NAMIC® CONNECT DIFFERENTLY

Driverless Cars and Crash-Avoidance Technology – Insuring the Cars of the Future

Tuesday, September 23, 2014, 10:30–11:45 a.m.

Scott Nelson
CEO
MILE Auto Insurance
Atlanta, Ga.

Scott Nelson is the co-founder and CEO of MILE Auto Insurance, an Atlanta-based insurance entity founded to develop and distribute traditional and mileage-based auto insurance products.

Prior to founding MILE, Scott spent his career developing, pricing, and managing auto insurance products for regional auto insurance carriers. He also spent several years helping build Answer Financial, one of the largest insurance agencies in the United States.

Scott has spoken about the insurance implications of a number of emerging technologies and marketplaces such as driverless cars at the AUVSI Driverless Car Summit and car sharing at the Shared Use Mobility Summit.

He has an MBA from Cornell University and a bachelor's degree in civil engineering from the University of Virginia.

Bryan Reimer
Research Scientist
Massachusetts Institute of Technology
Cambridge, Mass.

Bryan Reimer, Ph.D., is a research engineer at the Massachusetts Institute of Technology AgeLab and the associate director for the New England University Transportation Center. His research seeks to develop new models and methodologies that use physiological signals, visual behavior monitoring, and overall performance measures to measure and understand human behavior in dynamic environments.

Bryan leads a multidisciplinary team of researchers and students that focuses on understanding how drivers respond to the increasing complexity of the operating environment and on finding solutions for the next generation of human-factors challenges that are associated with distracted driving, automation, and other in-vehicle technologies.

He directs work that focuses on how drivers are affected by in-vehicle interfaces, safety systems, portable technologies, and different types and levels of cognitive load. This research also assesses the impact of medical impairments such as diabetes, cardiovascular disease, attention deficit hyperactivity disorder, and autism.

Bryan is an author of more than 70 peer reviewed journal and conference papers. He is a graduate of the University of Rhode Island with a doctorate in industrial and manufacturing engineering.

David Zuby
Executive Vice President & Chief Research Officer
Insurance Institute of Highway Safety
Ruckersville, Va.

David Zuby is executive vice president and chief research officer for the Insurance Institute for Highway Safety. Working out of the Vehicle Research Center, he oversees and coordinates research by the VRC, the IIHS's research department in Arlington, Va., and the Highway Loss Data Institute.

David is the author of numerous IIHS-published research papers on topics such as the biomechanics of injury, pedestrian protection, crashworthiness, and crash investigation.

Prior to joining the IIHS as a research engineer in 1993, David worked on research projects for the National Highway Traffic Safety Administration at its Transportation Research Center in Ohio. He holds a bachelor's degree from Northwestern University.

Session Description:
New vehicles with advanced crash-avoidance features are hitting the market, and experts predict driverless cars will be hitting the roads in the near future. What does this mean to the future of automotive safety and insurance?

This session will provide insight on these new technologies and discuss the potential implications for insurers.

Top Three Session Ideas

Tools or tips you learned from this session and can apply back at the office.

1. ____

2. ____

3. ____

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Driverless Cars & Crash Avoidance Technology – Insuring the cars of the Future

NAMIC Annual Convention
Washington, DC ● September 23, 2014

David S. Zuby
EVP/Chief Research Officer, IIHS

Rationale for automated vehicle control

People don't always "just drive"

- 1979 – Indiana "Tri-Level Study" estimated "driver error" to be proximate cause of 9 out of 10 crashes
  - 15 percent of crashes associated with driver inattention
    - Changing audio tapes/CDs
    - Eating/drinking
    - Children, bugs, animals in vehicle
    - Reading, shaving, and applying makeup
- 2011 – NHTSA estimated that distraction was a factor in15 percent of police reported crashes
- 2012 – 3,328 were killed and 421,000 were injured in crashes involving distracted driver in the U.S.

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NHTSA's levels of vehicle automation

Level 0

- Driver in complete, sole control of the primary vehicle controls at all times

Level 1

- Automation involves one or more specific control functions
- Examples: ESC; pre-charged brakes; AEB (autonomous emergency braking)

Level 2

- Automation of at least two primary control functions that work in unison to relieve the driver of control of those functions
- Example: Adaptive cruise control in combination with lane centering

Level 3

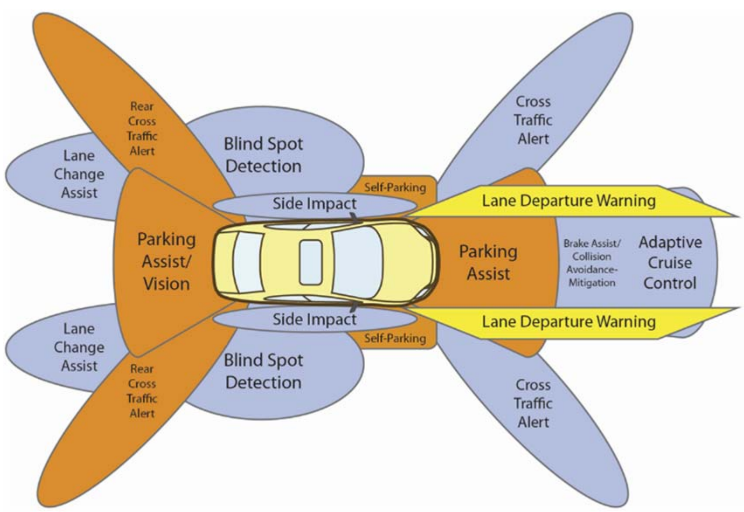
- Driver cedes control of all safety-critical functions under certain conditions and relies heavily on vehicle to monitor changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control
- Example: Google car

Level 4

- Vehicle performs all safety-critical functions and monitors roadway for entire trip

Driver assistance features

Radar, LIDAR, ultrasonic, infrared, cameras, GPS



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By type of system

Annual crashes potentially prevented or mitigated

	all	injury	fatal
forward collision warning	1,165,000	66,000	879
lane departure warning	179,000	37,000	7,529
side view assist	395,000	20,000	393
adaptive headlights	142,000	29,000	2,484
total unique crashes	1,866,000	149,000	10,238

- Forward collision prevention systems are working
- Adaptive headlights are working
- The benefits of these systems are less clear –
  - Lane departure warning
  - Blind spot warning
  - Rearview cameras
  - Parking proximity sensors

Low speed autobrake systems – Volvo City Safety

April 2013 Update

XC60 vs. other midsize luxury SUVs	claim frequency			claim severity			overall losses		
property damage liability	-16.0%	-14.6%	-13.1%	-$89	-$42	$4	-$17	-$15	-$12
bodily injury liability	-37.6%	-33.3%	-28.7%						
collision	-21.1%	-20.2%	-19.3%	-$512	-$450	-$389	-$98	-$92	-$86

S60 vs. other midsize 4-door luxury cars	claim frequency			claim severity			overall losses		
property damage liability	-19.5%	-16.3%	-12.9%	$257	$373	$486	-$8	-$4	$0
bodily injury liability	-30.4%	-18.2%	-3.8%						
collision	-10.7%	-8.7%	-6.6%	-$802	-$668	-$537	-$92	-$79	-$66

