

NIOSH Center for Motor Vehicle Safety: Research and Guidance Strategic Plan 2014-2018

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Work-related motor vehicle safety: Background and significance

The risk of motor vehicle crashes associated with on-the-job operation of motor vehicles or exposure to road traffic hazards affects millions of workers in the United States. Fatality data show that across all industries, motor vehicle-related incidents are consistently the leading cause of work-related fatalities, and they are the first or second leading cause in every National Occupational Research Agenda (NORA) industry sector. Of 47,718 work-related fatalities reported by the Bureau of Labor Statistics between 2003 and 2011, 17,037 (36%) were associated with motor vehicles.¹ The toll for this nine-year period included:

- 11,305 deaths in single- or multiple-vehicle crashes on public roadways
- 2,709 deaths in crashes that occurred off the highway or on industrial premises
- 3,023 pedestrian worker deaths as a result of being struck by a motor vehicle

Crash-related fatalities and serious injuries have a devastating impact on workers and their families, and on the economic health and productivity of American businesses. For crash-related injuries in 2010 requiring more than 6 days away from work, workers' compensation costs alone were estimated to be nearly \$2 billion [Liberty Mutual 2012]. Work vehicles also have an impact on the safety of the motoring public. For example, although motor vehicle crashes are the leading cause of fatality for truck drivers, these events result in far more fatalities of other road users.

In low- and middle-income countries, work-related road safety may receive little attention from policy makers or data collectors. However, for several reasons, it is likely that the burden of injuries and fatalities from work-related crashes is greater than in high-income areas such as the United States, Europe, and Australia. In lower-income countries, regulatory and management systems are comparatively weak, vehicles and road infrastructure are less safe, and more road users are vulnerable persons such as pedestrians, motorcyclists, and pedalcyclists. In these settings, death, disability, or injury of a family wage earner due to road traffic injury, in addition to causing physical and emotional pain and suffering, creates economic hardship for the injured worker and family members that may persist well beyond the event. The loss of a vehicle that is critical to earning a living can have long-term effects on a family's well-being.

Public and private sector organizations around the world whose employees drive for work purposes need wide-ranging, evidence-based solutions and guidance to prevent motor vehicle crashes and resulting fatalities and injuries. In some instances, effective interventions are known, and the challenge is to increase awareness and promote their adoption by employers and workers. Conversely, other interventions have been adopted by a number of employers, but their effects on crash and injury prevention have not yet been established. In still other cases, there is a need for more basic laboratory research to develop new interventions.

Employers have the opportunity to leverage the employer-employee relationship to complement and enforce government policies that will reduce work-related crashes and injuries. Safe-driving policies implemented in the workplace can promote safer driving for workers and family members away from work. In addition, employers, as purchasers of large fleets of vehicles, can spur improvements in vehicle safety and encourage development of

¹ Source: Bureau of Labor Statistics online query system at <http://data.bls.gov/cgi-bin/dsrv?fi>

road safety capacity and legislation in the local areas and countries in which they operate, thereby improving road safety for all.

The NIOSH Center for Motor Vehicle Safety

The National Institute for Occupational Safety and Health (NIOSH) is the federal agency charged with conducting research and developing recommendations to prevent all kinds of work-related injury and illness. Over its more than 40 years of existence, NIOSH has built the technical knowledge, understanding of workplace dynamics, and stakeholder relationships that are critical to successfully conducting research and transferring research and recommendations into improved practice in the workplace.

NIOSH is the only federal agency whose mission encompasses the prevention of work-related motor vehicle crashes and resulting injuries for all worker populations, work vehicles, and work settings. The NIOSH Center for Motor Vehicle Safety (CMVS) is the focal point for activities within the Institute that address this pressing occupational safety problem. The CMVS was designated in December 2010 to strengthen and sustain the Institute's research and prevention activities to reduce work-related motor vehicle crashes and resulting injuries. It is a "virtual" Center through which researchers from across the Institute and external partners from government, nongovernmental associations, academia, labor, and industry bring complementary expertise to identify crash risk factors, develop and evaluate workplace interventions to prevent crashes, and communicate the results to employers and other stakeholders.

VISION

All workers who are exposed to hazards of motor vehicle traffic while working have the highest possible levels of protection from the risk of motor vehicle crashes and resulting injuries.

MISSION

The NIOSH Center for Motor Vehicle Safety uses a multidisciplinary approach to conduct research, evaluate interventions, communicate prevention information, and foster partnerships to protect workers from work-related motor vehicle crashes and resulting injuries.

GUIDING PRINCIPLES

For optimum use of resources and greatest potential for impact, the NIOSH Center for Motor Vehicle Safety will:

- Maintain awareness of current research conducted elsewhere in the federal government and in other settings to avoid duplication of effort
- Leverage resources to add value and encourage the motor vehicle injury prevention efforts of partners and stakeholders in industry, government, labor, academia, and non-governmental organizations
- Consider motor vehicle crash risks for high-risk worker groups and for the broader population of workers exposed to hazards of motor vehicle traffic
- Communicate research findings and recommendations to stakeholders who are positioned to take action to improve motor vehicle safety in the workplace

Integration with other NIOSH, CDC, and DHHS initiatives

Prevention of work-related motor vehicle crashes is a component of the CDC Winnable Battle for prevention of motor-vehicle injuries (<http://www.cdc.gov/WinnableBattles/MotorVehicleInjury/>). The Winnable Battles denote CDC's public health priorities for the Nation. In addition, the prevention of motor vehicle crashes is a priority for many NORA sector and cross-sector programs, including: Transportation, Warehousing, and Utilities; Wholesale and Retail Trade; Oil and Gas Extraction; Public Safety; Traumatic Injury; Prevention through Design; and Global Collaborations.

The NIOSH topic page on motor vehicle safety provides current data and links to NIOSH publications on the topic (<http://www.cdc.gov/niosh/topics/motorvehicle/>). This page also serves as a portal to the NIOSH CMVS sub-page (<http://www.cdc.gov/niosh/topics/motorvehicle/NCMVS.html>), which provides short descriptions of ongoing intramural and extramural research projects on motor vehicle safety.

