



PAVING THE WAY

**BUILDING THE ROAD INFRASTRUCTURE OF THE FUTURE FOR
CONNECTED AND AUTONOMOUS VEHICLES.**

FEBRUARY 2018







CONTENTS

METHODOLOGY AND OBJECTIVES	2
INTRODUCTION	4
SUMMARY OF KEY FINDINGS	6
INFRASTRUCTURE CHALLENGES	7
DRIVING MOBILITY	14
LEADING THE WAY	18
CONCLUSION	21

ABOUT UK AUTODRIVE

UK Autodrive is the largest of three UK consortia launched to support the introduction of self-driving vehicles in the UK. The aim of the consortium is to establish the UK as a global hub for the development of autonomous vehicle technologies and to integrate connected and autonomous vehicle technologies into urban environments.

UK Autodrive brings together leading technology and automotive businesses, forward-thinking local authorities and academic institutions to deliver a major three-year UK trial of autonomous and connected vehicle technologies.

Consortium members are Arup, AXA, Coventry City Council, Ford, Gowling WLG, Jaguar Land Rover, Milton Keynes Council, HORIBA MIRA, RDM Group, Tata Motors European Technical Centre, Thales, The Open University, Transport Systems Catapult, the University of Cambridge and the University of Oxford.

ABOUT GOWLING WLG

Gowling WLG is a Global 100 legal practice, with more than 1,400 legal professionals across 19 cities in the UK, Canada, Europe, Asia and the Middle East. Focused on key global sectors including automotive, tech, energy, infrastructure and real estate, they are able to provide clients with deep sector expertise.

Led by Stuart Young, the market-leading automotive industry group brings together technical excellence in regulatory, corporate, employment, dispute resolution, real estate, commercial and competition law.

The group also successfully collaborates with the firm's specialist AutoTech team to stay current with our clients' innovative business strategies in a constantly changing and increasingly competitive landscape. The intersection of technology and automotive is at the heart of the firm's sector priorities.

It is the only law firm playing a significant role in the £19m UK Autodrive connected and autonomous vehicles programme, part of the UK government's driverless cars initiative.

Paving the way



METHODOLOGY AND OBJECTIVES

This is the fourth in a series of thought leadership reports about connected and autonomous vehicles (CAVs) produced by Gowling WLG on behalf of UK Autodrive. This study focuses on the infrastructure, both physical and digital, and how it will need to respond to the challenge of CAVs.

CAVs and autonomous vehicles (AVs) promise to change how we use the roads. The way planning, design and operation of road infrastructure will need to change is uncertain. This report focuses on some of the changes we may notice in the coming years and how these may impact the way we travel and whom we travel with. It will also discuss how we are planning for a future of unknowns.

The research was conducted by BizWord Ltd (www.bizword.co.uk), an independent business consultancy.

Specific sources have been listed in the body of the report. To compile the report, we undertook in-depth interviews with a panel of experts from industry and representatives from the UK Autodrive consortium during August and September 2017. We also conducted desktop research and analysis of publicly-available information, industry studies and forecasts.

Many thanks to our contributors, for giving their time and sharing their expertise. They included:

- Ian Auty, Head of Innovation at National Car Parks ("NCP")
- Stephen Bennet, Associate Director with Arup Transport Consulting
- Sunil Budhdeo, Transport Innovation Manager at Coventry City Council
- Rafael Cepeda, IoT & Smart Cities Lead for InterDigital Europe
- Max Crane-Robinson, Commercial Director at NCP
- Tim Gammons, Global Smart Mobility Leader at Arup

- Brian Matthews, Head of Transport Innovation at Milton Keynes Council
- Martin Walters, Strategic Partnership Development at Tata Motors

DEFINITIONS

AUTONOMOUS VEHICLE (AV)

A vehicle which is capable of fulfilling the operational functions of a traditional vehicle without a human operator.

