Our Transport Vision – Autonomous Readiness in Rural UK

CIHT Competition

Jeannie Foo
Fidel Olaye
Jannat Alkhanizi

Mott MacDonald

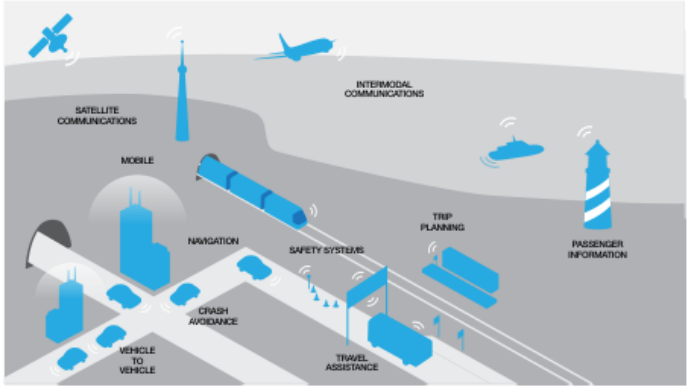
1 Future of Mobility: Connected Autonomous Vehicles (CAVs)

In 1968, the Vienna Convention on Road Traffic established a fundamental principle that a driver is always fully in control and responsible for the behaviour of a vehicle in traffic. Since then, technological advancements have produced vehicles that no longer meet this requirement. Part of the Future Mobility agenda focuses on CAVs that promote the use of connected, shared and smart vehicles. CAVs aim to reduce the levels of congestion by reducing vehicle ownership levels, and increase the mobility of people currently excluded from the transportation network such as the elderly, the economically marginalised, the disable, etc.

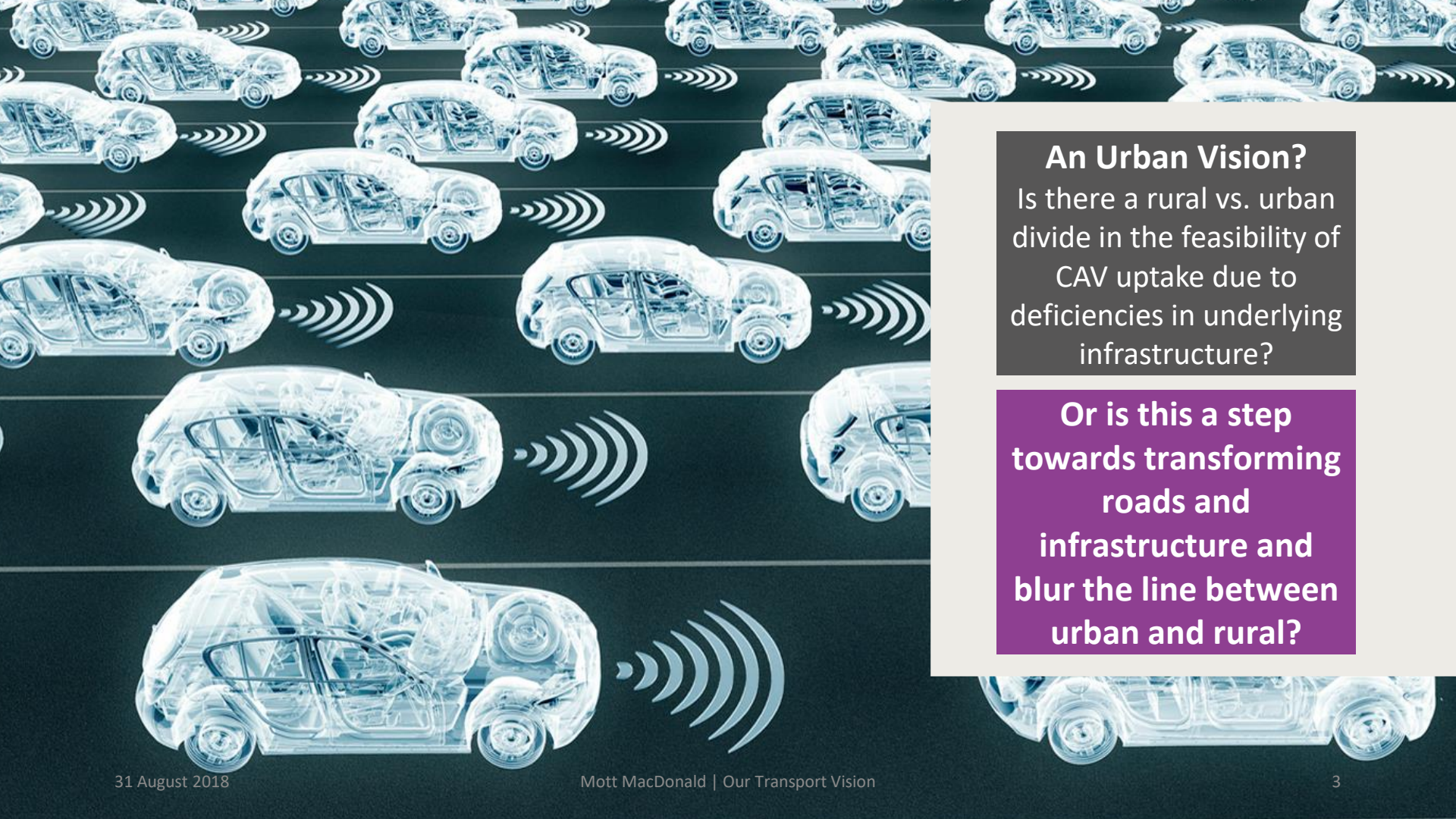
- **Connected Autonomous Vehicles (CAVs):**
  Vehicles that will have embedded electronics within them that will allow them to connect to other vehicles and surrounding systems. The highest level of autonomy (Level 5) will require no human interference and the vehicle would be fully self-driving.