Within CDC, the [National Center for Injury Prevention and Control \(NCIPC\)](#) has a major role in motor vehicle safety. NCIPC is responsible for injury prevention initiatives for the general population, but does not specifically address work-related motor vehicle injuries. Its current priorities for motor vehicle safety are to promote the use of seat belts and helmets, improve the safety of teen drivers, and reduce alcohol-involved crashes. The NIOSH CMVS also addresses these issues with respect to the occupational context.

At the level of the Department of Health and Human Services (DHHS), the Healthy People 2020 initiative has several objectives for injury and violence prevention (IVP), occupational safety and health (OSH) and sleep health (SH) that are relevant to work-related road safety [Department of Health and Human Services 2013]:

- OSH-1: Reduce deaths from work-related injuries (includes sub-objectives for high-risk industry sectors for work-related motor vehicle crashes, including transportation and warehousing [OSH-1.4]).
- OSH-2: Reduce nonfatal work-related injuries.
- SH-1: Increase the proportion of persons with symptoms of obstructive sleep apnea who seek medical evaluation.
- SH-2: Reduce the rate of vehicular crashes per 100 million miles traveled that are due to drowsy driving.
- IVP-13: Reduce motor vehicle crash-related deaths.
- IVP-14: Reduce nonfatal motor vehicle crash-related injuries.
- IVP-15: Increase use of safety belts.

How this document was developed

A Steering Committee made up of NIOSH scientists with expertise in epidemiology, engineering, social science, policy, and communications guides the work of the CMVS. The Center is hosted by the NIOSH Division of Safety Research, but researchers from across the Institute are involved in research projects tied to the Center and participate in setting its direction. The following individuals contributed to the development of this draft document:

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Stakeholders were offered the opportunity to comment on earlier drafts of this document via a notice in the *Federal Register*. In addition, key stakeholder agencies and associations were contacted directly to request their review, and the draft was posted on the NIOSH Motor Vehicle Safety web page (www.cdc.gov/niosh/topics/motorvehicle). Finally, the document was reviewed by the three external subject-matter experts in motor vehicle safety.

Scope of the NIOSH Center for Motor Vehicle Safety

Prevention of motor vehicle crashes

The scope of the CMVS encompasses prevention of work-related motor vehicle crashes affecting workers in all industries and occupations. *Work-related crashes* include:

- single- or multiple-vehicle crashes, on or off public roadways, which occur on the job
- events in which a pedestrian worker (e.g., a highway construction worker) is struck by a motor vehicle in operation, on or off a public roadway

A *motor vehicle* is defined here as a motorized conveyance designed primarily to transport goods or passengers. This includes cars, trucks, vans, and motorcycles used for work-related purposes. Events involving all-terrain vehicles (ATVs) or mobile equipment or machinery (e.g., forklifts, manlifts, cranes) are included, but only if that equipment is *in transport*, i.e., being driven from one location to another on a public roadway.

Work-related crashes and commuting-related crashes

Under the definitions used by the Bureau of Labor Statistics and other statistical agencies in the United States, *work-related crashes* are limited to those that occur in the performance of work duties, e.g., transporting goods or passengers, making client visits or sales calls, or traveling to meetings. Crashes that occur while commuting to or from work are not included. Although crashes which occur while commuting are found in the crash data systems that cover the general population, they are not identified there as work-related crashes.

Despite their exclusion under the current U.S. definition for work-related crashes, prevention of commuting-related crashes will be considered within the scope of the CMVS for the following reasons:

- Data from Europe and Latin America, where commuting-related crashes are generally covered under workers' compensation, reveal that commuting-related crashes account for three to four times as many crash fatalities as those meeting the narrower U.S. definition of a work-related crash. No data currently exist to document the burden of commuting-related crashes in the United States.
- On-the-job driving does not take place in a vacuum; what takes place during the work day may well

influence the safety of a worker's commute via motor vehicle, and the reverse. The effects of lengthy commutes on the risk of crashes or occupational injuries during the work day are unknown. Similarly, little research has addressed the effects of long work hours on the safety of workers on their commutes home [Barger et al. 2005].

- Strategies that will help to prevent work-related crashes (such as mandatory seat belt use policies or those related to alcohol and driving) will in many cases be applicable to prevention of commuting-related crashes.
- Increasingly, employers are promoting road safety for workers off the job, for workers' families, and in the communities in which they operate.

Occupational focus

The Center will limit its focus to projects and initiatives that are directly related to worker safety. There are other government agencies at both the federal and state level that have direct responsibility for road safety for the general public. Research results from the larger road safety community may have indirect "spillover" effects on worker safety; in other words, whatever improves motor vehicle safety for all will likely also improve motor vehicle safety for workers. However, these general lines of research are more appropriately left to other agencies and partners. NIOSH benefits from the experience and expertise of these entities but given the limited resources of the Institute, the NIOSH CMVS will maintain its focus on work-related road safety.

In general, the Center will assign higher priority to research and prevention activities focused on light-duty and passenger vehicles driven for work purposes, as well as specialized, purpose-built vehicles such as ambulances and fire apparatus. For heavy vehicles that transport freight and passengers, a research infrastructure is already well-established through longstanding collaborations between manufacturers, university-based research institutes, and private-sector laboratories and consultants. New research on large truck and bus safety will be considered, but only if it is clear that the Center brings expertise that does not exist elsewhere or is otherwise in a unique position to contribute.

Role of health-related factors

In many instances, antecedent health-related factors (e.g., obstructive sleep apnea, impaired vision, obesity, use of prescription or nonprescription medications) exacerbate crash or injury risk. Research that will lead to reduction of health-related risk factors for work-related crashes and injuries is within the scope of the Center. However, the link between antecedent health-related factors and work-related crashes or resultant injuries must be clearly delineated.

Missions of other federal agencies

NIOSH is a comparative newcomer to motor vehicle safety research. Other federal agencies, particularly those in the U.S. Department of Transportation, conduct and/or fund well-established research programs through their legislatively-mandated regulatory roles.

When worker safety is a consideration, the missions of the agencies within the U.S. Department of Transportation (DOT) often mesh with that of NIOSH:

- The primary mission of the [Federal Motor Carrier Safety Administration \(FMCSA\)](#) is to prevent commercial motor vehicle-related fatalities and injuries. To this end, FMCSA develops and enforces safety regulations on the operation of large freight- and passenger-transporting vehicles, and supports research and initiatives to improve safety information systems, commercial motor vehicle technologies, commercial motor vehicle equipment and operating standards, and safety management and awareness. FMCSA rulemaking and programs are supported by a well-established infrastructure consisting of federally-funded research centers and university transportation institutes.