CONNECTED VEHICLE (CV)

A vehicle which has technology enabling it to connect to devices within the vehicle, as well as external networks like the internet, allowing it to "talk" to its surrounding infrastructure and other vehicles.

CONNECTED AND AUTONOMOUS VEHICLE (CAV)

A connected and autonomous vehicle combines both sets of technologies' capabilities.

ULTRA LOW EMISSIONS VEHICLE (ULEV)/ULTRA LOW EMISSIONS (ULE)

An ultra-low emission vehicle is a motor vehicle that emits extremely low levels of emissions (less than 75g/km of CO₂) compared to other vehicles.



INTRODUCTION

Highways are dangerous and crowded places. According to CARE, the road accidents database of the EU, 25,500 people lost their lives in road accidents in the EU during 2016 and 135,000 people were seriously injured.

CAVs are now recognised as one of the two most important evolutionary steps for road transport and all the major vehicle manufacturers are moving them from the white board to the production line. The other important evolutionary step is electrification and both developments require serious infrastructure underpinning. The real challenge now is to make sure that the infrastructure i.e. all the hardware and software that makes an effective road transport network, allows electric vehicles (EVs) and CAVs to work to their full potential.

Transport remains largely dependent on oil, and current predictions show that carbon dioxide emissions from transport will only decline by 11.4% between 2005 and 2050. This would make transport the largest contributor of CO2 emissions in the EU after 2030. Electrification combined with greener sources of energy is commonly accepted as an important step in reducing emissions but there is an enormous additional contribution that could be made by CAVs in reducing congestion and making more efficient use of vehicles. Already the economic cost to the EU of congestion is estimated at

1% of EU Gross Domestic Product (€100 billion) and there is little room in our public finances to allow for the creation of significant additional transport infrastructure. Instead, we must work out how to use it more smartly.

UK and Europe have the chance to lead the transition towards an integrated and truly multimodal transport system. CAVs can play a significant part in that system but, in order to do so, they need to be able to operate in a connected way that allows traffic flows to be optimised. Simply adding autonomous but unconnected vehicles onto our roads could in fact be counter-productive as AVs replace journeys previously taken on shared public transport and AVs behave in an ultra-cautious manner slowing down traffic flows. AVs must be connected in order to reap the networked benefits and form part of a multi-modal transport system.

We hope you find the following pages thought-provoking and that they are a useful addition to the current debate.

If you have any comments or ideas that you would like to discuss, then please contact me using the details below.

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SUMMARY OF KEY FINDINGS

As long ago as the 1960s, the UK's Road Research Laboratory (RRL) developed a form of AV (a car steered by magnetic sensor, linked to a magnetic rail 'hidden' below the road surface to achieve a primitive form of autonomous driving, a system installed and piloted on a 9 mile section of the M4).

However it is only comparatively recently that technological developments have moved with sufficient pace to mean AVs and CAVs are truly possible.

Our research has found that these new vehicles will only be able to perform to their full specification if they are surrounded by, and connected to, the correct infrastructure.

Our experts identify the following key challenges and opportunities:

- The full benefits of AVs will only be achieved if they are connected, and today, the digital infrastructure in the UK cannot provide the level of connectivity required. More investment and research are needed.
- For AVs to be successful, they need to be accessible to all – so urban, suburban and rural environments need to be catered for.
- A common framework needs to be developed to ensure uniformity across countries and regions.
- It is not yet fully understood how society will use AVs and CAVs. Until more theoretical and empirical evidence is available it is extremely difficult to build the physical infrastructure they require.
- It is expected that AVs and CAVs will be powered by electricity as the industry moves to ULEVs (or ULE capable vehicles) as the standard source of propulsion, but rather than assuming we will simply "plug them in", we need to look for alternative ways to charge them and develop new technology.
- AVs and CAVs bring together technology and equipment from varying industries, and there are huge opportunities for new business collaborations to develop them further and change attitudes towards travel.
- The UK has shown itself to be a good place to test and develop AVs and CAVs, but more work is needed to maintain this momentum.

