You never see owls crash, do you?

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DaimlerChrysler
Answers for questions to come.

SAE Brake Colloquium

October 12, 2004

Keynote Address:

Active Safety
a Digital Paradigm

Dave McLellan
Corvette Engineering Director
1975-1992

Active Safety a Digital Paradigm

Active Safety

Active safety is avoiding crashes. Conversely, passive safety is reducing the damage done to the vehicle's occupants by a crash.

Active Safety a Digital Paradigm

Paradigm:

is a pattern, example or model.

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We’re going to explore active safety as an example of what’s becoming possible in the digital world.

Sensing impending crashes and intervening in time to avoid what had previously been the inevitable.

Active Safety a Digital Paradigm

In 1989 Burt Rutan was speaking to an Oshkosh audience in his usual “outside the box” manner.

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He observed that computing capacity was growing so fast that if you let your imagination explore what might be possible, the computing power would soon be there to make it possible.

Active Safety a Digital Paradigm

He envisioned an air traffic control system that was cockpit based where the pilot flew through a series of hoops in the sky virtually displayed on a head-up display.

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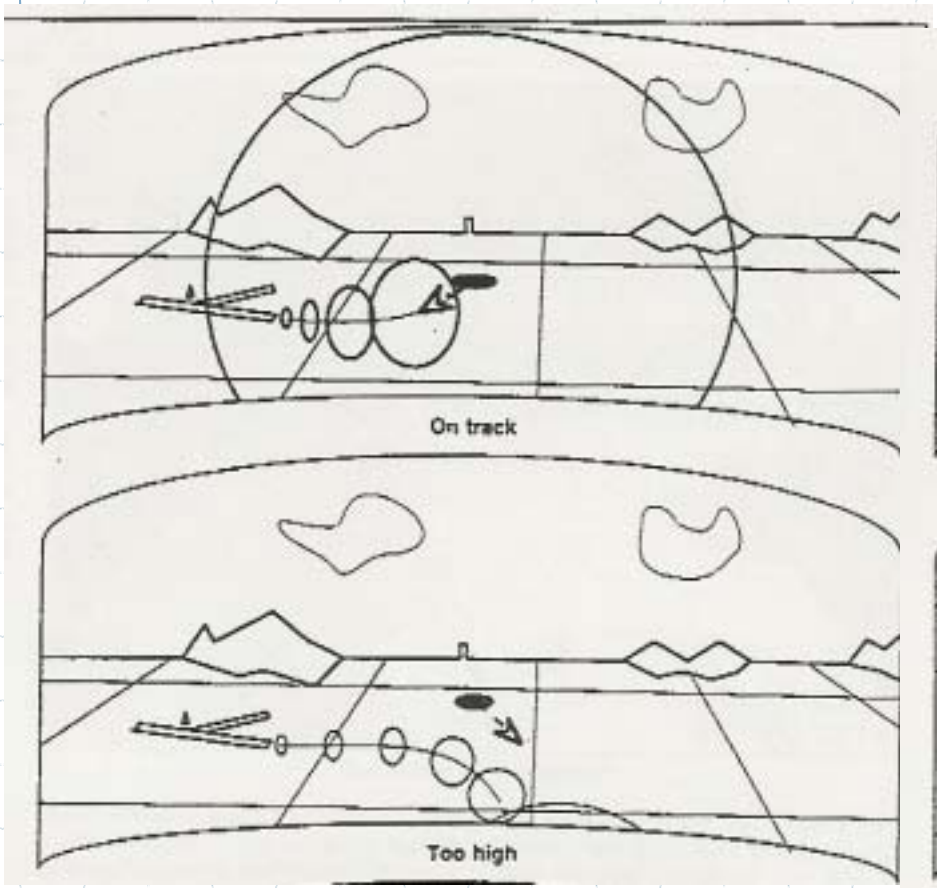