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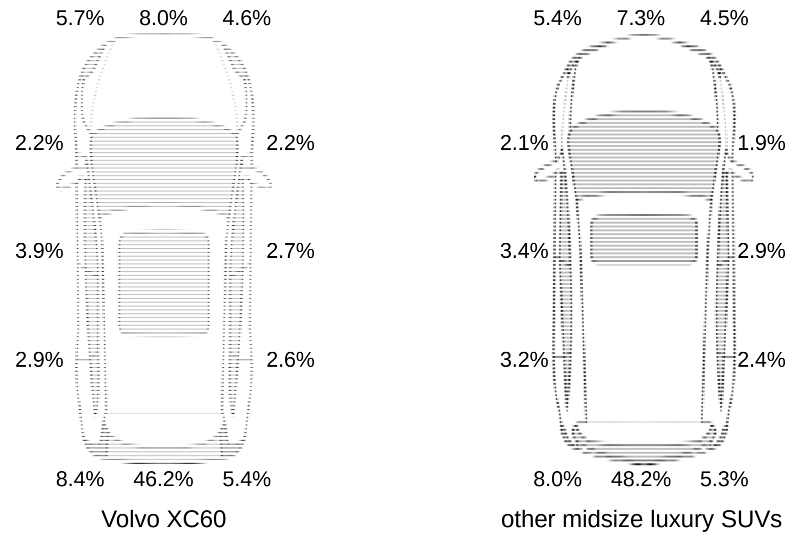
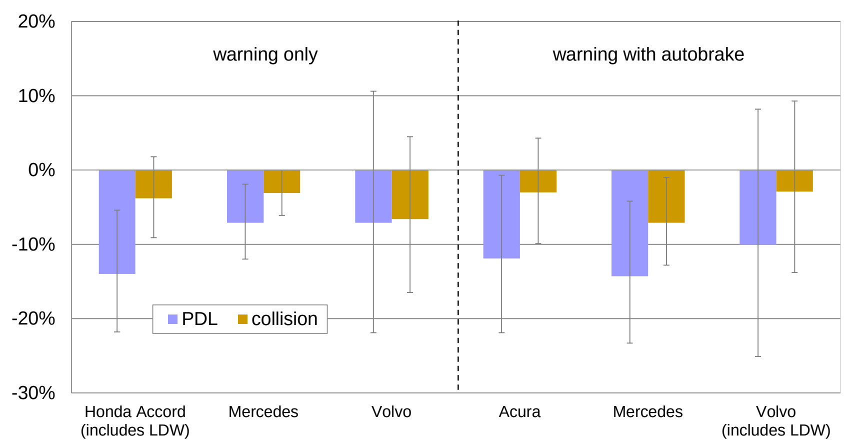
Point of impact distribution for PDL damage estimates



Higher speed front crash prevention systems

Percent change in vehicle damage claims per insured vehicle year



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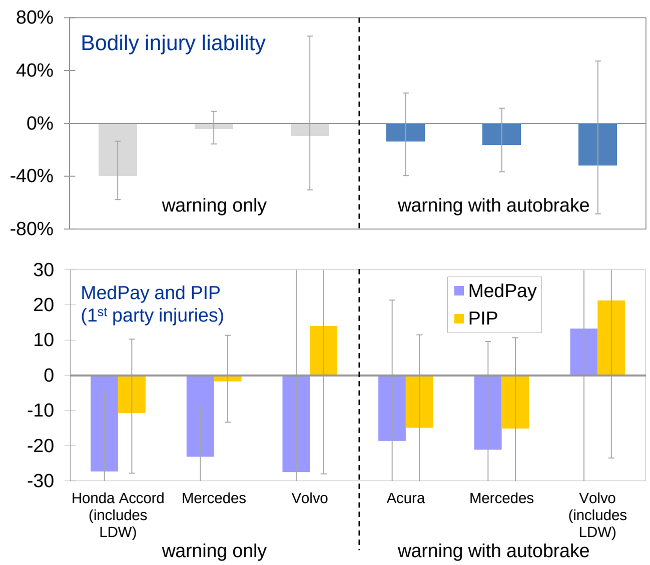
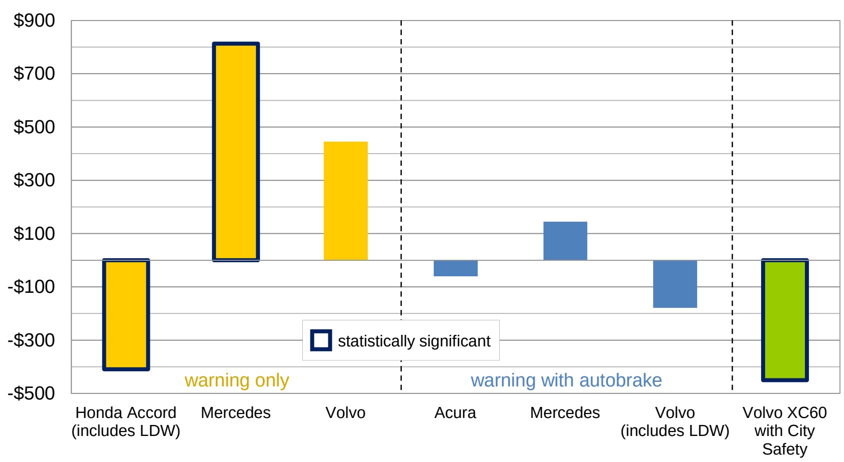
Higher speed front crash prevention systems

Changes in injury claim frequency per insured vehicle year



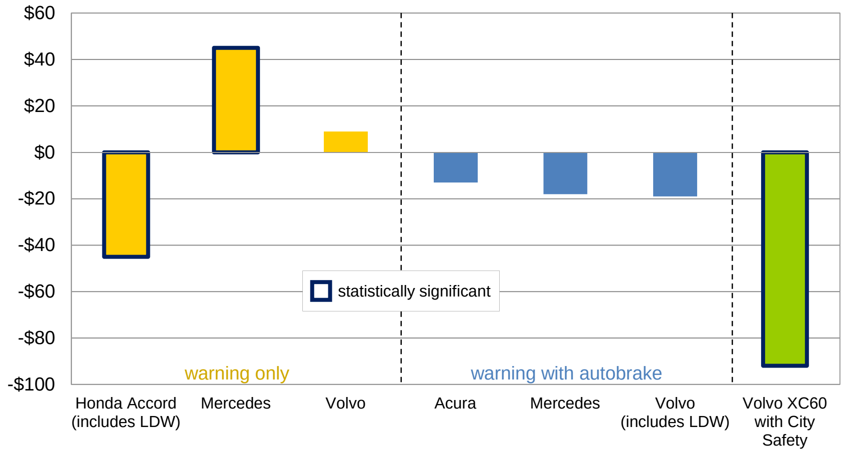
Collision claim severity for front crash prevention

By manufacturer



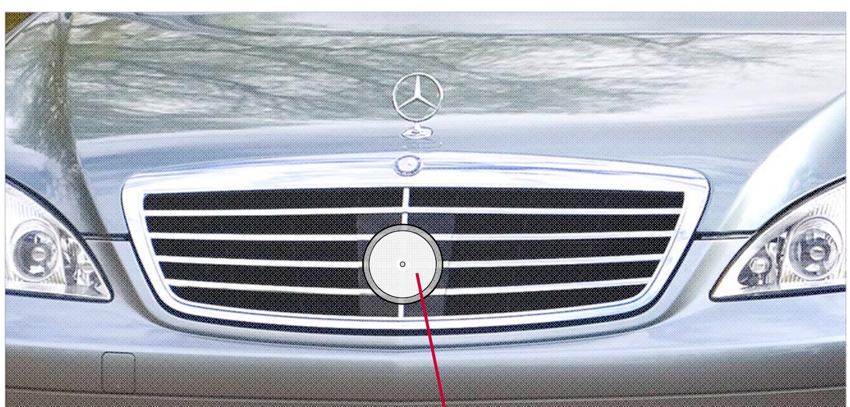
Collision overall losses for front crash prevention

By manufacturer



Mercedes-Benz radar units are vulnerable

And expensive



Distronic: $2,177.80
Distronic Plus: $1,961.70

More protected sensor locations?

Volvo City Safety laser sensor

Subaru Eyesight stereo cameras

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Inaugural front crash prevention ratings

September 2013

BASIC –

FCW; **or** moderate speed reduction in either 20 or 40 km/h braking test

ADVANCED –

FCW and moderate speed reduction in either 20 or 40 km/h braking test; **or** moderate speed reductions in both tests; **or** major speed reduction in one test

SUPERIOR –

FCW and major speed reduction in 40 km/h braking test; **or** FCW with at least moderate speed reductions in both tests; **or** major speed reductions in both tests

