

ANALYSIS, RESEARCH, AND TECHNOLOGY (ART) OFFICE

The strategic areas outlined in the current strategic plan include:

- *Produce Safer Drivers*
- *Improve Safety of Commercial Motor Vehicles*
- *Produce Safer Carriers*
- *Advance Safety Through Information-Based Initiatives*
- *Improve Security through Safety Initiatives*
- *Enable and Motivate Internal Excellence*

The following discussion identifies Research and Technology (R&T) division accomplishments in FY 2009. The R&T Division's completed a total of 25 safety studies in the following by strategic areas:

TO PRODUCE SAFER DRIVERS,

FMCSA completed 13 R&T studies, including a study of **(1) Driver Distraction in Commercial Vehicle Operations** using 20,000 crashes, near-crashes, crash relevant conflicts (i.e., safety-critical event) and baseline events recorded in naturalistic driving data. The data include 203 CMV drivers and about 3 million miles of continuously collected kinematic and video data. CMV drivers who were using their cell phones to send and receive text messages were 23.2 times more likely to be involved in a safety-critical event while texting than when not texting. During 6-second intervals, texting drivers took their eyes off the forward roadway for 4.6 seconds. This equates to a driver traveling the length of a football field at 55 mph without looking at the roadway. CMV drivers using a dispatching device while driving increased risk by 9.9 times. Other distracting activities included writing (9.0), using a calculator (7.0), looking at maps (7.0), dialing a cell phone (5.9), and personal grooming (4.5). Publication of these results prompted the Secretary of Department of Transportation to host a Summit on Driver Distraction. Additionally, the Agency completed a **(2) Pilot Test of Low Cost Onboard Monitoring System (DriveCam)** to improve CMV driver performance. The pilot test was conducted with two motor carriers and 100 outfitted trucks. Results indicated that feedback provided by the DriveCam system and coaching drivers can reduce driver errors by nearly 50 percent. FMCSA developed and launched a web-based **(3) Defensive Driving Tips for Fleet Safety Managers and CMV Drivers training tool**. This web site augments existing training programs by providing supplemental defensive driving tips i.e., "do's" and "don't" to CMV drivers and fleet managers. In the area of CMV driver fatigue, FMCSA completed two studies – **(4) Assessment and Refinement of North American Fatigue Management Program (NAFMP)**. In this study, FMCSA and Transport Canada implemented the full NAFMP program in three carriers to determine program cost/safety effectiveness. The study highlights important issues that need to be addressed in implementation of the NAFMP and raised concerns regarding compliance with sleep apnea treatment. FMCSA also completed an **(5) Investigation into Motor Carrier Practices to Achieve Optimal CMV Driver Performance**. The study examined the effectiveness of the current 34-hour restart provision in restoring driver performance under best case (day-time driving) and worst case (night-time driving)

scenarios. This research is in support of the hours of service rule. (6,7) The agency completed two field operational tests on different technologies for determining the availability of parking spaces at truck parking areas. These technologies are magnetometry and video imaging. The results of the field operational tests will determine whether a technology will be selected for continuation into Phase II of SmartPark project. SmartPark is a project to demonstrate technology for providing information about truck parking availability to truckers in real-time on the road. FMCSA also completed two Small Business Innovative Research (SBIR) phase I development efforts – (8) **Drowsy Driver Warning Device** to develop a prototype system that can detect and warn drivers who are drowsy and about to fall asleep and the other (9) **Safety Belt Use System** develop a low cost device that can easily installed in a CMV to increase safety belt use. FMCSA also completed the (10) **Skid pad project at Lewis-Clark State College** in Lewiston, ID. The skid pad project involved construction of a large, paved surface area and control center to train CMV drivers how to control maneuvers involving apparent loss of "vehicle control," such as on slippery surfaces or jack-knives, using a specially manufactured vehicle with skid technology (instead of wetting the pavement surface). FMCSA completed the (11) **Motor Carrier Efficiency Study**. The results identified key freight movement inefficiencies in the motor carrier industry and identified promising wireless technologies that had significant estimated benefits to address these inefficiencies. FMCSA is currently overseeing four Phase II field demonstrations of wireless technologies to document real-world benefits in order to promote their use by motor carriers. The Agency also completed the (12) **Wireless Roadside Inspection Proof-of-Concept (WRI POC)**. The results demonstrated the technical feasibility of wirelessly inspecting a truck and bus while the vehicle was traveling by a fixed roadside site and next to a State police cruiser at highway speeds. Technical efforts dealt with the ability of a wireless inspection system to collect driver, vehicle, and carrier information; format a safety data message set (SDMS) from this information; and wirelessly transmit a SDMS to a roadside receiver unit or mobile enforcement vehicle. As a result of the WRI POC testing, it is concluded that wireless roadside inspection holds considerable promise in increasing the safety of our highways by: improving the quality of the inspections performed, allowing more inspections to be conducted, and providing industry benefits for these technologies that encourage early adoption. FMCSA completed (13) **Santa Teresa, New Mexico Radio Frequency Identification (RFID) Field Operational Test**. The results of this field operational test demonstrated the time savings and safety enforcement benefits of integrating RFID roadside readers into the safety assurance and inspection operations at the international border crossings. This project demonstrated a system that reduced the manual safety screening process by FMCSA inspectors from 15 minutes to 1 second by scanning existing RFID tags already present on the windshields of all Mexican trucks entering the U.S. and correlating the tag ID with FMCSA safety data files.