INFRASTRUCTURE CHALLENGES

The automotive sector is going through a dramatic period of change. Developments are moving so fast that during the last 12-24 months it has become obvious that automation on its own is not enough, connectivity is vital too – the AV has become the CAV.



Central to the successful deployment of these new vehicles, therefore, is reliable connectivity and coverage. And all our experts mentioned this as the first major infrastructure challenge to be overcome.

DIGITAL CONNECTIVITY

Currently, less than 20% of UK roads have full 4G coverage, less than half have full 3G coverage, and 2% of roads (4,600 miles) have no 2G coverage from any network provider.

The Government has pledged £16 million towards a National 5G Innovation Network, but much more is needed. Martin Walters, Strategic Partnership Development at Tata Motors, comments:

“Future services being envisioned will rely on higher data rates and faster communication – these will generate a lot of data. We are moving from 4G to 5G, and new devices are being designed on the basis that there will be the communications infrastructure to support them. If this isn’t in place, then the new technology will simply not be able to perform to its full potential and some of the envisioned use cases will not be realised.”

The state of rural mobile and communication networks particularly troubles our experts, and it is important that the benefits of CAVs aren’t reserved purely for city dwellers. Many argue that those commuting to and from rural communities are the ones who have most to gain from AVs and CAVs. The safety aspects of driving in rural

areas can be more important, with accidents often more severe in the countryside where drivers are travelling faster and on more primitive road infrastructure than they do in a crowded city.

Stephen Bennett, Associate Director with Arup Transport Consulting, stresses:

“We really need to understand how much connectivity we need in the countryside and how this is best delivered. There will be less demand for it, but it will definitely not be less important.”

Existing infrastructure, however, does mean it looks as if the benefits of CAVs will be felt earlier in urban environments. This is why the UK Autodrive project is testing vehicles in two urban areas – Milton Keynes and Coventry.

Brian Matthews, Head of Transport Innovation with Milton Keynes Council, agrees that showing the advantages of CAVs is going to be easier in a city and particularly a modern, purpose-built one like Milton Keynes. However, opportunities may lie elsewhere:

“The immediate benefit obviously looks like it should be in cities” he says. “But in Milton Keynes, a significant amount of what we spend on transport goes into supporting movement in rural areas – subsidised buses etc. – so if we can get these shared/connected transport services to work in rural areas then it could have massive benefits both for the population and the authorities.”

— Tim Gammons, Global Smart Mobility Leader at Arup, makes the point:

“There is an assumption that all AVs will be connected. Technically they don’t need to be for autonomy to function, but most of the well-publicised benefits are associated with this connectivity.”



In several areas, Coventry provides a microcosm of how infrastructure can be developed and work in practice.

Sunil Budhdeo, Transport Innovation Manager at Coventry City Council, relates some of the infrastructure-led improvements that have already been made in his city:

“In Coventry, we used to rely on BT to provide us with a dedicated landline to a traffic controller. Now we are one of the largest users of wireless communications and have traffic lights, parking meters, CCTV cameras and bus information totems working on wireless comms. The next stage in this development is to install roadside devices for vehicle-to-vehicle and infrastructure-to-vehicle communications, through the same network.”

There are also questions being asked about how some level of uniformity can be achieved, in other words how to make sure CAVs connect to similar infrastructure, and using a similar methodology whether they are driving through Edinburgh or Exeter.

Rafael Cepeda, IoT & Smart Cities Lead for InterDigital Europe, spends a lot of his time looking at how transportation data from different regions can be integrated. He tells us:

“We need a common framework in vehicles so everything is available nationwide and then of course worldwide as well. If let's say you take your vehicle from the UK to France, first you need to have access to

a data network, and then you need to know what apps are available there. Added to this of course, everything will be in French – and there is no reason why the French should make other languages available. So, the issue is that we must have a framework that is adapted to the needs of the driver wherever they are. I think this is a big barrier we need to overcome.”

