

## FMCSA'S ANALYSIS, RESEARCH, AND TECHNOLOGY (ART) OFFICE - PROJECT OVERVIEW

The Federal Motor Carrier Safety Administration (FMCSA) has developed a series of "roadmaps" for the analysis, research, and technology programs as a planning tool to help identify and prioritize these programs and initiatives between now and 2013. These roadmaps are an extension of the Research and Technology 5-Year Strategic Plan that established the agency's strategic research and technology priorities for fiscal years 2005-2009. The agency is initiating an effort to update this strategic plan to identify the most promising analysis, research, and technology initiatives to explore in the next several years.

The strategic areas outlined in the current 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 Projects that the ART Office is currently working on:

### RESEARCH DIVISION PROJECTS

#### *(1) Produce Safer Drivers:*

##### *— Expected Completions*

- 1) Development of a website that provides **Defensive Driving Tips for Fleet Safety Managers and CMV Drivers** based on naturalistic driving video.
- 2) **Pilot Test of Low Cost Onboard Monitoring System (DriveCam) to Improve Driver Performance**. The pilot test was conducted with two motor carriers and 100 outfitted CMVs.
- 3) **Driver Distraction Study in Commercial Vehicle Operations** using naturalistic driving data. The objective of this study is to characterize crashes, near-crashes, crash-relevant conflicts (i.e., safety-critical event) and baseline events that were recorded in the FMCSA and NHTSA co-funded Drowsy Driver Warning System Field Operational Test (DDWS FOT) and the FMCSA-funded Naturalistic Truck Driving Study (NTDS). The characterization of these events will focus on identifying secondary tasks and other activities that drivers engaged in prior to the event occurrence. The frequency and percentage of various distraction types will be assessed.

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- 4) **Assessment and Refinement of North American Fatigue Management Program (FMP).** FMCSA & Transport Canada are working together to evaluate the FMP. FMP Components: sleep apnea screening as well as training for managers, schedulers, drivers, and drivers' families. In the current phase (Phase III) implementing the full FMP program in one U.S. (JB Hunt) and two Canadian motor carriers for one year to determine its cost/safety effectiveness and derive information for improving the program.
- 5) **Small Business Innovative Research (SBIR) phase I development and begin phase II of a Prototype Development of 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.
- 6) **Investigation into Motor Carrier Practices to Achieve Optimal CMV Driver Performance.** Study will examine the effectiveness of the current 34-hour restart provision CMV drivers in restoring performance and to evaluate alternative restart durations. A two-phase, in-laboratory, experimental approach is envisioned. In Phase 1, the effectiveness of the current 34-hour restart provision will be evaluated using best case/worst case designs. Phase 2, if needed, will look at alternative restart periods

### ***– New Starts***

- 1) **Onboard Monitoring System (OBMS) 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. Five "core behavioral categories," served as the basis for the onboard monitoring system: 1) speed selection, 2) following behavior, 3) attention/inattention, 4) fatigue, and 5) general safety (good driving practices). A field operational test will be started in 2009 involving 200 to 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. Each of these carriers has committed at least 100 trucks to this project. The study will answer research questions regarding the value of providing feedback to drivers regarding their safety performance. This effort will be the largest naturalistic driving study ever conducted for CMV drivers.
- 2) **Effectiveness study for Applying Alternative Instructional Technologies to prevent HAZMAT Cargo Tank Rollovers.**