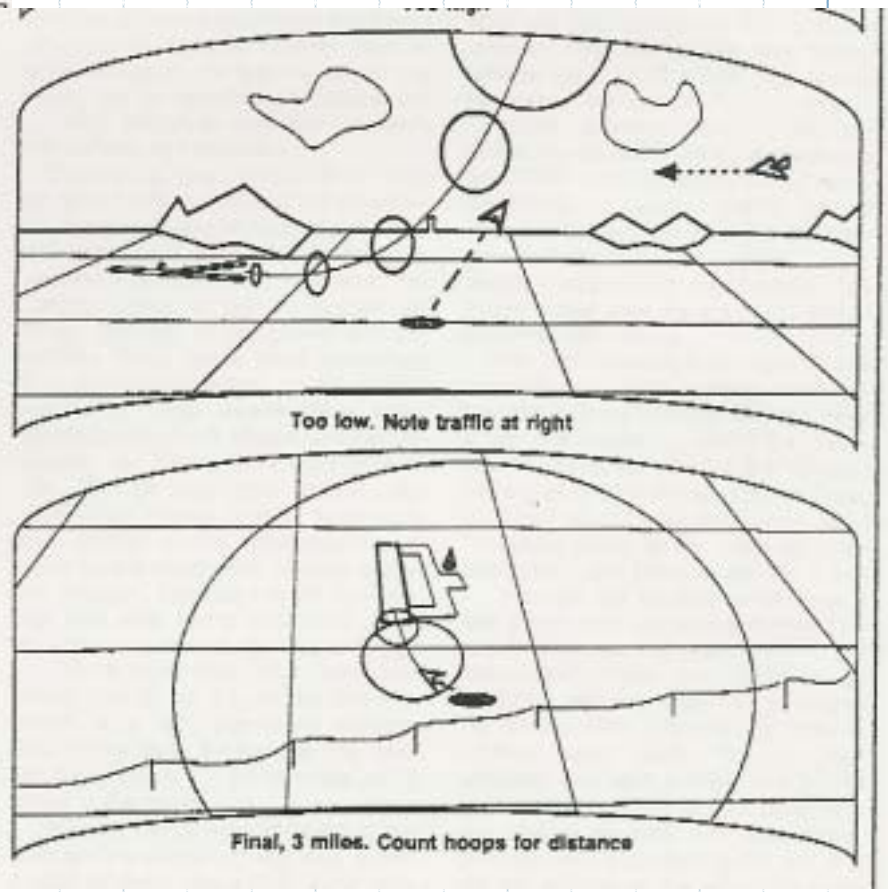

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He envisioned aircraft flight controls switching from rate to position based so that you would drive an airplane like you would a car.

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He went on to explore similar opportunities that could enhance automobile driving safety.

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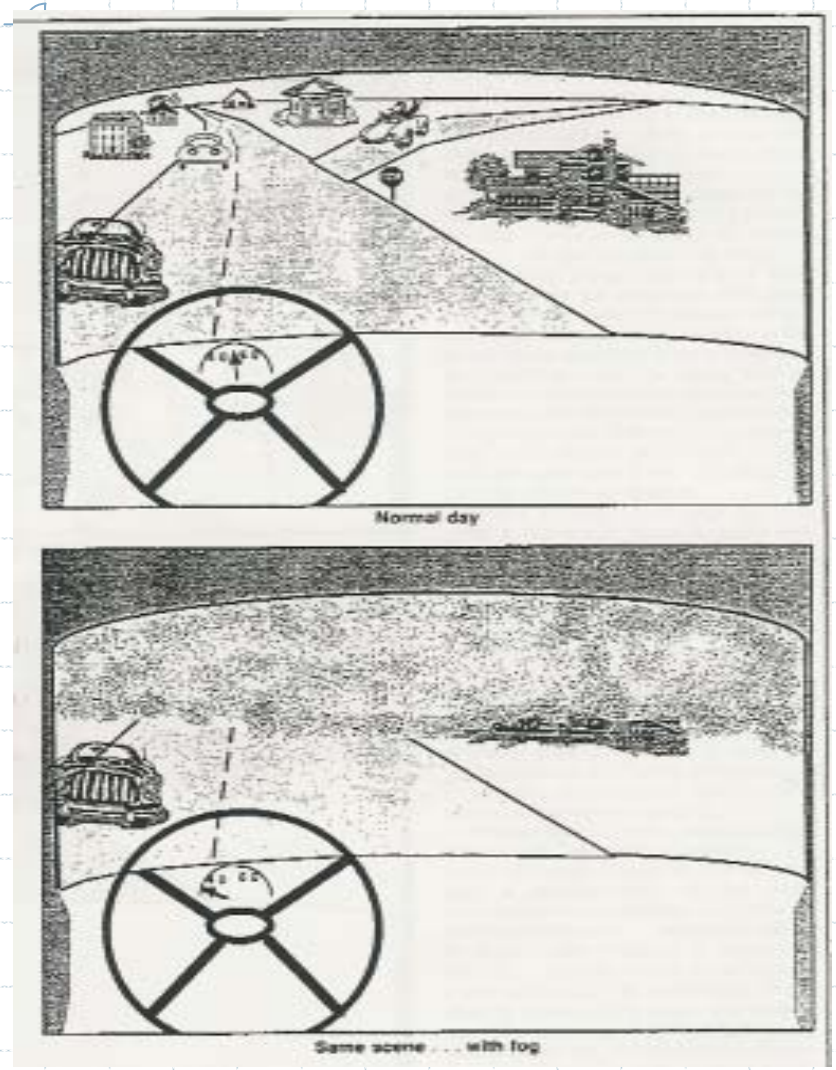

