THE EVOLUTION OF VEHICLE SAFETY AND CRASHWORTHINESS

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The current fatality rate is 1.8 fatalities per 100 million miles driven and continues to improve even though travel is increasing. On average the U. S. has the safest roads among industrialized countries.

However, injury is the fourth leading cause of death in the U.S. following heart disease, cancer, and strokes. The largest cause of injury is motor vehicle crashes.

Research shows that most accidents are avoidable and the driver has the primary responsibility in avoiding fatal crash situations. Two thirds of fatal crashes were caused by a driver's mistake. The largest fraction of these - 45 percent - could be characterized as inadvertent errors. Another 21 percent of those crashes could be attributed to aggressive driving.

In the 1930's, as the automobile became more prominent in meeting a mobile societies transportation needs, automobile crashes began to occur on a regular basis as did related injuries and fatalities.

U.S. fatalities per 100,000,000 miles reached 15.6, compared with 3.5 in 1980 and 1.8 today. Thankfully, the figure is still falling. However, automobile transportation safety efforts must continue, and they will, but the challenges to achieve continued reductions become more and more complex. In the very simplest of terms, those reductions are twofold and involve avoiding a crash altogether or increasing the opportunity to survive a crash. Both aspects have posed, and continue to pose, enormous challenges to the automotive safety engineer.

So then, the first challenge is to design cars and road infrastructures that are sufficiently adequate in every sense to significantly reduce the opportunity for a crash to occur. These designs embrace a whole raft of technologies, from ABS brakes and radial tires to Near Obstacle Detection systems that can cause a vehicle to pre-brake and avoid obstacles, to improved road surface materials and the use of computers in the control of city traffic flow.

The second challenge is to design and build cars that enhance the protection of the occupants in the event of a crash. These two mainstream aspects of safety exist in parallel, each complimenting the other while remaining essentially independent of the other.

However, it should be noted that there is a third element to crash reduction that is significant. It involves drivers and their behavior while driving a vehicle. In addressing driver behavior issues, training and disciplining are arguably two of the most ideal and cheapest paths to enhancing effective road safety. Tremendous gains in reducing death and injury as a result of driver error have been made. And much credit for this must be given to MADD, SADD, and other such organizations, as well as NHTSA's efforts regarding driver awareness. However the sad realism is that these efforts are never likely to be thoroughly effective. Therefore, efforts to apply new technology that will enhance total roadway safety must continue.

In the short space of the past 30 years, research into, and the development of automotive safety systems and equipment truly accelerated. Important to this progress were events that occurred peripheral to vehicle engineering innovation.

One of the more significant of these events was passage by Congress of the National Traffic and Motor Vehicle Safety Act of 1966 which brought the National Highway Safety Bureau, now the National Highway Traffic Safety Administration, into existence. The Safety Administration also was instrumental in putting into place a national accident data gathering system that permits a more accurate description of the accident scene.

However, it should be noted that the automotive industry had been expending much effort in reducing death and injury resulting from vehicle crashes before the passage of the safety act. For example, in 1955 GM installed front-seat lap belts on Cadillacs and in 1956 Buick developed finned aluminum brake drums for faster brake cooling. Also of note at this time was GM's efforts to gather field accident data into a data base to focus on vehicle crash performance.

Other significant events have been the automotive industry's invention of a vast array of safety test equipment, including improved test dummies, and an increase in understanding the tolerance of the human body to injury.

General Motors Research Laboratories are one of the prime contributors to the advancement of highway safety. In depth studies in the areas of biomedical science and the expertise and advice of the men and women involved in this area of GM research have been crucial to the building and selling of safe and efficient automobiles. Additionally, this area of research has provided a leadership role in developing test dummies, and in enhancing test dummy ability to simulate the response of human beings - to make test dummies more human-like in their response.

As a result of the development industry-wide of more critical tests and test evaluations vehicle interiors have experienced a dramatic increase in vehicle safety.

Many new occupant protection features have been introduced into the passenger cars since the early 60's, a tribute to engineers working with tools developed over the past 30 years.

In 1960, GM designed its initial crash decelerator sled which was installed at Wayne State University medical center in Detroit. For the first time occupant dynamics and impact could be simulated and measured.

By 1963, the first series of tests using cadavers took place. Deceleration forces were increased and measured to determine tolerance. It was found that 340kg could be tolerated if the force was concentrated, or 950kg if spread by the steering wheel and hub. This data was pivotal to engineering. It set the parameters for padding, but material and components had to be carefully designed for energy management.

By 1967, all GM cars used high-penetration resistant glass. Other manufacturers were also adopting it and it is regarded as one of the most significant contributions to automotive safety. Not only has it helped improve driver and passenger survivability but it has also helped reduce pedestrian injuries when struck by a car.

Also introduced during this time frame were the energy absorbing instrument panel, cushioned armrests and door interiors, energy absorbing front seat back tops, and head restraints.