TO IMPROVE SAFETY OF CMVS,

FMCSA completed six studies including an (1) **Assessment of Exposure Risks of Trucking Occupational Hazards faced by CMV drivers**. This study simultaneously measured air pollution concentrations, noise, and vibration inside truck cabs and sleeping berths while driving in different speeds and idling at a truck stop. This study identified

that late model CMVs do not pose significant health risks to drivers. Parking in congested trucks stops does, however, increase exposure to diesel particulate matter. The Agency conducted a study to **(2) Identify Factors That Affect the Service Life of Cargo Tanks**, which provided guidelines for testing, inspection, assembly, and repairing cargo tanks, as well as information needed to update the FMCSRs regarding cargo tanks. FMCSA completed an **(3) Onboard Safety System (OSS) Assessment Report** that focused on a survey of the industry's awareness of, use of, and satisfaction with these systems; their rate of deployment; the number of suppliers; and the associated costs and benefits. This report analyzed the economic costs and benefits for three commercial motor vehicle onboard safety systems: Forward Collision Warning Systems (FCWS), Lane Departure Warning Systems (LDWS), and Roll Stability Control Systems (RSC). To be widely deployed, these systems must be beneficial, cost-effective investments that meet motor carrier needs. The purpose of the benefit-cost analysis (BCA) reports was to provide return on investment information for the motor carrier industry in support of future purchasing decisions of the onboard safety system. Under the President's Hydrogen Fuels Initiative, FMCSA, in cooperation with the Research and Innovative Technology Administration, completed **(4) Hydrogen Fuel Regulations** study to determine the changes needed to accommodate hydrogen as an alternative fuel in CMVs. DOT envisions hydrogen will be used as a near-term or mid-term alternative fuel technology for commercial vehicles to provide auxiliary power (i.e., refrigeration, lighting, and air conditioning) in order to avoid diesel idling and propulsion power in local, urban fleets of delivery trucks. This effort identified several major changes required to accommodate the use of hydrogen in CMVs, including revisions to the FMCSR, the North American Standard Inspection Procedures, and the North American Standard Out-of-Service criteria. FMCSA also completed an **(5) Assessment of the use of Onboard Safety Systems** in truck fleets. This work included a major survey of fleets on their awareness of and use (or plans for future use) of these systems. The five technologies examined included: lane departure warning, electronic stability control, forward and side collision warning, and vehicle tracking systems. FMCSA completed an **(6) Onboard Safety System Industry Demographics Analysis Project** on small carrier usage of onboard safety systems. This work included case studies of 12 carriers as well as interviews with numerous other carriers on whether they use these systems and why or why not. By working with the trucking industry, the FMCSA envisions a future of smart technologies that support the expanding role of the trucking industry to transport the Nation's goods and products safely, securely, and efficiently. These technologies or safety systems include lane departure warning systems, stability control systems, and collision warning systems.

TO PRODUCE SAFER CARRIERS,

FMCSA completed four studies, including a **(1) Pilot Test of a State Employer Notification Service**. Research has shown that drivers with convictions are significantly more likely to be involved in crashes than those with no convictions. The goal of this pilot test was to evaluate how carriers use this real-time information and to evaluate whether it aids them in modifying the affected drivers' behavior or removing those drivers from the road. FMCSA completed the **(2) Efficacy of Web-Based Instruction for Training CMV Regulations and Best Practices study**. Because of resource

constraints and the sheer number of motor carriers, the FMCSA must employ state-of-the-art training methods to reach the Nation's 700,000 motor carriers. This study examined the efficacy of using WBI to disseminate information and train personnel within the motor carrier industry regarding FMCSRs. The Agency also completed a (3) **HAZMAT Shipper Prioritization study**. This study reviewed, documented, and refined an algorithm to identify HAZMAT shippers who should receive safety compliance reviews. The Agency also expanded on the (4) **HAZMAT Serious Crash Analysis**, which provided more detail on the factors that contribute to serious crashes involving trucks hauling HAZMAT.

