Recap of FMCSA's Research Activities for 2011

The Research Division has completed a number of studies that are or will be available to the public very soon.

1. **Split Sleep Study.** The objective of this study was to evaluate the consequences for safety and health of split sleep versus consolidated sleep by comparing the effects of consolidated nighttime sleep, split sleep, and consolidated daytime sleep on total sleep time, performance, subjective state, and biomedical measures correlated with health outcomes over the long-term. An in-residence laboratory study was conducted in 53 healthy participants making a between group comparison of nighttime, split, or daytime sleep across 5-day simulated workweek. The effect of condition was measured on sleep by polysomnography, performance by the psychomotor vigilance task (PVT), high fidelity driving simulator, and digit symbol substitution task (DSST), subjective state by surveys, and long-term health-related biomedical measures by blood glucose, IL-6, leptin, testosterone, and blood pressure. In comparison to consolidated nighttime sleep or split sleep, participants in the daytime sleep condition slept less and were subjectively sleepier. Performance, mood, and blood pressure were unaffected by sleep condition. There were elevations in glucose and testosterone in the daytime sleep condition at the end of the work week. With respect to total sleep time and sleepiness, the findings of the present study suggest that split sleep is preferable to consolidated daytime sleep. This finding has implications for any revision of the FMCSA rules governing sleeper berth use in CMV drivers. Soon to be published to FMCSA's website.
2. **New Entrant Program Study.** This report presents theory and analysis of data for new entrant motor carriers in Montana who received simple, proactive training in FMCSA regulations in 2005–06, compared to a control group of new entrants. There are strong implications for the FMCSA's requirement to address the knowledgeability requirement of the Motor Carrier Safety Improvement Act section 210(b). Theory states that safety training of new entrants is a scientifically sound way to foster a safety culture that improves safety performance. Analysis of results from a simple training curriculum performed in 2005–06 demonstrates the theory. Improvement in safety performance was dramatic and statistically significant for the new entrants who embraced the concepts, as demonstrated by completing the voluntary reinforcing hands-on homework and receiving a critique. Improvements in driver performance measures were also positive even for the new entrants who did not bother to complete the optional reinforcing homework. However, in general, improvement of the "no-homework" new entrants was not statistically significant because of the smaller change in safety performance and the very small sample size. This split in performance between the homework and no-homework subgroups is consistent with training theory about the importance of reinforcement for training to be effective, and with social diffusion theory that says there are members of a population who are resistant to new ideas. New research is underway that incorporates lessons learned for how to more effectively influence more of the resistant new entrants. Preliminary results are extremely encouraging. Soon to be published to FMCSA's website
3. **Nurse Tank Research.** Findings are reported from a recently completed project that studied causes and possible remediation inspection strategies for anhydrous ammonia nurse tanks to prevent failures. Nurse tanks are steel tanks used to transport anhydrous ammonia locally over public roadways and farm fields. Many of the reportedly 200,000 nurse tanks in use in the United States are three to five decades old. Several tank failures have occurred in recent

years. Nurse tank failures can injure workers and bystanders by chemical burns, frostbite, suffocation, and explosion injuries. The project studied this problem by preparation of a survey of the technical literature on nurse tank properties and case studies of tank failures; examination of 20 used nurse tanks by metallography, glow discharge spectroscopy, neutron diffraction analysis of residual stresses, and ultrasound and fluorescent dye penetrate examination for cracks; and exposure of 56 specimens of the commonly used tank steel stressed in tension while either immersed in liquid anhydrous ammonia or exposed to pure anhydrous ammonia vapor for periods of several months, totaling seven months, to study formation and propagation of stress corrosion cracks. This research further confirms that stress corrosion cracking is the greatest threat to nurse tank integrity. Best inspection practices recommendations are presented to reduce the risks associated with nurse tank failures. Soon to be published to FMCSA's website

4. **The Impact of Driving, Non-Driving Work, and Rest Breaks on Driving Performance in Commercial Motor Vehicle Operations.** Current hours-of-service (HOS) regulations prescribe limits to CMV drivers' operating hours. Besides assessing activities performed in the 14-hour workday, the relationship between safety-critical events (SCEs) and driving hours, work hours, and breaks was investigated. The data used in the analyses were collected in the Naturalistic Truck Driving Study and included 97 drivers and about 735,000 miles of continuous driving data. The assessment of the drivers' workday determined that, on average, drivers spent 66 percent of their shift driving, 23 percent in non-driving work, and 11 percent resting. Analyses on driving hours (i.e., driving only) and SCE risk found a time-on-task effect across hours. Analyses on work hours (i.e., driving in addition to non-driving work) found that risk of being involved in an SCE increased as work hours increased. This suggests that time-on-task effects may not be related to driving hours alone, but implies an interaction between driving hours and work hours: if a driver begins the day with several hours of non-driving work, followed by driving that goes deep into the 14-hour workday, SCE risk was found to increase. The finding from the workday characterization that drivers spent approximately 23 percent of their workday performing non-driving work provides a possible explanation for this time-on-task effect across work hours. Breaks from driving were found to be beneficial in reducing SCEs (during 1-hour window after a break) and were effective to counteract the negative effects of time-on-task.