Passenger guard inside door locks made their initial appearance. Folding front seat back locks, first appearing in 1958, now became standard equipment. Also in 1967, the energy absorbing steering column had its debut.

The inside rear view mirror received a day/night mirror glass encased in vinyl backing to resist shattering in an accident, and was mounted on a breakaway pedestal. And, of course seat belts were standard. In 1986, GM introduced the first rear seat lap/shoulder belts in the U.S. domestic automotive industry.

While not subject to as substantial change as the body structure or vehicle interior, the chassis and drive train too have experienced safety improvements since the late 50's. Brakes, fuel tanks, and tires have led the way. Standardization of the dual master cylinder and warning in 1967, for example, ensured that a passenger car would have effective braking if damage occurred to one of the brake lines.

Two years later cars with manual transmissions received a safety start switch to prevent them from being started while in gear, and fuel system integrity and security were increased.

By 1971 front disc brakes, with their improved capacity to resist fade and the effects of water, had made a successful engineering transition from racing car to passenger. The pressure lock radiator cap and maintenance free, sealed battery made their appearance.

The following year the disc brake lining wear audible indicator was introduced by Oldsmobile and soon spread to all car models. In 1973 tires with Tire Performance Criteria (TPC) number which made it possible for customers to order a replacement tire that duplicated the specifications of the original equipment tire became possible. That same year the pressure relief gas cap was also introduced.

In 1974, GM became the first automaker to offer air bag restraints as options on selected vehicles. Now new generations of air bags are being worked on to reduce any side effect issues that may occur such as bruising or abrasions.

Combined with all of this was the development of the "safety cage" occupant protection approach. Much engineering goes into designing the passenger compartment so that it helps to maintain its integrity during a collision. A reinforced safety cage surrounds passengers with a rigid, high strength structure. This reinforced safety cage is then combined with front and rear "crumple zones" that are designed to absorb crash energy and minimize intrusion into the passenger compartment.

The best way to survive a crash is to avoid it altogether. Many crash avoidance features have been incorporated into automobiles to improve this capability.

In 1984 the center-high-mounted stop lamp was introduced as standard equipment. By making cars more visible from the rear, the intent is to reduce rear end collisions. Data indicates rear end collisions are reduced by up to 17 percent.

Other accident avoidance options like Anti-lock Brakes and traction control help the driver maintain steering control under various types of adverse roadway conditions. Brakes, suspension, tires are all engineered as a system to maximize vehicle control.

And soon it will be easier to avoid GM cars and trucks. That's the advantage of daytime running lights. Daytime running lights are special headlights that come on whenever you start your engine. Cars that have them are often easier to see, and that can help other drivers avoid collisions. This fall, General Motors will be the first automaker to offer low intensity daytime running lights as standard equipment on thousands of its U.S. cars and trucks.

As you can see, what has been occurring regarding the safety of vehicle occupants over the past 30 years is substantial. But what does the future hold regarding further advancement in vehicle occupant protection and crash avoidance? Where do we go from here?

In the realm of test tools, safety researchers from GM and the University of Michigan are developing and refining the world's first "pregnant" crash test dummy as a new tool to help study the effects of vehicle crashes on pregnant women and their unborn infants. What makes the pregnant dummy unique is that it carries a special fetal insert consisting of a simulated seven-month-old fetus suspended in a special urethane gel that closely approximates the specific gravity of amniotic fluid.

Cars and trucks of the future will become smarter and most future crash avoidance technologies will be aimed at extending the driver's senses.

Obstacle detection systems, using radar and/or sonar, are under development. These systems warn the driver of objects behind the vehicle or in "blind" spot areas.

Adaptive cruise control is a radar based system which assists drivers to maintain proper separation from vehicles detected ahead and alerts the driver when necessary.

GM is developing a lane sensing system called "Lane Lok" which is a real time computer vision system. The system identifies road markers without the need for special markings as well as curvatures. It then calculates the vehicles position to provide a warning to the driver when the vehicle starts to go off course.

Night vision enhancement is another technology taken directly from military applications. The system uses infrared (heat) sensing and display technologies. Night vision aide in defining vehicle position on dark roadways and provides a distinct advantage in low visibility situations such as when rain or fog exists. All of these systems may eventually find their way into the vehicle of the future.

Navigational aid systems use satellite navigation or other methods to locate the vehicle and communication systems to route drivers from where they are to where they want to go. They do this while helping them avoid areas of congestion. GM was directly involved in such programs as "Travtek" and "Pathfinder" to test navigation systems in Florida and California.

As a result, GM is now able to offer a production system as an option on 1994 Oldsmobile and 88 LSS models sold in California. The system will be made available country-wide within the next two years, as roadway data bases are completed.

Improvements in vehicle technology will come as a result of looking at the vehicle as an integrated system of crash avoidance and crash protection features. These diverse technologies all work together to provide incremental benefits and come into play at the moment when needed. Along with this technology, we must not forget to keep a constant focus on enhancing resolution of issues involving driver behavior as well.