- The [National Highway Traffic Safety Administration \(NHTSA\)](#) works with the states to develop and implement educational and enforcement initiatives related to vehicle occupant protection, drunk and drugged driving, graduated driver licensing, the mobility of older persons, distracted driving, and other issues. NHTSA also develops guidelines on topics such as interfaces for in-vehicle electronics, and develops the Federal Motor Vehicle Safety Standards (FVMSS) applicable to vehicles manufactured for sale or use in the United States. Many of the behavioral issues within NHTSA's purview are relevant to workplace driving. The NIOSH Center for Motor Vehicle Safety addresses these issues in the context of unique occupational applications.
- The [Federal Highway Administration \(FHWA\)](#) provides stewardship over the construction, maintenance and preservation of the Nation's highways, bridges and tunnels, conducting research and providing technical assistance to state and local agencies in an effort to improve safety, mobility, and livability. FHWA oversees the Manual on Uniform Traffic Control Devices, which provides engineering and safety guidance for setting up highway construction work zones and placing temporary traffic control for emergency incidents on roadways. NIOSH's worker-protection role coincides with FHWA's in two areas: the protection of the workers who build and maintain roads, and the protection of emergency responders who manage incidents on roadways. For these groups of workers, NIOSH has a role to play with respect to design of work areas, development of safe work processes, and development and testing of personal protective equipment.

The [National Transportation Safety Board \(NTSB\)](#) is an independent federal agency charged by Congress with investigating every civil aviation crash in the U.S. and significant incidents in other modes of transportation. The NTSB determines the probable cause of each incident investigated and issues safety recommendations aimed at preventing future incidents. NTSB's work is critical to occupational road safety because its investigations frequently involve crashes of large trucks or motorcoaches.

The [Bureau of Labor Statistics \(BLS\)](#) of the U.S. Department of Labor is the principal Federal agency responsible for measuring labor market activity, working conditions, and price changes in the economy. Its mission is to collect, analyze, and disseminate essential economic information to support public and private decision-making. BLS collects and maintains data critical for monitoring progress toward reduction of all kinds of occupational injuries, including work-related motor vehicle crashes. Major BLS data systems for occupational injuries are the Census of Fatal Occupational Injuries (CFOI) and the annual Survey of Occupational Injuries and Illnesses (SOII). In addition, BLS programs such as the Current Population Survey (CPS) and Quarterly Census of Employment and Wages (QCEW) provide employment estimates that are used to calculate rates of occupational fatality and injury by employment and worker characteristics.

The [Department of Homeland Security \(DHS\)](#) has broad responsibilities to protect the safety and security of the United States, including emergency preparedness and response. In this role, DHS has an interest in the safe operation of emergency vehicles and the safety of workers engaged in emergency response. More specifically, the [United States Fire Administration](#), part of DHS's Federal Emergency Management Agency, works with the fire service, emergency medical services community, and federal partners such as NIOSH to enhance safety of emergency responders through model policies and protocols, comprehensive training curricula, and timely dissemination of safety information.

The [National Institute of Justice \(NIJ\)](#) is the research, development, and evaluation agency of the U.S. Department of Justice. Because its mission encompasses the development, testing, and evaluation of strategies to limit deaths and injuries of law enforcement personnel, NIJ has an interest in the reduction of motor vehicle crashes and resulting injuries in this worker population.

The role of non-governmental stakeholders

Collaborations with non-governmental stakeholders are essential to the CMVS accomplishing its mission. The CMVS regularly exchanges information and provides technical assistance to non-governmental organizations (NGOs) such as the Network of Employers for Traffic Safety (NETS), the American Society of Safety Engineers (ASSE), the National Safety Council (NSC), and the Transportation Research Board (TRB) on topics of mutual interest, including distracted driving, motor vehicle safety management systems, and vehicle manufacturing specifications. Collaborations with universities and research institutes lend skills and expertise that complement those available within the CMVS. Engagement with standard-setting organizations facilitates the translation of NIOSH research findings into voluntary safety standards. Finally, the cooperation and participation of industry partners and workers is essential for CMVS researchers to carry out research projects in real-world settings, and to develop injury-prevention recommendations and products that are both effective and practical.

Framework for Goal Development

It is well-accepted within the motor vehicle safety community that the primary levers for preventing motor vehicle crashes are related to the human, the vehicle, and the environment. The origin of these concepts is the Haddon Matrix developed by American epidemiologist William Haddon, Jr., a prominent advocate for crash prevention and injury control and the first Administrator of the National Highway Traffic Safety Administration. Haddon conceptualized injury prevention as a problem of reducing or eliminating the exchange of harmful mechanical energy [Haddon, Jr. 1968]. The original Matrix combined temporal “phases” (Pre-crash, Crash, and Post-crash) with “factors” (Human, Vehicle, and Environment) where crash risks and injury prevention opportunities are present (Table 1).

Table 1. Original Haddon Matrix.

	Human	Vehicle	Environment
Pre-crash			
Crash			
Post-crash			

Goals for the NIOSH Center for Motor Vehicle Safety will be guided by a modified version of the Haddon Matrix (Table 2) that differs from the basic Matrix in several ways:

- The three temporal phases from the original Haddon Matrix (Pre-crash, Crash, and Post-crash) are replaced by three “pathways” through which goals will be achieved: Epidemiologic Analysis, Engineering and Technology-based Interventions, and Management and Behavioral Interventions. These “pathways” may be seen as a combination of research methods and interventions.
- Research addressing the human (i.e., the vehicle driver or passenger, or the pedestrian worker) will focus on the human as he or she interacts with the vehicle, environment, or management structure *specific to work*. The “human” factor encompasses the job task and what the worker brings to the situation (i.e., innate traits as well as psychological and physiological states).
- In this framework, the vehicle is considered separately from the environment. The “Environment” factor encompasses not only the physical road environment, but also the work setting and any other external factors outside the direct control of the employer and worker.

