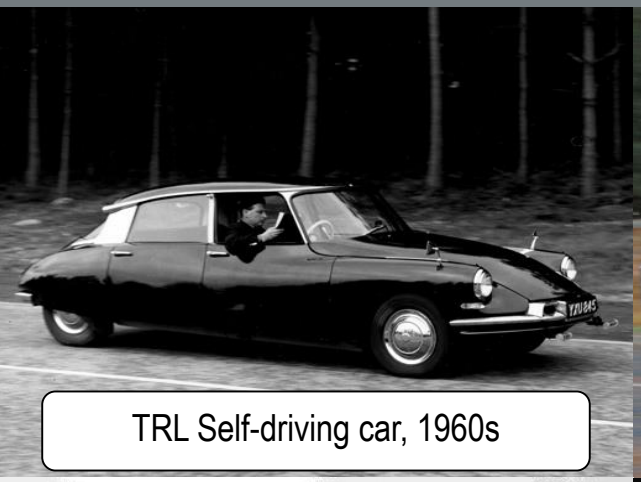
THE FUTURE OF TRANSPORT

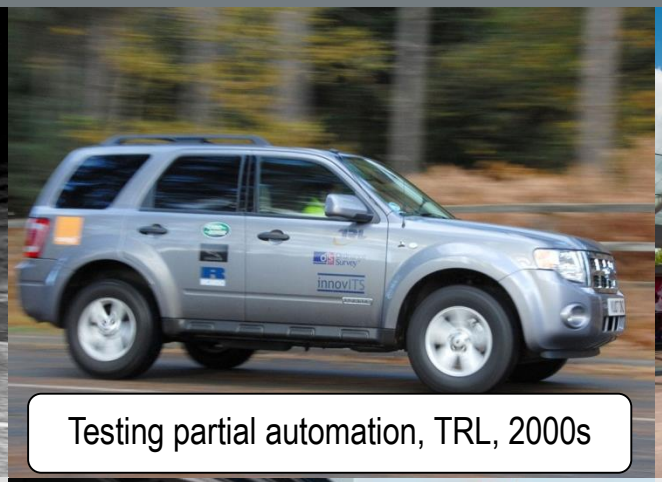
Safety Considerations of Autonomous Vehicles

Darren Divall
Head of International Road Safety
TRL

TRL History – Autonomous Vehicles



TRL Self-driving car, 1960s



Testing partial automation, TRL, 2000s

Testing in GATEway, Greenwich, 2015

TRL Self-driving car and bus, 1970

Testing automation in DigiCar, TRL, 2010s

Future testing, Greenwich, 2017+?

Background: Autonomous Vehicle Testing

TRL 1959 and 1971

Google 2010 and 2015

Tesla 2016

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TEST VEHICLE
00
RATE MY DRIVING
DRIVERLESS.TRL.CO.UK
00
#GREENWICHDRIVERLESS
GATEway
GREENWICH AUTOMATED TRANSPORT

The Potential for Automation Could Bring Enormous Benefits

Reduced congestion	Fewer traffic jams and less waiting time at intersections /lights → **80% improvement in traffic throughput[1]**
Higher fuel efficiency	Synchronized traffic flow → **23% to 39% improvement in highway fuel economy[2]**
Gain in productivity	Time in transit becomes more productive → **56 minutes per day freed up for other uses (US)[3]**
Democratization of mobility	Over-65 segment growing 50% faster than overall population → **Allow a variety of age ranges to be mobile**
Improved safety	95% of all accidents have some level of human contribution → **Reduction in motor vehicle accident rates**

[1] Shladover, Steven, Dongyan Su and Ziao-Yun Lu (2012), Impacts of Cooperative Adaptive Cruise Control on Freeway Traffic Flow, 91st Annual Meeting of TRB, Washington. [2] Atiyeh, Clifford (2012), Predicting Traffic Patterns, One Honda at a Time, MSN Auto, June 25. [3] US Department of Transportation Highway Safety Administration (2011), Report # FHWA-PL-II-022