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Autobrake performance tests

Volvo S60 with City Safety | Subaru Outback with Eyesight

12 mph

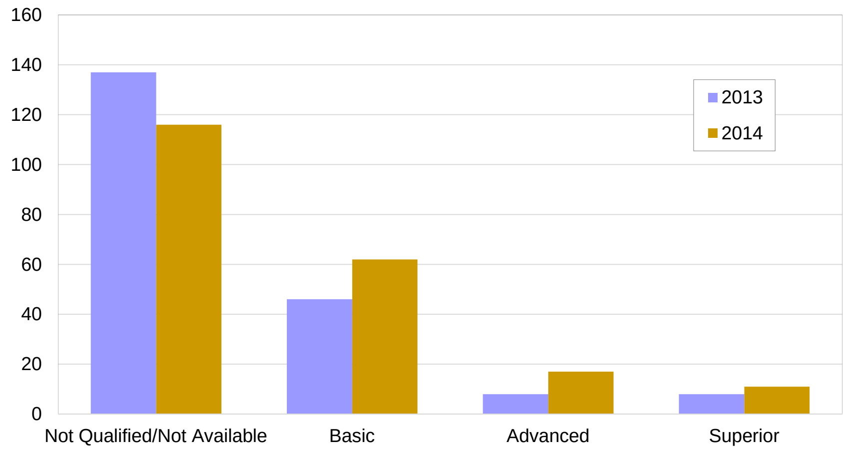
24 mph

BMW comparison video

12 mph tests

IIHS front crash prevention

Rating counts – 2013 and 2014 models



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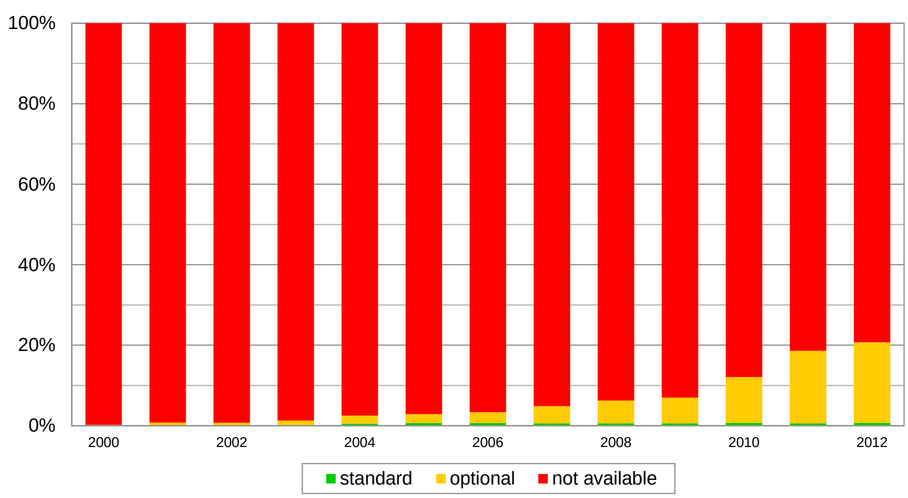
New vehicle series with forward collision warning

By model year



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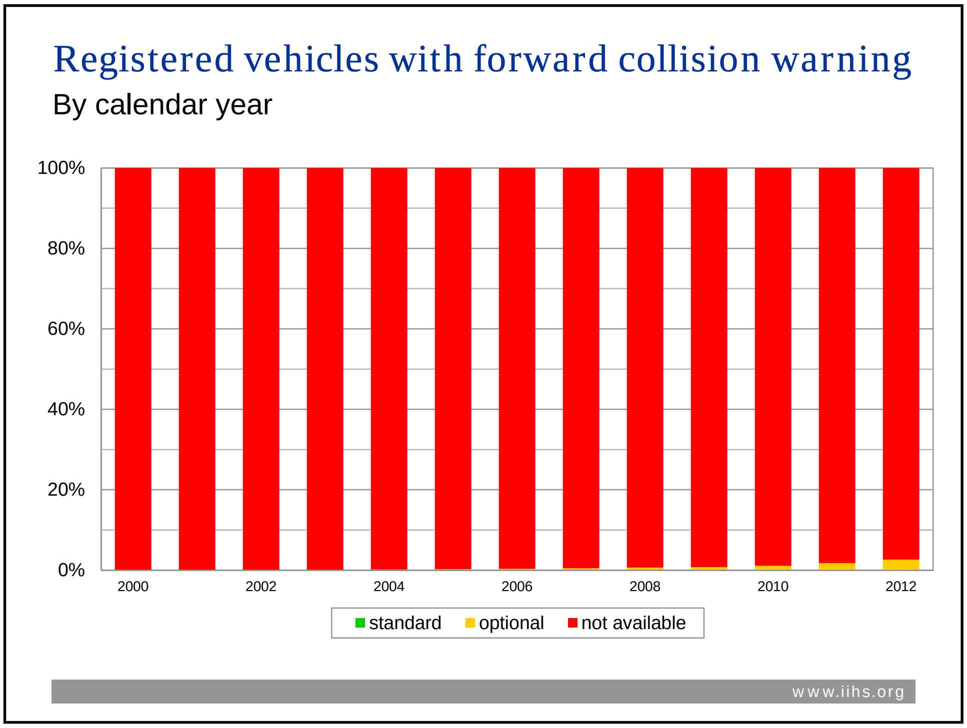
Registered vehicles with forward collision warning
By calendar year
100%
80%
60%
40%
20%
0%
2000
2002
2004
2006
2008
2010
2012
standard
optional
not available
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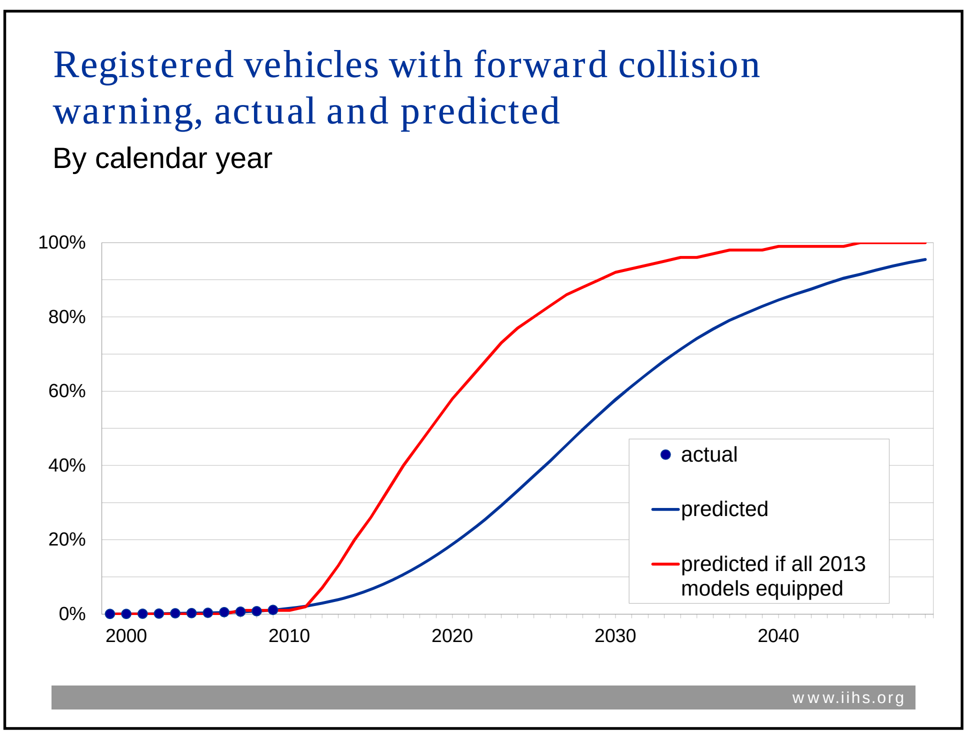
Registered vehicles with forward collision warning, actual and predicted
By calendar year
100%
80%
60%
40%
20%
0%
2000
2010
2020
2030
2040
actual
predicted
predicted if all 2013 models equipped
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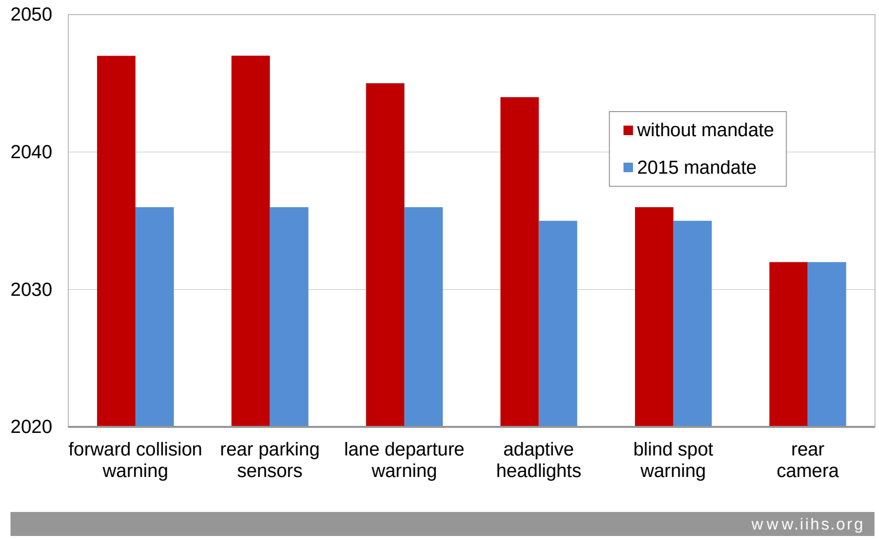
Calendar year features reach 95% of registered vehicle fleet with and without mandate