Infrastructure Needs:

- Current road and highway infrastructure needs to be transformed to adapt to new technologies. An Internet of Things (IoT) Network will need to be established in both urban and rural areas using road markings and street furniture (lamp posts, cabinets, etc.) to allow vehicles travelling through to communicate with them and carry out their normal operation.
- The Highways network could significantly benefit from this as roads could communicate with vehicles to provide real time incident reporting, allowing vehicles to take alternative routes and avoid delays.



Intelligent Transport Systems include communications in vehicles, between vehicles, and between vehicles and fixed locations. Source: European Telecommunications Standards Institute



An Urban Vision?

Is there a rural vs. urban divide in the feasibility of CAV uptake due to deficiencies in underlying infrastructure?

Or is this a step towards transforming roads and infrastructure and blur the line between urban and rural?

A future where future modes of transport could operate seamlessly between urban and rural environments to create a comprehensive and safer transportation network.

Future modes of transport should not replace the existing modes, but should focus on filling in the gap with the current network links.

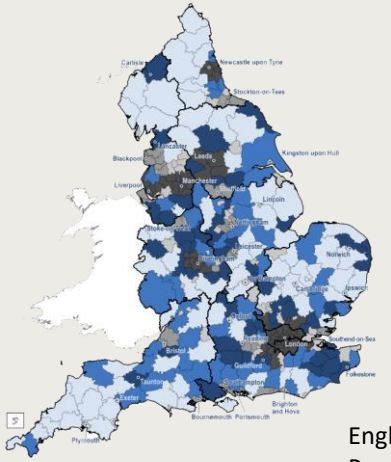
Our Transport Vision

2 The UK Setting

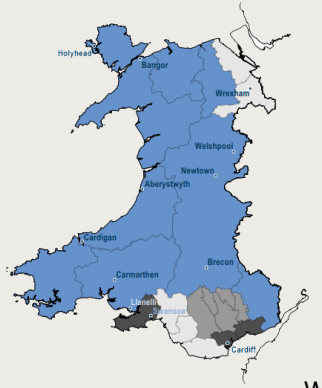
The urban landscape accounts for 10.6% of England, 4.1% of Wales, , 1.9% of Scotland and 3.6% of Northern Ireland. Put another way, that means almost **93% of the UK is not urban**.

