THE FUTURE OF TRANSPORT

Autonomous Driving and the Impact on Traffic Safety

PRI Conference, Lisbon

13th October, 2016

Agenda

1	Why automation?
2	Automation potential – and how to get there?
3	What are the safety implications?
4	Future unknowns and key final messages
A	Appendix – about TRL

Many motor vehicles are not used 95% of the time

Motor vehicles force us to reshape our towns and cities

Many vehicles are bought for spurious reasons…

…But, even so, driving often still isn't fun

Driving requires users to have >65 hours of training/practice…

…But, is still the most likely way for young people to die in many societies around the world

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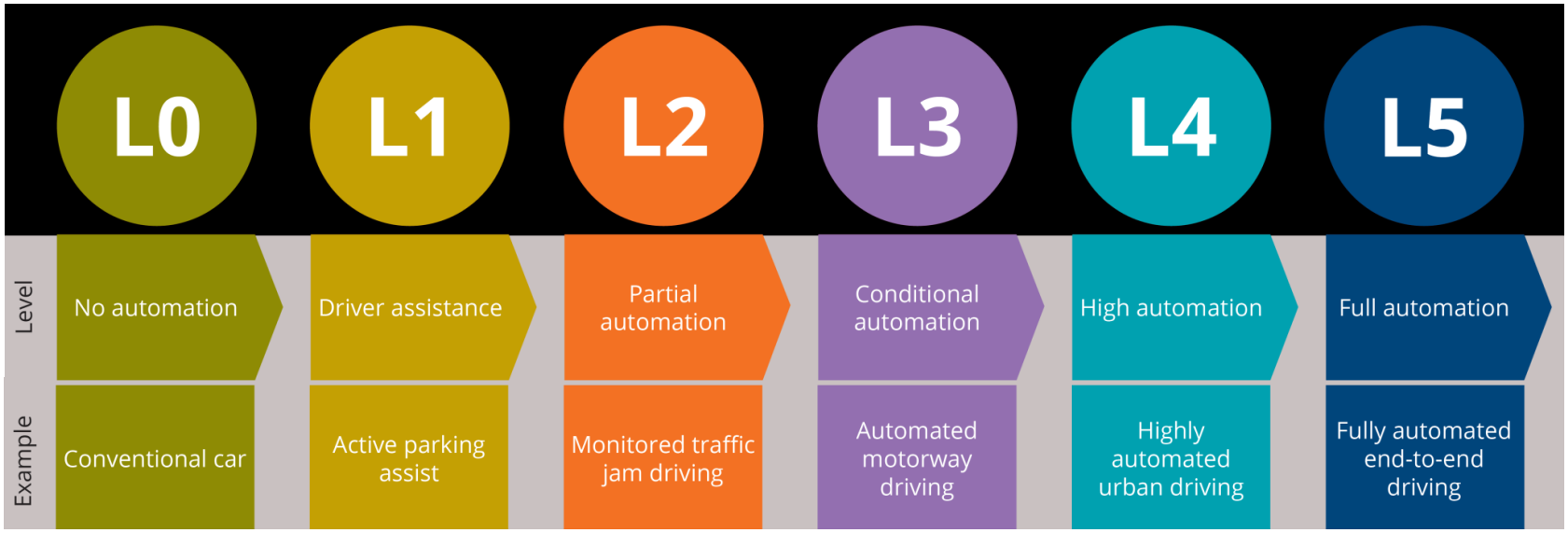
The potential for automation could bring enormous benefits

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

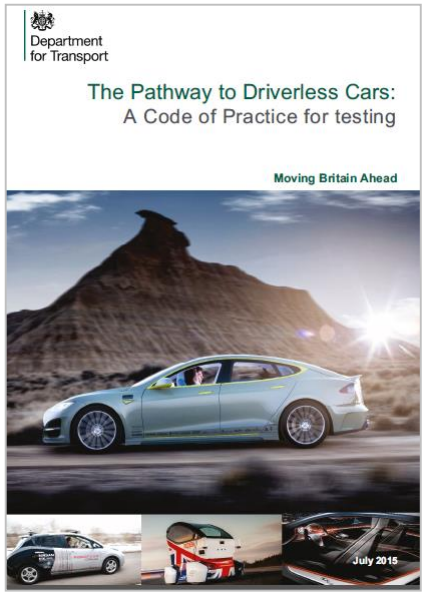
There are two models emerging on how to progress the levels of driving automation (SAE J3016)



- Incremental stages of automation – following SAE levels
  - Deliver a product development path & customer journey
  - Complexity of validation for all driving scenarios
- Full automation, new entrants
  - Initially restricted environments & defined use cases
  - The medium term – Google, Uber, Apple?

