Contributed Articles

On the Road to Safety - Milestones to Progress

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Well over 200 million vehicles are registered in the USA and their operation results in 3 million injuries and 43,000 fatalities annually. Those numbers are dramatic, but in the 1990s, highway fatalities dropped approximately 10% and the fatality rate, even with a substantial increase in vehicle miles travelled, dropped even more.

These improvements were attributed to reduced speed limits, increased use of seat belts, airbags, crash-absorbing vehicle frames, and campaigns to reduce drunk driving.

Unfortunately, those decreases in fatalities and injury rates have levelled off since the 1990s. So, while we have accomplished much in the past decade to improve the crashworthiness of automobiles, we have reached some practical limits in combating the physical forces involved in crashes. It is time to move beyond crash mitigation and enter a new era where technology will help us prevent accidents. I recognize that this will be a tough battle to win. Less than 1 % of accidents are fatal, so to save lives, we have to prevent a lot of crashes.

Let’s look at our current state of technology in that regard. I see three distinct milestones along the road to highway safety: technology for crash avoidance, telematics to better inform the driver about the vehicle and the highway, and command and control systems.

Crash Avoidance

The first milestone, crash avoidance technology, is in the foreseeable future. In fact, manufacturers already offer this technology in many current car models. These systems affect stability control, rollovers, lane departures, and rear-end collisions. In recognition of these advancements in vehicle performance, the National Highway Traffic Safety Administration (NHTSA), our vehicle regulator, is currently revising its New Car Assessment Program (NCAP). The NCAP 5-star rating, which tests new cars and ranks their crashworthiness, was designed to help new car buyers factor crashworthiness into their buying decisions. However, for the '06 Model Year, 95% of new cars received a four- or five-star rating. With every car getting nearly the same score, the ratings don't provide new car buyers with a clear measure for determining which car is the safest. NHTSA is seeking to refine the ratings system to provide consumers with more meaningful information.

The good news is that the similarity of these scores DOES reflect marked improvements in the crashworthiness of new cars. In the future, the NCAP program is seeking to evaluate improvements in crash avoidance, rollover resistance, and other safety features. For example, electronic stability control, required on vehicles sold in the USA by 2012, should significantly reduce run-off-the-road crashes and resulting rollovers. Once a vehicle leaves the road, it is "tripped" into rollover by soft soil, ditches, and other conditions: 7 out of 8 single-vehicle rollovers occur after the vehicle leaves the road. Although the proportion of crashes that result in rollover are low, they are significant, causing serious injuries and fatalities for most of the vehicle occupants. So, solving this problem means keeping vehicles on the road and reducing speed prior to crash impact to reduce the possibility of rollovers. We have good evidence that electronic stability control can help prevent road departures.

Depending on the manufacturer, crash avoidance systems may combine a variety of technologies and go by a variety of names. BMW has dynamic stability control, dynamic traction control, dynamic brake control, and variable active steering. Jaguar offers roll stability control that includes computer active technology suspension. GM has StabiliTrak. In addition to mitigating the number of fatalities and injuries, such technologies can provide a huge economic benefit. Every day, 19,000 crashes occur on American highways. These crashes incur an enormous cost: $230 billion a year - that's nearly $800 for each and every US citizen. We can no longer be satisfied with trying to protect people who get into crashes. We must instead use the technology at our command to prevent crashes from happening.

Telematics

The second milestone on our road to safety is telematics and it is actually a whole series of markers from today into the future. Telematics are wireless, location-based services for vehicles and drivers that trace their history back to the days when your neighborhood mechanic linked into your engine diagnostics to give you a report on the health of your car's various systems. Today, sophisticated technology provides not only on¬board navigation and entertainment services but also the means to a higher level of safety. We're all familiar with vehicle-based systems like General Motor's On Star, but research is well on its way to making road-based systems, vehicle-to-vehicle systems, and vehicle-to-infrastructure systems a viable means of promoting even greater roadway safety.

For example, vehicle-centered services, such as remote diagnostics, remote vehicle access, and automatic collision notification, are currently available on many cars. Survivability increases with quicker emergency response, which is directly related to this technology. For example, Broward County, Florida, has a severe incident response program that automatically notifies first responders and saved 360 hours of on-scene emergency response time last year.

