

# Moving Towards The Vehicles Of The Future

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CU Design Show, 2013

# Global automotive innovation and R&D spend

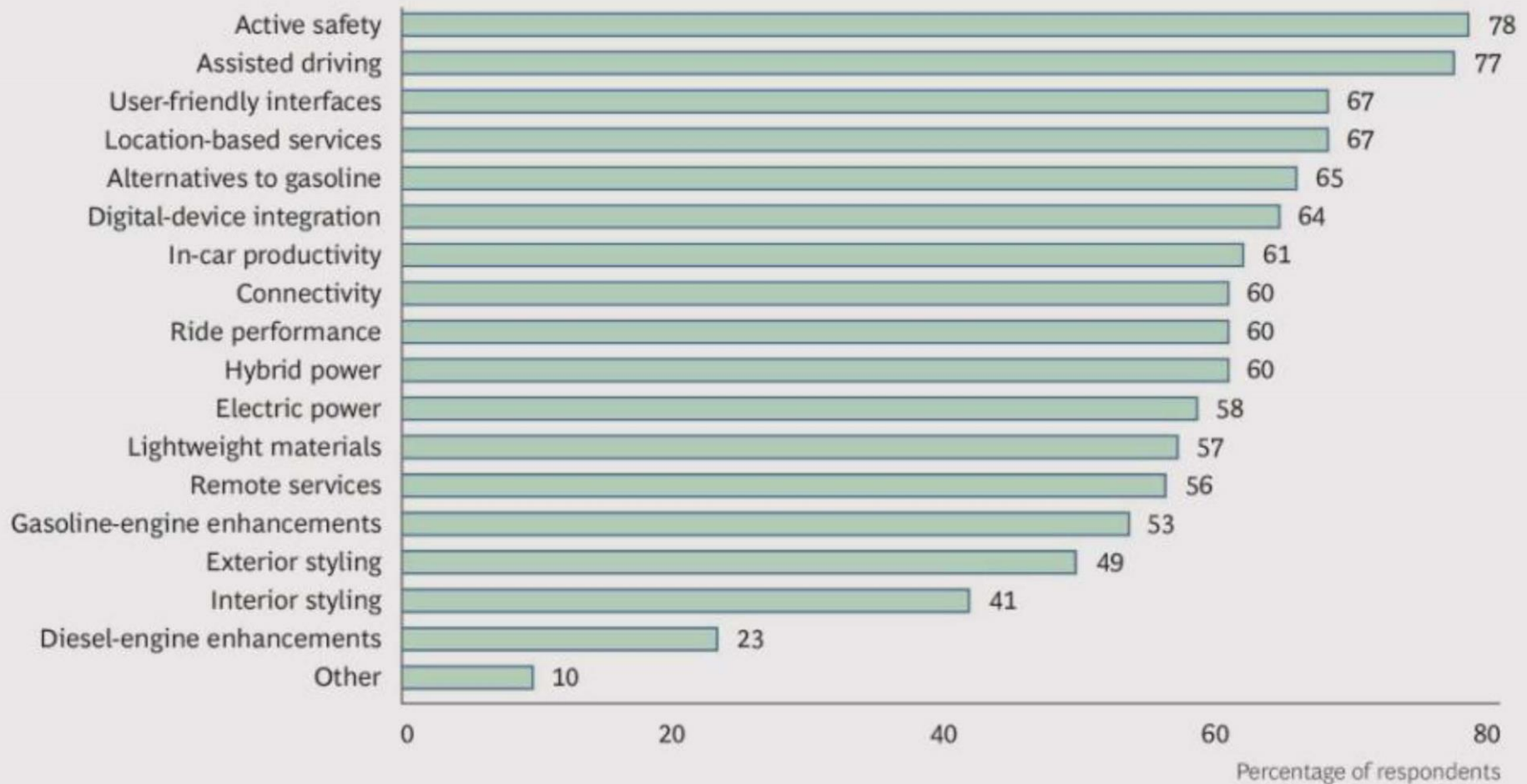
“14 automakers are among the top 50 most innovative companies compared with 10 carmakers in 2012 and only 5 in 2005. Three companies (Toyota, Ford, and BMW) rank in the top 10, and 9 automakers are in the top 20.”