- A fourth “factor,” Policies/Programs, is added to account for the substantial and crucial role played by regulations, policies, and actions of employers, government, labor, and industry in reducing motor vehicle crash and injury risk for workers.²

Table 2. Modified Haddon Matrix

Factors →	Human	Vehicle	Environment	Policies/ Programs
↓ Pathways				
Epidemiologic Analysis				
Engineering and Technology				
Management and Behavioral				

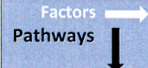
NIOSH motor vehicle safety projects placed in the modified Haddon Matrix

Listed in Table 3 are NIOSH projects initiated in 2004 or later, placed within the modified Haddon Matrix. Included are intramural projects led by NIOSH researchers as well as those that are extramurally funded by NIOSH through research grants to universities and state departments of health or labor.

The table shows that NIOSH has conducted or funded research within all four factor domains and within all three pathways. However, the amount of research conducted or dollars expended per cell vary greatly. The majority of the research in the Epidemiologic Analysis pathway has involved evaluation of human and policy/program factors related to motor vehicle crashes and injuries. Within the Engineering and Technology pathway, research has focused on addressing human and vehicle factors. The vast majority of the research in the Management and Behavioral pathway has focused on policy and program factors. As the table shows, there are important gaps in knowledge at the intersection of various factors and pathways that have yet to be addressed.

²For the general population, the content of Policies/Programs would appropriately be included under Environment. For work-related motor vehicle safety, it is taken out of Environment and handled as a separate issue.

Table 3. NIOSH Center for Motor Vehicle Safety Projects, 2004-2014 (Note: Completed projects are bolded; extramural projects are shown in italics.)

Factors Pathways 	Human	Vehicle	Environment	Policies/Programs
Epidemiologic Analysis	<ul style="list-style-type: none"> • Taxi Driver Survey on Motor Vehicle Safety and Workplace Violence • Survey of Truck Driver Injury and Health • Cops & Cars: Reducing LEO Deaths in Motor Vehicle Crashes • Survey of Drivers in the Oil and Gas Extraction Industry • <i>Risk Factors for Crashes in Retrospective Cohort Study of Commercial Truck Drivers</i> • <i>Kentucky Occupational Safety and Health Surveillance</i> • <i>Preventing Work Injuries and Chronic Illnesses in Truckers</i> • Mortality of Independent Truck Drivers 	<ul style="list-style-type: none"> • Evaluation of Commercial Vehicle Active Safety Systems and their Effect on Truck Driver Behavior 	<ul style="list-style-type: none"> • Survey of Truck Driver Injury and Health • <i>Preventing Work Injuries and Chronic Illnesses in Truckers</i> 	<ul style="list-style-type: none"> • Motor Vehicle Safety Initiative • Law Enforcement Officer Motor Vehicle Crash and Struck-By Fatality Investigations • Cops & Cars: Reducing LEO Deaths in Motor Vehicle Crashes • Analysis of Company Fleet Safety Management Data to Guide Research and Prevention • <i>Washington Occupational Injury and Illness Surveillance and Prevention Program</i> • <i>Kentucky Occupational Safety and Health Surveillance</i>
Engineering and Technology	<ul style="list-style-type: none"> • Fire Apparatus Design and PPE Sizing: Knowledge & Technology Transfer • Pilot Study: Sizing Law Enforcement Officers for Safe Vehicle Operation and Crash Protection • <i>Effects and Feasibility of a Computer-Based Intervention on Truck Drivers' Sleep</i> • Improved Truck Cab Design through Applied Anthropometry • Screening for Obstructive Sleep Apnea in Commercial Drivers 	<ul style="list-style-type: none"> • Ambulance Crash Survivability Improvement Project • Improved Truck Cab Design through Applied Anthropometry • Partnering with Industry to Build Safe EMS Work Environments • Evaluation of Commercial Vehicle Active Safety Systems and their Effect on Truck Driver Behavior • Reducing Firefighter Vehicle Crashes: Simulation and Intervention 	<ul style="list-style-type: none"> • Sizing Firefighters and Fire Apparatus: Safe by Design 	<ul style="list-style-type: none"> • Fire Apparatus Design and PPE Sizing: Knowledge & Technology Transfer
Management and Behavioral	<ul style="list-style-type: none"> • Impact of a Truck Driver Public Health Practice Project (PHP) 	<ul style="list-style-type: none"> • Evaluation of an Intervention to Reduce Collisions in Light and Intermediate Size Truck Drivers 	<ul style="list-style-type: none"> • Motor Vehicle Safety Initiative 	<ul style="list-style-type: none"> • Motor Vehicle Safety Initiative • Evaluation of an Occupational Motor-Vehicle Crash Prevention Program in Law Enforcement • Analysis of Company Fleet Safety Management Data to Guide Research and Prevention • Survey of Drivers in the Oil and Gas Extraction Industry • Motor Vehicle Safety: Best Practices in Oil and Gas Extraction Industry • Evaluation of an Intervention to Reduce Collisions in Light and Intermediate Size Truck Drivers • Business Case Calculator for Road Safety Strategies • Transfer Evaluation Results into Road Construction Practice (PHP) • Expanded Information Tools for Building Safer Work Zones (PHP) • Promoting Global Initiatives for Occupational Road Safety (PHP)

Goals for the NIOSH Center for Motor Vehicle Safety

The goals for the NIOSH Center for Motor Vehicle Safety were developed by the CMVS Steering Committee in 2013 and 2014, based on: (1) consideration of research gaps; (2) a review of related goals in the NIOSH sector and cross-sector programs; and (3) consideration of the research areas where NIOSH is best-positioned to add to the knowledge base on work-related motor vehicle safety.

Strategic goals 1 through 3 directly align with the “pathways” depicted in Table 2 above, and will add to the evidence base for employer programs and inform the development of safety standards and regulations. Strategic Goal 4 captures the global elements of work-related motor vehicle safety, and Strategic Goal 5 focuses on the communication of research results and stakeholder engagement to prevent work-related motor vehicle crashes and resulting injuries.

Strategic Goal 1: Advance understanding of risk factors associated with work-related motor vehicle crashes and resulting injuries through epidemiologic analyses to guide research and prevention strategies.

Rationale: Population-based data on factors associated with work-related motor vehicle crashes will help to identify priority areas for research and intervention. Variables of interest may be related to the driver, the vehicle, or the operating environment. Activities targeting this goal may involve collection of data through prospective studies, secondary analysis of administrative or company-level data collected for other purposes, analysis of naturalistic driving data, or use of novel approaches to linkage or analysis of injury surveillance data.