The Department (Ministry) 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."*
- July 2015 – Code of Practice:
  - *Applies to all vehicle types*
  - *Insurance (no bond required)*
  - *Engagement with stakeholders, emergency services etc.*
  - *Test driver/operator (vehicle operation, licence, training)*
  - *Vehicle (prior testing, roadworthiness, technology maturity)*
  - *Data recording/protection*
  - *Cybersecurity*
  - *Safety during mode transitions*
  - *No need to obtain certificates or permits*



The regulation will be informed and evolved through on-road trials such as GATEway

- **Venue: Greenwich, London, UK**
  - Smart City venue and fantastic historical links to navigation
- **Two year, £8m project – high level aims:**
  - **Demonstrate** automated transport safely and effectively in a range of environments
  - **Understand** societal, legal, technical changes and barriers to implementation based on direct experience of operation
  - **Create** a multifaceted, validated, long term test bed for the evaluation of future automated transport systems

GATEway

Greenwich Autonomous Transport Environment

TRL THE FUTURE OF TRANSPORT

ROYAL borough of GREENWICH

RSA

Telefónica O2

Royal College of Art

UNIVERSITY of GREENWICH

Imperial College London

COMMONPLACE

GOBOTIX LTD

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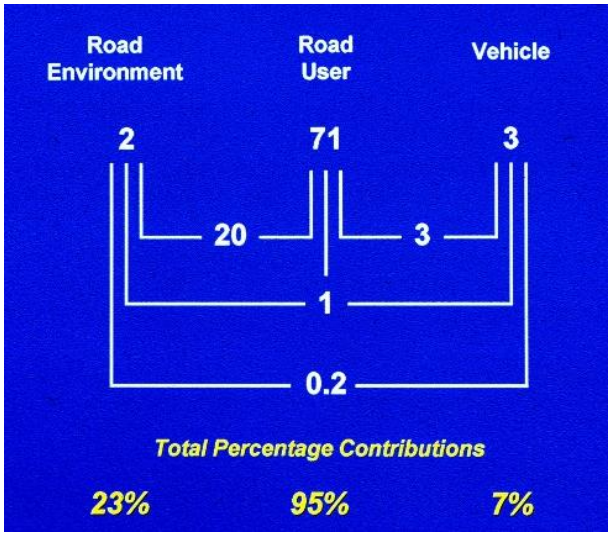
We understand many of todays safety challenges – but how do these change with greater automation?

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

Rigorous and robust validation and approval provide the critical path to adoption of automation

Validation of autonomy

- Completely different to traditional safety testing
  - Physical tests of engineering
- Testing of hazard detection, determination & decision making
  - Sensors, algorithms, environmental conditions, '000's of scenarios

Field based testing requires very high exposure

- Google 1.5M miles, repeat for each software update?

Accelerated validation approaches in development

- Real world driving data
- Contextual data for virtual test scenarios
- Evaluate system performance in critical and non-critical conditions

Future approval processes may rely on both physical and virtual testing

- Complex hazard types, weather/lighting conditions

Insurance, liability and post-event data collection and analysis will play a key role in automation safety

Insurers need to understand the technology and its impacts

- Opportunity and threat

OEMs must own liability for system failure?

- Volvo commitment

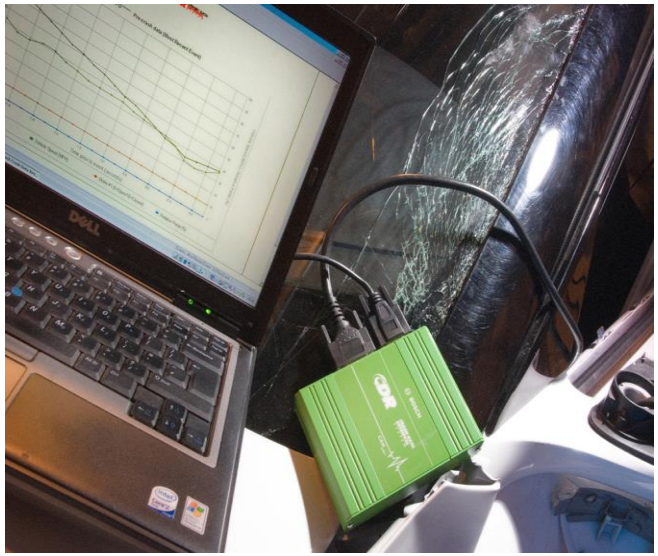
Automated driving systems pose new problems

- Transparency required in incident scenarios
  - Event Data Recorder (EDR) essential
- Sensor data (what the vehicle saw)
- Control system inputs (what the vehicle did)
- Consequences of response options: ethics