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- 3) **Phase II Development of a Low Cost Device to Increase Safety Belt Use.** This ongoing research initiative, entering Phase II in FY09, will explore a low-cost, easily installed device to increase the use of safety belts by CMV drivers. This project will pursue the development of a technology identified in the Safety Belt Technology Countermeasures Study (published December 2006) to increase safety belt use and/or improve the comfort level of safety belts in CMVs, particularly for smaller stature and larger drivers.
- 4) **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 3,000 cases (drivers that have been in crashes) and 3,000 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.
- 5) **Advanced Fatigue Modeling for Individual Differences – SBIR** We now have generalized fatigue models that were developed by Steven R. Hursh, Ph.D. as part of an SBIR project for the Air Force –The Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE™) Model and Fatigue Avoidance Scheduling Tool (FAST™) and few years ago they were validated by the Federal Rail Administration (FRA). This project will further develop fatigue models to take into account individual differences in fatigue and performance.
- 6) **Research to Support FMCSA Rulemaking Activities**
  - **Efficacy of Web-Based Instruction for Training Motor Carrier Regulations and Best Practices.**
  - **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.

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### *– Continuations*

- 1) **Driver Recovery and Napping.** FMCSA & Transport Canada are working together to evaluate recovery periods and napping strategies for CMV drivers. Study will investigate and make recommendations regarding the minimum duration of off-duty periods required for CMV drivers to recover from the effects of cumulative fatigue resulting from various work shift conditions.
- 2) **Motorcoach Driver Fatigue Study.** Builds upon previous motorcoach fatigue studies examining operating practices and driver schedules to develop an authoritative study upon which to support improved regulatory policy.
- 3) **Safety and Health Impacts of Split-Sleep.** Emerging research seems to be finding that splitting into two shorter sleep periods results in equal or better alertness levels although time of day in which the sleep periods are taken is critically important. This study will examine the effects of split sleep regimens on driver alertness and health.
- 4) **HOS & Driver Characteristics Research.** Study will involve gathering of motor carrier logbooks by operational type and will examine the relationship of each to the probability of a crash. Study will examine the fatigue-related large truck crash risk by hours of driver and the probability of a large truck crash.
- 5) **Simulator Validation (SIMVAL) for Training CMV Drivers Study.** Research partners include VTTI, Delaware DOT, and Delaware Tech. Phase I -pilot test was completed 2005. Developed the process, procedures and driving scenarios for study. Phase II Empirical Study began in 2006. Evaluate conventional CMV training vs. simulator-supported training vs. no formal training vs. CDL focused training. Examine whether simulator technology enhances CMV driver training and long-term driver performance. Examine benefits of training (no training group). Examine shorter training program (2-3 week) vs. longer PTDI-certified training program (8 weeks). "Showcase" the advanced capabilities of truck simulators to replicate emergency/emergency maneuvers and tankers
- 6) **Crash Analysis using Naturalistic and LTCCS data.** This project will serve as an opportunity to learn about crash causation by analyzing and comparing the Large Truck Crash Causation (LTCCS) data base and naturalistic driving data sources developed by FMCSA. Both of these data sources provide in-depth information, but they have contrasting strengths and weaknesses. The LTCCS contains information on a sample of fatal and injury crashes but relies on data collected during crash investigations and does not have detailed level of "driver behavior" data (e.g., data on driver eye glance prior to the crash). The naturalistic driving datasets contain data on a smaller set of crashes of lower severity and are

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detectable from dynamic vehicle events (e.g., hard braking). They provide direct video observations of the driver and the surrounding driving scene and precise dynamic data on driver input (kinematics) and captured events.

### ***(2) Improve Safety Of CMV:***

#### ***– Expected Completions***

- 1) **Assessing Exposure Risks of Trucking Occupational Hazards (Phase I).** 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.
- 2) **Identify Factors That Affect the Service Life of Cargo Tanks.**
- 3) **Engineering and Root Cause Analysis of Motorcoach Fires.** The purpose of this research is to conduct a DOT multimodal (NHTSA, FMCSA) sponsored study of bus and motorcoach fires. The study will initially determine the root causes of 10 bus and motor coach fires. For these fire incidents, detailed engineering root cause analyses will be conducted. After evaluating 10 incidents, a decision will be made on whether to expand the sample size to additional cases. Root cause analysis is a proven method for investigating, categorizing, and ultimately eliminating causes of incidents with safety, health, and environmental impacts. The findings of the analyses may lead DOT to generate specific, concrete recommendations for preventing future fire incidents.