V2X communication

- V2X is a parallel development to autonomous technology
  - V2X will not automate or assist any system or driver function
  - V2X provides additional information to onboard systems
    - Augmenting or replacing sensors used in current driver assistance systems
    - New capability to "see" around corners and far ahead
- Because V2X has its own implementation issues, it will not likely speed up the path to autonomy
  - Potential enabler of autonomous vehicle operation

Google says…

Summary of IIHS meeting

- Robot cars can drive better than humans
  - Sensors and controllers always attentive
  - Safe operation can be programmed
  - Could reduce congestion and improve fuel efficiency
- Autonomous driving should be driver's choice
  - Activated when desired
  - Easy to regain control

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What automakers say …

"… the redesigned 2014 Mercedes-Benz S550 … a system … that allows the car to virtually drive itself."

"…Audi's latest prototype … A7 test car is equipped with the company's traffic-jam assist feature, which uses an array of cameras, sensors, and radar to let the car take over the driving in highway traffic."

"Volvo is planning a test of 100 autonomous cars on public roads in 2017. Nissan has said it will have an autonomous vehicle in production by 2020."

Consumer Reports.org, February 2014

"Automated driving is a key component of Ford's Blueprint for Mobility . . . outlines what transportation will look like in 2025 and beyond."

PRNewswire, January 22, 2014

"John Capp who heads GM's active safety technology strategy …'Super cruise will let you drive without your hand being on the wheel on certain freeways …This is a step that we think is feasible by 2020'"

Detroit Free Press, January 15, 2014

"IHS Automotive said Tuesday it forecasts total worldwide sales of self-driving cars will rise from nearly 230,000 in 2025 to 11.8 million in 2035."

The Detroit News, January 1, 2014

Laws regulating autonomous vehicle control

- 1968 Vienna Convention of Road Traffic (40 countries, excluding U.S.)
  - Article 8(1) and 8(5): "*Every moving vehicle shall have a driver"* [who] "*shall at all times be able to control his vehicle….*"
  - Article 13(1): *"[e]very driver of a vehicle shall in all circumstances have his vehicle under control. . .* ."
  - Proposed amendment (March 2014) (Austria, Belgium, France, Germany and Italy) to Article 8:

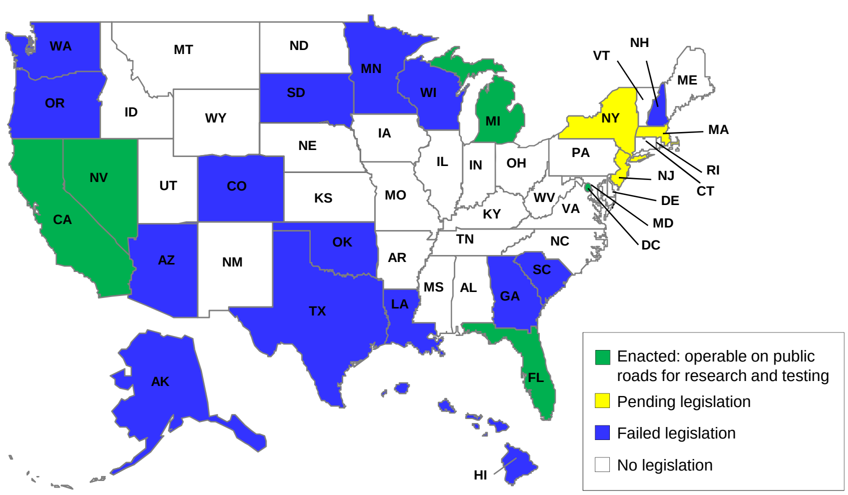
    Vehicle systems which influence the way vehicles are driven . . . shall be deemed in conformity with 8(1) and 13(1)

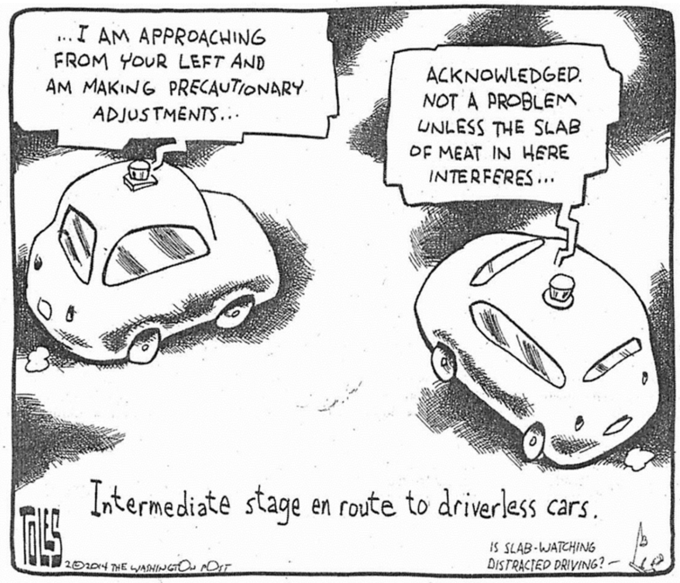
    when they are in conformity with … international legal instruments concerning wheeled vehicles" OR

    "when such systems can be overridden or switched off by the driver."
  - Equivalent amendments proposed for 1949 Geneva Convention on Road Traffic (94 countries, plus U.S.)
- The proposed amendments specify the conditions under which autonomous vehicle control is acceptable
  - Any level of autonomy appears acceptable if there are internationally agreed specifications for the control system
  - Autonomy levels 2 and 3 appear acceptable if there is a driver and the driver can override/turn off the system
- The amendments do not address Article 8(6): " A driver … shall … minimize any activity other than driving."
- In the US, federal and state laws neither envision nor specifically prohibit any level of autonomy on public roads, but
  - Every state has laws specifying requirements for licensure to operate a motor vehicle and laws requiring a licensed operator be in control of motor vehicles on public roads

Status of autonomous vehicle legislation

July 2014





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Summary

- Automated driving will help prevent and mitigate crashes
  - Actual effectiveness of partial automation has been documented
  - Ideal automated systems cannot be distracted as drivers can be
- Automated driving systems are not created equal
  - Not all are living up to their promise yet
  - Even those with similar functional descriptions may act differently
  - Consumer information testing can help identify important differences
- Wide spread automated driving will take time
  - Current partial automated systems are evolving quickly, but
  - Older vehicles are replaced by state-of-the-art vehicles slowly

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Dedicated to reducing deaths, injuries, and property damage on the highway

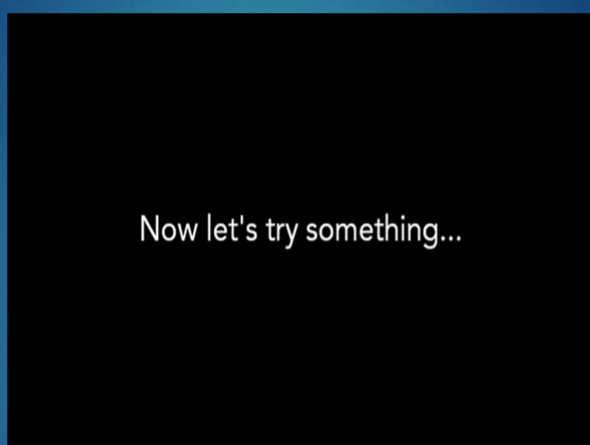
Driverless Cars and Crash-Avoidance Technology: Insuring the Cars of the Future

What Insuring Minds Want to Know

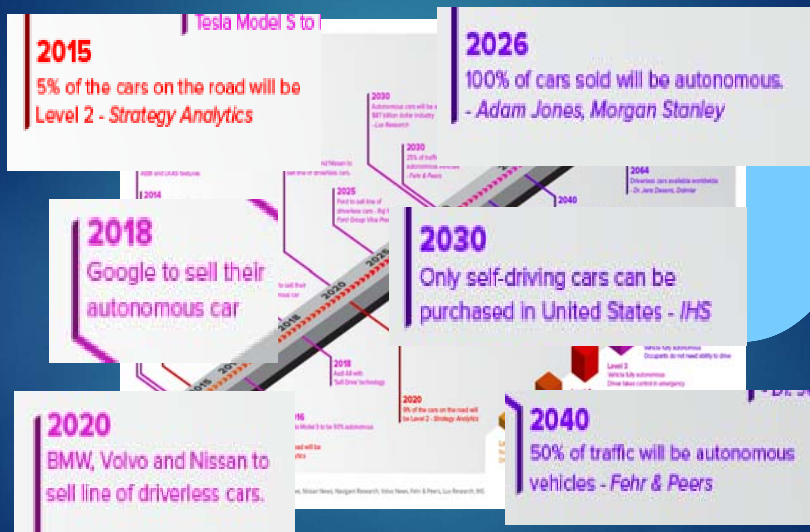
Three Questions:

- When?
- What?
- Who?

