GOVERNMENT STATUS REPORT – UNITED STATES

Joseph N. Kanianthra
National Highway Traffic Safety Administration
United States

OVERVIEW

The National Highway Traffic Safety Administration's (NHTSA) mission is to save lives, prevent injuries, and reduce traffic related health care and other economic costs. The agency develops, promotes, and implements effective educational, engineering, and enforcement programs directed toward ending preventable tragedies and reducing safety related economic costs associated with vehicle use and highway travel.

In 2003, the United States had a resident population of 291 million people and over 196 million licensed drivers. An estimated 2.9 trillion miles were traveled by the 231 million registered vehicles in the U.S. This is approximately 14,800 miles of travel per licensed driver. This high degree of mobility is accompanied by safety consequences. A study, published by NHTSA in 2000, estimates the economic impact of motor vehicle crashes to be $231 billion dollars, annually. Table 1 provides a breakdown of the major elements of this cost.

Table 1.
Economic Impact of Motor Vehicle Crashes 2000

Elements of Cost	Billions	Percent
Market Productivity	$61	26%
Property Damage	$59	26%
Medical	$33	14%
Travel Delay	$26	11%
Household Productivity	$20	9%
Insurance Admin	$15	7%
Others	$17	7%
Total	**$231**	**100%**
Source: The Economic Impact of Motor Vehicle Crashes 2000, NHTSA, May 2002		

This is approximately $800 for each person in the U.S., $1,200 per licensed driver and 2.3% of the gross domestic product.

In 2003, the U.S. fatality rate was at 1.48 fatalities per 100 million VMT, the lowest ever achieved. The fatality rate per VMT has been steadily decreasing. The safety improvements made are due to the collective efforts of the operating agencies of the department (NHTSA, the Federal Motor Carrier Safety Administration (FMCSA), the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA)), the States, automobile manufacturers and many other organizations. The seat belt use in the U.S. has also reached an all time high of 80 percent nationwide. NHTSA's engineering efforts combined with its educational and enforcement programs that ensure proper compliance with the US regulations have been mainly responsible for this significant achievement in safety. Figure 1 shows the number of fatalities for the period 1970 to 2003.

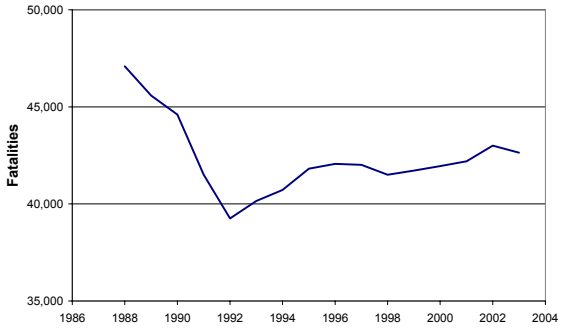

Figure 1. Number of Fatalities in the U.S. by Year

NHTSA's traffic safety program considers engineering, along with its educational and enforcement programs, essential to continue its goal to reduce fatalities, injuries, and crashes on the U.S. highway system. This 3-pronged process, relies on a strong educational program to inform drivers and passengers, an enforcement program to determine compliance with U.S. regulations, and vehicle safety, rooted in engineering, science and data, to develop a strong policy to continue to improve highway traffic safety.

NHTSA has identified 5 priority areas to maximize its effort in achieving this goal. The five priority areas are:

- Increased national safety belt usage

- Reduction in the number of alcohol related crashes, fatalities and injuries
- Reduction in the number and severity of rollover crashes, fatalities and injuries
- Improved compatibility in vehicle fleet
- Improved data addressing highway safety

CRASH ENVIRONMENT

In 2003, 42,643 fatalities occurred in the US as a result of motor vehicle crashes. This is contrasted with the 54,589 people who were killed in traffic crashes in 1972 and 39,250 in 1992, the highest and lowest in the past 35 years.

As mentioned earlier, the fatality rate per 100 million VMT in 2003 was 1.48. This is contrasted to 5.5 fatalities per 100 million VMT in 1966, the highest in the past 35 years. Similarly, the fatality rate on a person basis was 14.66 fatalities per 100,000 population in 2003. This is compared to 26.42 in 1969. In 2003, the fatality rate per 100,000 population was the lowest in the past 35 years.

The distribution of fatalities by crash type has remained fairly constant over the past many years. Figure 2 presents the distribution of fatalities over the past 2 decades.

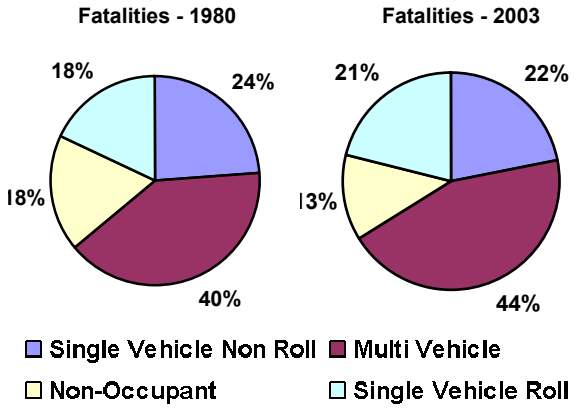

Figure 2. Distribution of fatalities by crash type in 1980 and 2003.

The changes that have occurred in these major segments of the fatality distribution are compared in Table 2.

Motorcycle rider fatalities, after a major decrease in the 1980s and early 1990s, have increased steadily since a historic low in 1997. In 2003, motorcycle rider fatalities numbered 3,661, an increase of over 1,500 fatalities from the 1997 level.

Table 2.
Percent change in fatalities by crash type

Segment	1980	2003	Change
Multi-vehicle	40%	44%	+10%
Single Vehicle (Non-roll)	24%	22%	-8%
Single vehicle (rollover)	18%	21%	+17%
Non occupant	18%	13%	-28%

The total number of police-reported crashes in the U.S. in 2003 was estimated by the National Automotive Sampling System (NASS) General Estimates System (GES) to be 6.3 million. These police reported crashes resulted in 2.9 million persons being injured. In recent years, the estimated number of injuries has decreased, as has the injury rate, based on VMT. In 2003, the injury rate reached 100 injuries per 100 million VMT.