Intermediate Goal 1.1: Employers will use results of NIOSH research on work organization, hours of work, and driver fatigue to develop programs, policies, and interventions to prevent work-related motor vehicle crashes.

Activity/Output Goal 1.1.1: Identify and evaluate factors related to the operating environment (e.g., work organization, scheduling and dispatching practices, pay and incentive schemes, travel policies) that are associated with risk of work-related motor vehicle crashes.

Performance Measure 1.1.1: By 2018, at least two intramural and/or extramural research projects addressing the role of operating environment factors on work-related motor vehicle crashes will be completed. Results will be published in peer reviewed journals, trade journals, and NIOSH numbered publications.

Activity/Output Goal 1.1.2: Assess the effects of long or irregular hours of work, long hours of driving, or fatigue/sleepiness on risk of motor vehicle crashes, particularly in worker populations not covered by the Federal Motor Carrier Safety Regulations (e.g., emergency responders, sales workers who drive passenger vehicles, or workers who commute long distances).

Performance Measure 1.1.2: At least two research projects or analyses related to hours of work, long hours of driving, or fatigue will provide evidence-based recommendations, particularly for workers not covered by FMCSA regulations.

Intermediate Goal 1.2: The research community will use results of NIOSH research based on novel data linkage approaches, previously untapped data sources, or naturalistic driving data to prioritize future research for work-related road safety.

Activity/Output Goal 1.2.1: Match work-related crash cases from the Census of Fatal Occupational Injuries (CFOI) and Fatality Analysis Reporting System (FARS), for the purpose of improving case identification and obtaining richer data on work-related crashes.

Performance Measure 1.2.1-1: By 2014, one methods paper on case identification and data

linkage procedures will be published in a peer-reviewed journal.

Performance Measure 1.2.1-2: By 2015, a second publication based on the matched CFOI and FARS data will be submitted to a peer-reviewed journal, examining the role of exposures relevant to occupational motor vehicle safety such as distracted driving, environmental factors, and roadway characteristics.

Activity/Output Goal 1.2.2: Identify and evaluate data sources on work-related trips or miles traveled, for the purpose of preparing exposure-based estimates of crash risk for workers.

Performance Measure 1.2.2: By 2016, initiate at least one research project to identify and evaluate sources of exposure data estimates.

Activity/Output Goal 1.2.3: Use naturalistic driving data to identify and evaluate risk factors for work-related crashes.

Performance Measure 1.2.3: By 2018, publish at least one manuscript on risks factors (e.g., distraction, roadway characteristics, and vehicle factors) for work-related crashes based on the analysis of naturalistic driving data.

Activity/Output Goal 1.2.4: Assess existing data sources for their inclusion of data on commuting-related crashes and explore options for identifying commuting-related crashes in current surveillance systems.

Performance Measure 1.2.4: By 2016, initiate at least one research project to identify and evaluate potential sources of data on commuting-related crashes.

Intermediate Goal 1.3: Standards organizations, policy makers, and regulatory bodies will use results of NIOSH epidemiologic research to inform safety standards, policy initiatives, and regulations on work-related motor vehicle safety.

Activity/Output Goal 1.3.1: The Center will provide evidence-based guidance and recommendations to organizations and regulatory agencies charged with the development of standards and regulations for motor vehicle safety.

Performance Measure 1.3.1: NIOSH CMVS will participate in meetings, conferences, and work groups to provide input on standards and regulations applicable to work-related motor vehicle safety.

Strategic Goal 2: Reduce the incidence and severity of work-related motor vehicle crashes by implementing engineering and technology-based safety interventions, and study the effects of other new technologies installed in vehicles that may have adverse safety consequences.

Rationale: Intervention development and evaluation are critical to building the evidence base to guide prevention of work-related motor vehicle crashes and resulting injuries. Engineering and technology-based solutions impose controls on the work environment so that prevention does not depend on driver initiative in all situations. In addition, the emergence of advanced in-vehicle technologies (installed by manufacturers as original equipment, or added later as job-related applications), self-driving cars, and “smart roads” has safety implications for occupational driving. Factors linked to safety concerns such as driver distraction and fatigue (e.g., driver cognitive load, human-vehicle interface, and driver decision making), as they relate to driving for work, need to be better understood and guidelines developed and implemented accordingly. NIOSH research and injury prevention activities in this arena will give highest priority to research and technology transfer that

focuses on specialized, purpose-built vehicles such as fire apparatus or emergency vehicles.

Intermediate Goal 2.1: Safety research organizations, trade associations, insurance companies, and employers will identify and characterize incidents and injuries associated with special-vehicle crashes through research and evaluation of engineering strategies, social-organizational characteristics, and human-vehicle-environment interface traits that are common precursors to crash incidents; and will use this information to design out crash risk or craft engineering solutions and organizational interventions.

Activity/Output Goal 2.1.1: Conduct research on special-vehicle operators' cognitive load, signal detection ability, and perception/reaction time in response to information from driver assistance systems or road safety information systems to reduce crash or rollover incidents.

Performance Measure 2.1.1: By 2018, develop and disseminate materials on special-vehicle operators' responses to driver assistance systems or road safety information systems, and the criteria for effective systems.

Activity/Output Goal 2.1.2: Identify, evaluate, and adapt effective driver assistance systems or road safety information systems for special-vehicle operators to reduce crash or rollover incidents.

Performance Measure 2.1.2: By 2018, transfer new knowledge and best practices on at least two effective interventions on driver assistance systems or road safety information systems to special-vehicle manufacturers and organizations that use special vehicles, to reduce crashes and injuries associated with these vehicles.

Activity/Output Goal 2.1.3: Conduct research on special-vehicle operators' cognition process in understanding intersection configurations and decision making in maneuvering through intersections and traffic light systems.

Performance Measure 2.1.3: By 2018, develop and disseminate materials on special-vehicle operators' practice in acquiring information on intersection configurations and decision making in maneuvering through intersections and traffic light systems.

Activity/Output Goal 2.1.4: Develop guidelines and engineering solutions to enhance drivers' understanding of vehicle constraints and capacity to maneuver among various intersections and traffic light systems.