When?

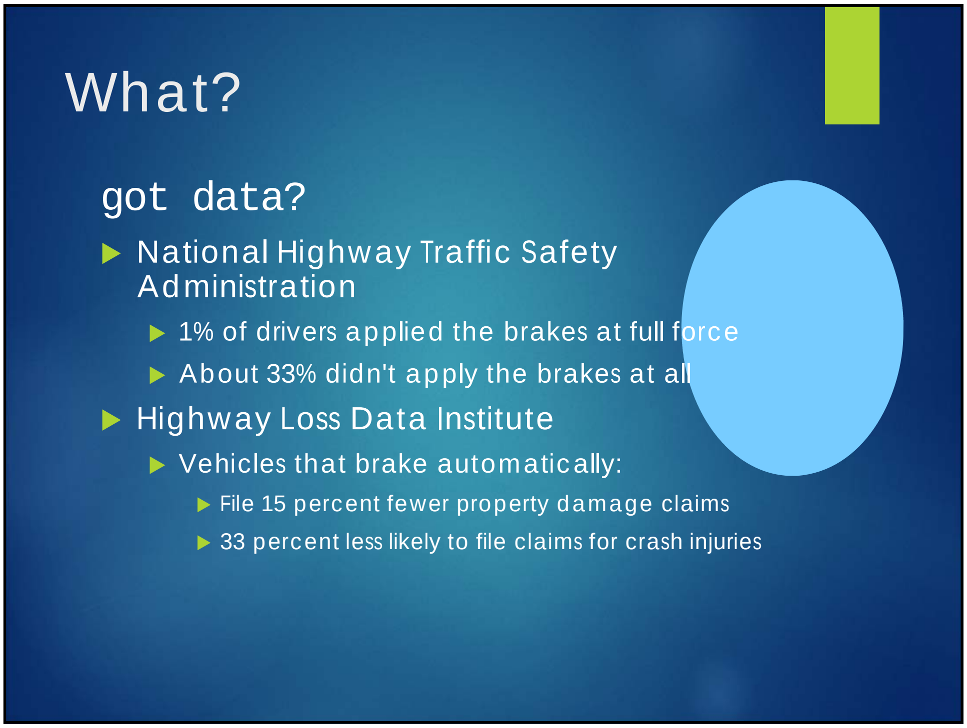


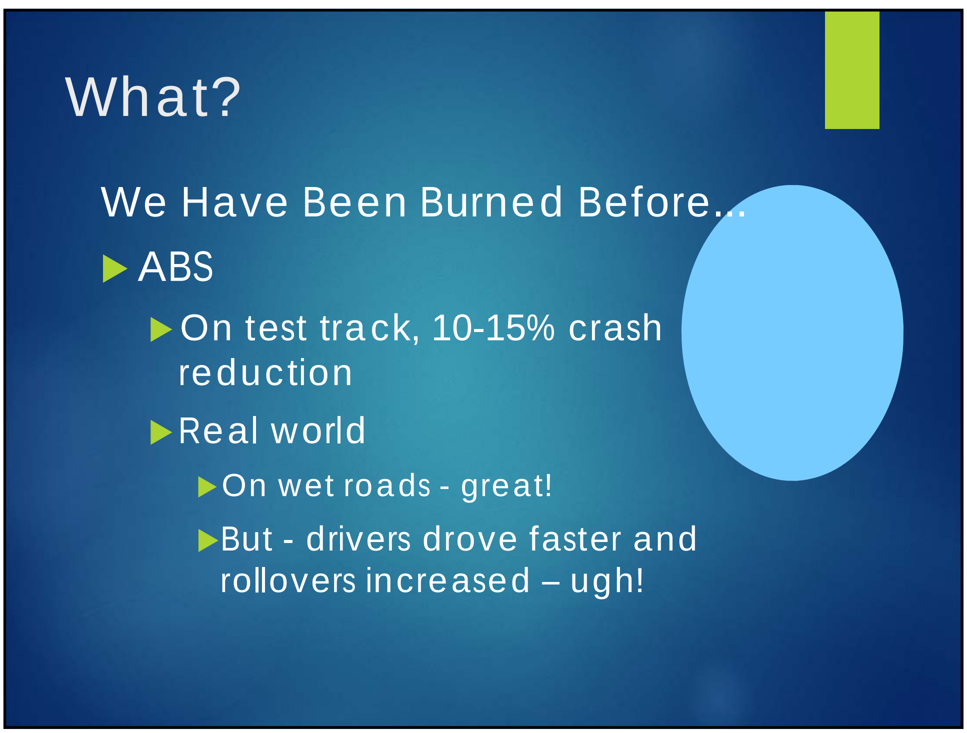
When?



What?

- Frequency * Severity + Expenses + Margin = Insurance Premium
- If the past looks like the future, we are really good at predicting the right price
- Driverless car world – future may look nothing like the past


What?
got data?
National Highway Traffic Safety Administration
1% of drivers applied the brakes at full force
About 33% didn't apply the brakes at all
Highway Loss Data Institute
Vehicles that brake automatically:
File 15 percent fewer property damage claims
33 percent less likely to file claims for crash injuries


What?
We Have Been Burned Before…
ABS
On test track, 10-15% crash reduction
Real world
On wet roads - great!
But - drivers drove faster and rollovers increased – ugh!

What?

Expert Opinions

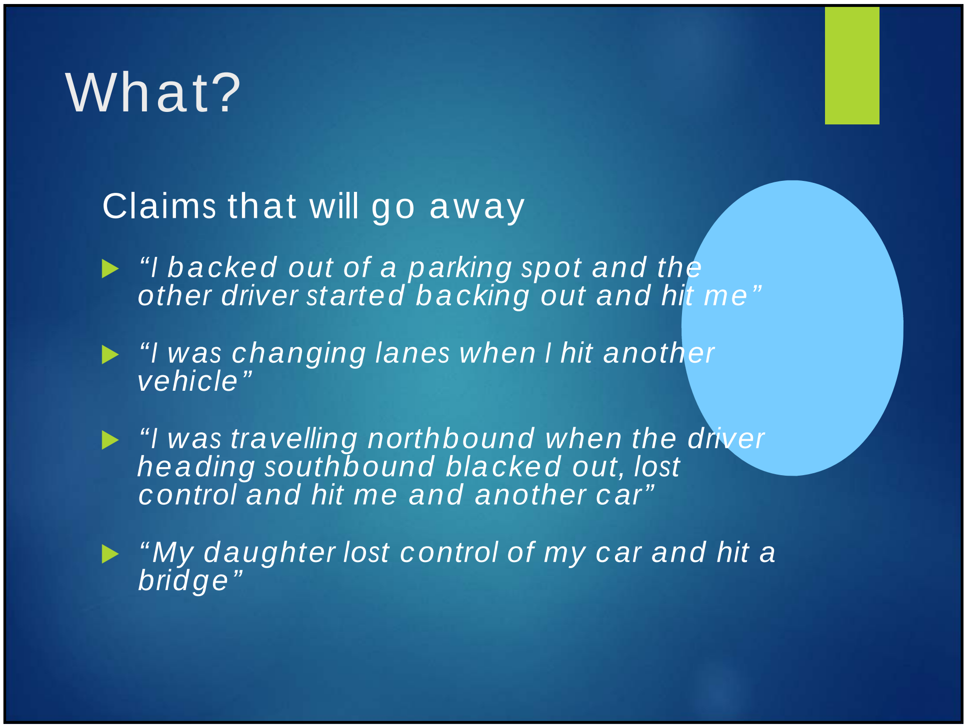
- "By 2020, nobody shall be seriously injured or killed in a new Volvo" - Volvo
- Insurance Institute for Highway Safety - a 31 percent reduction in fatalities is possible with full national deployment of active safety systems
- 80-90 percent of fatal car accidents involve human error