@BBCMarkEaston

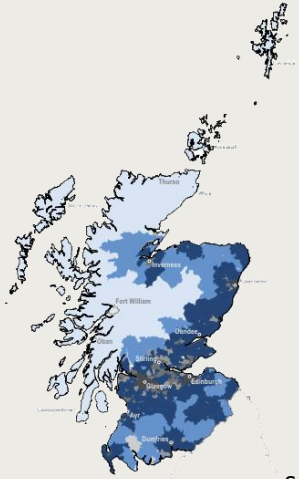
Major Urban | Urban | Other | Rural | Major Rural



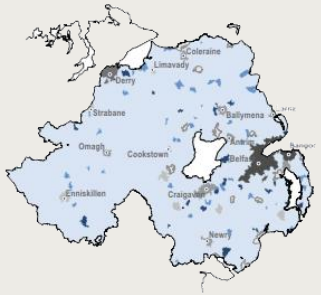
England - Rural Population: **36.5%**



Wales - Rural Population: **33.0%**



Scotland - Rural Population: **29.8%**



Northern Ireland - Rural Population: **39.0%**

3 The Political Scene

The UK government has led various initiatives to prepare for a shared, connected, and autonomous future. The efforts have predominantly focused on the urban setting and has not yet addressed the infrastructure requirements needed to support the policy framework.
The following highlights top efforts to transform the legislative framework.

2013	2015	2018	2018-2021	2022	2025	2040
The UK government permits testing of CAVs on public roads	The Pathway to Driverless Cars – study by DfT	The UK Government funds projects with £12.1m to work on simulation and modelling to aid in developing, testing, and proving the safety of connected and autonomous vehicles.	UK to undertake a 3 year review of law to launch fully autonomous vehicles on the roads by 2021	First fleets of shared self-driving cars, launch in Milton Keynes	AVs are authorised to operate in bus lanes throughout Bristol	95% of new vehicles sold in the UK are fully autonomous

4 Challenges of Future Mobility in Rural Areas

The transportation landscape in rural area is not fully equipped to embrace the changes that comes along with future mobility. As such, in order to consider future mobility, these underlying issues must first be identified.

- **Structural Challenge (Physical infrastructure)**: Roads in rural areas are known for having many structural issues such as cracks and potholes. To facilitate the rise of future mobility, rural roads will need to be monitored closely in order to identify and respond to issues quicker.
- **Design Challenge (Physical infrastructure)**: Major roads are designed according to the Design Manual for Roads and Bridges (DMRB). This manual doesn't apply to rural roads. Rural roads are usually designed with looser requirements resulting in poorer quality. Future mobility modes such as CAVs will require more "intelligent" road features to support their operation. This will require more detailed designs for rural roads.

4 Challenges of Future Mobility in Rural Areas

Continued

- **Technical Challenge (Digital Infrastructure)**: The autonomous technology relies on navigation and object sensing to communicate with its surrounding. Most rural areas are not mapped to the level of details required for AVs due to the informal nature of the roads, including road markings, crossings, curbs, pavements, and signs.
- **Cost Challenge**: In 2017, the budget for local roads was 1% of the national transport budget while the budget for national roads was 15%. Given that rural roads account for over 80% of the UK's road network, there is a clear fault in how budget is spread to local authorities. For the roll out of future mobility to be successful nationwide, there is a need for a fairer distribution of budget for both major and minor roads.
- **Social Challenge**: The percentage of population age 45 and above in rural areas are 53.3%. In England, 1.45 million of those 65 and over find it difficult to travel to hospital due to the lack of access, convenience and comfort of public transport (PT). As such, future mobility, particularly CAV, may provide a good solution in bridging the gaps in these services for the elderly.

5 Addressing the Challenges: Structural Challenge

Many simple, direct and minimalist improvements can be made to provide for future mobility. These designs can benefit conventional means of transport as well as future mobility through improved journey comfort and safety.

Road surface conditions

The **investment in existing road infrastructure** serve **both existing** transport modes, as well **as future modes**, i.e. CAV. Repaired potholes and cracks on roads, particularly urban areas, can improve driver comfort and reduce number of breakdowns.

Without providing additional features but merely maintaining existing road infrastructure, we have **already begun to provide for future mobility** as future modes of transport will also benefit from these improvements eventually. All road users including private vehicles, cyclists, buses, and inadvertently CAV will benefit from this.

Speed & road safety

30% of fatal accidents are associated with excessive speeds. A study conducted by the DfT showed that simply by reducing the national speed limit brought about **76% reduction in serious accidents**.