5. **Hours of Service and Driver Fatigue: Driver Characteristics Research.** There is a need to quantitatively and qualitatively associate crash occurrence with a range of commercial truck driver characteristics, including hours of driving and hours worked over multiple days. The need arises because of the desire to continue to refine Federal hours-of-service (HOS) regulations for truck drivers. An additional factor is the inconsistent and sometimes contradictory findings of truck driver safety research. This research used the probability of a crash after a certain amount of time driving given no crashes until that time. Carrier-supplied driver logs for periods of 1–2 weeks prior to each crash were used and compared to a random sample (two drivers) of non-crash-involved drivers selected from the same company, terminal, and month using a case-control logistic regression formulation. Data were separated into truckload (TL) and less-than-truckload (LTL) analyses because previous research indicated differences in crash contributing factors for these two segments of the trucking industry. Considering all the data, there is a consistent increase in crash odds as driving time increases. LTL drivers experienced increased crash odds after the 6th hour of driving. Breaks from driving reduced crash odds. In particular, a second break reduced crash odds by 32

percent for TL drivers and 51 percent for LTL drivers. There was, however, an increase in crash odds associated with the return to work after a recovery period of 34 hours or more.

6. **Efficacy of Web-Based Instruction to Provide Training on Federal Motor Carrier Safety Regulations.** This report presents an evaluation of the current state-of-the-art Web-based instruction (WBI), reviews the current computer platforms of potential users of WBI, reviews the current status of WBI applications for Federal Motor Carrier Safety Administration (FMCSA) stakeholders, and sets out specific instances of WBI successes in other Government regulatory agencies. The report also presents a set of measures that the FMCSA can use to measure the efficacy of any future WBI system that may be used to inform motor carriers and drivers, as well as Federal and State enforcement personnel, about regulations. Also included in this report is a literature review of general WBI literature, FMCSA and U.S. Department of Transportation uses of WBI, and other Federal and State Government WBI applications.
7. **Commercial Motor Vehicle Driving Simulator Validation Study: Phase II.** This study examined the effectiveness of a driving simulator for entry-level commercial motor vehicle (CMV) driver training and testing. Four training groups of 107 individuals (conventional 8-week certified course, conventional 8-week certified course with 60 percent of driving in a simulator, informal training with friends/relatives, and commercial's driver license [CDL] test-focused short courses) were followed from training into employment. There were no group differences in Division of Motor Vehicles (DMV) road tests. There were group differences in DMV range tests and validated real truck and simulator re-creations of DMV road and range tests. Conventional and simulator groups generally scored higher than informal and CDL test-focused participants. A 4-month follow-up after being hired as a CDL driver indicated no differences in performance, safety, self- or supervisory-ratings. Findings support the use of CMV driving simulator-based training, but simulator-based testing does not appear to be feasible at this point. Cost analysis indicated simulator training using the study simulator was $35/participant less expensive than conventional training. The simulator was examined in a demonstration of extreme conditions and emergency maneuvers under different vehicle configurations with 48 other drivers. Also provided is a case study of existing implementations of CMV simulator training, indicating benefits, drawbacks, and drivers' overall opinions.
8. **Synthesis of Literature Relating to Cellular Telephone/Personal Digital Assistant Use in Commercial Truck and Bus Operations.** There is an increasing awareness of the role of driver distraction in commercial motor vehicle crashes. This study presents the results of efforts to expand current knowledge of truck and motorcoach industry practices regarding commercial driver distraction. The project involved a thorough literature review on driver distraction. Little research specifically addressed commercial driver distraction; those studies that did examine commercial driving typically found significant degradations in driver performance due to visually demanding device use. However, the findings of automotive driver distraction research vary based on the type of examination (i.e., simulator, test-track, or naturalistic data collection methods) and the aspect of phone use. These findings, in light of the importance and potential safety risks posed by driver distraction, may help guide further research into the nature and magnitude of distraction faced by CMV drivers as part of their normal job functions.