Performance Measure 2.1.4: By 2018, transfer new knowledge and best practices on at least two effective interventions on driving assistance systems or road safety information systems, associated with intersection safety, to special-vehicle manufacturers and organizations that use special vehicles, to reduce intersection crash incidents.

Activity/Output Goal 2.1.5: Review literature and research on new technologies such as self-driving cars and streaming Internet in vehicles as they relate to driving for work, including research on collateral risks associated with the introduction of those technologies and recommendations for best safety practices.

Performance Measure 2.1.5: By 2018, publish a document on new and emerging technologies (e.g., self-driving cars, in-vehicle Internet) found in vehicles used for work purposes, challenges and risks associated with the introduction of these technologies, and research ideas on best safety practices.

Intermediate Goal 2.2: Special-vehicle and equipment manufacturers, professional communities, and national standards entities will use updated anthropometric information on special-vehicle occupants to implement effective and evidence-based safe vehicle configurations, protective measures, and national safety standards to

reduce work-related motor vehicle crashes and resulting injuries.

Activity/Output Goal 2.2.1: Collaborate with professional communities, trade associations, safety equipment manufacturers, and other government agencies to establish anthropometric databases of special-vehicle occupants (e.g., firefighters, emergency medical services persons, and law enforcement officers) for updating vehicle configurations and protective measures to adequately protect current workforces.

Performance Measure 2.2.1: By 2014 and 2018, establish national anthropometric databases of firefighters and emergency medical services persons, respectively.

Activity/Output Goal 2.2.2: Conduct research on the interface between occupants and special vehicles to advance knowledge on occupant accommodation for safe vehicle operation and development of digital occupant models, for crash-related injury control simulations and evaluations.

Performance Measure 2.2.2: By 2016, develop and disseminate materials on at least two improved interventions for fire apparatus.

Activity/Output Goal 2.2.3: Collaborate with professional communities, equipment manufacturers, and other government agencies to transfer anthropometry data, digital human models, and human factors engineering recommendations to improve vehicle configuration and guide the design and use of protective measures.

Performance Measure 2.2.3: By 2017, transfer at least two human factors engineering recommendations or interventions to improve the design of fire apparatus, use of protective measures, and standards/specifications for fire apparatus.

Intermediate Goal 2.3: NIOSH and other government agency partners, vehicle and equipment manufacturers, standards committees, and occupational safety professionals will work together to improve the configurations and designs of ambulances, fire trucks, and police cruisers to reduce the likelihood of crashes and rollovers and reduce risk of occupant injuries and fatalities associated with these types of incidents.

Activity/Output Goal 2.3.1: Conduct research to update crashworthiness data on special vehicles to advance knowledge on biomechanical loading and injury risk among special-vehicle users during crash and rollover incidents.

Performance Measure 2.3.1: By 2015, complete impact tests and update crashworthiness data (biomechanical loading and injury risk among special-vehicle users) of at least one type of special vehicle (e.g., ambulance).

Activity/Output Goal 2.3.2: Develop guidelines and engineering recommendations to reduce biomechanical loading and injury risk among special-vehicle users during crash and rollover incidents.

Performance Measure 2.3.2: By 2017, develop guidelines and at least three engineering recommendations to reduce biomechanical loading and injury risk among special-vehicle users during crash and rollover incidents of at least one type of special vehicle (e.g., ambulance).

Activity/Output Goal 2.3.3: Collaborate with professional communities, equipment manufacturers, and other government agencies to transfer biomechanical loading data and vehicle configuration improvements into vehicle safety practice standards.

Performance Measure 2.3.3: By 2017, transfer at least two human factors engineering recommendations or vehicle configuration improvements into safety standards/specifications for at least one type of special vehicle (e.g., ambulance).

Strategic Goal 3: Reduce the incidence and severity of work-related motor vehicle crashes through the implementation of comprehensive, evidence-based road safety management policies and interventions.

Rationale: In difficult economic times, even organizations that have successful motor vehicle safety programs are reconsidering the level of resources to dedicate to those programs. Empirical data from administrative and company-level systems are needed to help organizations select the program elements that are most closely associated with reductions in crashes and injuries, as well as those that are most cost-effective. These data will also be useful for establishing business cases to encourage organizations to implement motor vehicle safety programs. Also needed are evidence-based tools to help organizations measure changes in safety performance and return on investment associated with road safety interventions. Products with potential for application across industry sectors are preferable to those with narrow focus. Further, development of empirical data is preferable to case studies or compilations of “best practices” that are based solely on anecdotal evidence or informal reports.

Evaluations of comprehensive fleet management policies and programs are needed. Detailed pre- and post-implementation case studies have come out of the United Kingdom and Australia (see, for example, Darby et al. [2011], Murray et al. [2012], and Wallington et al. [2012]), but none has come from the United States. This research might also take the form of “natural experiments” that follow the implementation of individual road safety interventions in organizations. Such interventions might include changes in work organization, journey management protocols, and fatigue management programs. Few such studies have been published in the peer-reviewed literature (for good examples, see Gregersen et al. [1996] and Salminen [2008]), and the only one to come from the United States is dated and not broadly applicable (Ludwig and Geller [1991]).

Also needed is research that would help to establish links between road safety, fuel economy, alternative modes of travel, and environmental stewardship in the context of occupational driving. The potential cost savings of “eco-driving” can be used to leverage organizations to implement more aggressive road safety initiatives. The ability to show concern for the environment through reduced fuel consumption and reduced travel by road will also align well with organizations’ environmental goals.

Intermediate Goal 3.1: Organizations will apply evidence-based recommendations to develop, implement, and sustain comprehensive workplace road safety management interventions.

Activity/Output Goal 3.1.1: Conduct research to assess the effectiveness of road safety interventions in organizations. These interventions might include changes in work organization, journey management protocols, fatigue management programs, data systems for monitoring road safety performance, in-vehicle monitoring systems, or initiatives to reduce distracted driving.

Performance Measure 3.1.1: By 2016, initiate at least two intramural or extramural research projects to assess the effectiveness of road safety interventions.

Activity/Output Goal 3.1.2: Identify the factors critical to success of post-license driver training for occupational drivers.

Performance Measure 3.1.2: By 2016, publish a peer-reviewed paper and one article in a professional or trade association journal to report the results of an evaluation of driver training methods.