Rafael believes this is not just a problem for the vehicle manufacturers, but also for the cities themselves. “In the case of London, they have a lot of money to spend on a platform that supports all transportation solutions. But smaller cities will make different decisions and they won't necessarily be interested in talking to each other. Arguments about delivering competitive advantage and different transport priorities will get in the way.”

PHYSICAL INFRASTRUCTURE

It would appear therefore, that there is a lot to do before our digital infrastructure is up to the challenge of CAVs. Is the physical infrastructure any easier to deal with?

Let's begin with a physical change, associated with CAVs, which has been in the news recently – charging electric vehicles (EVs).

There is a general assumption that CAVs and electrification go hand-in-hand. The UK government recently announced that the sale of new cars and vans powered solely by petrol or diesel will be banned in the UK from 2040 and their goal is for EVs to make up 9% of the fleet by 2020.

But what changes are we likely to see? Obviously more charging zones will appear, but our experts think we may not notice them too much.

— Stephen Kenny Projects Partner at Gowling WLG:

“The local political agenda will be a big issue that could delay the introduction of CAVs on our roads. In some communities, a higher priority may be to invest more in measures to relieve congestion, reduce pot-holes and provide better parking. It may take a while for local transport decisions to leap to the investment required in digital solutions to support CAVs.”

Stephen Bennett explains:

“We are going to need more charging infrastructure but I don't think we are going to need as much as people think. Many car journeys are very short, and are therefore easily within the capabilities of the batteries. So, we'll need more infrastructure in homes and at offices and obviously motorway service stations, but I don't think we'll need charging points everywhere, at the supermarket for example.”

Another key point to consider is that there are likely to be significant developments to the way we charge EV batteries.

Brian Matthews adds:

“Milton Keynes is one of the flagship cities for supporting EVs. Part of our exploration is to look at charging on the move, so a vehicle can go into a deceleration lane and pick up charge. Or to look at inductive charging for example. I am about to issue a tender for this sort of research.”

We have summarised some of their key points in the table below, giving examples to illustrate some of the challenges.

OTHER PHYSICAL INFRASTRUCTURE

A report entitled "Future Proofing Infrastructure for Connected and Automated Vehicles" written by UK Autodrive member, Transport Systems Catapult, concentrated on eight different aspects of infrastructure adaptation that CAVs were likely to need, namely:

- Traffic management measures
- Road markings
- Safe harbour areas
- Role of service stations
- Automated demand responsive public transport vehicles
- Crossings and junctions
- Impact on bridge structures
- Car parking

	<p>TRAFFIC MANAGEMENT MEASURES</p>	<p>CAVs need to be able to deal with both planned and emergency roadworks. So, they need to be able to receive real-time updates for example, or to be able to use a contraflow lane marked with cones. This will mean changes to the existing New Roads and Street Works Act ("NRSWA") legislation and operating practices.</p>
	<p>ROAD MARKINGS</p>	<p>Procedures for maintenance of markings may need to be improved and signs checked for cleanliness and clarity.</p>
	<p>SAFE HARBOUR AREAS</p>	<p>The frequency and design of these areas need to be reviewed and measures considered to avoid them being misused.</p>
	<p>ROLE OF SERVICE STATIONS</p>	<p>Is it possible to use a service station as a transport hub, where passengers can board an automated motorway taxi for example?</p>
	<p>CAR PARKING</p>	<p>Parking may need to change to a system of "valet" parking and test schemes need to be started. If CAVs result in fewer vehicles on the road, then existing car parks could be available for other uses.</p>
	<p>AUTOMATED DEMAND RESPONSIVE PUBLIC TRANSPORT VEHICLES</p>	<p>An opportunity exists for public transport providers to encourage the use of shared "pods".</p>
	<p>CROSSINGS AND JUNCTIONS</p>	<p>Signal controlled crossings and junctions will be easier to deal with than those without signals. So, highway authorities need to consider using more of these where practical. This is a significant change to road and town planning (and the focus on roundabouts as the most effective form of junction).</p>
	<p>IMPACT ON BRIDGE STRUCTURES</p>	<p>Platooning of vehicles, particularly HGVs, could put unforeseen stresses on existing bridges.</p>