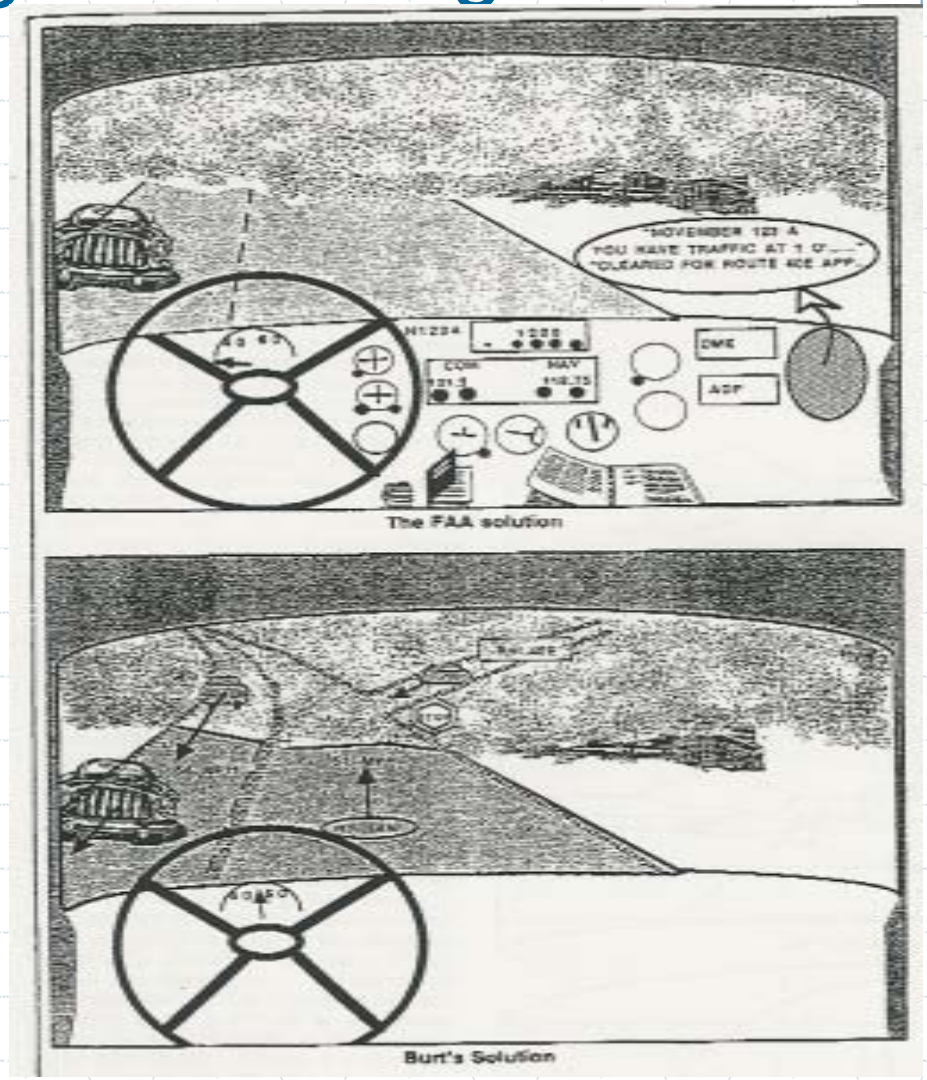

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As an industry we've done an excellent job of making crashes less injurious (passive safety) but until the advent of digital electronics we've not been able to do much to keep accidents from happening (active safety).

Active Safety a Digital Paradigm

ABS, traction control, yaw control and now adaptive cruise control are all contributing to the stability and active safety of the automobile.

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By the way, a University of Michigan study predicts that adaptive cruise control, with a use rate of as little as 20%, will stabilize traffic flows.

Active Safety a Digital Paradigm

ABS has been criticized for not making a difference in accident statistics.