#### ***– New Starts***

- 1) **Safety Impacts of Speed Limiter Devices on CMV.** The purpose of this research is to determine the impacts on a motor carrier of implementing speed limiter programs by the motor carrier industry. These impacts can be safety through a reduction in the number and severity of crashes as well as economic, through increased fuel economy and reduced maintenance. The study will collect both quantitative and qualitative data to evaluate the impacts of speed limiters. The study approach envisioned is a before-after evaluation using an advanced methodology to control for a number of confounding factors. This research is to determine the impacts on a motor carrier of implementing speed limiter programs by the motor carrier industry.
- 2) **Test and Recommend Best Practices to Improve Nurse Tank Safety.** The purpose of this research is to determine the service life limitations of nurse tanks that are used for transporting/applying anhydrous ammonia and to make recommendations as to the periodic testing and maintenance of these types of cargo tanks. The study will collect both quantitative and qualitative data to evaluate the service life of nurse tanks. The study approach envisioned is a literature review to identify previous research on the service life of nurse tanks,

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identification of the procedures and regulations that other governments have put in place to monitor the safety of nurse tanks. The study will test a number of nurse tanks to determine the corrosion rates of materials and welds used for these tanks. The testing results will then be used to model the degradation of nurse tank integrity.

### ***(3) Produces Safe Carriers:***

#### ***– New Starts***

#### **Effectiveness of Fostering Safety Culture in Motor Carriers**

### ***(4) Advances Safety through Information-Based Initiatives:***

**Partnerships with the Transportation Research Board (TRB).** FMCSA has a long-standing partnership with the National Academies of Science's TRB, which will be broadened to increase TRB's participation and expertise in FMCSA's analysis, research, and technology programs. Specific joint activities include publishing truck and bus synthesis reports and special reports, conducting conferences, and publishing reports from the Innovations Deserving Exploratory Analysis (IDEA) program.

### ***(5) Improve Security through Safety Initiatives:***

#### **Cost Effectiveness of FMCSA Providing CDL, Carrier Licensing and Insurance, Other Public Safety and Credentialing Data to the Nlets Community.**

### ***(6) Enable and Motivate Internal Excellence***

- 1) **Development of the ART Office 5-year Strategic Plan.** Begin the process of updating the Research and Technology 5-year Strategic plan (2010-2015) and further develop and enhance the R&T program metrics.
- 2) **Conference Support.**
  - ART Office Forum at TRB's Annual Meeting in Jan 2009.
  - International Fatigue in Transportation Operations Conference in Mar 2009.
  - Driver Assessment Conference in Jun 2009.
  - Planning for the 3<sup>rd</sup> NSC's International Truck and Bus Safety Conference.
  - Planning for FMCSA/NIOSH CMV Driver Health & Wellness Conference

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## TECHNOLOGY DIVISION PROJECTS

### *(1) Produce Safer Drivers:*

**Employer Notification Service, Phase II.** The purpose of this study is to determine the potential safety benefits of Employer Notification Service (ENS). The agency completed the first phase that found that such a system would be both cost-beneficial and feasible. To further analyze the system, an 18-month pilot test will be conducted. The main goal of this project is to evaluate how carriers use this real time information and if it aids them in either modifying the affected drivers' behavior or removing them from the road. The second phase will: (1) Develop study design and performance measures; (2) Build and test prototype ENS; (3) Select Pilot States and Motor Carriers; (4) Develop and deploy prototype system in Pilot States; (5) Conduct Pilot Test; (6) Evaluate and document results of the Pilot Test.