In comparison to the challenges of digital connectivity, our panel made fewer comments about physical infrastructure requirements. However, as is shown by the list above, this does not necessarily mean that the physical infrastructure required for CAVs is any less demanding.

Tim Gammons at Arup, sums it up:

“We need to properly understand how society is going to use these vehicles, and we can't build the infrastructure until we know this.”

It will be many years before AVs dominate the roads and managing the transition will be key to their development. Some commentators have suggested that having separate lanes for AVs and manually controlled vehicles is one way to manage the process, but such proposals are yet to be widely accepted.

Tim Armitage, associate director at Arup, believes:

“There are already a significant number of vehicles that operate successfully on the roads with growing levels of automation. The use of advanced driver aids such as cruise control, adaptive cruise control and lane keep assist are already widespread without the need for segregation on our major trunk roads and motorways. There is no reason to suggest that segregated lanes will be necessary. They would be difficult to enforce and severely impact the efficiency of the road network.”

Whatever the transition looks like, it is vital to remember that the asset life of the infrastructure being built now will span the transition period. So current providers and operators must have CAV technology in mind as they continue to support existing vehicles.

Stephen Kenny added:

“There is a risk that the investment in CAV technology speeds ahead of the planning and resourcing needed to deliver the physical road infrastructure required to get CAVs up and running on our road network.

Our road network is delivered through a number of agencies (Highways England, local authorities and so on), so central planning and co-ordination is needed to ensure that the physical infrastructure is in place. In our

experience, for most local authorities, the issue of CAVs is not high on their current agenda as they deal with more pressing demands.”

Both Milton Keynes and Coventry are examples of local authorities that have bought into the concept of CAVs and their potential. They are looking to projects like UK Autodrive to help them understand how we will use CAVs and deliver the practical recommendations needed to construct the physical infrastructure they require.

For example, will automated pods, like those being tested in Milton Keynes as shown on the next page, be able to share a pavement with pedestrians. The tests may show that pods and pedestrians need segregating in some areas. This could involve different signage, or even the use of creative planting.

Brian Matthews, at Milton Keynes Council, tells us:

“It is a deliberate stance to make sure that we are infrastructure-light. We are trying to fit it into what is there already. We want to change the transport to fit the city rather than the other way around – we know our residents like the city, so changing the infrastructure often doesn't work.”

PARKING A CAV

Car parking is listed in the TS Catapult report as both a challenge and an opportunity¹.

CAVs could lead to improvements for the driver and exciting opportunities for the infrastructure provider:

- The user can leave and pick up their vehicle in a designated drop off zone, and not waste time looking for a parking space.
- The car park owner can significantly increase the amount of spaces they provide, because CAVs could block each other in and let each other out when necessary.

But there are a lot of challenges to overcome before these benefits can be delivered.

¹Section 4.6, Catapult Transport Systems: “Future Proofing Infrastructure for Connected and Automated Vehicles” February 2017

Max Crane-Robinson begins:

“There are all sorts of infrastructure requirements that go along with parking CAVs. For example, if you assume that the vehicle hasn’t driven itself to the car park, then you need to build a holding bay where people can get out of the vehicle before it parks, or for people returning to pick up their car.”

Car park operators must also be ready to interact with vehicles digitally. You can buy a cup of coffee on an app, so someone in a CAV should be able to deal with parking on an app or via an automated process. Car parks will need to be digitally enabled to automatically recognise a vehicle or driver.