Activity/Output Goal 3.1.3: Assess safety climate and culture as determinants of the success or failure of road safety interventions in organizations.

Performance Measure 3.1.3: By 2016, initiate at least one intramural or extramural research project to assess safety climate and culture as determinants of the success or failure of road

safety interventions in organizations.

Intermediate Goal 3.2: Organizations will use evidence-based resources to implement effective road safety management programs.

Activity/Output Goal 3.2.1: Develop a “business case” to justify implementation of comprehensive workplace motor vehicle safety programs.

Performance Measure 3.2.1: By 2016, develop a guide to help organizations justify the economic and occupational safety benefits of implementing a comprehensive motor vehicle safety program.

Activity/Output Goal 3.2.2: Develop and evaluate tools to help organizations measure and monitor road safety performance.

Performance Measure 3.2.2: By 2016, develop and distribute tools to support monitoring of organizational road safety performance.

Activity/Output Goal 3.2.3: Assess the value of road safety management programs within private and public sector organizations, taking into consideration cost-effectiveness and return on investment.

Performance Measure 3.2.3: By 2018, publish a peer-reviewed paper and one article in a professional or trade association journal to report the results of economic research on road safety management programs.

Activity/Output Goal 3.2.4: Validate audit tools for assessing the quality of fleet safety management practices.

Performance Measure 3.2.4: By 2018, initiate intramural or extramural research to validate audit tools for fleet safety management.

Intermediate Goal 3.3: Standards organizations and regulatory bodies will use results of NIOSH research on fleet safety management strategies to inform safety standards and regulations on work-related motor vehicle safety.

Activity/Output Goal 3.3.1: NIOSH research will contribute to future revisions of the ANSI/ASSE Z15.1 and ISO 39001 standards.

Performance Measure 3.3.1: By 2018, NIOSH input will be incorporated into any revisions made to either of these fleet safety management standards.

Strategic Goal 4: Reduce work-related motor vehicle crashes and resulting injuries globally through national and international collaborations on occupational motor vehicle safety research and guidance.

Rationale: NIOSH is a member of the UN Road Safety Collaboration (UNRSC), a public-private consultative mechanism coordinated by the World Health Organization. The UNRSC developed the implementation plan for the UN Decade of Action for Road Safety 2011-2020 and is monitoring progress toward goals for the Decade. In addition, NIOSH participates in a UNRSC project group on work-related road safety.

High-priority actions for the Decade of Action for Road Safety are based on five “pillars” that address spheres where progress must be made if overall reductions in road traffic injuries are to be achieved at global level: (1) Road safety management; (2) Safer roads and mobility; (3) Safer vehicles; (4) Safer road users; and (5) Post-crash response. Each of the five pillars has some relevance to work-related road safety. Although the action plan for the Decade sees governments as the major agents for change, a number of key actions can also be

taken by employers, labor, non-governmental organizations, and researchers. See the [Appendix](#) for more information on relevant elements of the Decade of Action plan.

To learn more about the Decade of Action for Road Safety and to download a full copy of the action plan, visit the World Health Organization (WHO) "Decade of Action" Web site at http://www.who.int/roadsafety/decade_of_action/en/.

Intermediate Goal 4.1: NIOSH will provide technical assistance and consultation for international initiatives and documents on work-related road safety.

Activity/Output Goal 4.1.1: Develop partnerships for identifying research and for the sharing of research needs, approaches, and results.

Performance Measure 4.1.1-1: Strengthen coordination of research through international organizations and nongovernmental organizations with global reach.

Performance Measure 4.1.1-2: Expand collaborations to developing nations and emerging markets (Americas, Asia-Pacific).

Activity/Output Goal 4.1.2: Enhance global dissemination of strategies for reducing occupational road traffic injuries worldwide.

Performance Measure 4.1.2-1: Establish partnerships for translation of NIOSH publications to other languages.

Performance Measure 4.1.2-2: By 2018, utilize and regularly update social media channels with new and noteworthy NIOSH research results and injury prevention messages tailored to global stakeholders.

Activity/Output Goal 4.1.3: Increase global acceptance of strategies for reducing occupational road traffic injuries worldwide.

Performance Measure 4.1.3-1: Strengthen participation in globally recognized organizations.

Intermediate Goal 4.2 (14PPGLCIG3.3): NIOSH and partners will initiate and promote international research and demonstration projects to prevent road traffic injury in worker populations, in support of high-priority activities around the UN Decade of Action for Road Safety.

Activity/Output Goal 4.2.1: Assess the differences between definition and capture of data on work-related crashes in regions and countries around the world, for the purpose of encouraging standardization in data systems.

Performance Measure 4.2.1: By 2016, publish a peer-reviewed paper comparing sources of data on work-related crashes around the world.

Activity/Output Goal 4.2.2: Collaborate with the Institute of Road Traffic Education (IRTE) and CDC colleagues to analyze data on training of heavy-goods vehicle drivers in India, demographic and health characteristics of drivers, and fleet safety management in transport operators in India.

Performance Measure 4.2.2: By 2016, publish at least two peer-reviewed papers on truck driver safety in India covering the following topics: driver training outcomes, demographic and health characteristics of drivers, and fleet safety management by transport operators.

Strategic Goal 5: Enhance availability of clear and concise guidance and informational products on the

prevention of work-related motor vehicle crashes and resulting injuries.

Rationale: Organizations whose employees drive motor vehicles for work purposes want research-based recommendations and tools they can put into action in the workplace. NIOSH needs to do more to translate research into “actionable” steps for organizations.

Intermediate Goal 5.1: Disseminate information on existing and new programs and products of the Center for Motor Vehicle Safety to employers and other external stakeholders as it becomes available.

Activity/Output Goal 5.1.1: Use social media to digest NIOSH research results and communicate appropriate injury prevention messages to stakeholders.

Performance Measure 5.1.1-1: By 2014, utilize one social media channel (e.g., Twitter, Facebook, blog) to communicate NIOSH research results and injury prevention messages to stakeholders.

Performance Measure 5.1.1-2: By 2015, utilize at least three social media channels (e.g., Twitter, Facebook, blog) to communicate NIOSH research results and injury prevention messages to stakeholders.