“Volkswagen currently invests more in R&D than any other company worldwide, outpacing the likes of Samsung and Microsoft.”

Boston Consulting Group, 2013

## Consumers See Active Safety and Assisted Driving as the Most Innovative Features

Auto features that are considered “extremely innovative” or “somewhat innovative”



Source: BCG Consumer Survey, October 2013.

Top three: active safety, assisted driving & user-friendly interfaces

# Lines of software code (MLOC)

F-22 Raptor (Avionics system):	1.7
F-35 JS Fighter (Onboard systems):	5.7
Boeing 787 (Avionics and onboard):	6.5
Mercedes Benz S-Class (radio and navigation):	20
Modern luxury vehicles (estimate):	100

Frost & Sullivan, 2008/13

# Vehicular platforms will offer...

- increased onboard processing power and intelligence;
- more sophisticated health and usage monitoring data;
- advance human and environmental sensing;
- a bigger variety of (wireless) communication interfaces;
- opportunities for platooning, cooperative and infotainment applications.

Product  
recalls  
(software)

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## Toyota recalls every third generation Prius over software glitch

The Japanese car manufacturer is recalling 1.9 million cars across the globe, nearly 31,000 of which are registered in the UK



# Cryptographic attacks

theguardian

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## Scientist banned from revealing codes used to start luxury cars

High court imposes injunction on Flavio Garcia, who has cracked security system of cars including Porsches and Bentleys

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Lisa O'Carroll

theguardian.com, Friday 26 July 2013 18.18 BST

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# Eavesdropping and integrity attacks



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# Wireless Car Sensors Vulnerable to Hackers

Researchers figure out how to hijack sensor communications.

By Robert Lemos on August 10, 2010



Hackers could "hijack" the wireless pressure sensors built into many cars' tires, researchers have found. Criminals might then track a vehicle or force its electronic control system to malfunction, the University of South Carolina and Rutgers University researchers say.

The team, which successfully hijacked two popular tire-pressure-monitoring systems (TPMS), will describe the work at the [USENIX Security](#) conference in Washington, DC, this week.

SH

# Autonomy: where are we going?

Manual control  $\Rightarrow$  driver assistance  $\Rightarrow$  full autonomy

Some important questions:

- How much autonomy? Are we assuming autonomy always brings better performance?
- Formal verification for autonomy: is it always going to behave as it is expected to behave? What is expected?
- Is autonomy transparent to us? Why are the decisions made actually made? Is this an ethical position? Or simply a regulatory issue?

# Autonomy: where are we going? (2)

“The problem isn't technology, it's legislation, and the whole question of responsibility that goes with these cars moving around ... and especially who is responsible once there is no longer anyone inside.”

Carlos Ghosn, 2014

# Human factors: not so autonomous?

The human is still in control of the vehicle.

In the context of autonomy, how do we deal with:

- “sensory conflict” for the driver?
- “handover” between manual and automated control, as it is not easy to judge when to reclaim control?
- “inadequate feedback” with the consequence that the system fails on drivers’ expectations during a task?
- “change of task” for driver as it changes from monitoring the situation to monitoring the situation and automation?

# Human factors: departure from traditional analysis?

Issues of fatigue, distraction and cognitive overload persist.

Some new developments to address:

- Quantitative physiological assessments of human stress against vehicle interface design: could we carry out more objective assessment of the human condition? and system adaptation for refined interaction?
- Ultimately, could we bring the driver “in the control loop”?
- Formal behavioural modelling: could we verify correct interaction?

# Security and safety: where does it all converge?

Increasing distributed control systems in vehicles. This means:

- ⇒ More system interactions and interdependencies
  - ⇒ More integration complexity
    - ⇒ More difficult to test
- How do we leverage advances in software safety and security checking to a highly diverse and competitive supply chain?
- Could we bring together the formal methods and automotive embedded software communities together?
- Could we build on MISRA and ISO26262 initiatives?



Chevrolet

Thank You