Ensuring the safety of automated vehicles

Alan Stevens

Workshop on Verification and Validation for Autonomous Road Vehicles  4 Nov 2016
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1. Planning trials and safety
2. Estimating safety in use
3. Behaviour
4. Timescales constraints and enablers
DfT: Pathways to driverless cars

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:

- Insurance (no bond required)
- Engagement with the public, 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

Federal Automated Vehicles Policy.
Accelerating the Next Revolution In Roadway Safety September 2016
GATEway project in Greenwich, London

Automated passenger shuttles in real urban environment
**GATEway trials**

### Last-mile shuttle transport

- Greenwich peninsula
- Different demographic groups invited to participate in a managed process
- ‘Steward’ on board to comply with DfT Code of Practice
- In-depth engagement with participants

### Urban deliveries

- Demand from retailers
- Deliveries to be made via automated EVs
- Zero emission, low noise, automated vehicle

### Accessibility/ Valet Parking

- Focus on users with mobility needs
- Test-bed for Tier-1 technology
- Vehicles to search for space and park autonomously
- Vehicles to be summoned / dispatched via smartphone

Draft route:
- InterContinental Hotel
- North Greenwich tube/bus station
- Emirates Airline cable car
- The Pilot Inn
- Thames Clipper river-bus stop
- Greenwich Peninsula Ecology Park
- 2.2 miles / 3.5 km

**GATEway**

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Developing a safety case for automated vehicles

- Overview and description of the system, vehicles and control system
- Operating principles and design features
- Demonstrating compliance with relevant legislation
- Risk assessment including hazard identification, risk analysis, risk mitigations and risk evaluation
- System response to specific (planned or unplanned) events
- Operating parameters and limitations
- Safe operating procedures
- Vehicle safety and stability
- Driver/ passenger safety
- How business continuity can be assured
- Emergency response (fire/ collision/ breakdown)
- Training requirements
- Data recording and monitoring
- Communication
- Physical security
- Cyber security
- Monitoring required
- Due diligence tests and results
- Minimising litigation/ liability claims

“To demonstrate that the entire system is safe, fails safe and does not pose unacceptable risk to any affected parties”
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Estimating benefits of AV for pedestrians

- Best performance currently estimated as technically feasible

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<tr>
<th></th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
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<tbody>
<tr>
<td>2023+ (DE)</td>
<td>-9.9%</td>
<td>-15.8%</td>
<td>-14.8%</td>
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Road accident fatalities EU27

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Pedestrian</td>
<td>21%</td>
</tr>
<tr>
<td>Pedal cycle</td>
<td>8%</td>
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<tr>
<td>Passenger car</td>
<td>47%</td>
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<tr>
<td>Motorcycle/moped</td>
<td>18%</td>
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<tr>
<td>Goods vehicle</td>
<td>4%</td>
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<tr>
<td>Other</td>
<td>2%</td>
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GATEway trials

Trial 4: Simulator trial

- Examining driver behaviour with fully automated vehicles
- Investigating whether human drivers adapt their driving upon recognising an AV on road (e.g. overtaking decisions, gap size acceptance)
- Using a photorealistic 3D model of the Greenwich peninsula
TRL’s UK Smart Mobility Living Lab
The only ‘Living Lab’ in the UK for smart, connected & autonomous vehicles...

- Designed to enable CAV and Mobility solutions to be brought to market faster
- Focused on new product, technology and service R&D
- Human interaction with technology
- Understand how new technology will work in a complex urban environment
- A space for demonstration to investors, decision makers, stakeholders
- The opportunity to collaborate with other innovators
- Develop strategy in a rapidly evolving and supportive political environment
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<td>4</td>
<td>Timescales constraints and enablers</td>
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Connected and automated vehicles may change highway driving dramatically. What do national highway authorities need to be doing now to maximise benefits?

Project is funded by CEDR and led by TRL – expected outputs:

- International expert review of predicted changes in vehicle connectivity and automation
- Case study approach to understand how national road authorities in different EU nations might adapt their approach to maximise the benefits of connectivity and automation
- Guidance for national road authorities in how to set policy to achieve the anticipated benefits of CAVs
DRAGON WP1 – Current situation and forecasts

- Review of current projects
- Review and consolidation of roadmaps from Europe, US + Japan, South Korea, China, Singapore, Australia and UAE

European CAV projects 2005 -2020
We’re very clear that it is highly unlikely SAE L5 vehicles will be having any influence on traffic congestion or road safety by 2025.
# DRAGON WP2 – Impacts, Constraints & Enablers

## STEEPLE ANALYSIS - Automated Vehicles

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<thead>
<tr>
<th>Social</th>
<th>Technology</th>
<th>Economic</th>
<th>Environment</th>
<th>Political</th>
<th>Legal</th>
<th>Ethical</th>
</tr>
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<tbody>
<tr>
<td>Social aspects are significant</td>
<td>Early developmental stage</td>
<td>Global industry</td>
<td>Global benefits</td>
<td>Roll-out requires political will</td>
<td>Legal and regulatory drag</td>
<td>Public safety is paramount</td>
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<td>Provide solution’s to many of societal needs</td>
<td>Currently available as add-on</td>
<td>High tech industrial sector</td>
<td>Usage model to be key factor</td>
<td>All party support</td>
<td>Laws, regulations, standards require full review</td>
<td>Development and deployment of vehicles to be built on this premise</td>
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<tr>
<td>Active familial engagement, and improved use of time</td>
<td>Collaborative and cooperative infrastructure</td>
<td>Funding and Roll key to overall success</td>
<td>Improved efficiencies</td>
<td>Continuous and on-going process</td>
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### Conclusions

- Globally, mass deployment of automated vehicles, requires significant cooperative and collaborative engagement between all stakeholders in the chain.
- From technology developers, industrial suppliers, the political and legal establishment and the general public, whom will ultimately use the transport.
- Significant bridges to cross remain, from developing a safe and efficient transport medium, the level of funding for infrastructure upgrades, and the determination of robust regulations and standards, to the engagement of the end users.
Thank You

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