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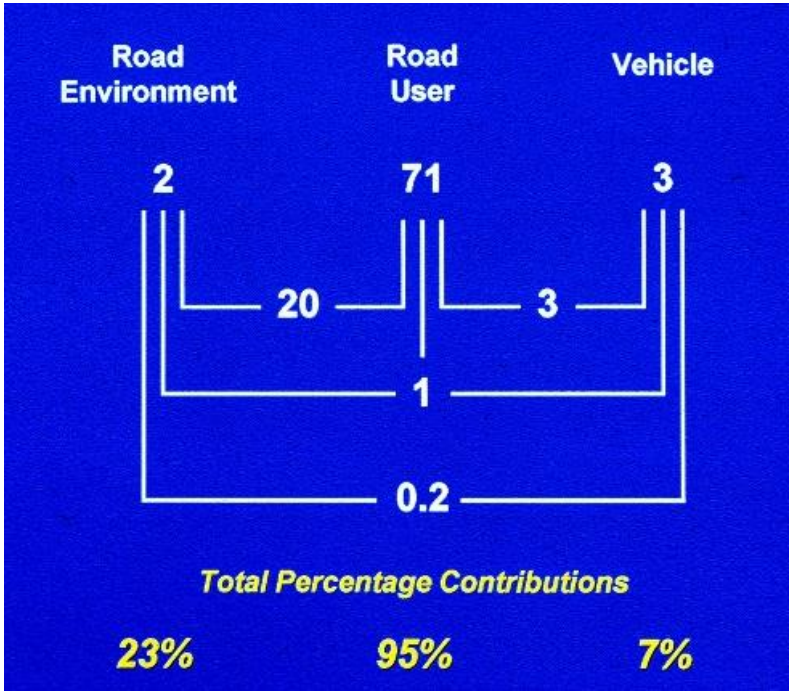
We Understand Many of Todays Safety Challenges – But How Do These Change with Greater Automation?

Contributory Factors



Prevention of conventional collisions

- Driver inattention, distraction, impairment
- Misinterpretation of road environment or other road user actions
- Consistent and reliable vehicle control
- Fast reaction time (once hazard identified)

Unintended consequences

- Driver disconnect & re-engagement
  - SAE Level 2– driver under-load
  - SAE Level 3– driver doing something else
- Communication with other road users (external HMI?)
  - Pedestrians, cyclists, other drivers
- Detection, identification, context limited by long range sensor performance
- Erode driver skills – critical conditions

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Impact on Achievement of Goals/Targets

DECADE OF ACTION FOR ROAD SAFETY 2011-2020

SUSTAINABLE DEVELOPMENT GOALS

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AV Market Share and Decade of Action

Self-Driving Car Deployment Growth

In Millions	2020-2024	2025	2030	2035
Global Sales	0.15	0.25	3.79	11.8
Share of Sales (%)	0.03%	0.23%	3.19%	9.44%
Cumulative Sales	0.15	0.4	10.5	51.4
Share of light vehicles in operation (%)	0.001%	0.026%	0.60%	2.68%

Source: IHS Automotive sales forecast, December 2014; volumes represented in millions.

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Expected Safety Impact

- AVs will make no positive safety impact by 2030.
- Major issues with software, consumer acceptance, cyber security, regulatory approvals, transition periods, etc.
- Risk that development into AVs will divert attention from:
  - Electronic Stability Control
  - Autonomous Emergency Braking
  - Intelligent Speed Assistance