Yaw control will soon be on all SUVs.

Some cars now have the technology to steer themselves independent of the driver’s input.

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So, what's going on here? What is the set of technologies that will reduce accidents and what should we expect from them?

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- A 1998 study by General Motors and UMTRI has given us a road map of the scenarios that lead to crashes.
- Reported as “44 Crashes” the study identifies 44 distinct scenarios and the injury associated with each scenario.

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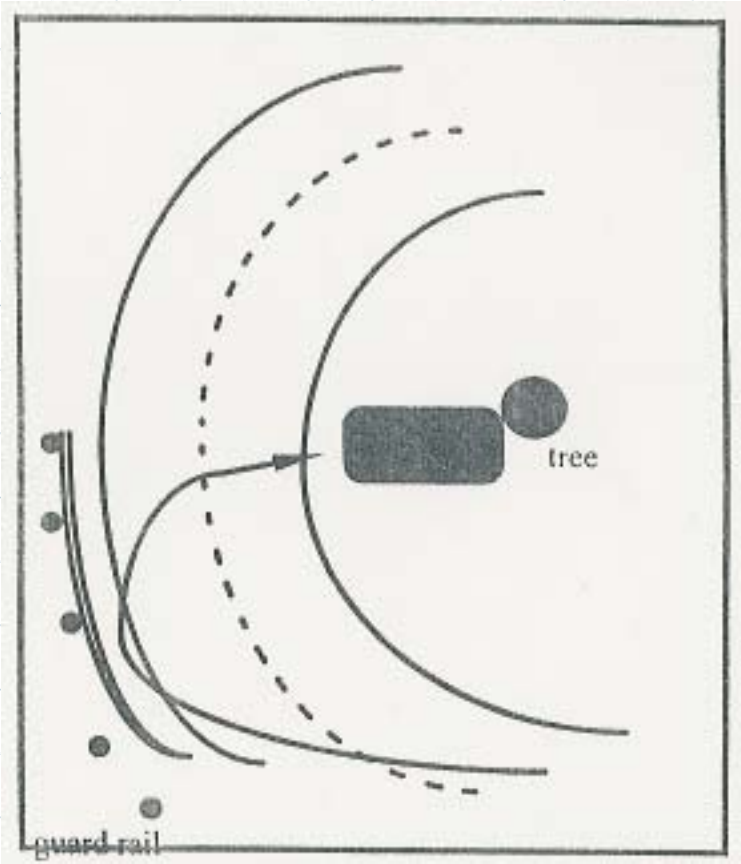
When you Praetoize the 44 crash scenarios you find the the first 10 represent over 50 percent of the harm associated with accidents.

And, that the first two scenarios actually represent the breadth of the 44.

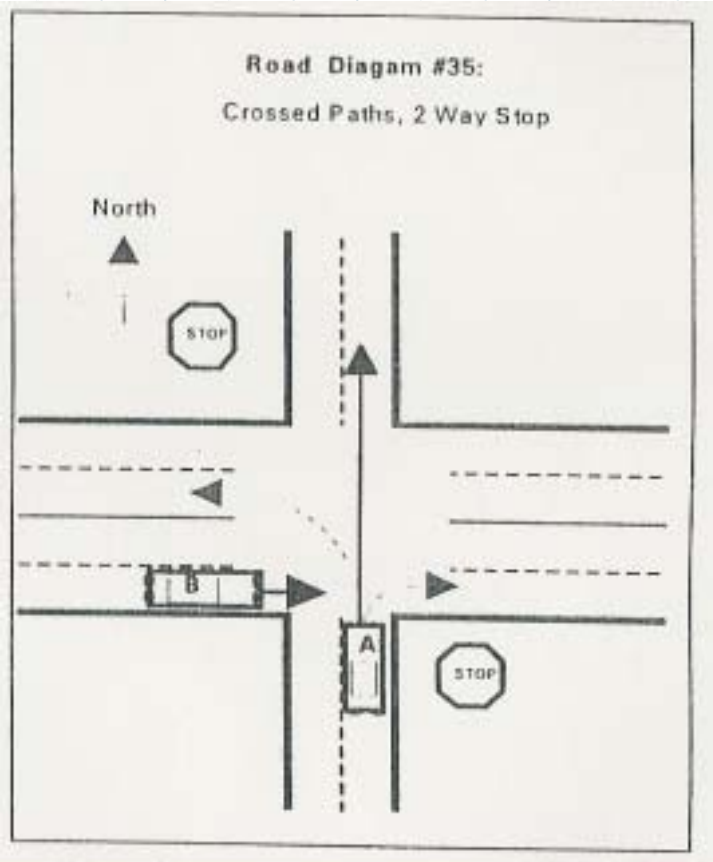
e-Safety



Crash# 10

Taking just the top 25 of 44 crashes, running off the road in various ways accounts for 42% of the Functional Years Lost.

e Safety



Crash #35

Of the top 24 of 44 Crashes, cars running into cars accounts for 48.3% of Functional Years Lost.