In theory, the technology to do this already exists. Automatic number plate recognition (ANPR) for example, as well as vehicles and car parks fitted with Bluetooth and near field communication technologies. The problem is that none of these have been built into car park technology in the last 20 years and retro-fitting could have significant costs.

Ian Auty tells us:

“In most car parks you show up, push a button and get given a piece of paper. The retro fit of technology would be expensive – ANPR for example would cost about £4,000 per entry and exit lane. Low energy Bluetooth would probably be the most cost-efficient option,

although there are legitimate concerns around its cyber security. In addition, we expect car park equipment to depreciate over around nine years. Some of the car parks we run for local authorities might have infrastructure that is 14 years old. Then consider that this is a car park, so when it was fitted the technology would not have been cutting edge and you can start to see the sort of legacy equipment that we are dealing with.”

But there is a more fundamental problem. Multi-storey car parks are made of steel and concrete, in other words they are an effective “Faraday Cage”, and many others are underground. GPS and mobile signals are, therefore, blocked.

Ian comments:

“GPS is being cited as the way to pinpoint a CAV. But even very good GPS technology like that on military ships, only has accuracy to around a metre. The GPS fitted to CAVs won’t be as good as that used by the military and in a car park it will be surrounded by a concrete structure. This could leave you with an accuracy of maybe two metres – and this would put you wholly inside another car!”

So, in the light of all these challenges, how can we begin to plan a route for CAVs to deliver their potential?





DRIVING MOBILITY

The introduction of CAVs is not only about removing the need for a driver, it also heralds a step change in our approach to transport.

As Stephen Bennett at Arup says: "It is about achieving a better quality of life. Transport needs to support the development of resilient cities. Places that are socially resilient, where the community works together, and environmentally resilient, where weather events and shocks are accommodated."

So what sort of changes may occur?

CAR SHARING

Changes to our current model of car ownership are much talked about and companies like 'Zipcar' in London have for some time offered easy access to vehicles via a mobile app. Zipcar cites the Carplus Annual Survey of Car Clubs 2013/14 (London) which says: "One Zipcar helps take 17 privately-owned vehicles off the road in the UK."²

In Singapore an electric car-sharing service began last year, with about 80 electric cars and 30 charging stations, offering a total of 120 charging points, being rolled out progressively from December.

Brian Matthews, at Milton Keynes Council backs this up:

"We are particularly interested in stimulating a sharing economy. And if we have a suite of vehicles that can drive more closely together, use narrower roads etc. then there is potential that we can deliver more for the same in terms of highway assets. The bigger prize is to stimulate behavioural changes.

If we have very clever vehicles that can do more than sit in the drive for most of the day, then we might stimulate a new approach to using the car on a shared basis. This could lead to a significant reduction in vehicles on the road and an improvement in air quality."

Our experts agree that car sharing will be an important development, but there is uncertainty over timing.

Max Crane-Robinson at NCP believes car sharing will come sooner than fully autonomous vehicles.

"I think the car ownership model, particularly in urban areas will change, so we won't see people taking their own cars to their own homes. In more rural and suburban areas I think the drag around non-car ownership will be in line with or much longer than people are predicting. We could see small pools of ownership starting in villages, but I think this will take a long time."

However, Stephen Bennett comments:

"I think people assume AVs are shared and a lot of the forecast benefits are attached to this. My thinking is that sharing will take longer, and so there is a risk that in the short to medium term we will end up with more vehicles on the road."

²Carplus Annual Survey of Car Clubs 2013/14 produced by Steer Davis Gleave

It could be argued that the technology within AVs will give people who aren't able to drive currently, the power to do so.

Perhaps the key is that shared ownership requires a new legal model and this needs to be tested in real-world situations. It could mean that required changes to the regulations will hold up implementation more than the development of the technology or the infrastructure.