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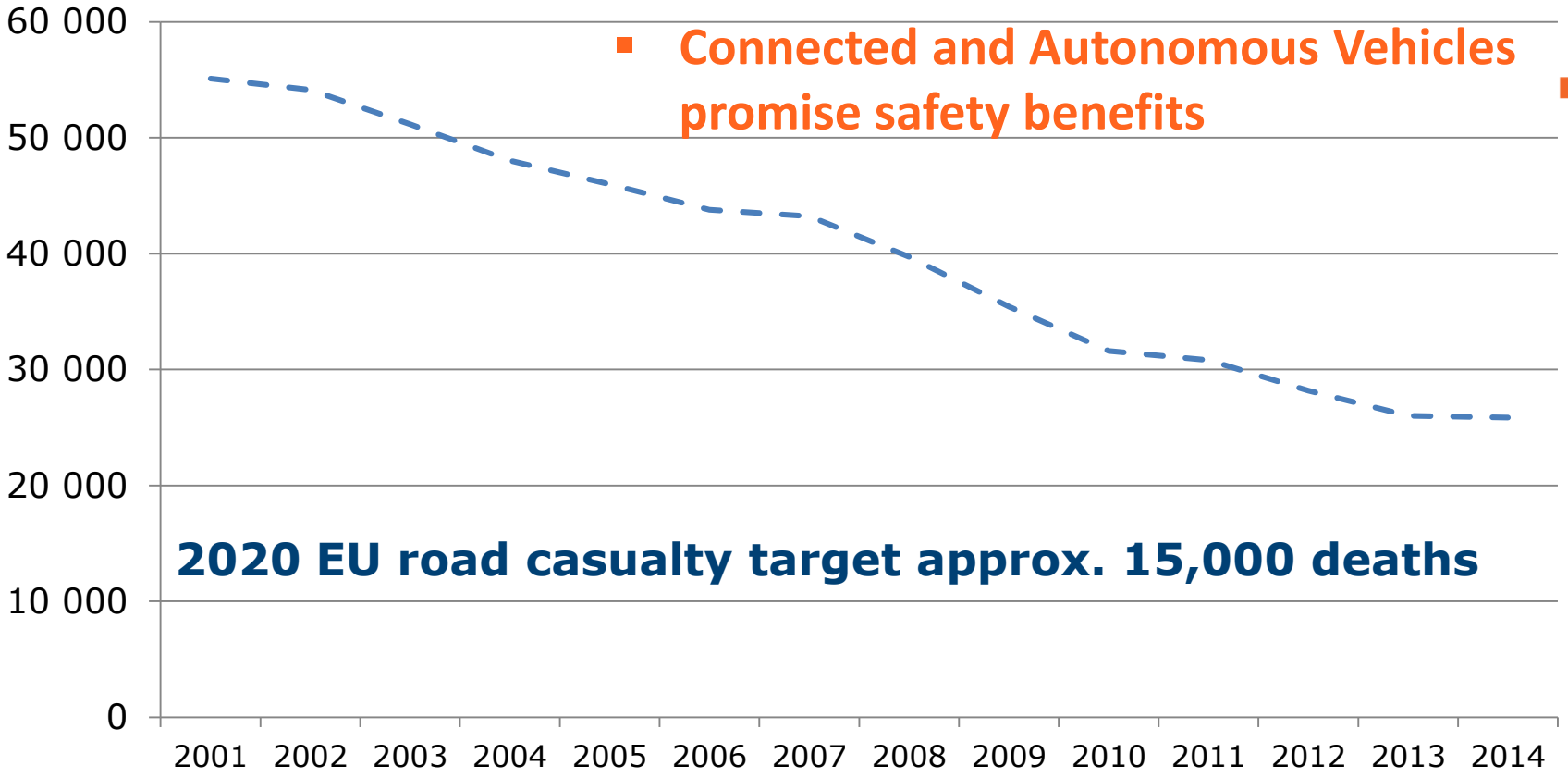
Road Casualties

Road fatalities in EU28

- Road casualty reductions have ‘flatlined’ since 2010
- Connected and Autonomous Vehicles promise safety benefits



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Background: Future CAVs & Technologies

In 2016 Ford announced automated vehicle programme

2021

We're announcing our intent to have fully autonomous vehicles in commercial operation for a ride-hailing or ride-sharing service beginning in 2021. This is significant. Ford will be mass producing vehicles capable of driving fully autonomously within five years. No steering wheel. No gas pedals. No brake pedals. A driver will not be required.