In 2004, safety belt use reached an all time high in the U.S. Current estimates indicate front outboard-seated occupants during daytime hours have a usage rate of about 80 percent. The recent safety belt estimate, by observation year, is shown in Figure 3.

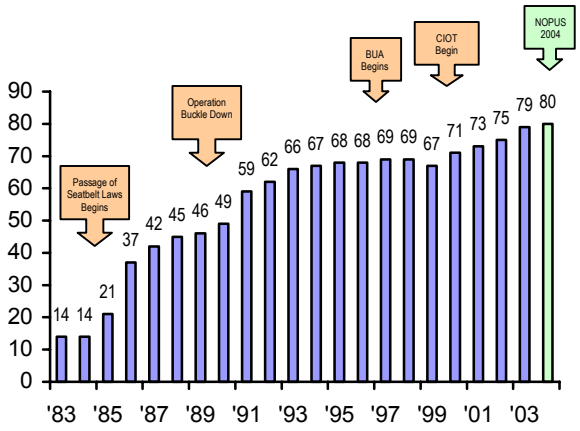

Figure 3. Safety belt use in the U.S. by year.

DATA COLLECTION AND ANALYSIS

NHTSA conducts a motor vehicle crash data collection program through the National Center for Statistics and Analysis (NCSA). It is composed of: the data collected from the states, including Fatality Analysis Reporting System (FARS) and the State Data Program, crash investigations, which includes the National Automotive Sampling System and the Special Crash Investigations (SCI) programs.

FARS is a census of all fatal crashes occurring on public roads in the United States. FARS has co-operative agreements with State agencies to identify fatal motor vehicle crashes and collect information about them. This information is coded into a common format and transmitted to NCSA. NCSA data are complemented by state crash data files provided through the State Data Program. Each year, the crash data files from 29 states are obtained, documented and provided to the Agency. Also a specialized crashworthiness database is created from several of the state data files. In another component of the State Data Program, NHTSA continues to work with states to develop Crash Outcome Data Evaluation Systems (CODES). CODES projects link statewide police-reported crash data to medical outcome data.

The NASS is comprised of the General Estimates System (GES) and the Crashworthiness Data System (CDS). The GES provides national estimates of characteristics of all motor vehicle crashes. The CDS conducts detailed investigations into a nationally representative sample of crashes involving towed passenger vehicles to investigate injury-causing mechanisms and to evaluate countermeasures. The SCI program provides in-depth data on crashes where emerging issues may be of interest.

A new NHTSA initiative called the National Motor Vehicle Crash Causation Survey (NMVCCS) began collecting data starting in January 2005. This survey will conduct on-scene crash investigations and collect data from a nationally representative sample of passenger vehicle (passenger cars, vans, sport utility vehicles, pickups and other light trucks) crashes. The data will provide information on the events and factors related to the causation of crashes. The survey will help identify the events and factors related to how crashes occur.

NCSA conducts key analyses of the collected data and publishes reports, including the annual traffic safety facts book. A copy of the most recent report can be found at NCSA's web site using the following URL:
http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/AvailInf.html

CRASHWORTHINESS RESEARCH

Incompatibility Between Passenger Cars and Light Trucks

For decades, the light vehicle category consisted primarily of automobiles. The growing popularity over the past 10 years of light trucks, vans, and utility vehicles (LTVs), all weighing 10,000 pounds gross vehicle weight rating (GVWR) or less, has changed the marketplace as well as the safety picture. LTV sales have soared to almost eight million units sold in 2002 – 49 percent of new passenger vehicle sales. In 2003, the number of registered LTVs in the United States exceeded 85 million units or approximately 37 percent of registered motor vehicles in the U.S. The majority of LTVs are used as private passenger vehicles and the number of miles logged in them increased 26 percent between 1995 and 2000, and 70 percent between 1990 and 2000. Beyond the growth in sheer numbers of vehicles, LTVs also have increased in size, the curb weight gaining on average about 300 pounds from 2000 to 2004, whereas passenger cars gained approximately 110 pounds during the same period.

NHTSA is continuing research to identify vehicle characteristics that affect compatibility and evaluate their effects in real world crash performance. Several compatibility performance metrics have been developed and are being evaluated against real world crash experience and staged vehicle crash testing. Evaluation of compatibility performance measures is using sophisticated computer models to assess the impact of vehicle changes on fleetwide safety performance. The fleet studies are focused on evaluating the impact of changes made to the entire fleet (i.e., both LTVs and cars) on safety. In addition to NHTSA's initiatives, vehicle manufacturers have committed to a set of voluntary standards for enhanced vehicle-to-vehicle crash compatibility. NHTSA is closely monitoring these voluntary efforts and future research developments from industry participants.

Crashworthiness Rollover – Ejection Mitigation

The crashworthiness rollover research program can be separated into two main topics, ejection mitigation and protection for non-ejected occupants. The ejection mitigation program is aimed at occupant containment countermeasures, developing performance requirements, test procedures for evaluating these countermeasures, and developing procedures to evaluate rollover sensor performance. The research program for the protection of non-ejected occupants includes roof crush test method development and rollover restraint performance. Ejection is a major cause of death and injury in light-vehicle rollover crashes. Almost two thirds of all ejection related fatalities occur during rollover

crashes. NHTSA is pursuing a phased approach to reducing occupant ejection in rollover crashes. The recently proposed side impact pole test would amend FMVSS No. 214 to provide improved head protection for occupants, and likely result in greater use of side curtain air bags. The ability of window curtains in preventing ejections remains to be proven. Depending on their characteristics and performance, as well as other design features such as tethers, window curtains could be designed to prevent ejections. However, much work remains to be done in this area. The next phase is to establish performance requirements for rollover sensors. The agency collected considerable information (from manufacturers and suppliers) in its effort to develop a research plan for rollover sensor performance requirements.