TO ADVANCE SAFETY THROUGH INFORMATION-BASED INITIATIVES,

FMCSA completed an **Evaluation of the Commercial Vehicle Information Systems and Networks (CVISN) Program**. The objective of the CVISN program is to assist all States in completing deployment of core and expanded CVISN capabilities. FMCSA had an independent evaluation of the deployment and operation of CVISN program. With the main goal of measuring the effects of CVISN on the safety, efficiency, and economics of commercial vehicle operations, four main analyses were performed: motor carrier survey, cost analysis, safety analysis, and benefit-cost analysis. The evaluation of the CVISN Program documented the potential safety benefits that could be realized with nationwide deployment of expanded electronic screening capabilities. Depending on the level of advancement, these annual benefits included: 3,686 to 21,046 fewer commercial vehicle-involved crashes and potentially over 928 million dollars saved through avoided fatalities. In addition to these safety benefits, the evaluation documented a series of productivity and mobility enhancements that also are being realized by state agencies that are participating in the CVISN program and by motor carriers that are making use of CVISN services. These benefits include improved efficiency, reduced costs, reduced congestion, improved working conditions, and improved accuracy and customer service.

TO IMPROVE ORGANIZATIONAL EXCELLENCE, the Analysis, Research, and Technology (ART) Office begin the process of updating the ART Office's 5-year strategic plan (2010-2015); this effort will be completed by December 2009. The research and technology divisions sent two Reports to Congress, one on the Motor Carrier Efficiency Study and the other regarding 2009 Research and Technology Funding Report. Additionally, the ART Office supported and participated in Driving Distraction Summit, DOT's Human Factors Coordinating Committee's (HFCC) International Conference on Fatigue in Transportation Operations. The ART Office supported and participated in the 2009 International Driver Assessment Conference.

NEW SAFETY INITIATIVES.

Onboard Monitoring Field Operational Test (FOT). The goal of this effort is to develop and evaluate an onboard monitoring system (OBMS) that allows for direct measurement of a set of driving characteristics that are indicators of unsafe driving behavior. FMCSA will be using a prototype suite developed to provide real-time feedback to CMV drivers or provided to carrier management via a roll-up report for discussion with the driver regarding their driving performance. The system has the potential to improve drivers' attentiveness and enhance their safety performance. A field operational test will be started in 2009 involving 250 trucks with the OBMS suite of technologies and include as many as 1,000 CMV drivers. FMCSA has received letters of commitment from two large motor carriers. The study will answer research questions regarding the value of providing feedback to drivers regarding their safety performance. Eighteen (18) months data collections X 250 trucks X ~ 100,000 miles per year equates to approximately 32 million miles of naturalistic driving data. This effort will be the largest naturalistic driving study ever conducted for CMV drivers.

Case-Control Commercial Driver Individual Differences Study (CDIDS). The purpose of this study is to identify the most critical driver risk factors through a case-control study approach. The primary factors to be examined include demographic characteristics, medical conditions, personality traits, personal attitudes, work environmental conditions, and behavioral history. The study will link the characteristics of individual drivers with their driving records with a focus on crashes and moving violations. This study will consist of a medical examination and battery of psychological and behavioral history measures administered to 21,000 drivers with the expectation that at least 2,000 cases (drivers that have been in crashes) and 2,000 controls (drivers that have not been in crashes) can be identified. A recently completed pilot study proved the methodology for this larger study and produced some preliminary findings. This effort will be a full-scale CMV driver case-control study.

Driver Distraction

Synthesis of Literature & Operating Safety Practices Relating to Cell Phone/PDAs Use in Commercial Truck and Bus Operations. The objectives of this study are threefold. The first is to synthesize findings relating to cell phone use in automobiles, and any research findings and conclusions relating to commercial vehicle operations. Second, the project will identify current cell phone practices (including limitations on the use of PDAs) of motor carrier operations to identify the magnitude of the use in the industry. Consideration will be given to the applicability of findings relating to car drivers to truck and bus driving environments, as well as to the rationale and driving factors that have led fleet managers to restrict or manage cell phone and/or PDA use.