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"Accelerating automated driving by connected validation and big data analysis"

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MOVE_UK: The Road to Automated Driving

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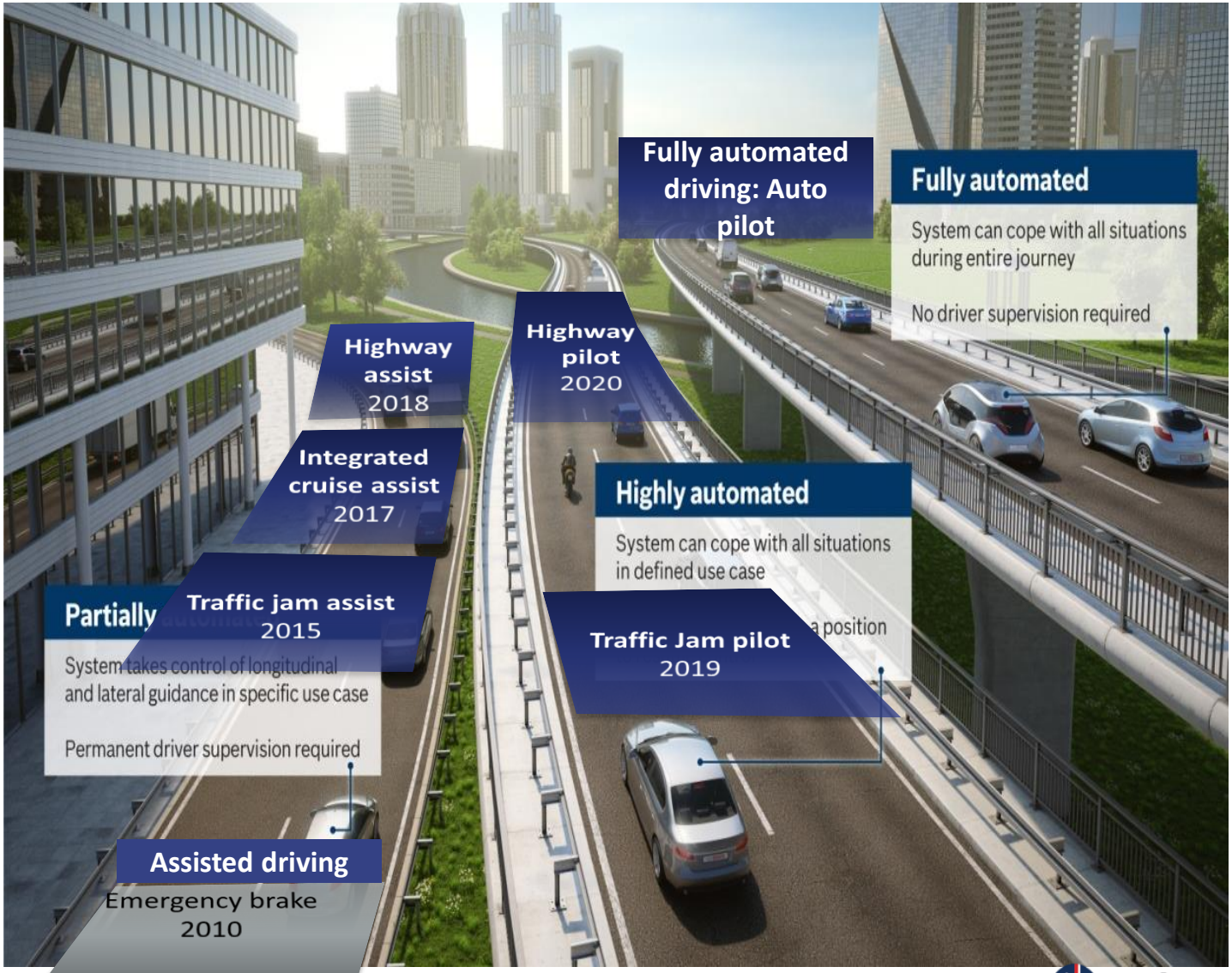
MOVE_UK: The Road to Automated Driving



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Prerequisites for Autonomous Driving

360° surround sensors

highly robust functions on all use cases

redundancies for fail operation

surround sensing

validation

system architecture

legislation

standards, frameworks & liability

Focus of MOVE_UK

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Remote Access

Ford is working with cloud software provider Pivotal on a platform to allow Ford owners with SYNC technology to locate, lock/unlock and remotely start their vehicle