Side Impact Research

NHTSA's FMVSS No. 214 upgrade proposal would require auto manufacturers to provide head protection in side crashes and to enhance thorax and pelvis protection for a wider range of vehicle occupants. The proposed upgrade augments the current side-impact standard by requiring an additional performance test involving a 20-mph (32 kph) vehicle side crash into a rigid pole at an approach angle of 75 degrees. The Agency is moving toward incorporating the more precise biomechanical knowledge provided by second generation side impact dummies. The upgrade proposes the use of two dummy sizes representing a 5th percentile adult female (the SIDIIs) and a 50th percentile male dummy (Eurosid-2 Re, a modified version of Eurosid-2) for both the proposed oblique pole test and the current FMVSS No. 214 barrier-to-vehicle test. In order to develop this proposal, the Agency has undertaken research in biofidelity assessment of dummies. Additionally, a number of crash tests were also undertaken to generate the necessary data for benefits assessment.

Hydrogen, Fuel Cell and Alternative Fuel Vehicle Safety Research

NHTSA's program for hydrogen, fuel cell, and alternative fuel vehicles is focused on establishing safe performance requirements for hydrogen-powered internal combustion engine (ICE) and fuel cell vehicles. Safety requirements are vital to support the launch of the FreedomCAR Program, a cooperative automotive research partnership between the U.S. Department of Energy and the U.S. Council for Automotive Research (USCAR). The President's Hydrogen Fuel Initiative, announced in 2003, expands on the FreedomCAR Program to make fuel cell vehicles a practical and cost-effective choice for a large number of Americans by 2020. NHTSA's safety initiative will complement these efforts by developing foundational research information that will be necessary to evaluate future requirements.

Event Data Recorders

NHTSA has been conducting research and collecting information related to Event Data Recorders (EDR) for several years. Circa 2000, NHTSA sponsored two working groups, one on light duty vehicles and one focused on heavy vehicles. Both working groups published findings, available on NHTSA's web site at www.nhtsa.dot.gov. Since 2000, NHTSA has concentrated on the collection of EDR data via its National Automotive Sampling System Crashworthiness Data System (NASS-CDS) and Special Crash Investigation (SCI) programs. Several thousand EDRs have been read as part of these routine crash investigations. Based on the information gathered, the agency initiated a rulemaking action on EDR.

NHTSA's crash data collection program will continue to collect EDR data for the foreseeable future and publish those data as part of public crash records of these programs (also see NHTSA web site). Several papers have been published on various aspects of EDRs, including a separate 19th ESV paper by Niehoff (ESV paper 05-0271), that examines the accuracy of the current generation of EDRs. Analyses of about 40 crash tests indicated that the EDRs in several manufacturers' vehicles measure crash delta-Vs, pre-crash vehicle speed, and belt use fairly accurately.

BIOMECHANICS

Experimental Impact Injury Research

NHTSA continues to build upon the science of biomechanics by expanding our experimental research programs. Ongoing biomechanical projects include studies of the efficacy of new seat belt systems (force limiters, pre-tensioners, and four-point belt systems) on human thoracic response. We are also studying injury processes in the knee-thigh-hip complex and and in the foot and ankle within an impact environment. These efforts form the backbone of subsequent work to improve anthropomorphic dummies and etablish injury criteria associated with dummy measurements. Moreover, a renewed emphasis has been placed on understanding how human injury tolerance transitions with age and the physiological differences.

Advanced Anthropomorphic Dummies

NHTSA has released a new version of a 50th percentile male frontal impact dummy known as the THOR-NT. This latest version is an update of the previous THOR-Alpha version. It has much improved anthropometry, biofidelity, durability, and ease of use. The head is now adorned with a single, integrated skin that meets both isolated head drop and whole-body impact requirements. The neck has a new atlanto-occipital joint that provides a more human-like range of motion. The ribcage has been revised to provide improved biofidelity of the ribcage to the lower speed Kroell impact, while a new femur design provides a more biofidelic range of motion at the trochanter. Injection molded flex joints throughout the THOR-NT translate into upgraded performance and durability. Other improvements include a shoulder with better anthropometry and more durable external pelvis and femur skins.

A new 5th percentile female version of the THOR has also been released, ensuring that THOR concepts may be broadly applied. The lower extremities of both the 50th percentile male and the 5th percentile female THOR dummies have been adapted to replace the corresponding components on the Hybrid III dummy.

Figure 4. THOR-NT 50th percentile male dummy.

Biomechanics research continues to take advantage of rapidly expanding capabilities of analytical modeling techniques. The Simulated Injury Monitor (SIMon) concept, introduced at the 17th ESV, exemplifies our use of analytical models to improve our understanding of the basic underlying mechanics of injury including that of brain injuries. The latest version of the brain model is being evaluated by multiple academic and governmental organizations and the automotive industry. Biomechanics research is now expanding the SIMon concept to a thorax model for injury assessment of the human chest.

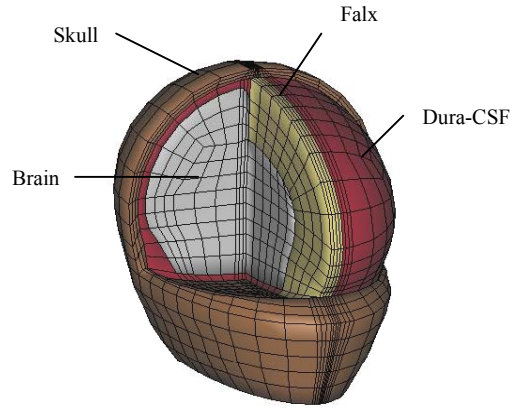

Figure 5. SIMon Finite Element head model

Crash Injury Research and Engineering Network (CIREN)

CIREN is composed of 10 level one-trauma hospitals. Spanning the United States and funded by NHTSA, American Honda Motor Company Inc. and academia. CIREN continues to produce "real-world" research findings on crashes, injuries, treatments, and outcomes. CIREN medical researchers, working with engineers at NHTSA and in the automotive industry and research universities, have produced more than 130 scientific papers and presentations analyzing the basic causes of more than 2,700 cases of serious crash injuries. The agency is exploring new ways to enhance NHTSA's understanding of injury causation in crashes and refining the capability to define injury criteria.