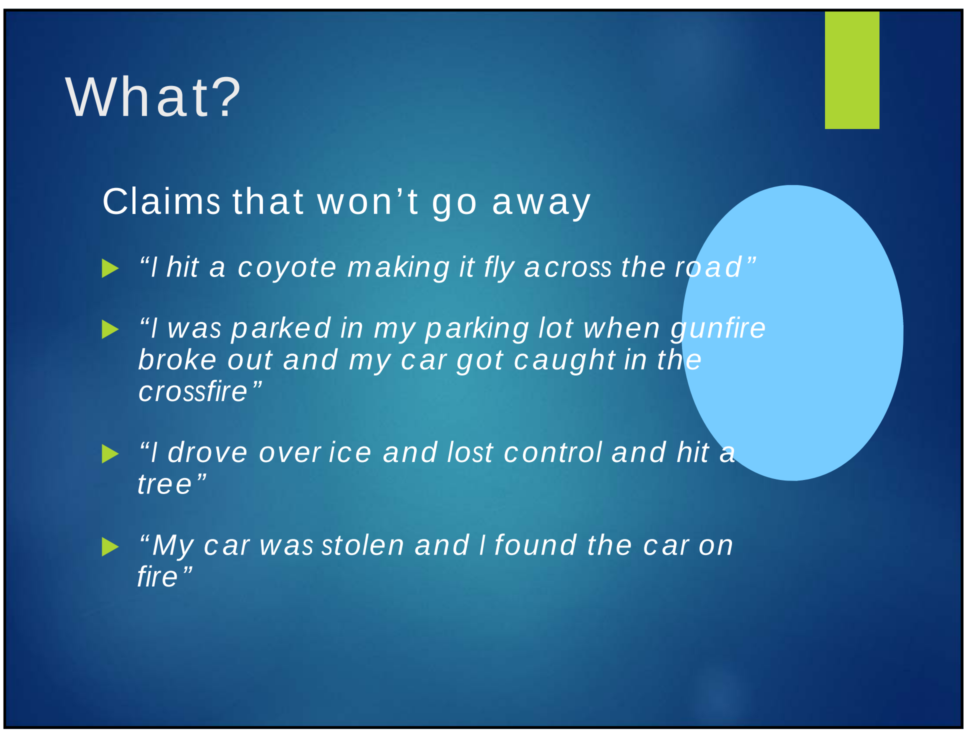
What?

On the Other Hand…

" *Smarter driving will lead to more driving, because smarter driving reduces the cost per mile of vehicle usage. The end result of additional driving could be more traffic and more aggregate fuel consumption.*"

- Casey B. Mulligan, economics professor at University of Chicago


What?
Claims that will go away
“I backed out of a parking spot and the other driver started backing out and hit me”
“I was changing lanes when I hit another vehicle”
“I was travelling northbound when the driver heading southbound blacked out, lost control and hit me and another car”
“My daughter lost control of my car and hit a bridge”


What?
Claims that won’t go away
“I hit a coyote making it fly across the road”
“I was parked in my parking lot when gunfire broke out and my car got caught in the crossfire”
“I drove over ice and lost control and hit a tree”
“My car was stolen and I found the car on fire”


What?
PROGRESSIVE 15-YEAR FREQUENCY FORECAST
25%
20%
15%
10%
5%
0
1984
1988
1992
1996
2000
2004
2008
2012
VOLVO
NISSAN
Google


What?
PROGRESSIVE 15-YEAR FREQUENCY FORECAST
25%
20%
15%
10%
5%
0
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
2024
2028
ACTUAL FREQUENCY
PGR PROJECTION WITHOUT CRASH AVOIDANCE
PGR PROJECTION WITH CRASH AVOIDANCE

What?

Why the Difference?

- Been burned before (ABS)
- Timeline longer
  - "We saw stuff that made us a little nervous," Christopher Urmson, Google

What?

What About Severity?

- Speed at impact
- Cost to repair
  - Air bags
  - Rear view cameras

Who?

- Today, our insured pays the premiums
  - Vehicle owner/occupant
- With a driverless car, our insured could be:
  - Vehicle owner – which could be a corporation
  - Vehicle “driver” – person in the driver’s seat? vehicle manufacturer? network?

Who?

Oregon

"Our legislation does require that there is driver in the car that is sitting the driver's seat, who is licensed driver," says Oregon state Representative Sara Gelser (D-Corvallis)

Washington

A licensed driver is legally responsible for the autonomous vehicle for traffic infractions and criminal offenses in the same manner as a driver of a nonautonomous vehicle

Who?

"It's absolutely the case that after the first accident involving an automated vehicle, there will be an automated ambulance chaser following,"

- Robert Hartwig, President of the Insurance Information Institute

- Flood insurance
- Self insure

Conclusion

- Insurance savings will lag drop in frequency
  - We will wait for the data
  - Margins will improve, competition will drive down prices
- Initially, drivers still liable
  - But manufacturers, etc. will get sued
  - Over time, insurance will morph products to fit liability as defined by the courts
- Insurance solution is critical, as RelayRides found out in NY

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Human Factors Considerations in the Development of Driverless Cars & Advanced Crash Avoidance Technologies

Bryan Reimer, Ph.D.
MIT AgeLab & New England University Transportation Center

NAMIC Annual Convention

September 22, 2014

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Benefits of Vehicle Automation

"Autonomous cars may seem like a gimmick, he begins, but when you consider all the **time** that people won't be devoting to their rear view mirrors, and all the **efficiencies** that come from cars that could be zipping between errands rather than idling in parking lots, the world looks like a very different place. Car ownership would be unnecessary, because your car (maybe **shared** with your neighbors) will act like a taxi that's summoned when needed. The **elderly** and the **blind** could be thoroughly integrated into society. **Traffic deaths could be eradicated**. Every person could gain lost hours back for working, reading, talking, or searching the Internet."

Google co-founder Sergey Brin as reported by Brad Stone of Bloomberg Business Week – May 22, 2013

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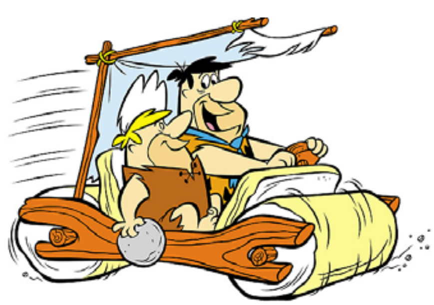
Evolution

- Drivers are "outdated … with stone age characteristics and performance controlling a fast, heavy machine in an environment packed with unnatural, artificial signs and signals." (Dewar, 1988)
- Faber (1993) expands on this by noting that our ancestors were daytime hunters used to monitoring animals running at speeds of no more than 25 MPH



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Human Factors for Automated Vehicles

A sample of questions "I" keep getting asked about

- How do we ensure a smooth transition from highly automated driving back to "manual" control?
- How can we develop an interface that can provide a "driver" with a clear understanding of the status of the automation?
- How do we ensure that the "operator" remains attentive and capable of resuming control if the automation fails?
- Do we need to keep the driver "in the loop"?

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Some Big Picture Human Centered Considerations

A partial list in no particular order of significance

- Trust in technology
- The theory of experience
- Education
- Lessons from other domains
- Workload
- Failures in automation

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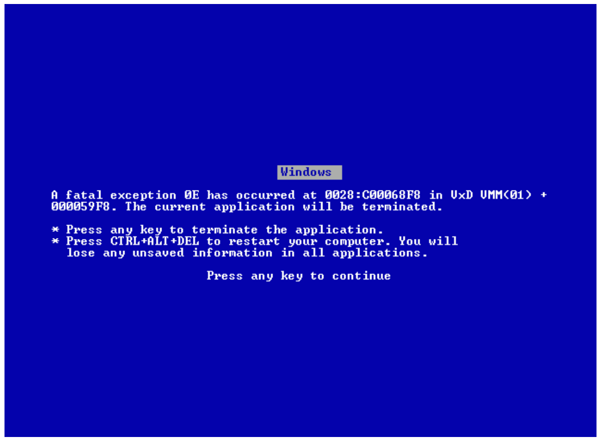
My Trust in Technology



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Automation and the Big Red Button

To trust or not?