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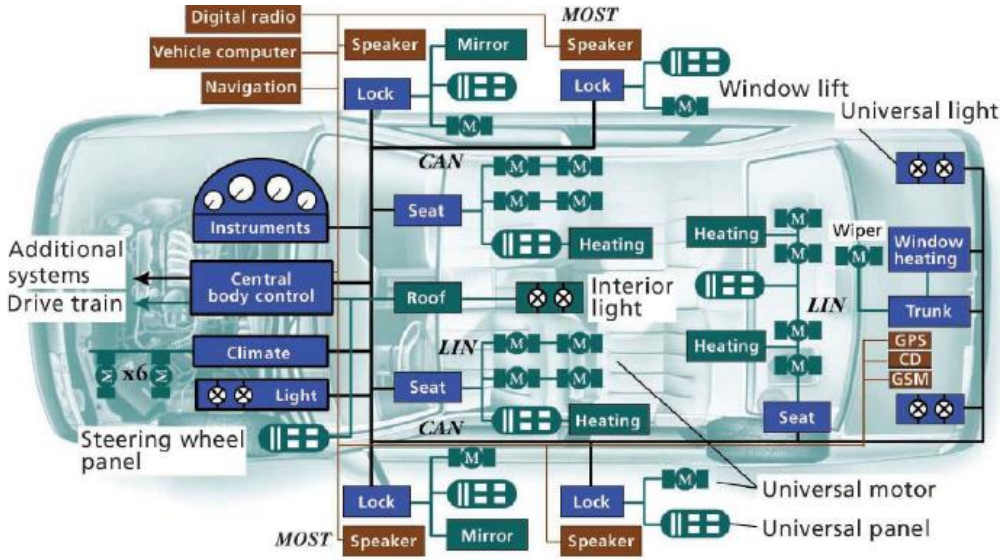
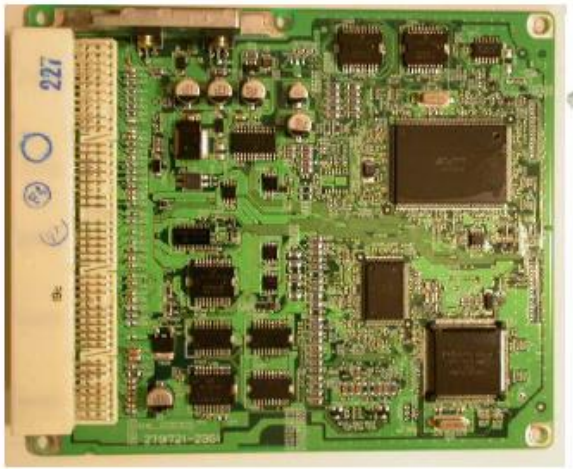
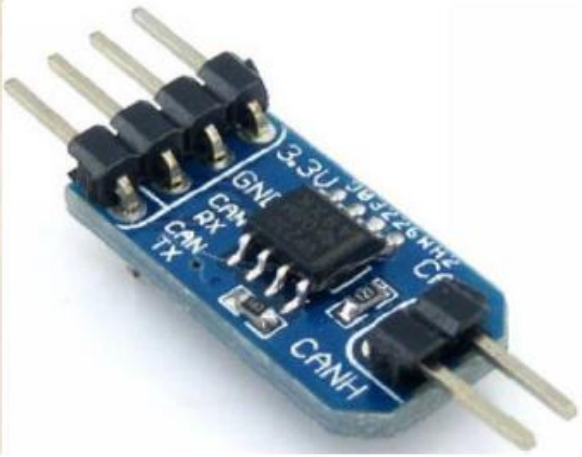
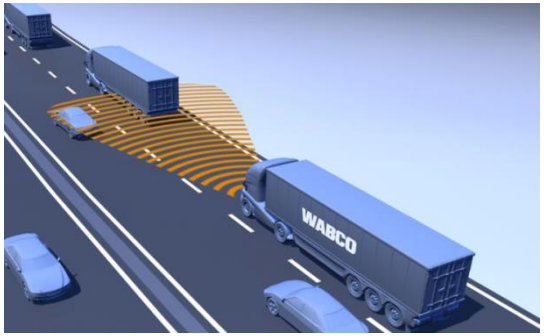
Cloud Services