CRASH AVOIDANCE RESEARCH

Vehicle Handling/Electronic Stability Control

The Agency has long been concerned with the growing number of single vehicle crashes in the United States. A major portion of these crashes result from loss of vehicle control and many such incidents end up in rollover crashes. The Agency has addressed the rollover issue by providing consumer information on the rollover likelihood of vehicles. The Agency undertook research to develop dynamic test procedures to assess rollover risk complementing the assessment based on the static stability factor.

Research was also initiated to develop procedures that could be used to measure the handling performance of vehicles. The overall goal was to identify maneuvers that would have universal acceptance in discriminating handling performance of vehicles.

During the past year or so, many studies have been published showing substantial benefits from electronic stability control (ESC). However, such studies were considered preliminary, due to the paucity of data on vehicles equipped with ESC in the fleet. A recent study by NHTSA estimated that single vehicle crashes were reduced by 35-67% in vehicles equipped with ESC. Because of ESC's large potential benefits for eliminating single vehicle crashes, the research focus was shifted from the identification of generic handling maneuvers to the identification of maneuvers that can distinguish between vehicles with and without ESC.

Four test maneuvers have been shown to induce oversteer (spin-out) in vehicles without ESC, while maintaining adequate control in vehicles equipped with ESC. The four candidate maneuvers are:

1. 0.7 Hz sine with dwell
2. 0.7 Hz increasing amplitude sine
3. 500 deg/s yaw acceleration steering reversal
4. 500 deg/s yaw acceleration steering reversal w/ pause

All maneuvers are accomplished with a computerized steering controller, for steering precision. Tests are currently underway to obtain results from 50 production vehicles of various vehicle classes. Using the National Advanced Driving Simulator, extreme maneuvers will also be researched to evaluate ESC performance.

National Advanced Driving Simulator (NADS)

Using NADS, NHTSA has examined driver distraction, specifically the effects of different wireless phone interfaces on dialing, talking and answering phones in situations that vary driver workload. Results of this research effort are expected to be available in 2005.

NHTSA is also conducting a multi-year, four phase program of research on alcohol impairment and driving. The first phase, currently in progress, concentrates on impairment associated with various levels of blood alcohol concentration (BAC) ranging from 0.00% to as high as 0.08% and 0.10%, and will establish baselines for drivers of various ages and different drinking practices. Later phases of this research effort will explore how impaired driving interacts with the effects of variations in environmental conditions, roadway and driving scenarios. The results of this research program will assist in the development of crash avoidance approaches to reduce the incidence of crashes due to alcohol impaired driving.

The NADS study is also investigating driver behavior and performance with respect to ESC by addressing the effects of ESC icon type, driver age, and time to respond to crash-imminent situations.

Heavy Vehicle Research

NHTSA's Heavy Vehicle research program continues to be directed toward improving the collision avoidance capabilities of these vehicles. Agency research has shown that major improvements in braking performance can be achieved by a combination of disc brakes and more powerful front axle brakes. Stopping distance improvements of up to 30 percent or more have been demonstrated. Electronic control of brake systems (ECBS) on heavy vehicles also offers opportunities for faster brake applications and more precise control, including independent braking of individual wheels for balanced braking and stability control. Advanced disc brake systems with ECBS are currently being tested on the test track and in fleet use. The fleet test program also includes forward collision warning systems. Research on improving indirect visibility from heavy trucks is also underway.

Intelligent Transportation Systems (ITS)

In 2004, the U.S. Department of Transportation's (USDOT) ITS program launched a new generation of initiatives aimed at improving transportation safety, relieving congestion and enhancing productivity. These initiatives reflect an ongoing recognition of the potential of ITS technologies to significantly improve the operation of America's transportation systems. In order to maximize that potential the ITS Management Council, which is comprised of senior leadership of the USDOT, conducted a multi-year review of the ITS program to determine its future direction and focus. As part of this review, the Council adopted a list of criteria it used to evaluate possible new initiatives. The criteria included an emphasis on identifiable outcomes, performance schedules, private sector partnerships and return on investment. Upon completion of the review, the Council chose nine major initiatives to comprise the centerpiece of the ITS program. The Intelligent Vehicle Initiative (IVI) was conducted as part of the

ITS program from 1997 through 2005. Significant progress was made in understanding the impact that advanced technology can have in helping drivers to avoid crashes. Three of the new ITS initiatives were developed in response to the successful research that came out of the IVI program.

Intelligent Vehicle Initiative

The theme of IVI was "Saving Lives through Advanced Vehicle Safety Technology." This supported the agency's mission of preventing highway crashes and the fatalities and injuries they cause. The IVI addressed three driving conditions where there is the greatest opportunity to improve safety: (1) Normal driving condition, by encouraging the design of in-vehicle communications and information systems that drivers can operate without distraction, (2) Degraded driving conditions, such as conditions of reduced visibility or driver fatigue, by encouraging accelerated commercialization of advisory systems, and (3) Imminent crash situation by encouraging accelerated commercialization of crash avoidance warning systems. The IVI program addressed these driving conditions within the context of four classes of vehicle platforms: light vehicles (passenger vehicles and LTVs), commercial vehicles (heavy trucks and interstate buses), transit vehicles (intra-city buses) and specialty vehicles (highway maintenance vehicles and emergency response vehicles).

Additionally through the Intelligent Vehicle Initiative, NHTSA sponsored a cooperative agreement to develop protocols and metrics to quantify how operating in-vehicle devices can affect driver workload. The Collision Avoidance Metrics Partnership (CAMP) organized a team from Ford, GM, Nissan, and Toyota that undertook the work. The goal of the four-year effort was to identify driver distraction metrics and tests that are practical, meaningful, and repeatable for use in the product development process and human factors guidelines.

IVI conducted two field operational tests of light vehicles. One evaluated the safety performance of a warning system for rear-end crashes. This fleet consisted of 10 vehicles equipped with a sophisticated data collection system in addition to the crash warning system using heads-up displays and auditory warnings that included a state-of-the-art forward looking radar, a forward looking camera, a differential global positioning system (GPS) receiver, and a digital map data base as well as extensive monitoring of in-vehicle controls.