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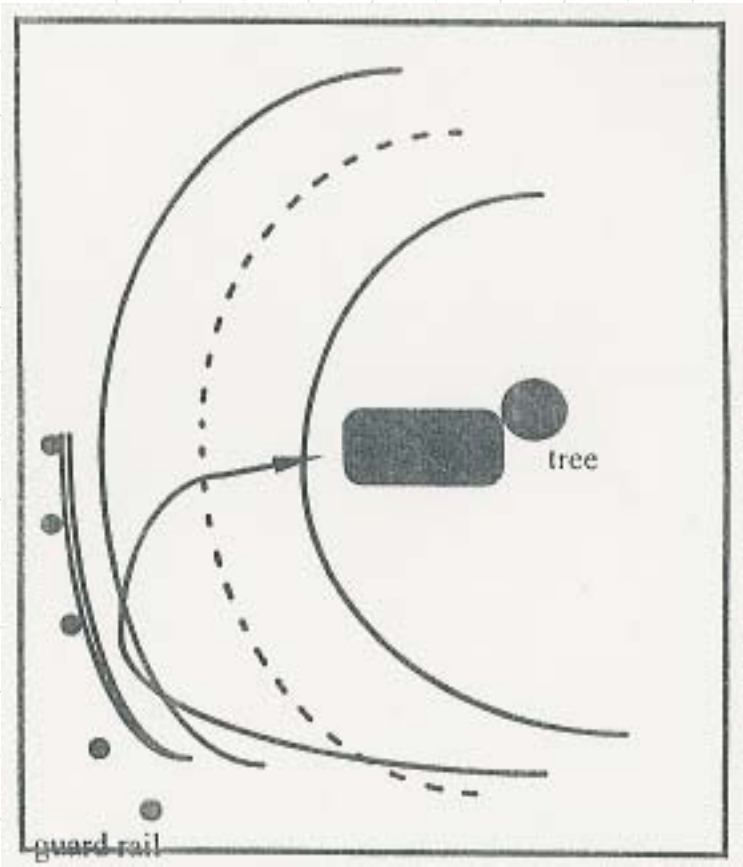

Loss of Control- Running off the Road:

We've actually made a lot of progress with this scenario with: ABS, traction control and yaw control

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These are all driver managed tools that in essence say “driver, if you’ll tell me where you want to go(with braking and steering) I’ll get you there (within the limits of physics).

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If we add to this:

GPS,

digital road mapping and

coefficient of friction prediction

we can make the car “smart” enough to know when it can’t manage the road just ahead and that it’s about to run off the road and crash.

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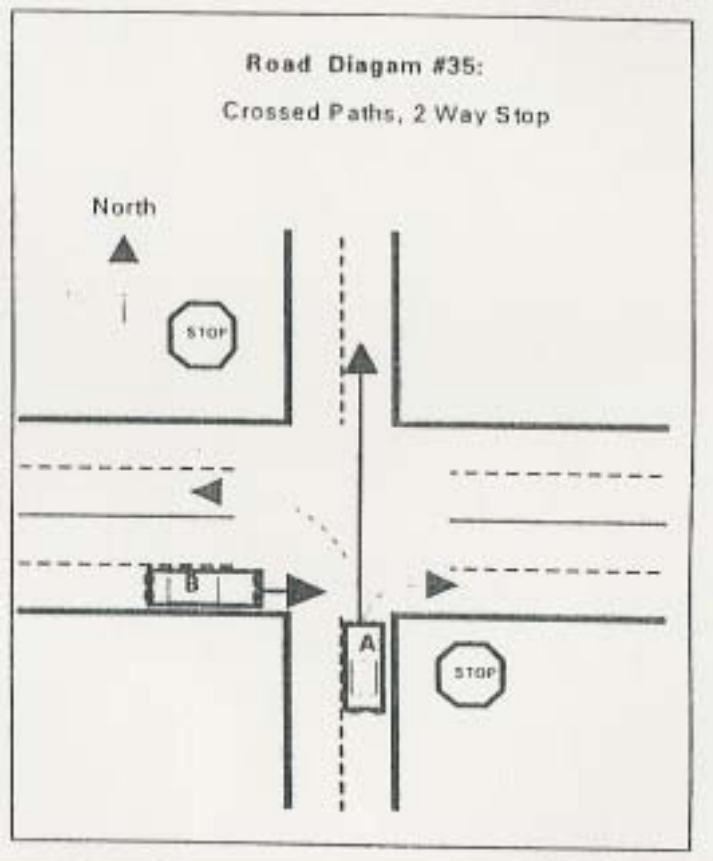