Platooning



- European COMPANION project

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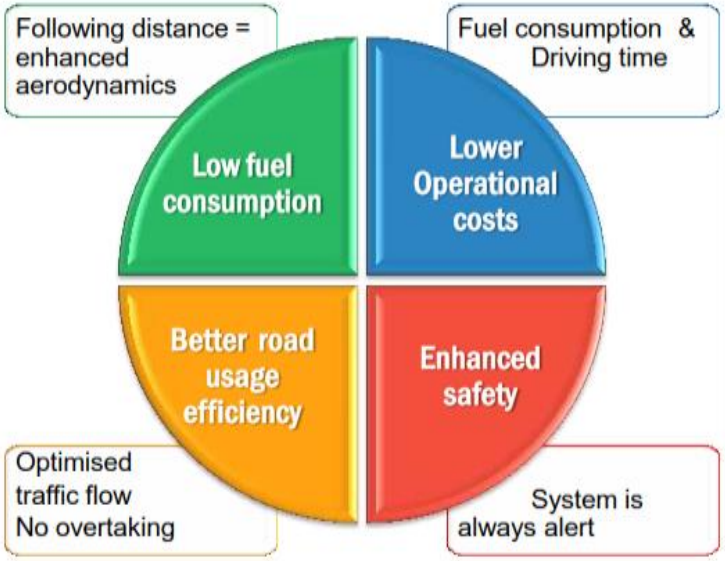
New Technology, New Connectivity

HGV Platooning trials

Pedestrian and pedal cyclist AEB



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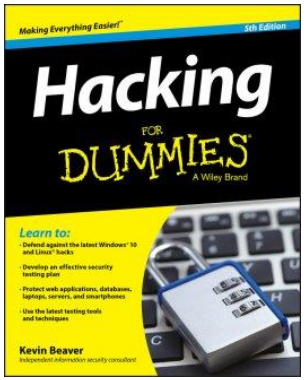
System Safety and Cybersecurity



The number of technologies added on the vehicles is constantly growing, the transportation networks are becoming more and more complex, making them more susceptible to cyber-attacks.

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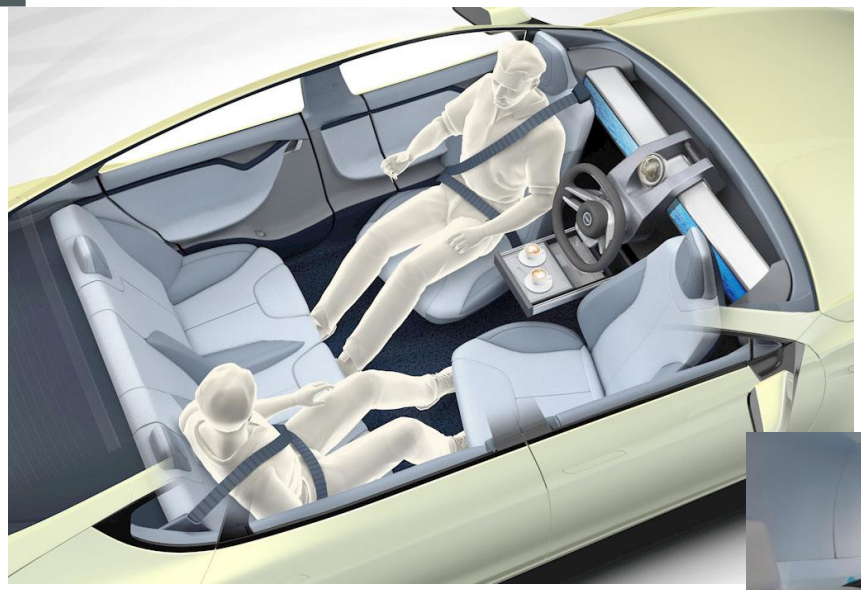
What are the Future Requirements for Occupant Protection?



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What are the Future Requirements for Occupant Protection?