Recap of FMCSA's Research Activities for 2011

The following are new studies that FMCSA started this calendar year:

1. **Performance Based Testing of Older Commercial Motor Vehicle Drivers Study**. Conducted an official project kick-off meeting for the above study on the 24th of October, 2011. Industry advocates, particularly representatives of motorcoach operations, have raised concerns that the Age Discrimination in Employment Act of 1967 precludes them from removing older drivers on the basis of safety concerns. Previous research has indicated that older drivers are more likely to cause at-fault crashes and other research has suggested that older drivers are almost twice as likely to be involved in crashes. This research study will determine whether the need exists for performance-based testing of older commercial motor vehicle drivers.
2. **Low Cost Device to Increase Safety Belt Use**. Conducted a project kick-off meeting for the SBIR Phase II development of a low cost device that can easily be installed in a CMV to increase safety belt use on the 12th of July, 2012. This SBIR project will pursue the development and full testing of the shift-interlock device; a prototype accelerator pedal resistance device along with a learning curve software to increase safety belt use by commercial motor vehicle drivers. It is anticipated that data from the Phase II multi-vehicle study will demonstrate a noticeable increase in seatbelt usage among large commercial vehicle drivers.
3. **North American Fatigue Management Program (NAFMP).** Conduced project Kickoff Meeting for the NAFMP. The NAFMP Steering Committee has been developing a comprehensive approach to managing fatigue in a motor–carrier operating environment. The research will address corporate culture, education and training, sleep disorders screening and treatment, scheduling and tools, and fatigue monitoring and management technologies.
4. **Cognitive Distraction and Eye Glance Analysis.** Conducted an official project kick-off meeting for the above study. The objective of this project is to better understand cognitive distraction through analysis of mobile phone conversations in real driving conditions. In addition, an analysis of eye glances will be performed as it relates to crash risk. The data will be from an existing naturalistic database from a vendor of onboard monitoring systems.

The following are new studies that FMCSA we will begin later this year:

1. **EOBR Cost and Safety Benefits Study.** The objective of this research effort is to conduct an assessment of the safety benefits of electronic onboard recorders (EOBRs) currently in use and its effect on HOS compliance. As part of its research questions, the study will examine whether CMVs or fleets equipped with EOBRs have a significantly lower crash and violation rates than CMVs or fleets without them.
2. **Research to Support Revisions to the Agency's EOBR Rule.** The objectives of this survey research effort is to a) collect data from drivers regarding their perceptions and experiences on how /whether electronic onboard recorders (EOBRs) are used to harass drivers; b) collect data from motor carriers on their usage of EOBRs to monitor driver and fleet productivity. The research will explore the relevant issues from the perspective of both drivers and carriers. Based on findings from the data collected, the study will outline a set of best practices that will ensure that HOS-MDs are not used by carriers for driver harassment.
3.

4. **Identifying Sleep Disorders in CMV Drivers Using Physiological and Behavioral Metrics.** The goal of this project is to develop a protocol for using OBMS video data and driver physiological measures (e.g., BMI) to identify drivers who show persistent drowsiness behind the wheel of a CMV. This protocol would provide guidance to fleets, working together with OBMS companies, to aid in the screening of drivers who may show signs of sleep disorders. If known to be effective, such a protocol may lead to both health and safety improvements. That is, in improving drivers' health by identifying those with characteristics for sleep disorders and improving roadway safety for all those who share the road with CMV drivers with an undiagnosed sleep disorder condition.
5. **Examining the Effectiveness of Commercial Motor Vehicle Entry Level Driver Training in improving Driver Safety Performance.** Earlier research has indicated that entry-level commercial motor vehicle (CMV) drivers were not receiving adequate training prior to beginning their professional driving careers. 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). The primary objective of this research effort is to examine the relative effectiveness of different entry level CMV driver training methods in improving driver safety performance.
6. **Quantifying Performance Differences in Simulator, Test Track, and Real World Driving for Distracted Driving Study**. Research on driver behavior and driving performance in surface transportation typically examines performance in either a driving simulator, on a test track, or under naturalistic conditions. However, the use of these different platforms can lead to results differing when examining similar concepts. The primary objective of this research effort is to prepare a method by which driver behavior and driving performance differences may be examined, across different three research platforms, with the ultimate goal of providing insight into the interpretation of study results from these platforms.
7. **Obesity Cost and Safety Risk for Commercial Motor Vehicle Drivers.** There is limited information on the safety and health implication of obesity in commercial vehicle operations. As such, the current project shall examine and quantify the health care treatment costs and safety risk in commercial vehicle operations (including commercial truck and bus drivers). The study shall also develop and test a pilot behavior-based health and wellness obesity program that will demonstrate weight loss in CMV drivers and can be adopted by large and small truck and bus companies. The study is aimed at providing data to the CMV industry showing that health and wellness programs can deliver return-on-investment via reduction in health care costs and safety risk.