### *(2) Improve Safety Of CMV:*

- 1) **Enhanced Rear Signaling, Phase II** In 2005, FMCSA initiated development of a prototype enhanced rear signaling system for use on large trucks. The system addresses rear-end crashes involving vehicles hitting the rear of trucks. The countermeasures identified in Phase I for the rear signaling system include: (1) LED brake lamps with an ambient light sensor to make the lamps brighter in direct sunlight and more conspicuous in bright ambient light, (2) brake lamps that are activated by engine braking to address the increasing use of Jake brakes in trucks, (3) additional conspicuity markings that create a more accurate perception of the truck position for following drivers, and (4) a sensor system that detects and tracks a following vehicle and sounds a focused audio signal and illuminates a traffic clearing lamp when the vehicle is following too closely. The system was evaluated by installing it on a test truck and by observing the behavior of drivers in real-world conditions. Based on the analysis of following driver behavior, the system showed that there are possible benefits. The current phase of the project will entail lab, simulator, track, and jury tests to ascertain the best configuration and combination of countermeasures to be used in a large scale field operational test. One part of the research will explore the most effective photometric characteristics of the enhanced brake lamps. Finally, a large-scale field operational test will be conducted to fully analyze the rear-signaling system. Its goal will be to determine the effectiveness of the specific components of the system and develop support for any potential rulemaking action.
- 2) **Indirect Viewing System Field Test, Phase III.** FMCSA and NHTSA have a joint project underway with VTTI involving the use of Camera/Video Imaging Systems (C/VISs) in large trucks to improve visibility. In the first phase of this project, both mirror surrogates and enhancements are being studied and tested. Mirror enhancements provide the driver with images that are presently unavailable from standard mirror configurations (e.g., elimination of blind spots).

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Mirror surrogates provide the driver with the same or similar images that are available from standard mirror configurations. In the first part of this project, the tests are limited to conventional video systems, with cameras at appropriate locations on the exterior of the vehicle and with video monitors in the cab at locations that have been selected on the basis of human factors considerations and preliminary testing. This work defined field of view requirements and performance specifications for indirect viewing systems. The second phase of this project was directed at enhancing C/VISs for night and poor visibility conditions, which was tested and evaluated in a controlled setting (i.e., Smart Road). The current third phase of the project is a field demonstration of an advanced C/VIS using commercial vehicle fleets. The goal is to assess the safety and driver performance benefits of enhancing the "west coast" style mirror system with advanced indirect viewing technologies. Generally referred to as the "360-degree/all-weather" indirect visibility system, C/VISs have potential to reduce the large number of heavy vehicle lane change/merge crashes.

- 3) **Field Demonstration Test of the Collision Mitigation System, Phase I**
- 4) **SmartPark: Real-time Parking Availability.** FMCSA has undertaken an initiative called SmartPark to demonstrate whether an intelligent transportation system (ITS) for providing parking availability information in real-time to truckers on the road will work for diverting trucks from filled to unfilled parking areas. A potential benefit of the system for drivers is that it may help them manage fatigue. Phase I of the project began in May 2007 to examine different technologies for providing parking availability information. Awards were made to two different contractors to demonstrate a technology to collect data on space occupancy and to analyze the collected data to determine truck parking availability. Phase II includes tasks for calibrating parking count, disseminating real-time truck parking availability information, making truck parking reservations, forecasting truck parking availability based on past usage, equipping adjacent truck parking areas in a corridor or region to divert trucks from overfilled to under-filled lots, converting temporary to permanent installation, assigning truck parking based on departure, and compiling a business plan for self-sustainability.
- 5) **Wireless Roadside Inspection.** This program will evaluate the potential benefits to both the motor carrier industry and the government of a wireless roadside inspection program. In 2007, the technology to support wireless roadside inspections was successfully demonstrated at the FMCSA's CMV Roadside Technology Corridor along Interstates 40 and 81 in Tennessee. One potential benefit of this inspection system includes keeping safe and legal drivers and vehicles moving on the highways without having to stop at roadside stations. The system has the potential to significantly support FMCSA's Comprehensive Safety Analysis 2010 (CSA 2010) initiative. The program is currently in the pilot testing phase. In 2009 and 2010, several information technology elements to support wireless roadside inspections will be developed and tested.