5 Addressing the Challenges: Design Challenge

The following components of road design are likely to be influenced to support the operation of autonomous driving:

1 Road Geometry

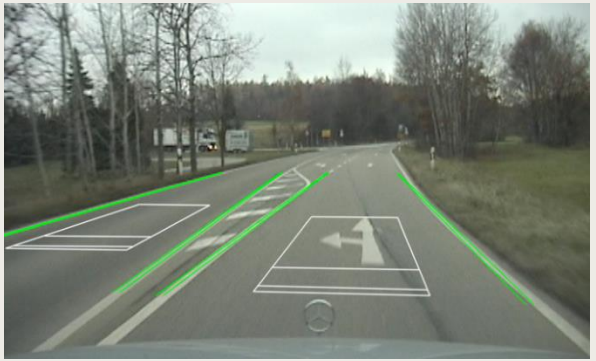
- Narrower lane and shoulder widths
- Shorter Stopping Sight Distance (SSD)
- Positive impact on intersection sight distance and presence of vegetation

2 Road Markings

- Materials that improve vehicle vision e.g. **3M** has been able to develop road markings in Canada that can be detected by car sensors (even) in extreme snow conditions

3 Signs & Stripes

- Signs would have to take unique shapes for block recognition
- Signs would possibly have to incorporate specially printed bar codes



5 Addressing the Challenges: Technical Challenge

Self driving cars rely on highly-detailed 3D maps with exact positions of lanes, curbs and signs. To overcome that barrier, researchers from MIT have been developing a new mapping technology called MapLite which uses no prior 3D maps and depends on GPS and LIDAR only. This technology can overcome certain safety hazards associated with rural roads such as blind curves. Scenario testing is therefore essential for rural settings:

Out of the 6 UK Government grants dedicated for AV research, the following two projects are relevant for overcoming the rural challenge:

VeriCAV: Horiba Mira is leading a consortium of eight in the development of simulation test system with automated generation of scenarios and realistic virtual actors.

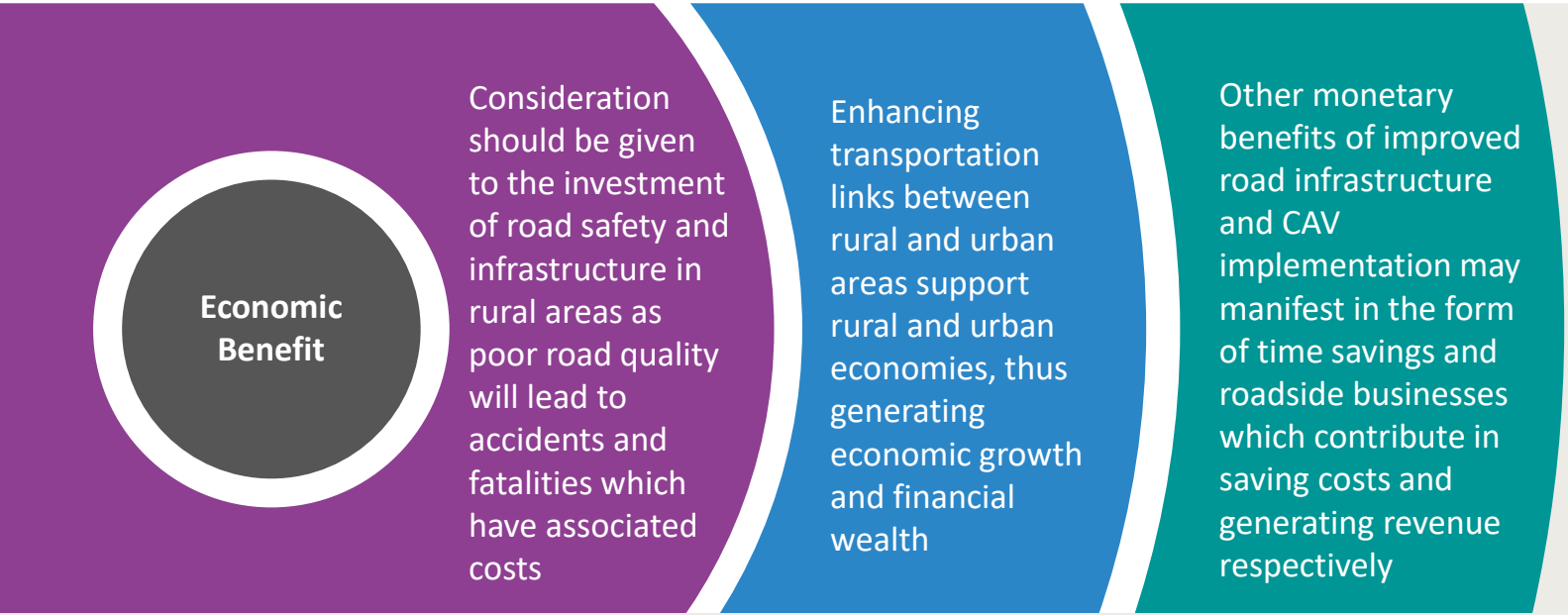
Rural Scenario Examples:

- Most rural roads are single tracks, if two CAVs are approaching each-other on the same road, which CAV will reverse back down the lane?
- What could cause AVs to leave the travelled way?

Simulation of Complex Off-Road Environments: Dynium Robot, a young start up from Cambridge, is leading a consortium of three to develop off road simulation environments which will reduce the cost of deploying autonomous vehicles on farms in order to help smaller farms compete with larger ones that benefit from economies of scale.

5 Addressing the Challenges: Cost Challenge

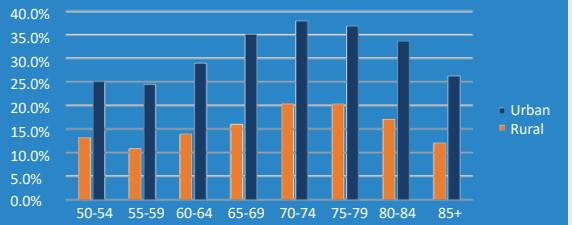
Rural areas makes up 93% of UK and over a third of the population resides in rural areas. However, the budget for transportation between rural and urban areas are massively disproportionate, with the rural area receiving insufficient funding.



5 Addressing the Challenges: Social Challenge

Future mobility calls for the embracement of a new technology, one which depends on artificial intelligence readiness. In rural areas, the level of uptake therefore relies on the willingness to interact and accept these technologies.

Providing **cost-effective** and **regular** PT in rural area is challenging because of the **low population density**. Rural population also expected to **age faster** than urban population.



Proportion of people aged 50 and over using PT at least once per week

The use of CAV to **bridge the gaps** in PT services in rural area by providing better accessibility and greater level of comfort for the elderly.

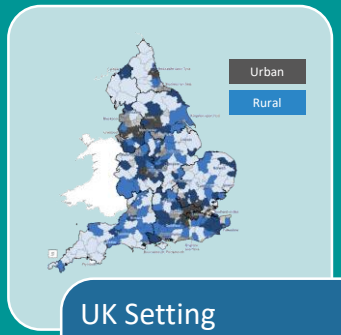
Elderly population concerns regarding rapid technological advancement associated with CAV:

- **Lack of knowledge**
- **Feeling of inadequacy** and comparison with younger generation
- **Scepticism** and mixed feelings about technology

Inclusive design schemes of CAV to encourage CAV acceptance by the elderly:

- Online systems easily accessed remotely by relatives/friends to book transport for older people
- Dial-a-ride scheme for CAV
- Simple, straight-forward phone apps
- CAV stand/station to enable the marginalised (i.e. people who have no phones and access to internet) to call for CAV

6 Conclusion



UK Setting

- 93% of areas are rural
- Almost 1/3 of the population lives in rural areas

Challenges

- Structural & Design (Physical Infrastructure)
- Technical (Digital Infrastructure)
- Cost
- Social

Addressing the challenges

- Connected roads
- MapLite using GPS and LIDAR
- Increase funding for rural roads on a national level
- Eliminate the introduction of technological barriers

Prepared by

Jeannie Foo – Graduate Traffic Engineer
Jannat Alkhanizi – Graduate Transport Planner
Fidel Olaye – Graduate Electrical Engineer

Mott MacDonald