The second field operational test is evaluating the safety performance of a road-departure crash warning system. This system provides warnings if the driver is following a path that will lead to a departure from the paved roadway or if the driver is approaching a curve at a speed that is excessive for that curve. The system utilizes a forward-looking camera, a state-of-the-art radar that looks forward, a second radar that looks to the side, a GPS receiver, and an advanced digital map.

The Vehicle Safety Communications (VSC) project was conducted to evaluate vehicle safety applications enabled or enhanced by communications. The project evaluated vehicle safety applications, identified associated communications requirements, and promoted the accommodation of these requirements in developing communications standards. As a result of work on this project, VSC has:

- Prepared a comprehensive list of thirty-four potential vehicle safety application scenarios, enabled or enhanced by wireless communications. Included eight high-priority vehicle safety applications based on estimated potential safety benefits.
- Developed preliminary communications requirements for the potential application scenarios.
- Estimated potential safety benefits resulting from the deployment of vehicle safety applications.
- Implemented and demonstrated successful exchange of preliminary SAE common message set needed for vehicle-to-vehicle safety applications.
- Identified channel capacity issues in traffic density scenarios through simulations and recommended development of an adaptive dedicated short range communications (DSRC) protocol to improve communication reliability in stressful traffic environments.
- Determined that 5.9 GHz DSRC represents the wireless technology most likely to support the communications requirements of the majority of vehicle safety applications.

Driver/Vehicle Performance and the 100-Car Naturalistic Driving Study

The 100-Car Naturalistic Driving Study was the first instrumented vehicle study undertaken with the primary purpose of collecting large-scale naturalistic driving data. Drivers were given no special instructions, no experimenter was present, and the data collection instrumentation was unobtrusive. In addition 78 of 102 vehicles were privately owned. The resulting database contains many extreme cases of driving behavior and performance, including severe fatigue, impairment, judgment error, risk

taking aggressive driving and traffic violations. The data set includes approximately 2,000,000 vehicle miles, almost 43,000 hours of data, and 241 primary and secondary drivers. Parameters such as vehicle speed, vehicle headway, time-to-collision, and driver reaction time are recorded. The project report addresses ten goals, which include rear-end events, lane change events, the role of inattention, and implications for a larger scale data collection effort. The report is expected to be released before the end of 2005.

NHTSA is also involved in the implementation of three of new major ITS initiatives that support the Department's safety goals: Integrated Vehicle-Based Safety Systems, Cooperative Intersection Collision Avoidance Systems and Vehicle Infrastructure Integration.

Integrated Vehicle Based Safety Systems (IVBSS)

The goal of this project is to generate research information to support equipping vehicles with advanced driver assistance systems that would help drivers avoid the most common types of deadly crashes. This initiative, in partnership with the automotive industry, will build on completed and ongoing IVI field operational tests as well as results from naturalistic driving studies. This initiative will be the first attempt to fully integrate individual solutions to address specific safety problems that were developed under IVI.

Cooperative Intersection Collision Avoidance Systems (CICAS)

In order to achieve deployment of intersection collision avoidance systems that can save lives and prevent injuries at 15% of the most hazardous signalized intersections nationally, the research program is aimed at developing in-vehicle support in 50% of the vehicle fleet, by 2015. Intelligent intersection systems can be vehicle-based, infrastructure-only or infrastructure-vehicle cooperative systems. This initiative builds on research and operational tests conducted under USDOT's Intelligent Vehicle Initiative.

Vehicle Infrastructure Integration (VII)

The goal is to achieve nationwide deployment of a communications infrastructure on the roadways and in all production vehicles and to enable a number of key safety and operational services that would take advantage of this capability.

VII builds on the availability of advanced vehicle safety systems developed under the IVI and the availability of radio spectrum at 5.9GHZ recently approved by the FCC for dedicated short range communications. The VII would enable deployment of advanced vehicle-vehicle and vehicle-infrastructure communications that could keep vehicles from leaving the road and enhance their safe movement through intersections.

FUTURE RESEARCH DIRECTIONS

The federal role in vehicle safety research in NHTSA has been primarily in support of the promulgation of its safety standards. Additionally, consumer information programs such as the new car assessment program (NCAP) for crashworthiness rating has also been providing consumers with valuable information on crash safety performance of vehicles for many years. NHTSA has now added a similar rating program in one area of crash prevention, namely, rating on rollover resistance based on research and test procedures the agency has developed.

However, the emphasis in NHTSA's regulations as well as in consumer information that are provided has been mostly in crashworthiness of vehicles. The approach the Agency has used is by first defining the safety problems identified by the crash statistics that the Agency collects. Then it develops the necessary countermeasures that could improve crash protection showing what is feasible, evaluating the safety benefits and effectiveness of those countermeasures, estimating the economic costs involved in promulgating safety regulations and issuing the necessary regulations.

While this approach has worked well for many years, as new technologies emerge, a paradigm shift in research is also becoming necessary. As vehicle technologies evolve, the clear distinctions that existed thus far across the Haddon matrix are fast disappearing, and there is considerable overlap between the human and the vehicle and the vehicle and the environment across the board from the pre-crash to post-crash events.

This shift demands a change in the research approach the Agency has used in the past, to address the emerging safety issues in the future. Consider the events that precede a crash and those that occur during and after the crash. Laying these events along a time line and considering the crash event to be occurring at time zero, time available at the users disposal before zero is unlimited, assuming there is

no threat of any crash. However, the critical time period from a safety perspective is the few critical seconds before time zero, the few milliseconds during the crash, and the few minutes after the crash. Vehicle technologies can be incorporated into every phase of these events along the time line even far before time zero. As one moves closer and closer to the time zero, the technologies must progressively detect imminent threats from all sources – external to the vehicle and from within the vehicle and from the user, and assist the user in coping with the problem at hand whether it is in avoiding crashes, reducing their severities, or protecting the occupants. Many technologies are being introduced in to the fleet in each of the above phases. However, it is evident that technologies need to be thoroughly researched as to their relevance to the various parts on the crash time line if safety is to be enhanced.