Driver Distraction in Commercial Trucks and Buses: Assessing Prevalence in Conjunction with Crashes and Near-crashes. The purpose of this research is to conduct an analysis of naturalistic data collected by DriveCam over a 1-year period. Commercial trucks (3-axle and tractor-trailer) and buses will be the target vehicles in the

analyses. These data will provide FMCSA with descriptive data on the adverse consequences of cell phone use and other distractions while driving. In addition, DriveCam will re-review all valid cell phone events within the last 90 days to determine the frequency of the following cell-phone variables: dial cell phone, reach for cell phone, reach for Bluetooth/headset/earpiece, talk/listen on hands-free cell phone, talk/listen on hand-held cell phone, and text/email/surf web on cell phone. The results of these analyses will provide information on the scope of cell phone use, and other distractions, during valid safety events and crashes within the time periods noted above. The current project consists of eight research tasks conducted over a 12-month period.

Drowsy Driver Monitoring System. Begin phase II of a Small Business Innovative Research (SBIR) project to develop a Drowsy Driver Monitoring System. Working to develop fully functional a drowsy driver monitoring system that works 24-hours a day, on all drivers through the use of machine vision and a fusion of multiple sensors. The system at a minimum measure the percentage of eye closure and lane tracking to evaluate alertness.

Effectiveness of Fostering Safety Culture in Motor Carriers. Evaluate effectiveness of proactive FMCSA regulation training for new entrant motor carriers on: their pass rate of the required Safety Audit; and their ongoing safety performance. Because past experience documented most new entrants do not have any business knowledge, FMCSA is also partnering with the Service Corps of Retired Executives (SCORE) to provide them business training. In keeping with the recommendations of the TRB Synthesis report 14 (Safety Culture), the goal is to evaluate effectiveness of fostering development of a culture for making daily operating decisions based on both good business practices and FMCSA regulatory requirements.

IntelliDrive Program. The U.S. Department of Transportation's (USDOT) IntelliDrive program has an ultimate vision of "crashless" vehicles operating on an information-rich transportation system. With its vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications of crucial data, advisories, and potential alerts, IntelliDrive offers tremendous benefits in reducing crashes. The richer exchange of more information will allow truck and bus drivers to respond faster and more effectively to potential hazards on the road. Other related safety applications include wireless monitoring of the safety status of drivers, vehicles, and fleet operators as they drive down the road, and a "real time" parking system that allows truck drivers to reserve guaranteed parking spaces at the end of their work day.

IntelliDrive is a suite of technologies and applications that use wireless communications to provide connectivity that can deliver transformational safety, mobility, and environmental improvements in surface transportation. IntelliDrive applications provide connectivity with and among vehicles, between vehicles and the roadway infrastructure, between infrastructure and wireless devices (i.e., consumer electronics, such as cell phones and PDAs) carried by drivers, pedestrians, and bicyclists. Four initial categories of IntelliDrive applications for commercial vehicles include:

- Safety technologies that reduce commercial vehicle crashes, and improve response to crashes that do occur, such as driver condition monitoring, collision avoidance, and Trucker Advisory Systems.
- Travel information technologies that reduce travel times and make trip time estimates more reliable for commercial vehicle drivers and dispatchers, such as commercial vehicle specific routing and interactive maps.
- Fleet management technologies that provide total asset visibility for motor carriers, shippers, and receivers as well as real-time diagnostic monitoring of commercial vehicles for motor carrier maintenance, operations, and safety managers.
- Wireless inspection and enforcement technologies that enable more efficient operations at inspection stations, intermodal facilities and border crossings; and improved security and tracking for high-risk/regulated cargo, such as vehicle and driver e-screening and credentialing.

The scope and complexity of the motor carrier industry is vast. Trucks carry 80 percent of all U.S. goods, and motorcoaches transport about 600 million passengers each year. Although trucks and buses represent about 3% of registered vehicles and only 7 percent of travel volume, they are involved in 12 percent of highway fatalities. Almost 100 Americans lose their lives each week from crashes involving large trucks and buses. As shown in the figure, V2V and V2I systems would prevent approximately 71 percent of all heavy-truck crashes annually. Applying this number to the 4190 fatal truck crashes in 2007 shows that 2975 crashes could potentially have been prevented by the use of IntelliDrive—a quantum leap forward in improving truck and bus safety, mobility, and emissions.

Wireless Roadside Inspection research program – expect to pilot test concept in TN, KY, and NY starting in June 2010 through Dec 2010.

Motor Carrier Efficiency Study. As part of the Motor Carrier Efficiency Study, FMCSA has funded a project to evaluate commercially available truck-based cargo theft technologies. The “Testing and Evaluation of Truck-Based Cargo Theft Technologies” project is in Task 2 of 6 and will conclude in September 2010. The final report will include a literature review, results and analysis of data generated in field demonstrations as well as interviews with fleet users of these systems.