Stephen Bennett continues:

“With car sharing comes a huge opportunity to change the way we charge for road use. Income from road tax is already declining because of cleaner vehicles, but a shared ownership model could charge per trip, with the potential to charge more for a peak-time trip in a congested city, for example. But this needs to be built in the shared AV model from the start.”

LAST MILE SOLUTIONS

Allied to car sharing are last mile solutions – this used to be a term used to describe the final leg of a telecoms network i.e. the cable into your house. But now it is also used in transportation planning to describe the movement of people and goods from a transportation hub to their destination.

Brian Matthews considers this to be especially applicable to Milton Keynes:

“A pod could have specific last mile uses in the city environment. If our city centre is going to double in size because of increased population then we don't want a lot of that extra space to be taken up with car parking. A door-to-door service that runs on pavements offers better service and could stimulate more economic activity in the city.”

In Coventry they are already planning for pods to deliver last mile journeys.

Sunil Budhdeo, from Coventry City Council, tells us:

“We know that taxi drivers hate doing short, last mile journeys. So, the intention is for pods to stand next to the taxis and take over those trips. We also want to use pods in large shopping areas instead of mobility scooters. The advantage being that they can take multiple people rather than just one.”

There is however, a societal problem with these sorts of services as Tim Gammons at Arup points out:

“CAVs could do away with walking or cycling the final mile home. And we all know that we need to be encouraging the public to be more active and healthy, rather than offering everyone a pod.”

Dominic Richardson, director in the Transport team at Gowling WLG, agrees:

“This type of model could be similar to the 'Dial-a-ride' service already operated by various public sector transport bodies, to provide transport to people in need of accessible services. One criticism of this type of service is that users often feel they are treated 'like a parcel'. Either way, models have been developed (by the public and private sectors) to deliver similar services, but it needs more than efficiency to make it a user experience that will actually encourage greater uptake.”

COLLABORATION

Our panel agrees that while there are a great many technological developments required, a new business model is also needed.

Martin Walters tells us:

“A lot of the work on future vehicles is being done in development centres around the world, but it does seem that companies are starting to come together for strategic reasons for future mobility solutions and this can only be beneficial. If we can manage to bring competitors and industries that traditionally weren't bed-fellows into collaboration then this could bring new value and new opportunities.”

One such example is mapping data and services company, Here Maps. They are owned by a consortium of Audi, BMW and Mercedes, with Intel recently confirming a 15% stake.

Another example of this is Finnish company MaaS Global. Their app, Whim, claims to help subscribers ditch their car by working out the best option for each journey they make, whether that's a taxi, public transport, a car service or a bike share. Their innovative service began its UK trials when it was launched in the West Midlands last year. It is attempting to bring together regional transport authorities, traditional service providers and new mobility companies.

Walters continues:

“MaaS Global are attempting to blend different services together to give end users a new value proposition. Innovation can come in many different forms. It could be that a new value proposition to end users around CAVs becomes one of the key success factors in any future success.”

NCP is also thinking about how it can accommodate new transport modes in its car parks. The company has signed several contracts with local authorities where Uber drivers can use the top floors of quieter car parks very cheaply.

Ian Auty observes:

“This gets them off the road and therefore, frees up the traffic system. My own expectation with CAVs is that one-day NCP will probably love them, because they don't just disappear when no-one is in them. They still need somewhere to park.”

All our experts feel that more collaboration is needed. Rafael Cepeda at InterDigital has helped set up a forum for different cities and regions to share and improve their understanding of the digital economy and how smart cities work, for example.

“The problem is that all cities are at different stages in their development and they don't see the advantages of talking to each other currently”, he says. “At this point government intervention is necessary to tell them what the framework is and explain why they should stick to it. Then all the regions can work together on using the bits of the harmonised network that are appropriate for their region and their citizens. Once you have the framework, you can support regional or national solutions within it.”

BIG DATA

Allied to improved collaboration, and the very nature of the connectivity associated with these new vehicles, is the amount of data that will be available.