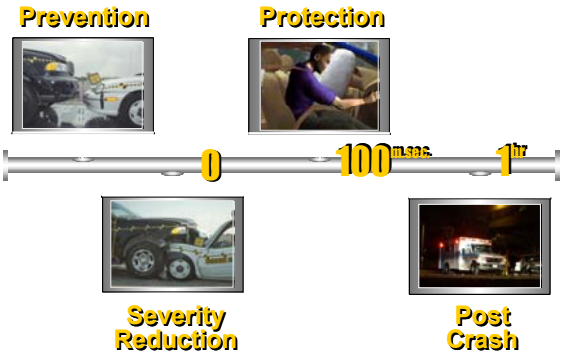

Figure 6. Time line for Vehicle Safety

Therefore, the Agency is planning and developing its research agenda for future delivery of safety by aggressively proceeding with the preliminary assessment of near-term safety technologies and their potential to address specific safety problems, developing suitable test and evaluation procedures and preliminary estimates of anticipated benefits. This would require collaborative research efforts with automobile manufacturers and tier 1 suppliers of technologies in the future and it is anticipated that such research efforts will be launched in the near future.

INTERNATIONAL HARMONIZED RESEARCH ACTIVITIES (IHRA)

Traffic crash injuries are universal in nature. Over the past 30 years, motor vehicle-related fatalities have been the principal focus of NHTSA's research efforts. Given the cost of motor vehicle injuries to society and their consequences on human lives, more widespread and innovative efforts must emerge to reduce injury. A harmonized research program was considered to be a suitable program for providing the solid foundation for enhancing global safety through sharing of research information and harmonization of standards where possible.

With this in mind, the United States proposed at the 15th International Technical Conference on the Enhanced Safety of Vehicles held in Melbourne, Australia, in 1996, that its international partners establish initially a five-year program for the IHRA. Senior representatives from the Government of twelve countries and two international organizations reached consensus on a five-year international research activities program. The representatives also identified research priority items with a lead country to coordinate the research activities. For IHRA, the steering committee makes recommendations for research and has final approval authority on the research agenda and any reports that are released under this program. NHTSA serves as the secretariat for the program. In 2001, the steering committee extended the program for another three years.

The ongoing research activities conducted under this program included biomechanics research with the United States as the lead country, pedestrian safety led by Japan, vehicle compatibility and advanced frontal protection under the leadership of EC/EEVC, side impact protection led by Australia and Intelligent Transportation Systems Research led by Canada.

Eight years of the life of the IHRA program have passed. The working groups for many of the research topics, though functional, are still evaluating the accomplishments over the last eight years. Depending upon the progress made in each of the working groups, the research findings are being compiled and will be reported at the 19th Enhanced Safety of Vehicles (ESV) conference. The steering committee is taking stock of the accomplishments of the last eight years and is developing recommendations for future activities and it is anticipated that a decision on future directions will be decided by June 2005.

INTERNATIONAL HARMONIZATION

The harmonization of regulations continues to be a matter of increasing importance to the United States and NHTSA. Efforts to coordinate regulatory practices on a global scale have resulted in establishment of fora and agreements to promote and guide the process of harmonization both at the bilateral and multilateral levels. NHTSA has been

and continues to actively participate in many of these forums, ensuring that all harmonization activities take into account best safety practices and best available technologies.

World Forum for the Harmonization of Vehicle Regulations (UN/ECE/WP.29)

1998 Global Agreement: On August 25, 2000, the United Nations/Economic Commission for Europe (UN/ECE) Agreement Concerning the Establishment of Global and Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can Be Fitted And/or Be Used On Wheeled Vehicles (the"1998 Global Agreement") entered into force. There are currently 22 contracting parties to this Agreement. The 1998 Global Agreement provides for the establishment of global technical regulations regarding the safety, emissions, energy conservation and theft prevention of wheeled vehicles, equipment and parts. The Agreement contains procedures for establishing global technical regulations by either harmonizing existing regulations or developing new regulations. The establishment of global technical regulations is expected to lead to a significant degree of convergence in motor vehicle regulations at the regional and national levels. However, while in some instances the result may be the adoption of identical or substantially identical regulations at those levels, in other instances, the result may be regulations that differ but do not conflict with each other. The Agreement recognizes that governments have the right to determine whether the global technical regulations established under the Agreement are suitable for their own particular safety needs. Those needs vary from country to country due to differences in the traffic environment, vehicle fleet composition, driver characteristics and seat belt usage rates.

Implementation of the 1998 Global Agreement: In June 2002, the Executive Committee of the 1998 Global Agreement formally adopted the Program of Work and requested that contracting parties volunteer to sponsor each listed regulation by submitting a formal proposal as required by Article 6 of the 1998 Global Agreement. During the June and November 2002 sessions of WP.29, several contracting parties stepped forward as sponsors for the individual work items.

The U.S. took the lead in advancing several areas on the Program of Work. It sponsored and chaired the informal working group to develop a global technical regulation (GTR) on door locks and door retention components. In November 2004, the Executive Committee voted in favor of establishing this door lock GTR, as the first GTR under the 1998 Global Agreement. Immediately after the establishment of this GTR and consistent with its obligations under the 1998 Global Agreement, NHTSA published a notice or proposed rulemaking to adopt this GTR as a Federal Motor Vehicle Safety Standard. This GTR is expected to pave the way for the establishment of more GTRs.

The U.S. has also sponsored and is chairing the informal working group to develop a global technical regulation on Head Restraint and is working toward completing and establishing this GTR by November 2006. More recently, the U.S. also agreed to co-chair the informal group responsible for developing a GTR for hydrogen fuel cell vehicles.

In addition to its leadership in the above mentioned areas, the US has also been actively participating in the development of other global technical regulations such as the installation of lighting and light signaling; motorcycle brake; passenger vehicle brake; and safety glazing. Apart from the hydrogen GTR, which is a longer term development effort, other GTRs are expected to be developed and established under the 1998 Global Agreement within the next two years.

Bilateral Cooperative Agreements

The US continues to leverage its resources by working closely with Canada, the European Commission, France, Japan, and the United Kingdom on bilateral cooperative regulatory activities. These efforts include the exchange of information on rulemaking initiatives as well as joint testing and research. In addition to the leveraging of resources, these cooperative activities are expected to establish an early understanding between parties regarding regulatory approaches, and thus, facilitate the establishment of harmonized regulations.

