehicles (DMV) road and skills tests. In addition, in order to meet demand for qualified drivers, some larger carriers may hire employees and provide entry-level driver training through a CDL-focused type of training course. These programs are not eligible for PTDI certification.

Data were collected for all groups, including each participant's score on road and range tests conducted at the DMV (tests conducted by the DMV authority prior to issuance of a CDL), BTW road and range tests performed at the Delaware Technical and Community College (DTCC) testing facility, and on road and range tests performed in the Simulator. All tests involved the same driving maneuvers and were scored to the same (DMV) criteria. Scoring on the DTCC and Simulator tests was independently verified by a subject matter expert in order to ensure that no bias in scoring was present.

Key Findings

While analysis of the DMV road test scores indicated no differences between groups, analysis of the DTCC road test scores did indicate a difference between groups. There were no statistical differences between Conventional and Simulator training group participants' road test scores. The Conventional and Simulator groups both had statistically higher road test scores as compared to Informal and CDL-focused participants. Similarly, on the Simulator road test, there was no difference between Conventional and Simulator training groups, and both the Conventional and Simulator groups scored higher than either Informal or CDL-focused training group participants.

Overall, data on participants' entry-level range tests displayed similar findings. For DMV range tests, there was no difference between the Conventional and Simulator training groups. The Conventional training group had a significantly higher score on the DMV range test as compared to both the CDL-focused and Informal training groups. However, it is important to note that all study participants (in all groups) passed the DMV range tests. With respect to the DTCC range test, the Conventional, Simulator, and Informal training groups all had higher scores than the CDL-focused training group. On the Simulator version of the range test, the Simulator group had higher scores than the Conventional, CDL-focused, and Informal training groups.

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Summary Findings and Recommendations

Based on the lack of significant differences between the Conventional and Simulator training groups on DMV road and range test scores, as well as the lack of any significant differences between the two groups on the validated DTCC road and range tests, simulator-based training of entry-level CMV drivers appears to be feasible.

Additionally, when analyzing the scores on DTCC and Simulator versions of the DMV tests (scores that were validated by an independent, external reviewer), there are significant group differences present. In DTCC road and range testing, the Conventional and Simulator Training Groups almost always outperformed both the Informal and CDL-focused training groups. The statistical differences suggest that students trained in a PTDI-certified program, on average, scored better than the drivers that did not undergo a certified training program in these tests.

However, based on the finding that Simulator road and range test scores were lower overall as compared to DTCC road and range test scores, and that the Simulator and Conventional training groups did not have equivalency on the Simulator range test, it does not appear to be feasible to test entry-level CMV drivers using simulators at this time. Advances in simulation technology may change this finding.

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