- In many situations automation will outperform human operation, but will the driver trust it?
- How will one choose when to or when not to provide / accept autopilot control?
- Experiential learning does not yet exist.

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Experience

Vehicle Miles Traveled (VMT)

Vehicle Miles Driven (VMD)

Today	Tomorrow?
VMT = VMD	VMT ≠ VMD

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Education

"One of the myths about the impact of automation on human performance is as investment in automation increases, less investment is needed in human expertise"

David Woods as quoted by Robert Sumwalt, 2012

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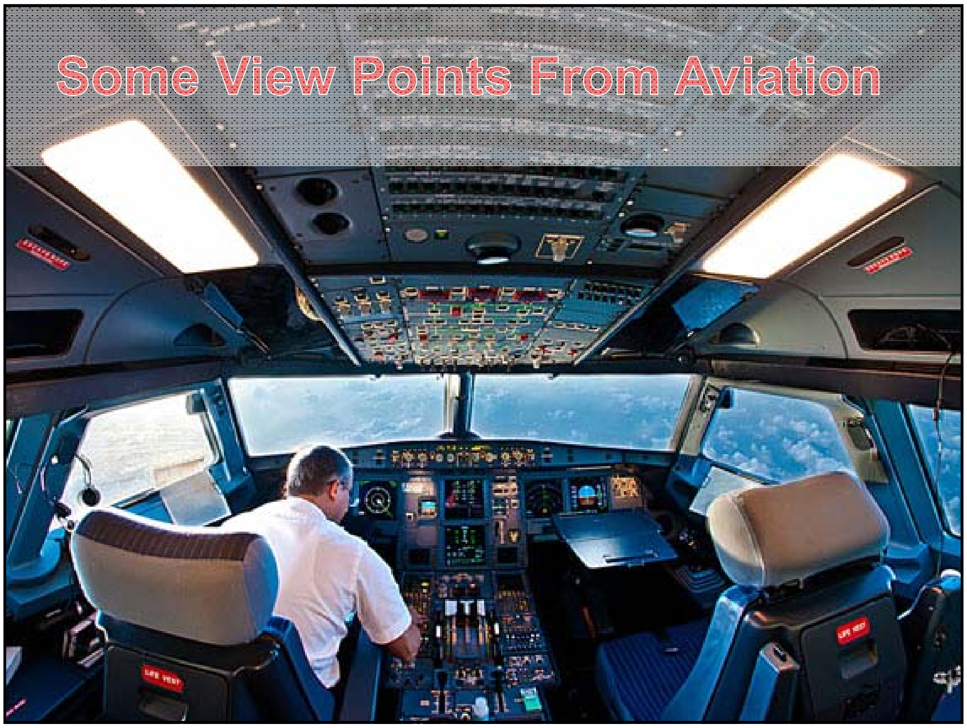
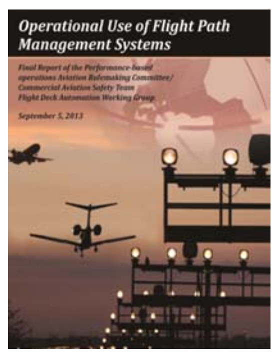


Aviation Experts Have Been Studying Automation for Decades

- In 1996, the Federal Aviation Administration (FAA) Report on the Interfaces between Flightcrews and Modern Flight Deck Systems was published. In this report, the Human Factors (HF) Team described how the aviation system is very safe. However, the review of data at that time identified issues that showed vulnerabilities in flightcrew management of automation and situation awareness.
- A 2013 report by the "Flight Deck Automation Working Group" summarize changes since 1996 and published a set of recommendations.
- A large body of literature also appears in national defense related literature.



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What are "We" Automating

Billings describes three types of automation:

- Control automation - control-related tasks (e.g. Autopilot, flight director guidance, autothrust)
- Information automation - calculation, integration, presentation of information (e.g., moving map display, Heads-up display, alerting systems)
- Management automation - management tasks (e.g., certain flight management systems functions)

Is the automated system backing-up the pilot or is the pilot backing-up the automated system?

Or is the pilot a passenger, "along for the ride"?

"We still hold pilots responsible"

(Kathy Abbott, 2014)

(Summary drawn from Kathy Abbott (FAA), 2014)

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Learning from Our Mistakes

"Various levels of automation (LOA) designating the degree of human operator and computer control were explored within the context of a dynamic control task as a means of improving overall human/machine performance. **Automated systems have traditionally been explored as binary function allocations; <u>either the human or the machine is assigned to a given task.</u> More recently, intermediary levels of automation have been discussed as a means of maintaining operator involvement in system performance, leading to improvements in situation awareness and reductions in out-of-the-loop performance problems**." (Endsley, 2010)

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Pilots Frequently Mitigate Issues

- Manage unexpected situations
- Adopt to changing situations
- Unanticipated errors by other humans in the system
- Equipment limitations and failures

Kathy Abbott (2014)

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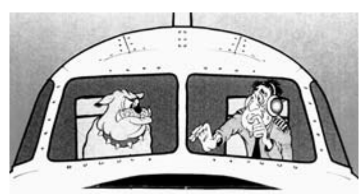
A Shifting View Point

- Old view
  - Human error is the cause of accidents
  - Human is the most unreliable component
  - Improve safety by restricting human action



- New view
  - Human error is the indicator of deeper issues
  - Humans in the loop are necessary to enhance safety
  - Improve safety by understanding (and leveraging) human performance

Dekker (2002) as summarized by Kathy Abbott (2014)

We need to design systems that support drivers / operators!!!

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Encouraging Manual Flight Control

SAFO
Safety Alert for Operators

U.S. Department of Transportation
Federal Aviation Administration

SAFO 13002
DATE: 1/4/13

Flight Standards Service
Washington, DC

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo

A SAFO contains important safety information and may include recommended action. SAFO content should be especially valuable to air carriers in meeting their statutory duty to provide service with the highest possible degree of safety in the public interest. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO.

Subject: Manual Flight Operations

Purpose: This SAFO encourages operators to promote manual flight operations when appropriate.

Background: A recent analysis of flight operations data (including normal flight operations, incidents, and accidents) identified an increase in manual handling errors. The Federal Aviation Administration (FAA) believes maintaining and improving the knowledge and skills for manual flight operations is necessary for safe flight operations.

Discussion: Modern aircraft are commonly operated using autoflight systems (e.g., autopilot or autothrottle/autothrust). Unfortunately, continuous use of those systems does not reinforce a pilot's knowledge and skills in manual flight operations. Autoflight systems are useful tools for pilots and have improved safety and workload management, and thus enabled more precise operations. However, continuous use of autoflight systems could lead to degradation of the pilot's ability to quickly recover the aircraft from an undesired state.

Operators are encouraged to take an integrated approach by incorporating emphasis of manual flight operations into both line operations and training (initial/upgrade and recurrent). Operational policies should be developed or reviewed to ensure there are appropriate opportunities for pilots to exercise manual flying skills, such as in non-RVSM airspace and during low workload conditions. In addition, policies should be developed or reviewed to ensure that pilots understand when to use the automated systems, such as during high workload conditions or airspace procedures that require use of autopilot for precise operations. Augmented crew operations may also limit the ability of some pilots to obtain practice in manual flight operations. Airline operational policies should ensure that all pilots have the appropriate opportunities to exercise the aforementioned knowledge and skills in flight operations.

Recommended Action: Directors of Operations, Program Managers, Directors of Training, Training Center Managers, Check Pilots, Training Pilots, and flightcrews should be familiar with the content of this SAFO. They should work together to ensure that the content of this SAFO is incorporated into operational policy, provided to pilots during ground training, and reinforced in flight training and proficiency checks.

Contact: Questions or comments regarding this SAFO should be directed to the Air Carrier Training Branch, AFS-210, at (202) 267-8166.