Asia Pacific Economic Cooperation (APEC)

NHTSA continues to be involved in APEC activities. Of significance is the Road Transport Harmonization Project (RTHP), which began in 1994, and whose objective is to promote the harmonization of standards within APEC region. Within the last few years, APEC has stepped up its efforts in promoting regional and global harmonization of vehicle

standards in light of the 1998 Global Agreement's entry into force in August 2000. As of January 2003, there were seven contracting parties among the APEC economies (United States, Canada, Japan, Russian Federation, People's Republic of China, Korea and New Zealand). NHTSA will continue to play a role in facilitating other APEC economies accession to the 1998 Global Agreement.

More recently, NHTSA has also become very active in APEC's Road Safety Experts Group (RSEG). Under the auspices of RSEG, NHTSA proposed a project to establish in a volunteer APEC economy a model traffic safety data collection system. According to World Bank rough estimates, nearly 500,000 persons die and millions are injured. Reliable and efficient data system is a much needed tool as APEC economies undertake region-wide and national efforts to reduce the number of people who get killed and injured in road traffic crashes every year in the Asia-Pacific Region.

North America Free Trade Agreement (NAFTA)

NHTSA has been actively involved in NAFTA harmonization efforts through the Automotive Standards Council (ASC). The Council has been seeking for the last ten years to identify incompatibilities in standards among NAFTA countries and set up a process that addresses these incompatibilities. Working groups, which comprise government and industry representatives, have been established to facilitate the process. During the past three years, the focus of the group has been primarily on the cross-border commercial vehicle traffic and the safe entry of commercial vehicles into the three jurisdictions. Several workshops were organized to bring greater understanding of the various regulatory and enforcement systems within NAFTA.

RULEMAKING

Since the last ESV Conference in Nagoya, Japan, NHTSA has published several final rules and important proposals. The following is a compilation of these actions, ordered in the following three areas: Crash Avoidance, Crashworthiness, and Consumer Standards. On July 25, 2003, NHTSA published the Vehicle Safety Rulemaking Priorities and Supporting Research plan. The plan included rulemaking actions of highest priority for the period 2003 to 2006, in all three areas.

Crash Avoidance

- On June 26, 2003, in response to the Transportation Recall Enhancement, Accountability, and Documentation Act of 2000, NHTSA established a new standard, FMVSS No. 139, that set new and more stringent tire performance requirements that will apply to all new tires for use on light vehicles, i.e., those vehicles with a gross vehicle weight rating of 10,000 pounds or less, except motorcycles and low speed vehicles. The final rule increases the stringency of the existing high speed and endurance tests. This final rule is effective June 1, 2007.

- On August 11, 2003, NHTSA issued a final rule adopting amendments to FMVSS No. 105 and FMVSS No. 121 that extended application of a braking-in-a-curve dynamic performance test requirement to single-unit trucks and buses that are required to be equipped with ABS. The amendments made in this rule were effective October 10, 2003.

- On November 1, 2003, NHTSA removed the regulatory text in the Code of Federal Regulations by the final rule issued on June 5, 2002 (effective on November 20, 2003), to conform with a court decision vacating the Federal motor vehicle safety standard for tire pressure monitoring systems.

- On August 11, 2004, NHTSA amended the Federal lighting standard for motor vehicle turn signal lamps, stop lamps, taillamps, and parking lamps (FMVSS No. 108), to increase compatibility with the requirements of the Economic Commission for Europe and to improve visibility of these lamps. The final rule was effective September 10, 2004.

- On September 15, 2004, NHTSA amended FMVSS No. 118, Power-operated window, partition, and roof panel systems, to require that switches for these windows and systems be resistant to accidental actuation, particularly by children. The amendments apply to passenger cars, multipurpose passenger vehicles, and trucks with a gross vehicle weight rating (GVWR) of 4,536 kg (10,000 lbs.) or less. The final rule was effective November 15, 2004.

- On October 1, 2004, in response to petitions for reconsideration, NHTSA clarified the

applicability of FMVSS No. 403 and 404, on platform lifts. This final rule also amended the definitions of certain operational functions, the requirements for lift lighting on public lifts, the interlock requirements, compliance procedures for lifts that manually deploy/stow, the environmental resistance requirements, the edge guard requirements, the wheelchair test device specifications, and the location requirements for public lift controls. The amendments in the rule were effective December 27, 2004.

- On December 17, 2004, NHTSA established an option in the Federal motor vehicle safety standard on hydraulic and electric brake systems (FMVSS No. 105) to permit the use of a roll bar structure during specified testing of brake systems in single unit trucks and buses. This rule was effective January 18, 2005.

- On December 20, 2004, NHTSA published a final rule that updates FMVSS No. 106, Brake hoses, to incorporate the substantive specifications of several Society of Automotive Engineers Recommended Practices relating to hydraulic brake hoses, vacuum brake hoses, air brake hoses, plastic air brake tubing, and end fittings. This final rule becomes effective December 20, 2006.

Crashworthiness

- On May 5, 2003, NHTSA published a final rule to address the issue of how to treat limited line manufacturers during the course of the first phase-in of the advanced air bag requirements of FMVSS No. 208. NHTSA expanded the definition of a limited line manufacturer to a manufacturer that produces no more than three vehicle lines and provided limited line manufacturers with an additional year to comply with the new advanced air bag requirements. The amendments made in this rule were effective July 7, 2003.

- On June 24, 2003, NHTSA made a number of revisions to FMVSS No. 213, child restraint systems, including amendments for incorporating improved test dummies, updated procedures used to test child restraints, and extension of the standard to child restraints recommended for use by children up to 65 pounds (30 kilograms). This action strengthened the technical underpinnings of the standard and ensures that a firmer foundation is laid for possible technical improvements in the future. The amendments made in this rule were effective December 22, 2003.

- On July 25, 2003, NHTSA updated the Federal motor vehicle safety standard on glazing materials (FMVSS No. 205) so that it incorporates by reference the 1996 version of the industry standard on motor vehicle glazing. This rule was effective September 23, 2003.