Here we're dealing with conflicts in the driving space.

If the car has: GPS, digital road mapping and can "see" in radar, visual or IR spectrums, we can make it "smart" enough to recognize other cars that are on a collision vector.

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- With a car so smart what should we do next?
  - Tell the driver?
  - Or, just do it?

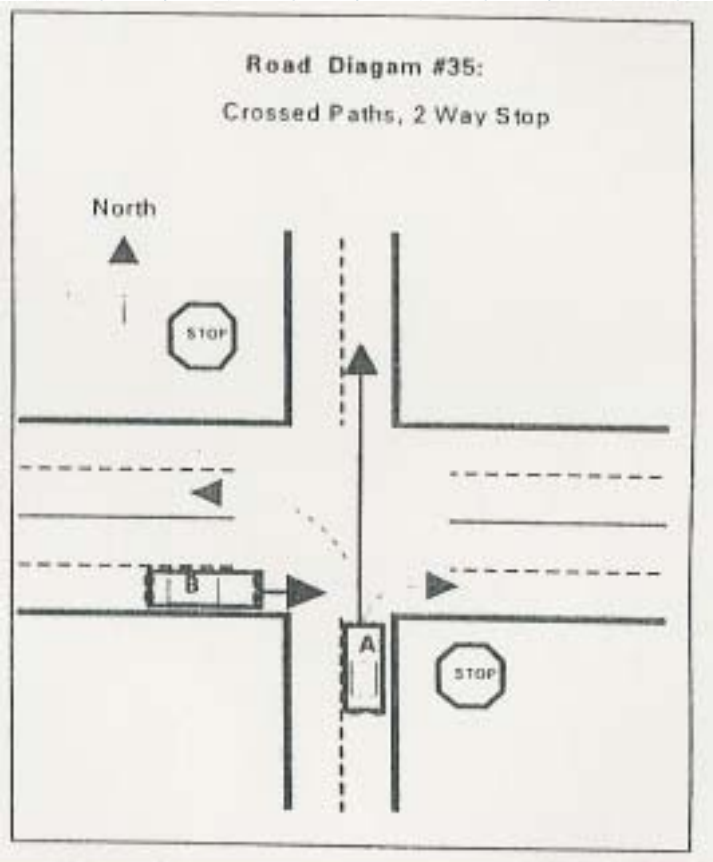
Active Safety a Digital Paradigm

A NHTSA study conducted at TRC gives us insight into this question:

They instrumented a car with multiple video cameras.

Tasked 100 civilian drivers with driving around TRC.

Active Safety a Digital Paradigm



Driver B traveling from the left to right is confronted with driver A pulling out part way into the intersection.

The simulated emergency task is timed so that driver B has time to brake or steer to avoid A.

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So, what did they do?

Of some 100 civilian drivers:

- 90 did nothing and crashed into car A.
- A few braked or steered.
- One steered right for car A's door.

In every case the camera, looking at the driver's eyes, told us that the driver recognized a real emergency.

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What can we learn from this?

Don’t put yourself in the position of the target car and expect the other driver to save you!

Active Safety a Digital Paradigm

What can we learn from this?

In devising responses to emergency situations we probably cannot rely on the driver to respond correctly.

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We can afford to communicate with the driver until all but the functional response time is used up.

Any communication needs to be unambiguous.

The best possible communication would be a wide angle HUD that leads the driver’s eyes to the danger present in the driving space.

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There are several ways to help our now informed driver with what to do.

- Haptic (tactile) motion of the steering wheel.
- Audio commands.

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- Ultimately and most importantly we need to consider having the car take charge at the critical moment as we do now with yaw control and adaptive cruise control.

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What's still needed?

A coefficient of friction (mu) prediction.

This is a necessary parameter if the car's response to danger is to be timely.