Driver monitoring

- Understanding driver condition/activity
  - Essential level 2 and 3 autonomy

Re-commissioning of damaged components must be robust



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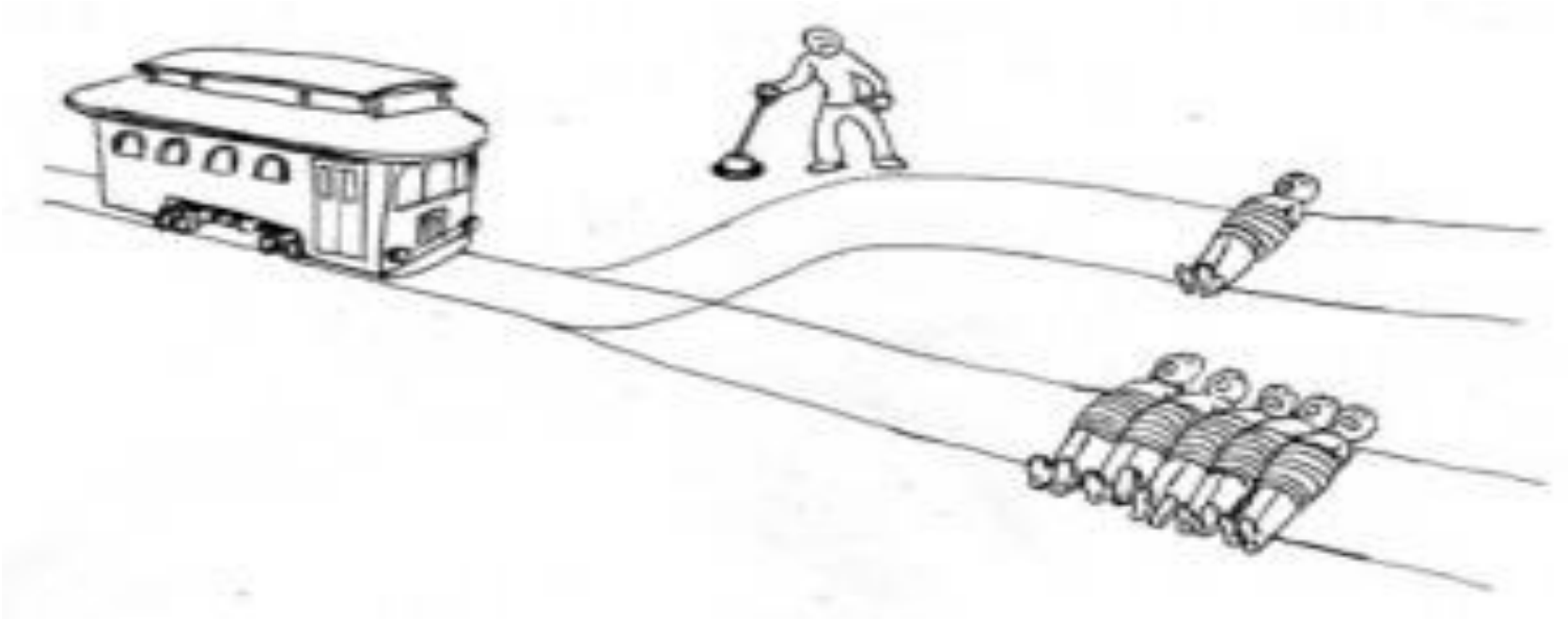
There are still lots of “unknowns” for vehicle automation, e.g. the morality question



- Trolley dilemma (Foot, 1967)
- Driver of a runaway tram can only steer from one narrow track on to another; five men are working on one track and one man on the other; anyone on the track he enters is bound to be killed

Key final messages

- Automation is coming – and it will bring positives
- But the path to get there needs to be carefully managed
- There will be a safety dividend
- But there will also be some hard questions to answer too