- On July 31, 2003, NHTSA established a new class of school buses, multifunction school activity buses, for use in transporting children on trips other those than between home and school. This rule became effective September 3, 2003.

- On December 1, 2003, NHTSA upgraded the rear impact test in FMVSS No. 310, Fuel system integrity. This final rule was effective January 20, 2004.

- On July 16, 2004, NHTSA amended 49 CFR Part 572 by adding a new subpart describing a weighted version of the current Hybrid III six-year-old child size dummy (HIII-6C). This final rule became effective January 12, 2005.

- On August 20, 2004, in response to petitions for reconsideration on FMVSS No. 208, NHTSA addressed issues raised by petitioners regarding positioning of the 5th percentile adult female, six-year-old and three-year old test dummies; determination of target points during low risk deployment tests; specifications for child restraint systems for automatic suppression system tests; and clarification of seat adjustment procedures. The amendments made in this rule were effective September 1, 2004.

- On October 15, 2004, NHTSA made permanent the temporary exclusion issued by the agency in an interim final rule published on May 8, 2003 to exclude funeral coaches from the requirements of FMVSS No. 225, “Child Restraint

Anchorage Systems." This rule was effective November 15, 2004.

- On November 5, 2004, NHTSA amended the definition of "special purpose vehicles" in FMVSS No. 223, Rear impact guards, by adding a precise description of the cubic area in which work-performing equipment must reside in or move through while a trailer is moving. This final rule was effective November 5, 2004.

- On November 19, 2003, in response to petitions for reconsideration, NHTSA addressed detailed seat and dummy positioning procedures in FMVSS No. 208. The amendments made in this rule were effective January 20, 2004.

- On December 8, 2004, this final rule established the requirement, under FMVSS No. 208, for Type 2 integral lap/shoulder safety belts in all designated seating positions in rear seats, other than side-facing seats. Side-facing seats may be equipped with either a Type 1 lap belt or a Type 2 belt. This rule responds to a Congressional mandate that the agency begin to phase-in requirements for lap/shoulder belts for all rear seating positions, wherever practicable, not later than September 1, 2005.

- On December 14, 2004, NHTSA upgraded FMVSS No. 202, Head restraints, in order to reduce whiplash injuries in rear collisions. This rule was effective March 14, 2005.

Consumer Standards

- In April 2003, a final rule that established new fuel economy standard for MY 2005 – 2007 light trucks was issued.

- On July 2, 2003, NHTSA announced the determination for model year (MY) 2004 high-theft vehicles lines that are subject to the parts-marking requirements of the Federal motor vehicles theft prevention standard, and high-theft MY 2004 lines that are exempted from the parts-marking requirements because the vehicles are equipped with antitheft devices determined to meet certain statutory criteria pursuant to the statute relating to motor vehicle theft prevention. The amendment was effective July 2, 2003.

- On February 19, 2004, consistent with the Alternative Motor Fuels Act of 1988, a final rule extended the incentive created by that Act to encourage the continued production of motor vehicles capable of operating on alternative fuels. The amendments made in this final rule were effective October 1, 2004.

- On June 3, 2004, in response to petitions for reconsideration, NHTSA modified certain aspects of its November 2002 final rule on Tire Safety Information.

The New Car Assessment Program (NCAP) has been the central focal point for the development, planning, and implementation of new crashworthiness programs designed to stimulate voluntary improvements in the area of occupant crash protection and occupant survivability since 1979. Over the years, the program has continually improved the information it has given the consumers as well improving the test methods used to rate vehicles. The program has recently included a rollover resistance rating program and has begun rating child safety seats on their ease-of-use. All NCAP ratings are posted to the agency's newly created website, www.safercar.gov.

Model year 2005 is just the second year in which NHTSA has rated vehicles for rollover using both static stability factor and dynamic rollover testing. There are clear suggestions that the program is having an impact in the marketplace, particularly with vans, pickups and SUVs. For example, for the 2004 Model Year, the average of risk of rollover in a single vehicle crash has shifted downward for vans, pickups, and SUVs.

CONCLUSIONS

NHTSA has made substantial progress in addressing the safety needs of the motoring public in the United States through its research activities, the safety regulations it promulgates, the consumer information in disseminates and through the traffic safety programs it implements. The gains made in the last three decades can also be attributed to a combination of improved vehicle and roadway designs and the crash test ratings by other organizations such as the Insurance Institute for Highway Safety. Additionally, significant gains have also been made

in safety belt use rate and due to other safety measures adopted at the State and Federal levels over the years. The National Highway Traffic Safety Administration has estimated that the cumulative lives saved by vehicle safety technologies including safety belts grew to 328,551 by 2002.

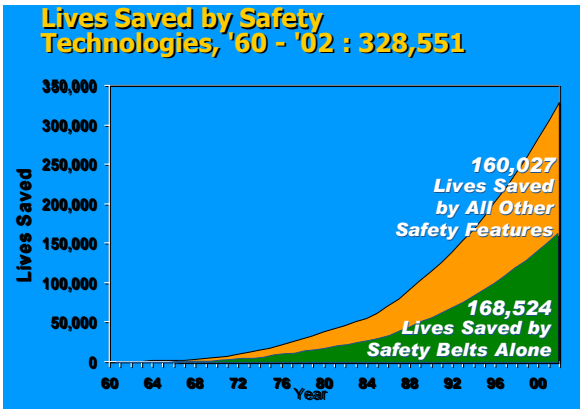

Figure 7. Lives Saved by Safety Technologies, 1960 – 2002

However, the question remains whether the steps adopted over the last three decades would be sufficient to continue to yield further gains to make a difference in resulting safety benefits at the same rate in the future. It is conceivable that the safety need will continue to grow while the approaches adopted for safety in the past may result only in limited gains with the result that there will be an ever-widening gap between the safety need and the safety gains that could be made in the future. It is therefore extremely important to find technological solutions to the extent possible to address various safety problems that exist. NHTSA is poised to meet this challenge by developing an aggressive research agenda and vigorously pursuing the necessary vehicle safety research in the future.