In addition to coordinating first responders and traffic management equipment, such automatic crash notification systems can reduce the likelihood of pedestrian fatalities after an accident by keeping motorists from leaving their vehicles. It can also decrease the likelihood of secondary crashes by expediting the removal of disabled vehicles.

In addition to vehicle-based systems, road-based systems are being incorporated into our highway infrastructure. Vehicle Infrastructure Integration, a DOT initiative, will provide drivers with a sophisticated means for obtaining information about their vehicles and the road. What more do drivers need to know? How about location-specific weather conditions, route-specific road closures, and work zone status, to name a few? Location-specific weather and roadway information can be acquired directly from sensors that run beside or are embedded in the roadway.

Such sensors provide real-time information about fog, standing water, or freezing rain. Adverse weather is associated with 800,000 injuries and more than 7,000 fatalities in the USA annually (approximately 1 in 5 fatalities): These systems may well be one way to reduce those numbers and improve highway safety significantly. Telematics is often associated with cameras used to identify drivers who run red lights. But telematics can do more. For example, systems like Traficon, which operate within the highway infrastructure, are available to detect accidents, stopped vehicles, wrong-way drivers, lost cargo, and smoke and fire, and can be used to monitor pedestrians. The CAR 2 CAR communication consortium in Europe is currently developing information standards with plans to do a demonstration next year and frequency allocation by 2010.

We'll eventually see basic connectivity for the life of the vehicle without the need for ongoing subscription payments, working through a shared message handling utility on behalf of all manufacturers. Highway information that you and your car can access directly will eventually be as affordable and common as FM radio.

The USA broadcast spectrum for this technology has been identified (5.9 GHz), and geostationary satellites and ground-based towers are planned for 2012 with limited rollout by 2009. NHTSA currently is collecting public comments on a proposal to establish guidelines for information sharing specifications and data exchange formats to make traffic and travel information available to public agencies and private enterprises.

Further down the road, I predict that we will see a migration of communication and entertainment to fully portable devices like cell (mobile) phones and PDAs that are based on the individual rather than the vehicle. Meanwhile, vehicle-and road-based data services will continue to mature. Already, commercial fleet operators use data communications to track truck locations, plan routes, and schedule maintenance.

As of last year, NHTSA has published a final rule that standardises the collection and retrieval of light vehicle event data recorder (EDR) information. In the future, I think such transmissions will include vehicle software upgrades, malfunction and diagnostic reports, and the capability to order parts, and receive recall and service notifications.

Vehicle-to-vehicle and vehicle-to-infrastructure demonstrations are being conducted by Intelligent Transportation Systems (ITS) America. There were 135 exhibitors registered for the ITS Annual Meeting and Exposition in Palm Springs, FL earlier this year. The price of these technologies is pushing telematics into the market place.

The cost of digital cameras has dropped below $10. Applications that emit and receive infrared pulses to detect range, sense rain, dim headlights, warn of impending lane departures, or monitor blind spots are at a price point for fleet-wide applications. And satellite-connected operating systems like On-Star offer ever-more-powerful services through audio and video streaming of traffic, weather, and parking information. These technologies hold great promise for providing drivers with a powerful set of tools for closely monitoring their vehicles, the weather, the roadway, and, in time, other vehicles as well.

Command and Control

The third milestone along the highway to safety is automated vehicle control. Electronic devices and automated systems used in commercial aviation offer clear examples of how technology can improve our ability to operate in complex environments. With the introduction of electronic safety devices, we can trace the decline in commercial aviation accidents rates. Beginning in the 1950s, radio navigation aids (VOR/DME), radar, and ATC control technology dropped the number of accidents per year from 4 to 1.

Further refinements came with long-range radar, precision approaches, and secondary radar. Beginning in the late 70s, early automation offered Area Navigation (RNAV) and Traffic Collision Warning Systems (TCAS). The aviation industry has since implemented computerised flight management systems, wind shear alert systems, Ground Proximity Warning Systems (GPWS), and fly-by-wire electronic control of aircraft. We are now seeing real-time weather and traffic displays in the cockpit, precision landing systems for zero visibility conditions, hybrid vision, and remotely operated Unmanned Aerial Vehicles (UAVs).

