BOSCH Group

# Australasian Road Safety Conference Presentation


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**Abstract**

For as long as the automobile has existed, it has been a regrettable fact that injury and death of occupants, pedestrians and other road users has been considered unavoidable.

With more than 90% of all crashes caused by human error, it is clear that people are at the core of the problem. To mitigate the risks, various “in vehicle” safety technologies have evolved. Firstly with a focus on “occupant protection” in the event of a collision, but later, and as technology permitted and consumers demanded, safety technologies that “automatically intervened” when a collision was likely. But even with the most sophisticated of systems, we can’t change the laws of physics.

Notwithstanding the importance of the safe system approach to road safety, it is clear that:

1) We can’t change the laws of physics, and
2) Humans don’t always learn from their mistakes.

Looking to the future, it is expected that the biggest benefit to road safety will likely come from removing human decision making in the driving activity.

**[SLIDE 1]**

In my keynote today I am going to resist quoting too many statistics. Rather I want to focus on the remarkable developments in technology over the 130 or so years of the automobile and the opportunities in front of us that will hopefully allow us to dispense with the need to collect and analyse road safety statistics at all.

While I am a strong supporter of the "safe system" approach to road safety, I do believe that the biggest bang for the buck comes from the rapid development and accelerated adoption of driver assistance technologies. After all, the root cause of more than 90% of all crashes is Human Error.

**[SLIDE 2] Vale BRIDGETT DRISCOLL**

Even though cars were a rare sight on the road in the late 1800's, strong anti-car sentiment had quickly developed. By the turn of the century many were voicing concern about drivers running around the country scaring horses.

So concerned were they in Pennsylvania that legislators in 1896 passed a bill through both houses of the legislature that would require all motorists piloting their “horseless carriages” upon chance encounters with cattle or livestock to

1) Immediately stop the vehicle
2) Immediately and as rapidly as possible… disassemble the automobile, and
3) Conceal the various components out of sight, behind nearby bushes” until equestrian or livestock is sufficiently pacified

**[SLIDE 3]**

Later that same year, the first pedestrian “Death by Automobile”, occurred. 44 year old Bridget Driscoll was struck by a horseless carriage reportedly travelling at a ”tremendous pace”, like a fire engine, in fact “as fast as a horse could gallop” eye witnesses said. The Roger-Benz Automobile was travelling at 4mph when it struck the bewildered Mrs Driscoll. A 6 hour inquest into her death returned a verdict of “accidental death”.

At the time, no driver training or driver’s license was required, and appropriate road regulations had not been framed, other than those carried over from the days of road going steam locomotives.

Since then, and for more than 125 years, the Automobile has been a murderous weapon in the wrong hands, and our regulations have lagged the evolution of vehicle technology.

## The AUTOMOBILE has come a long way

While fundamentally unchanged in form for all this time, with a wheel at each corner **[SLIDE 4],** with a few notable and disastrously unstable Exceptions,

an engine at the front (the middle, or the back),

hand and foot controls within easy reach of a “driver” **[SLIDE 5]** and room for goods or passengers (or both), and equipment that enables it’s use all day and all year, the modern automobile is nonetheless a far cry from the first incarnations.

As the number of cars on the road grew, so did the number of fatalities. Whilst automobiles were travelling relatively slowly, any impact with a pedestrian was likely to be fatal. In response, the first pedestrian safety innovations began to appear at the turn of the 20$^{th}$ century. The first of these was the O’leary Fender **[SLIDE 6]** – a curious wire mesh styled cowcatcher designed to scoop the pedestrian up out of harm’s way. To say that it never really took off is probably an understatement.

Over the years even sound approaches to safety had to battle with consumer apathy and hard-nosed, bottom line driven attitudes in the auto industry.

As pressure for greater safety began to mount after the second-world war, some industry figures denied that they needed to make vehicles safer. Instead it was drivers who had to improve. The innovations that actually improved safety were mostly touted as advances in handling, comfort, styling or performance.

In 1946, one “expert” wrote that the latest models were “as safe as science” can make them. Not surprisingly, physicians became advocates for safety improvements, evidently tiring of the carnage they were seeing in their hospitals.

The Journal of the American Medical Association charged in 1955 that vehicle interiors “are so poorly constructed from a safety standpoint that it is surprising that anyone escapes from an automobile accident without serious injury”.