Performance Measure 5.1.1-3: By 2018, utilize and regularly update social media channels with new and noteworthy NIOSH research results and injury prevention messages to stakeholders.

Activity/Output Goal 5.1.2: Develop a biannual electronic newsletter to provide information about the Center and its activities to external stakeholders.

Performance Measure 5.1.2: By 2015, publish first electronic newsletter to external stakeholders.

Activity/Output Goal 5.1.3: Redesign the NIOSH “Motor Vehicle Safety” topic webpage to serve as a portal for the dissemination of NIOSH research results, appropriate motor vehicle injury prevention messages, and products and outcomes of the NIOSH Center for Motor Vehicle Safety.

Performance Measure 5.1.3: By 2015, publish redesigned “Motor Vehicle Safety” topic webpage.

Activity/Output Goal 5.1.4: Evaluate the reach and the audience characteristics for NIOSH information products on prevention of work-related crashes.

Performance Measure 5.1.4: By 2015, prepare an assessment of the reach and the audience characteristics for selected NIOSH information products on prevention of work-related crashes.

Intermediate Goal 5.2: In partnership with NIOSH, employers and other stakeholders will consolidate, segment, and strategically disseminate information on evidence-based practices to increase knowledge and awareness about prevention of work-related crashes and resulting injuries.

Activity/Output Goal 5.2.1: Develop and maintain strong linkages with stakeholders for work-related motor vehicle safety (i.e., other federal agencies, trade and professional associations, labor organizations, and non-governmental organizations) to exchange information and foster research collaborations.

Performance Measure 5.2.1: By 2016, incorporate collaborative activities on road safety into existing agreements with at least two partner agencies or organizations, or initiate new agreements to collaborate on research and prevention activities.

Activity/Output Goal 5.2.2: Summarize research results for dissemination through trade associations and professional organizations.

Performance Measure 5.2.2: By 2015, summarize the results of one NIOSH research study for dissemination through publications or other communication channels of trade associations and professional organizations.

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Appendix

Elements of the Decade of Action for Road Safety action plan with relevance for work-related road safety, and their linkage to CMVS goals

Pillar 1: Road Safety Management	
<p><u>Action plan item:</u> Develop a national strategy (at a cabinet or ministerial level) coordinated by the lead agency through:</p> <ul style="list-style-type: none"> • Promoting road safety management initiatives such as the new ISO traffic safety management standard ISO 39001. • Establishing and maintaining the data collection systems necessary to provide baseline data and monitor progress in reducing road traffic injuries and fatalities and other important indicators such as cost, etc. 	<p><u>Relevance and link to CMVS goals:</u> ISO 39001:2012, <i>Road Traffic Safety (RTS) Management Systems – Requirements with Guidance for Use</i>, is an important global standard that delineates road-safety management processes to be followed by a variety of organizations with responsibility for road safety. These include the government agencies that design and manage the road network, as well as organizations whose employees are a major road user group (International Organization for Standardization [2012]).</p> <p>Data collection is critical for monitoring progress in achieving road safety targets at national, regional, and organizational levels. This includes targets for work-related road safety.</p>
Pillar 2: Safer Roads and Mobility	
<p><u>Action plan item:</u> Adhere to and/or fully implement the major United Nations road safety related agreements and conventions; and encourage the creation of new regional instruments similar to the European Agreement concerning the Work of Crews of Vehicles engaged in International Road Transport (AETR).</p>	<p><u>Relevance and link to CMVS goals:</u> This activity notes the importance of cross-national agreements for promoting work-related road safety.</p>
<p><u>Action plan item:</u> Promote safe operation, maintenance and improvement of existing road infrastructure by requiring road authorities to:</p> <ul style="list-style-type: none"> • Identify the number and location of deaths and injuries by road user type, and the key infrastructure factors that influence risk for each user group. 	<p><u>Relevance and link to CMVS goals:</u> In the bullet to the left, “road user type” is probably meant to refer to categories such as pedestrians, two-wheeler operators, or youth. However, it can also be extended to include road user categories related to employment, for example, deaths and injuries that occur during the work day, or during travel to or from work.</p>
Pillar 3: Safer Vehicles	
<p><u>Action plan item:</u> Encourage managers of governments and private sector fleets to purchase, operate and maintain vehicles that offer advanced safety technologies and high levels of occupant protection.</p>	<p><u>Relevance and link to CMVS goals:</u> Public and private sector organizations purchase or lease large numbers of vehicles. Demand for safer vehicles from these major customers can influence vehicle manufacturers to improve crashworthiness and add advanced safety features. Influence by major customers is especially important in parts of the world that lack government-</p>

	led standards for vehicle manufacturing.
Pillar 4: Safer Road Users	
<u>Action plan item</u> : Set and seek compliance with transport, occupational health and safety laws, standards and rules for safe operation of commercial freight and transport vehicles, passenger road transport services and other public and private vehicle fleets to reduce crash injuries.	<u>Relevance and link to CMVS goals</u> : This activity reflects the importance of occupational safety regulations and consensus standards in preventing work-related motor vehicle crashes in organizations that transport goods and passengers and those that operate motor vehicles for other business purposes.
<u>Action plan item</u> : Research, develop and promote comprehensive policies and practices to reduce work-related road traffic injuries in the public, private and informal sectors, in support of internationally recognized standards for road safety management systems and occupational health and safety.	<u>Relevance and link to CMVS goals</u> : This activity reflects two important insights about work-related road safety: (1) the recognition that occupational safety regulations in combination with traffic rules do not offer adequate protection from the risk of work-related motor vehicle crashes; and (2) that the majority of activities that fill this gap are initiated by the organizations whose employees operate motor vehicles on their behalf.
Pillar 5: Post-crash Response	
<u>Action plan item</u> : Increase responsiveness to post-crash emergencies and improve the ability of health and other systems to provide appropriate emergency treatment and longer term rehabilitation for crash victims.	<u>Relevance and link to CMVS goals</u> : In parts of the world that lack timely and high-level crash response, or in remote work locations, employers may take responsibility for providing some level of crash response and ensuring that workers obtain needed medical care.

Adapted from: World Health Organization and UN Road Safety Collaboration [2010]. Global plan for the Decade of Action for Road Safety 2011-2020. http://www.who.int/roadsafety/decade_of_action/en/.