Technological advances have made commercial aviation the safest mode of transportation and I believe new technologies may enable us to repeat those successes in highway travel. In addition to seat belts and airbags, which have greatly increased survivability, automated command and control systems will help prevent crashes, not just mitigate their effects. To that end, Integrated Vehicle-Based Safety Systems is a new US Department of Transport (DOT) vehicle safety initiative to build and field-test integrated crash warning systems to prevent rear-end, lane change, and roadway departure collisions on light vehicles and heavy commercial trucks. These systems are being deployed in cars as well.

Let me offer a practical example of how this technology can be used. Every parent's nightmare is to back over a young child in the driveway. Nearly 200 fatalities and approximately 7,000 such injuries were reported in the USA last year, though that is surely only a fraction because many of these events are not reported as highway fatalities because they occur on private property. Back-over avoidance systems are being marketed as "parking aids" using ultrasonic or radar technology to warn drivers as they approach an object. Initial evaluations indicate that camera-based systems offer the greatest potential, but driver use of these systems is still under evaluation.

The Motor & Equipment Manufacturers Association recently had an Advanced Safety Technology Ride and Drive Event in Washington DC. A dozen companies brought vehicles to showcase their technologies for both heavy duty trucks and passenger cars. Camera technologies for Blind Spot Warning Systems (by Delphi), Mirror-Integrated Rear Camera Display (by Gentex), Park 4U (by Valeo), and Total Blind Zone Management (by Magna) were impressive.

One out of every four crashes occurs at highway intersections. We have the capability to manage the traffic at those intersections by measuring an approaching vehicle's estimated time of arrival, speed, and range in order to extend the green light to prevent collisions. Another crash-avoidance technology is the adaptive cruise control system, such as the system available in the Mercedes S class. This system uses two radar frequencies to keep the car at a safe following distance and can even bring the car to a complete stop.

If the car detects conditions for a frontal collision, it not only sounds an alarm but also applies the brakes to stop the car. The system also has "night view assist," an infrared camera system offering a video dash display of the upcoming road that extends more than 100 feet beyond the low-beam headlights. Several other manufacturers, Honda, for example, now equip certain models with crash mitigation braking systems that tighten seat belts and apply brakes before a collision occurs. With the development of adaptive cruise control with lane monitoring and active steering (or evasive steering) underway, we are approaching the technical feasibility of autopilot systems.

I am confident that highway automation will greatly improve safety, but I am not naive about what it will take to see these benefits. We have work to do to ensure that the safety promises of these systems become reality. System integration, for example, is an important issue. Different manufacturers make anti-lock brakes, stability control systems, collision avoidance - and these systems and all their sensors must work in concert to avoid a variety of road hazards. Developers of these technologies must consider how the systems will be used, where displays will be located, how much information is needed, what information has priority, when the systems should be active, and how the systems should function in an emergency. Privacy is another issue that must be addressed for the public to embrace these technologies with enthusiasm.

In the end, it is the public, and their ability and willingness to make use of these systems, that will determine how effective they will be, and how soon. I made some earlier aviation comparisons, but the distinctions between drivers and pilots must be factored into the development of these technologies. Unlike pilots, drivers receive minimal qualification training, no recurrent training, no medical evaluation, and their education and language skills vary widely. Drivers may be totally inexperienced in their vehicle type, may have conducted no trip planning, and may view driving as secondary to other personal activities in the car.

Further, many drivers don't take the time to understand their cars and how their own driving habits may affect their safety. Let's face it: most drivers by and large don't even read their owners manuals. But manufacturers are taking steps to fill this need. Last November, Audi launched a series of video podcasts to explain features of its new car. It was available through the Audi web site and on iTunes, with downloads of 2000/day. They characterised it as a "bridge" between the owner's manual and the driving experience. Toyota Lexus 460's innovative self-parking system comes with an instructional DVD. Many manufacturers also use email contact to distribute information to owners. As safety systems evolve, manufacturers will be faced with ever¬more-difficult challenges in training drivers to take full advantage of the technology available.

The bottom line is that, no matter how well crash avoidance and other systems work, they will be more effective once drivers understand how the car and their driving performance can prevent crashes. Yes, we must test and evaluate all of these technologies to determine how these systems can affect the likelihood and seriousness of accidents. And to that end, I encourage our research community to work with industry and government to move quickly to deploy these available technologies. I fully expect that the Safety Board will be an active participant in understanding the implications of advanced highway technology. But in the end, we recognise that the driver must take responsibility. OUR job is to give drivers the tools they need to make the most of that responsibility.