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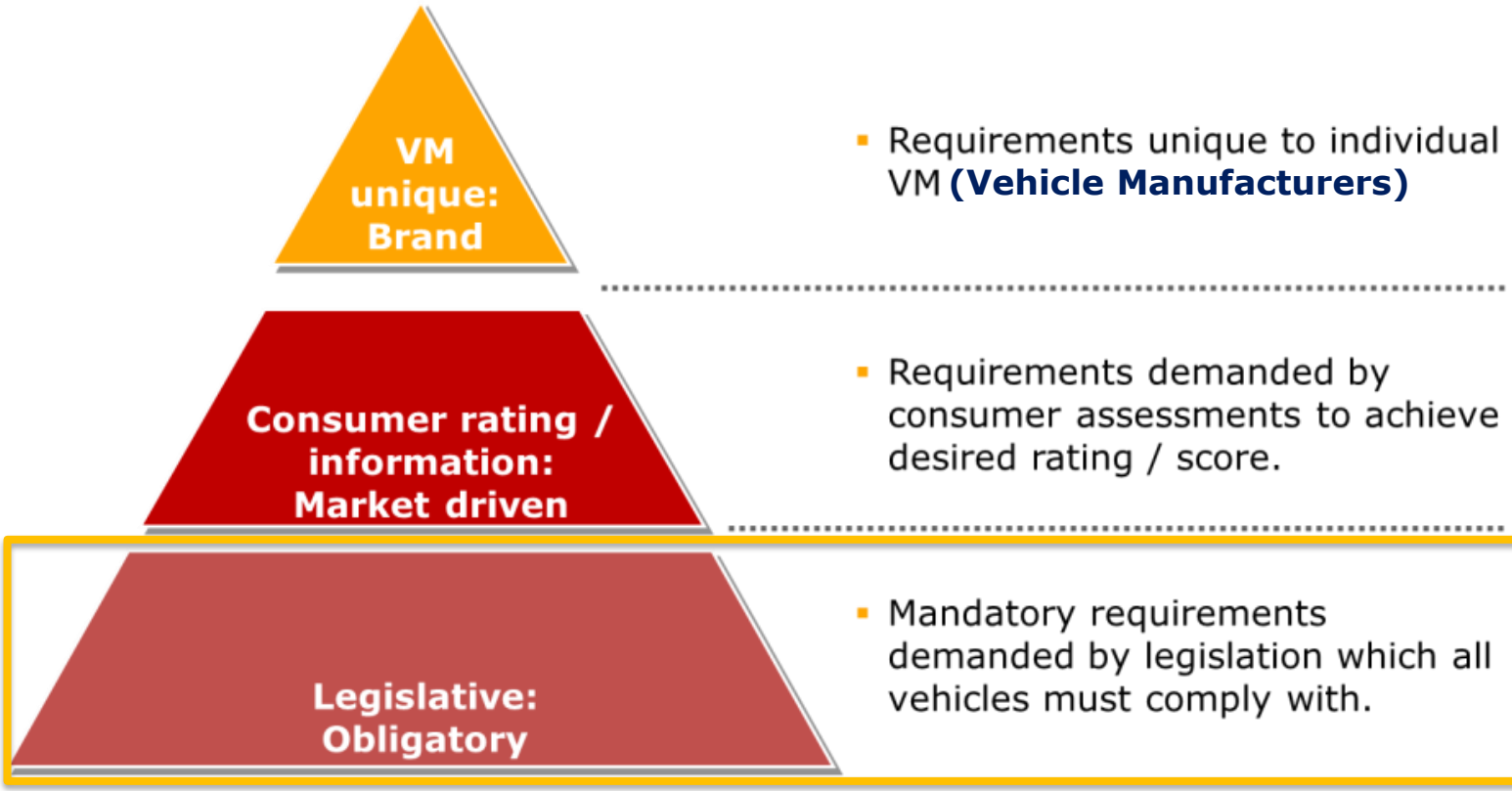
Opportunities to Influence Vehicle Safety

Vehicle design and casualty prevention



- Requirements unique to individual VM **(Vehicle Manufacturers)**
- Requirements demanded by consumer assessments to achieve desired rating / score.
- Mandatory requirements demanded by legislation which all vehicles must comply with.