At least some in the industry were listening. In the early 1950’s, the auto companies, after an inexplicable half century delay, finally put padding wherever the drivers head might hit a hard surface. By mid-decade, seat belts started becoming popular as options, although advocates  had to put up with criticism about their effectiveness.

By the 60's independent vehicle safety research was emerging, with researchers focused on innovations to reduce the danger to vehicle's occupants. Though few were realized, such innovations included elastic windshields, two levers as a replacement for the steering wheel and rear facing seats for passengers. It took consumer activist Ralph Nader's blistering attack on the GM Corvair, **[SLIDE 7]** which he described as "unsafe at any speed", for the US Government to initiate a congressional enquiry into the Industry, culminating in the National Highway Traffic Safety Act of 1966.

From this point, the authorities took a much stronger stance on vehicle safety. Initially, and for the decades that followed, vehicle safety developments were passive in nature, ie oriented to improving the chance of survival for occupants in the event of a crash rather than accident avoidance, and largely ignoring the impact on pedestrians. Crumple zones, interior design for occupant safety, seat belts, and airbags were innovations of the day.

## Milestones in Road Safety Technology

**[SLIDE 8]**

Antilock braking systems, first applied in Aviation have been around since the 1930's but only started to become commonplace in automobiles after Mercedes began fitting it to their range topping "S Class" in the late 70's. The price of an ABS system in the 1970's was around $350 on a $6000 car[1], explaining why it was fitted to premium vehicles only. With ongoing development, and the benefits of mass production, an ABS unit sells for less than 100 dollars today.

ABS was the first of the active safety systems. Active safety systems were to become a generation of systems aimed at accident prevention rather than just occupant protection. Active safety technology came of age thanks to the arrival of the microprocessor in the 1970's, and the phenomenon of Moores Law. The electronic brains becoming smarter and smarter enabling incredible improvements in performance over a relatively short time. While the various safety innovations that the IC made possible are credited with saving countless lives, the Integrated Circuit is really the unsung hero of modern vehicle safety systems.

**[SLIDE 9]**

[1] https://www.hagerty.com/articles-videos/Articles/2013/04/09/Antilock-Brakes

While ABS was hailed as a breakthrough in safety technology in its day, the 1995 Bosch and Mercedes co-developed Electronic Stability Control system has been described by many experts as "the most important advance in auto safety". Again, initially fitted to the Mercedes S class in the early '90's, the technology soon found its way into entry level cars, and is now increasingly standard fitment, although not so much in emerging markets.

Stability Control is credited with saving 10's of thousands of lives a year, and reducing 100's of thousands of accidents. Many drivers and occupants are even oblivious to its intervention in situations where without it they would have crashed and potentially died. Given the low cost, and high benefit, there is no valid explanation why every car produced should not be equipped with stability control today.

It was hoped that the early 90's application of Radars in automobiles could be another "silver bullet", but unfortunately the systems were error prone and too expensive at the time. The application of Radars in cars did not find favour until Mercedes and Ford brought their radar assisted adaptive cruise controls in the late 90's.

**[SLIDE 10]**

Since then we have seen dramatic developments in the performance and cost of Radars, Cameras, and Ultrasonic sensors that has resulted in the increased application of these technologies in active and passive safety systems, as well as the emergence of driver assistance functions, all of which are making the cars of today more fun, easier to drive, and safer for occupants, pedestrians and other road users.

**[SLIDE 11]**

We should take our hats off to our old friend, “The Integrated Circuit”, without which none of this would be possible.

The accepted reality that vehicles will crash and people will be hurt or killed has also seen new emergency response systems and services released in some markets. Emergency Call systems, automatically activated by the vehicle in the event of a crash of defined severity, ensures the speedy dispatch of appropriate emergency services to the exact GPS location of the vehicle. Beyond this, future eCall systems **[SLIDE 12]** will be able to predict the type & severity of injuries for each occupant thereby further improving the emergency response. Such systems will combine historical crash data, simulation models, occupant detection data, information recorded by vehicle sensors at the time of the crash, emergency center connectivity and big data analytics.

**[SLIDE 13]**

Volvo, a recognized leader in automobile safety, saw for the first time late last decade that a future where cars would not crash was conceivable. Volvo's ambitious 2008 statement that "By 2020, no one shall be seriously injured or killed in a new Volvo" gave a clear insight to this vision. While that statement has since been softened in favour of reference to the "trend toward zero deaths", what Volvo saw, and clearly believed, was that technology could enable the automobile to be less reliant on Human decisions in the avoidance of collisions.