What each of us does today when we question the coefficient of friction under us is spike the brakes and observe the response of the car.

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- Mu prediction
- Spike just one wheel.
- Use fuzzy logic and ABS software to minimize the extent of the wheel spin down.
- Activate the process only when the system decides it needs to know mu.

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- What will a sophisticated active safety system accomplish?
- DaimlerChrysler Research is predicting a 50% reduction in accidents on German roads when systems they now have in development are implemented.

Active Safety a Digital Paradigm

DaimlerChrysler has described its research in a brilliant series of ads.

You never see owls crash, do you?

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Find out more about our vision for accident-free traffic at www.daimlerchrysler.com.

DaimlerChrysler
Answers for questions to come.

We're teaching our cars to see, because mum can't be everywhere.

As a mother, knowing your child is alone on the streets can be a nightmare. Because, like it or not, you can't always be there to protect them. That's why we're working on a Pedestrian Recognition System for our cars. This technology will help drivers to avoid accidents by warning them if there are people on the road ahead. And may well become every mother's dream. At DaimlerChrysler Research we're developing these intelligent technologies today. For the automobile of tomorrow.

To obtain more detailed information on the 'Vision of Accident-free Driving' visit www.daimlerchrysler.com.

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Answers for questions to come.

Your car will warn you before they do.

In the future, this is one kind of trouble we'll be able to help you avoid. That's because we're developing technology that enables cars to recognise stop signs, speed limits, no over-taking warnings and other traffic signs. By letting the driver know about them in advance, the car can help prevent dangerous situations and accidents occurring in traffic. At DaimlerChrysler Research, we're developing these intelligent technologies today. For the automobile of tomorrow.

To obtain more detailed information on the 'Vision of Accident-free Driving' visit www.daimlerchrysler.com.

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Answers for questions to come.

Your car will be watching the road, even if you're not.

We can't stop your mind wandering when you're on the road. Instead, we are working on ways to help prevent your car wandering too. We're also developing the 'electronic eye', which is designed to recognise obstacles in the road. And bring your car to a halt if necessary. Now do we have your attention? Find out more about the 'Vision for Accident-free Driving' at www.daimlerchrysler.com.

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Answers for questions to come.

Every part of the street should be a safe place to cross.

At DaimlerChrysler, we look at the road with pedestrians in mind. Which is why we're developing an intelligent recognition system for our vehicles. The purpose of this technology will be to sense if there's an obstacle ahead of the car, and help the driver to avoid it. Good news for motorists. And for anyone crossing their paths. Find out more about the vision of accident-free driving at www.daimlerchrysler.com.

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Answers for questions to come.

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- Last year we had 43,000 deaths from transportation accidents.
- We now have the tools to cut this number in half.
- The cost in car insurance and health insurance is staggering. $140 billion for car accident insurance alone!
- Car accident insurance averages $1,000/car/year.

Active Safety a Digital Paradigm

As engineers, can we take this $1,000/car/year and use it to pay for the technology?

What we have to work with is the net present value of a payment stream of $1,000/year that extends for the life of the car.

I.e., what would one be willing to pay today rather than incur a yearly insurance payment of $1,000 for the life of the car?

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- At current interest rates, one would be payment-neutral with a net present value of about $9,000.
- Medical costs and the personal cost of being injured is layered on top of the cost of car insurance.

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In conclusion:

We are on the path to active safety with ABS, yaw control, GPS, digital road mapping, and adaptive cruise control.

With additional perimeter sensors, mu prediction, and steering intervention, the car can be made “smart” and capable of responding.

Active Safety a Digital Paradigm

What is now required is the vision to know where we want to take active safety and to, relentlessly, develop the systems needed to systematically reduce accidents.

People don't always see accidents coming. But their cars will.

'Accidents will happen', as the saying goes. Especially when people lose concentration. In fact, inattentiveness is one of the most frequent causes of mishaps, both at home and on the road. Which is why we're developing cars that can actually recognise obstacles independently. The car will then alert the driver to a potential hazard and help to avoid it. DaimlerChrysler Research is already creating intelligent technologies like this today, for the automobile of tomorrow. Because one day we hope there will be a new saying: 'Accidents won't happen'.

To obtain more detailed information on the 'Vision of Accident-free Driving' visit www.daimlerchrysler.com.

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Answers for questions to come.

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What I've sketched for you is a thumbnail view of what's going on and what's possible.

I ultimately envision the accident rate being driven down by orders of magnitude!