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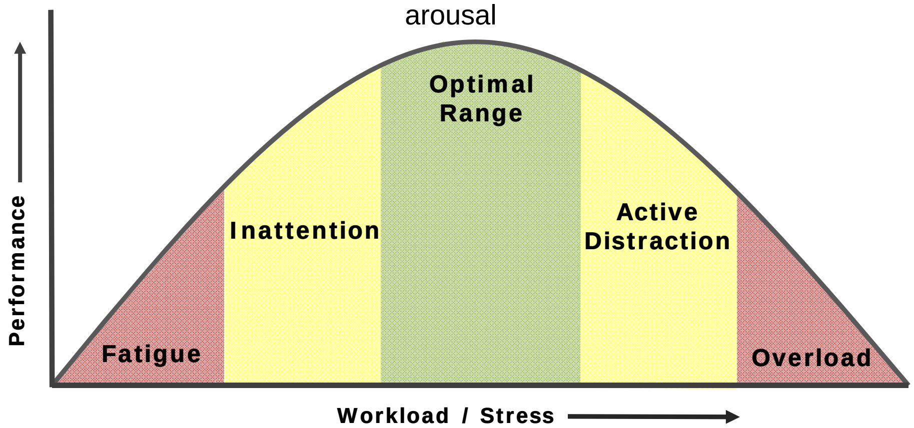
Workload & Performance

Yerkes-Dodson Law
The relationship between performance and physiological or mental arousal



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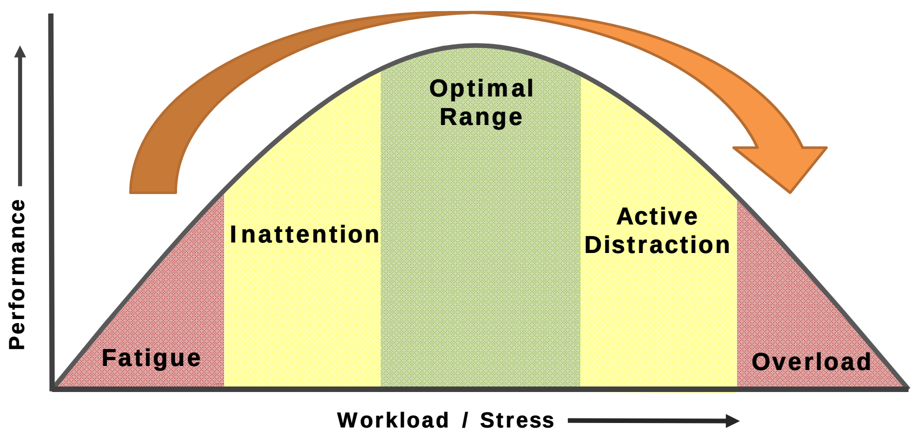
Workload & Performance

More Information in the Vehicle Tends to Increase Workload



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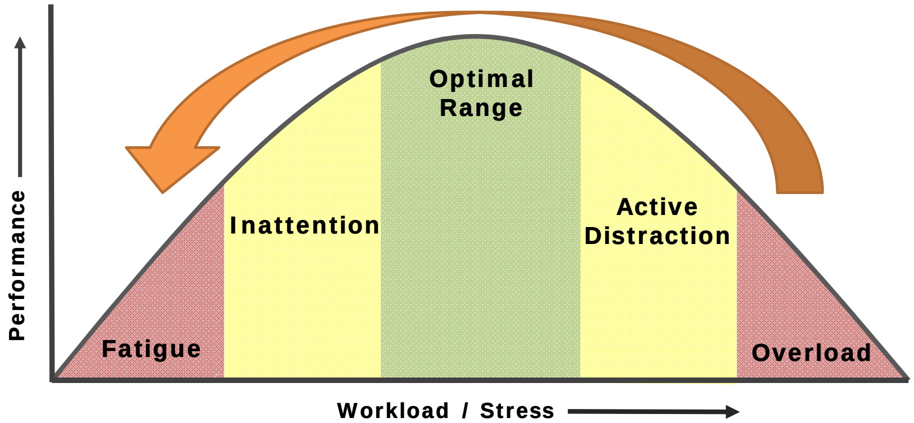
Workload & Performance

Automation Tends to Lower Workload



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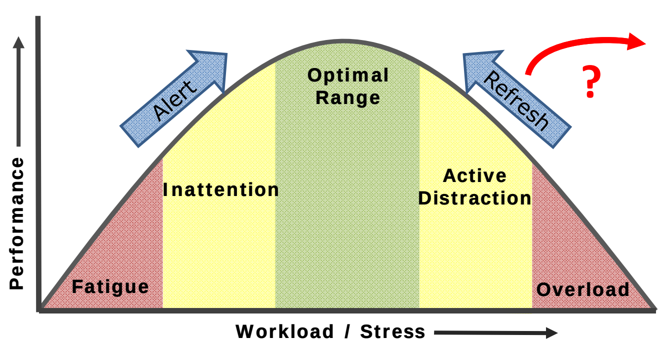
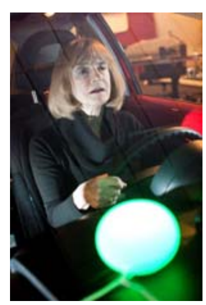
Aware Vehicles

Individualized real-time feedback to <u>support</u> the driver

- Improve self control
- Increase trust (person as an active vs. passive partner)
- Tailor to individual reactivity profiles and capacity





(Coughlin, Reimer & Mehler, 2011)

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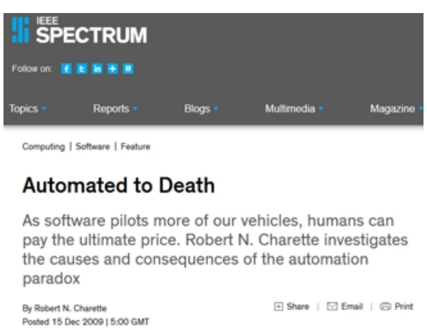
Failures in Automation

Required reading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Automated to Death

As software pilots more of our vehicles, humans can pay the ultimate price. Robert N. Charette investigates the causes and consequences of the automation paradox

By Robert N. Charette
Posted 15 Dec 2009 | 5:00 GMT

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"There will always be a set of circumstances that was not expected, that the automation either was not designed to handle or other things that just cannot be predicted," explains (Raja) Parasuraman. So as system reliability approaches—but doesn't quite reach—100 percent, "the more difficult it is to detect the error and recover from it"

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Liability

No system is "truly perfect"

"The first time that a driverless vehicle swerves to avoid a shopping cart and hits a stroller, someone's going to write, 'robot car kills baby to save groceries,' " he said. "It's those kinds of reasons you want to make sure this stuff is fully tested."

(Ryan Calo, a law professor at the University of Washington who co-founded the Legal Aspects of Autonomous Driving Center at Stanford, 2013)

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What is Defective?

Is it the technology or the operator?

NHTSA Office of Defects Investigation (ODI) "received two complaints of false application of emergency braking in model year 2013 Infiniti JX35 vehicles. In both complaints, the **consumers allege that the intelligent brake assist system inappropriately activated emergency braking autonomously** bringing the vehicle to an immediate and complete stop." – **Nissan's resolution was a software update**

An investigation is currently active looking at a similar ODI complaint against the **2014 Chevy Impala.**

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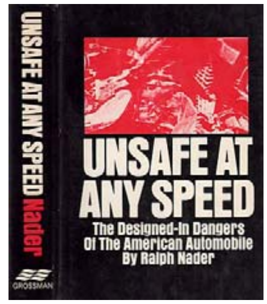
Unanticipated Consequences

Failure is not an option

1. Driverless car accident that results in loss of life
2. Major media coverage
3. Public outcry and fear of automation limits use of active safety (level 1) systems
4. Push for expedited regulation that may result in inefficient standards
5. Setbacks in auto safety could last for years
6. Benefits of Level 4 autonomy delayed



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The Future May Be Autonomy, But Questions on How and When Remain

- Current safety and convenience systems can improve comfort and mobility
- Next generation vehicles may help you do more safely
- Some key developments are needed before highly automated vehicles will significantly impact our roadway

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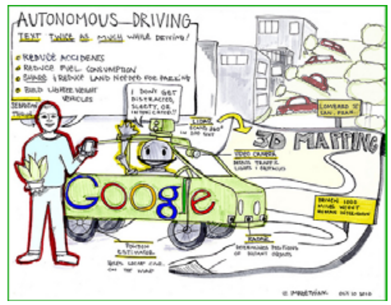
In Summary, I Believe We Need To:

- Continue exploring technologies for autonomous vehicles
- Make parallel investments in developing our understanding of how to optimize the human's connection with autonomous systems
- Clarify the benefits and consequences of system use and misuse
- Learn from complementary domains
- Stop assuming that automation technology will "automatically" solve our transportation safety problems



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Questions

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