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- 6) **Safety and Security Technology Deployment.** In 2009, FMCSA will initiate more rigorous analyses of existing and "next generation" onboard safety systems. For systems currently deployed on large trucks, the efficacy of lane departure warning systems, forward collision warning systems, and electronic stability control will be determined using previously collected crash data from motor carriers using these systems. This research will focus on the different types of crashes prevented by these technologies. Additional information about specific carriers' experiences using these systems will be collected to highlight the key steps and elements of safety technology installation, testing, maintenance, training, acceptance, and usage.
- 7) **CVISN Deployment Program, Support for Expanded Capabilities.** The Safe, Accountable, Flexible, Efficient Transportation Equity Act for the 21st Century (SAFETEA-LU) established a Commercial Vehicle Information System and Networks (CVISN) deployment program to support state efforts at \$25 million per year from FY 2006–2009. The primary objective of the CVISN program is to assist all states in completing deployment of core and expanded CVISN capabilities. Core capabilities support exchanging motor carrier safety information among federal, state, and industry partners, electronically screening trucks for compliance with safety and weight regulations at the roadside, and automating the application process for interstate commercial vehicle registration and fuel tax credentials. Expanded CVISN capabilities will focus on enhancing the safety, security, and productivity of commercial vehicle operations in the following four primary areas: 1) driver information sharing, 2) enhanced safety information exchange, 3) interoperable technology for future roadside operations, and 4) expanded electronic credentialing. FMCSA will direct its future research and development activities on developing expanded CVISN capabilities associated with sharing commercial driver information.
- 8) **CDL 3rd Party Testing Anti-Fraud Software.** FMCSA entered into a cooperative agreement with the American Association of Motor Vehicles (AAMVA) to initiate a two-phase commercial driver license (CDL) anti-fraud testing project. The goal of the project is to develop and implement a system to detect and deter fraud during the commercial skills testing portion of the CDL application process. As part of this project, FMCSA funded the CDL Skills Test Information Management System (CSTIMS), which applies not only to third-party testers, but all CDL testers. The CSTIMS is web-based and manages the information storage and retrieval process for all skills tests, and prevents and detects fraud.

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## **ANALYSIS DIVISION PROJECTS & ACTIVITIES**

### **New Starts:**

**Pre-employment Screening Program** – FMCSA is developing the Pre-Employment Screening Program (PSP) to meet the requirements of SAFETEA-LU to allow drivers to make their crash and inspection data available to potential motor carrier employers. FMCSA will award a contract in 2009 for this voluntary program which will allow a motor carrier to review crash and inspection files from MCMIS on a driver prior to hiring the driver.

### **On-going:**

**CSA 2010 Op Model Test** – FMCSA has contracted with the University of Michigan Transportation Research Institute to conduct an independent evaluation of the proposed Comprehensive Safety Analysis 2010 program. CSA 2010 is expected to improve safety through using more and better data to identify high risk carriers and drivers and then apply a wide range of interventions to correct high-risk behavior. The Operational Model Test, started in 2008, involves four states (CO, GA, MO, NJ) with carriers divided into control and test groups so that UMTRI can measure any differences in safety performance between the current way of identifying and intervening on high risk carriers and the new procedures under CSA 2010. The testing will be completed in 2010.

**Data Analysis** – the Analysis Division produces analytical studies and statistical compilations, either in-house or via contract, of key motor carrier safety-related issues. This includes Regulatory Impact Assessments of FMCSA rulemakings, crash statistics and related-studies, and analyses and reports on safety topics such as drug and alcohol usage.

**Data Quality** – FMCSA has a comprehensive data quality program to provide assistance to States in improving the completeness, accuracy and timeliness of the data they report to FMCSA. Assistance comes in several forms, including awarding \$3 million annually in Safety Data Improvement Funding grants to States, on-site State data quality reviews, and holding data quality training and conferences.