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- We've lived too long with a transportation system failure rate that results in some 40,000 deaths/year and injuries more than an order of magnitude more.
- We've lived with this failure rate because we had no acceptable alternative.
- Shutting the system down is not an alternative.

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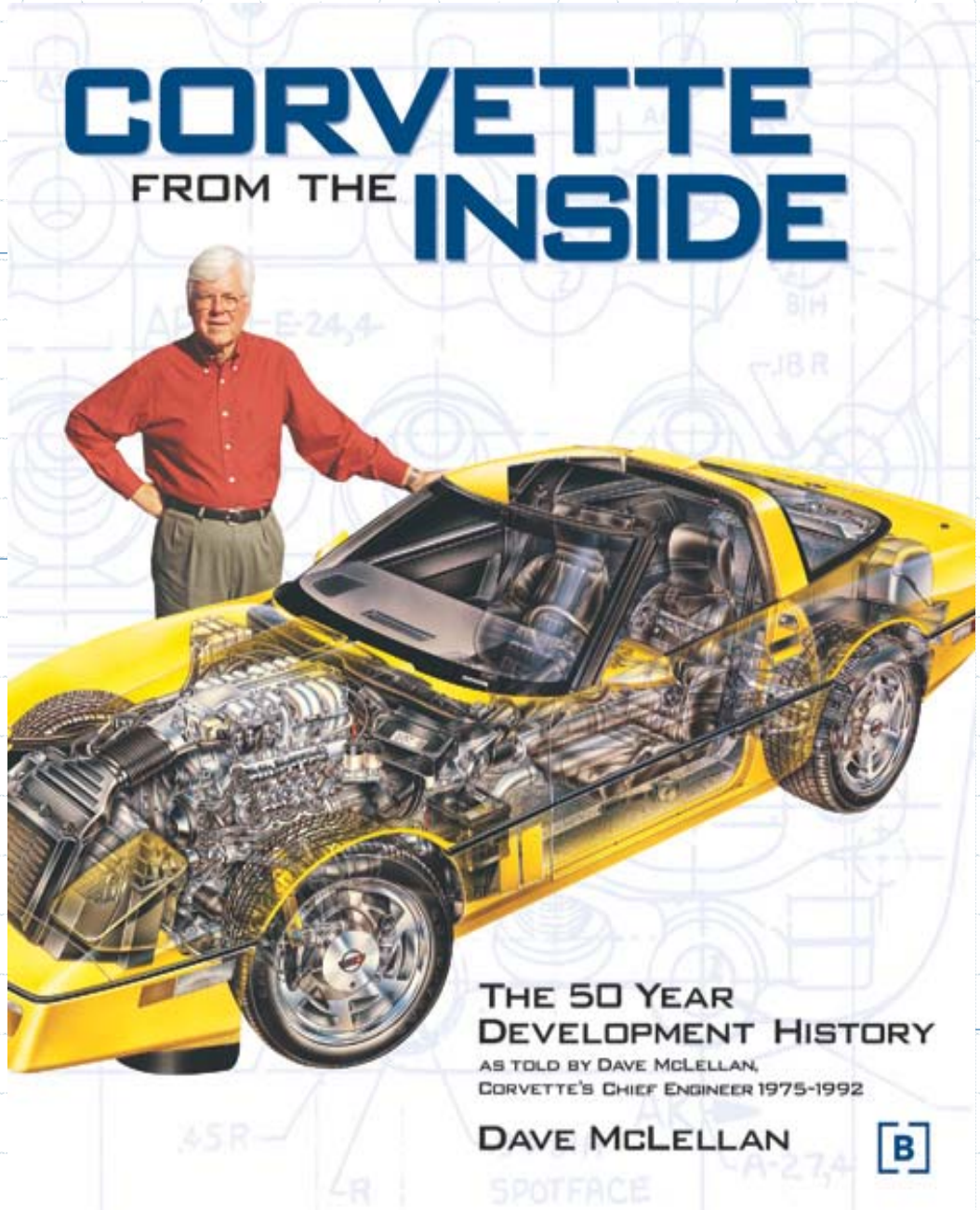
However, we now have the tools to dramatically reduce this failure rate. This deserves the priority of a:

Manhattan Project,

a Star Wars

or a War on Terror.


CORVETTE
FROM THE INSIDE
THE 50 YEAR
DEVELOPMENT HISTORY
AS TOLD BY DAVE MCLELLAN,
CORVETTE'S CHIEF ENGINEER 1975-1992
DAVE MCLELLAN
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