EUROPEAN COMMISSION

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

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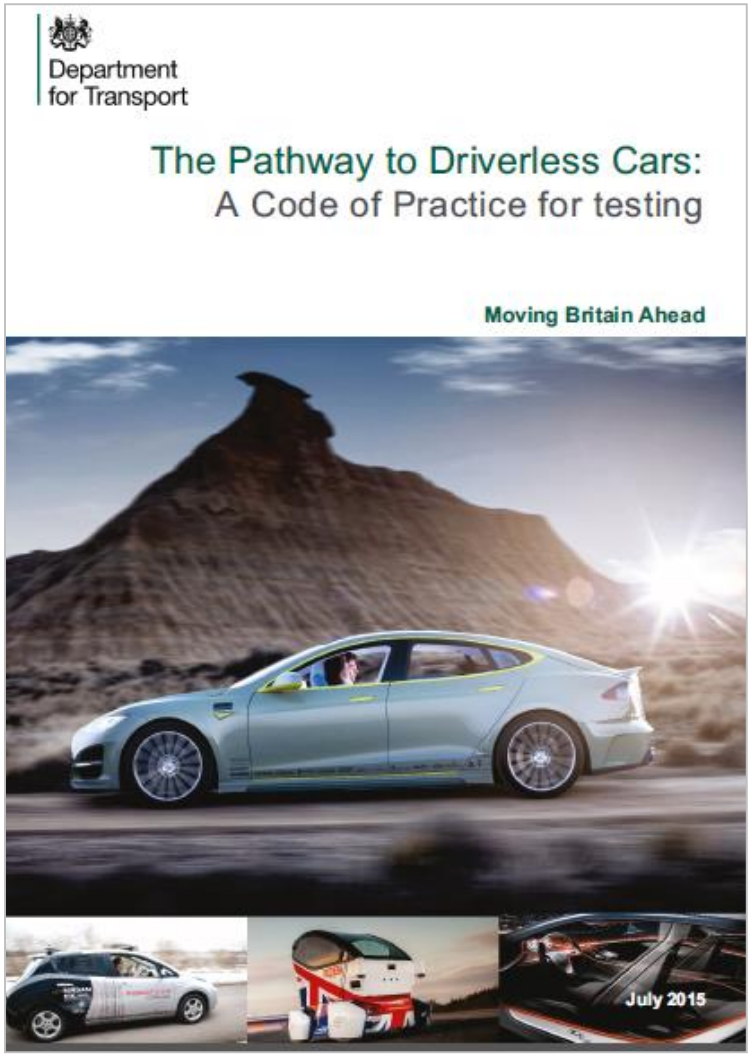
The Department for Transport in the UK Has Begun Work on Regulation

- February 2015 – Regulatory review:
  - *"Driverless vehicles can legally be tested on public roads in the UK today providing a test driver is present and takes responsibility for the safe operation of the vehicle; and that the vehicle can be used compatibly with road traffic law."*



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Conclusions

- Positive future benefits
- Need to time to validate the system
- More significant conversion of vehicle fleet required
- Technological challenges, especially in urban environments (This is a mobility revolution!)
- Known and unknown risks (system capabilities, cyber security, change in dynamics for vehicle occupant safety)
- Needs well defined regulation

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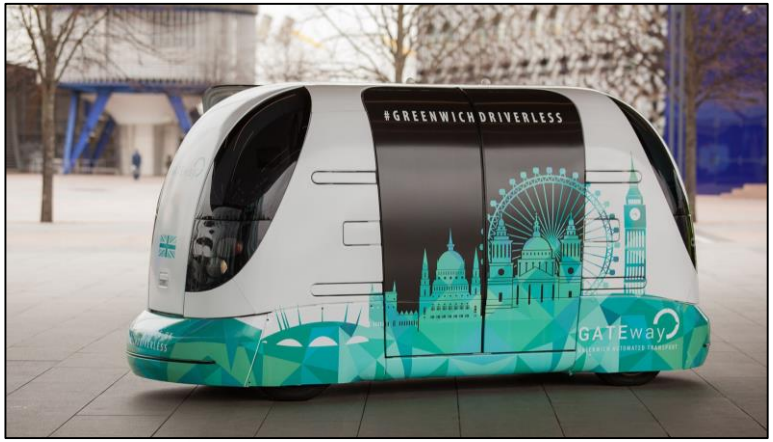

GATEway

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Thank you

Any questions?

Darren Divall
Head of International Road Safety
Email: ddivall@trl.co.uk