شكرا Thank You

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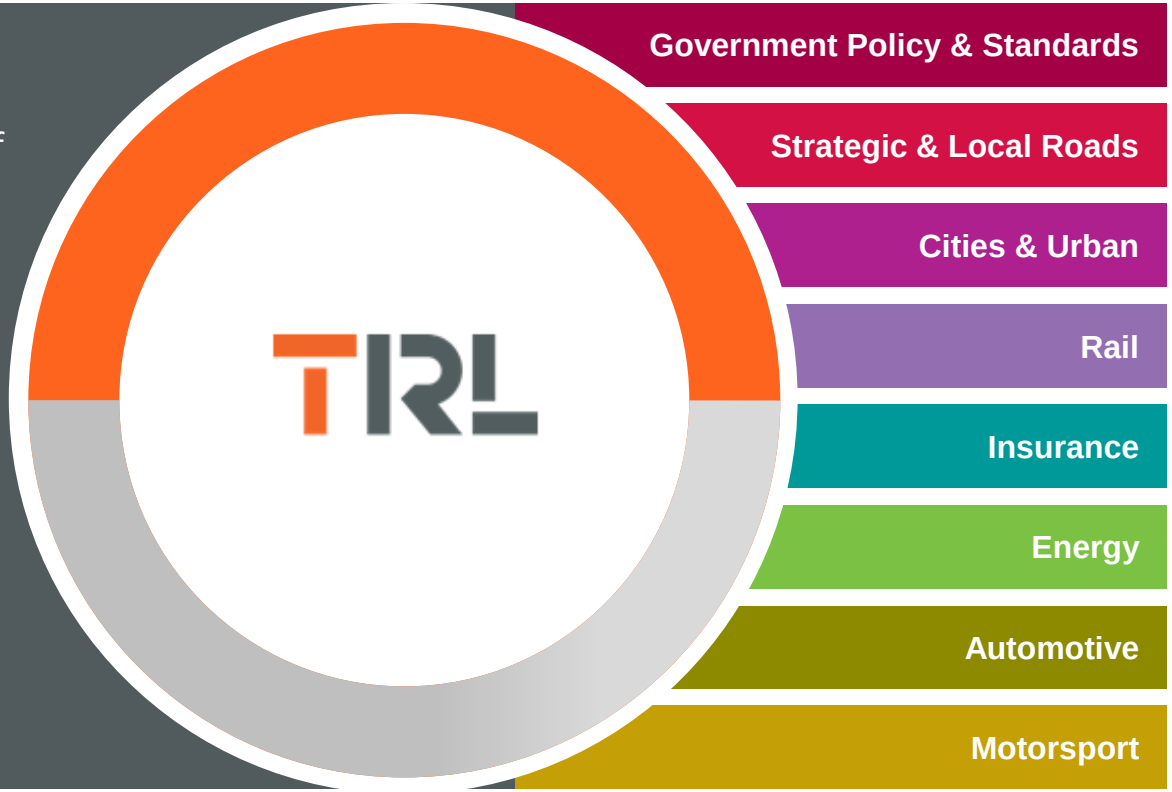
TRL offers unrivalled industry expertise focused on surface transport and related mobility segments

- Transport research and consultancy
- Established in 1933 as part of the UK Government's Department (Ministry) for Transport; Semi-privatised in 1996
- Parent company is the Transport Research Foundation
- A non-profit distributing company
- 350+ staff including many world recognised experts
- Independent, trusted advisor to public and private sector



TRL has a long history of developing genuinely new Research & Innovation in the Middle East

- Present in the GCC for over 10 years
- Current offices in Abu Dhabi & Qatar
- Opening offices in Dubai and Kuwait
- Regional research and innovation themes include:
  - Materials – QNRF collaboration and funding
  - Road Safety – especially data collection, analysis and insight
  - Technology – including connected, autonomous and electric vehicles

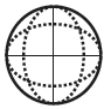
We look at the global megatrends that influence local, national & international mobility themes

Societal Challenges

- Increasingly urbanised population
- Ageing society
- Increased demand for connected transportation
- Accessibility of transportation modes

Safety & Environment

- Safety targets
- Climate change targets
- Policy & regulation
- Congestion
- Electrification of vehicle fleet
- Infrastructure design implications



Connectivity & Automation

- New mobility business models
- Smart cities
- Growth in sharing economy e.g. Uber, Lyft, AirBnB
- User behaviour
- Vehicle design implications

We also look at the underlying drivers of these emerging themes as well as technology enablers

Innovation & Research Drivers

- Relevant legislation, i.e.
  - Standards, licensing, insurance
- Efficient costing and pricing. i.e.
  - Ticketing, vehicle and fuel costs
- Improved health and well-being, i.e.
  - Safety, population demographics
- Environmental impact, i.e.
  - Emissions reduction, recycling
- Better customer experience, i.e.
  - Multi-modal integration
- Satisfied demand, i.e.
  - Movement of people and goods

Technology Enablers

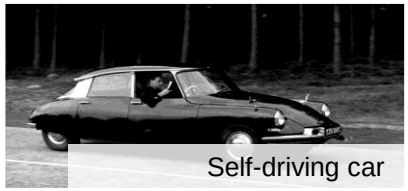
- Energy
  - Vehicle efficiency, fuel types, Ultra Low Emission Vehicles (ULEVs)
- Autonomy
  - Self-driving vehicles
- Connectivity
  - Telecommunications
- Analytics
  - Modelling and “big data”

TRL has Connected and Autonomous Vehicle (CAV) experience and heritage spanning over 65 years

1950s


Self-driving car

1960s


Self-driving car

1970s


Self-driving car & bus

2000s


Testing partial automation

2016


Autonomous pod

"Driverless cars will improve road safety and bring huge benefits to the economy. We have backed projects in Greenwich with £9m of funding that are helping to turn it into a major centre for testing and demonstration. I am excited to see the UK Smart Mobility Living Lab progress, helping to keep the UK at the forefront of the motoring of the future."

Andrew Jones
Transport Minister, UK

1960s Autonomous Citroen DS Video