For such a vision to be realized, the automobile will have to be able to sense its own surroundings, see around corners and over crests, be able to predict road conditions ahead and alter its speed and course instantaneously without reliance on decisions and reactions of the person behind the wheel. **[SLIDE 14]** All this can be delivered by largely existing driver assistance functions, now being bundled together under the collective description of "Autonomous Driving".

The concept of Autonomous driving of course is not new. Popularised in the 1950's Walt Disney program "Magic Highway" **[SLIDE 15/1]**, and brought to life in the form of "Kitt", Michael Knights Autonomous car from the 1980's TV series Knight Rider **[SLIDE 15/2]**, it was only a matter of time before big auto would find a way to make this a commercial reality.

Surprisingly though, it was the internet behemoth, Google, **[SLIDE 16]** not a major automobile manufacturer or component company that showed us cars such as these were possible. Applying radars, cameras, sonar sensors, GPS positioning and serious computing power, Google caught our imagination when they publicly unveiled their "highly autonomous vehicles" in 2009. Now on public streets for more than 6 years Google's experimental cars have clocked up more than a million miles of "autonomous driving", with incidents limited to those occasions where they have been struck by other vehicles.

Naturally, the big Auto makers and component sector companies have subsequently taken the covers off their equivalents, and now we see a true race to an Autonomous future.

## The Autonomous Future – degree of automation

**[SLIDE 17]**

The underlying technology that will enable fully autonomous driving is already implemented in stand-alone and combined functions. Functions such as adaptive cruise control, drowsy driver detection, lane keeping support, traffic jam assist, auto emergency braking and auto parking. To name but a few. These functions are already mature and by now well accepted.

The technical leap therefore is not so much in the underlying technology, although some work still needs to be done here too, it's more about integrating and combining these functions so that they work flawlessly and in all conditions. Rain, Hail, Sleet, Snow, Fog, Daylight, Nighttime, in Glare, on perfect roads and those that are not, at all speeds, with occupants and without.

**[SLIDE 18]**

There is still quite some work to be done to commercially deliver what could be described as full "auto pilot", but we are well on the way. Partially automated functions such as Park Assist and Semi Automated highway driving are already here. Semi-Automated highway driving typically involves at least two primary control functions designed to work in unison to relieve the driver of control of those functions. For example adaptive cruise control in combination with lane centering.

**[SLIDE 19]**

In parallel with the general developments in Automated Driving, Automated parking will be available fairly soon. Park steering and park maneuver control is already in production, remote park assist, the ability to park the car from outside it, will come in 2016. The auto park pilot and the driverless valet parking in car parks will follow before the decade ends.

**[SLIDE 20]**

In the 2020's Vehicles with the "Highway Pilot" level of automation will enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions.

In Highway Pilot mode the driver will rely heavily on the vehicle to monitor changes in conditions that would require transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

**[SLIDE 21]**

**Auto Pilot equipped vehicles will be** designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

Aside the technical challenges, there is much that needs to be considered, not least of which is amending the relevant road regulations, as has been done in South Australia, to facilitate AV trials and enable accelerated adoption.

But there is more.

The arrival of AV's will present new questions for example about

- **[SLIDE 22]** Effective traffic controls,
- **[SLIDE 23]** and road infrastructure needs
- **[SLIDE 24]** How young is too young, and does it matter if the "driver" actually can't drive
- **[SLIDE 25]** And what is allowed and not allowed, and what should limits be

In closing,

The benefits of Autonomous vehicles are widely reported.
Less congestion, reduced fuel consumption and emissions, improved road asset utilization, reduced road infrastructure needs, improved productivity but above all reduced collisions and road trauma.
Autonomous vehicles will be another road safety silver bullet.

Globally, the most progressive countries and states are enabling the earliest possible adoption of Autonomous Vehicles by sensible adjustment of regulation to facilitate vehicle trials and mass market entry when the technology is commercially available.

In this regards Australia is already quite late, although South Australia should to be congratulated for taking a leading position so far.
Given what's at stake, embracing Autonomous Driving should become a national priority.

**[SLIDE 26]**
In the meantime however, we could accelerate the standard fitment of life saving technologies which are already available, for example Auto

Emergency Braking in cars and ABS and Stability control for Motorbikes, as well as improving the odds of survival by applying eCall systems

**[SLIDE 27]**

Thankyou

I believe we have some minutes should anyone like to ask a question