Martin Walters believes this brings opportunity:

“We are witnessing an explosion of new connected devices which will produce a huge amount of data and we believe there is enormous value to be generated from this data, whether it is to help improve the service models or the user experiences, but it takes vision, an amount of experimentation and a collaborative approach. The main aim for us is to bring all the emitting devices, or beacons, together with well-thought-out use cases so that the data they produce becomes increasingly useful to more and more people.”

When new data appears, there are always opportunities to commercialise it. And as Tim Gammons comments:

“Once we start to get all this transport data, we will want more and more of it. The question is what we will do with it and whether we will have correctly estimated the bandwidth we are going to need to deal with it.”





LEADING THE WAY

The UK government's stated aim is to ensure this country "has a vibrant, world-leading connected and autonomous vehicles industry". But are they delivering on this and truly leading the way?

It would appear we started well, but that there is a lot more to do.

A recent report by the SMMT³ and PwC⁴ states:

"While the UK is positioned favourably at present for the testing of AVs, some vehicle manufacturers have not identified the UK within their top three markets of choice to launch connected features, due to poor connectivity."⁵

Looking purely at this connectivity issue, Tim Gammons comments:

"We must have government intervention, as with the fibre roll-out, to improve connectivity. The private sector is simply not going to invest in 5G in places where there is no return on investment. We need more collaboration between the auto manufacturers, government and the telecoms providers. Firstly, to understand the connectivity, latency and the bandwidth we need and then to present the business case for better connectivity."

Max Crane-Robinson reinforces the call:

"We are a private company and can invest in technology and make it happen reasonably quickly. But the majority of the parking market in the UK is managed by local authorities. And they simply don't have the budget to invest in digitising their car parks currently. And we wouldn't want all of them developing their own technology solutions for this. We already have a fragmented mobile parking payment situation – with companies such as RingGo, PayByPhone and many other (sometimes even local authority specific) mobile payment solutions. This proliferation of different unintegrated platforms without common standards is already hard enough for the public to deal with before we even get to CAVs."

³The Society of Motor Manufacturers and Traders is the trade association for the United Kingdom motor industry. Its role is to "promote the interests of the UK automotive industry at home and abroad."

⁴PricewaterhouseCoopers (PwC) is a multinational professional services network and one of the 'Big Four' auditors.

⁵Page 17, CONNECTED AND AUTONOMOUS VEHICLES: Revolutionising Mobility in Society, SMMT 2017

Rafael Cepeda adds that the vehicle manufacturers also have to take responsibility in this area:

“There is a particular standard based on the evolution of wifi that is currently being used for CAVs, but they need to look at what is going to happen in the future. Putting the technology for a car together is complex so manufacturers work in five to ten-year bands. But in the race to get these vehicles on the road they are just using current technology. This is OK, but it won't have the dynamic flexibility that will be needed in the future.”

He adds:

“I think the legislation has to change. We have to make sure that all regions are advancing in the same direction and are using technology that has the capacity to evolve and change as we advance.”

Our experts strongly recommend that further collaboration between the public and private sectors is what is really needed.

Brian Matthews agrees:

“City authorities are thinking about what they want these vehicles to achieve. The manufacturers are understandably thinking about what needs to go into the vehicles to give them the best return on sales of the vehicles. This means there will be different strategies from each manufacturer. This is fine but it doesn't reflect the needs of cities. I think we need to look at the regulatory environment and work out what we want these vehicles to do – is their priority capacity or safety, for example? In other words, the regulation needs to focus on the capability that is consistent across all vehicles, then manufacturers can add a distinct feature if they want to, but the core will always be the same because it is regulated.”

Alongside collaboration, our experts also stress the need for a campaign to promote knowledge and take-up of CAVs.

Many of our experts say that their experience of transport is that telling people something is good for them doesn't make any difference. “We've been telling people for years that walking and cycling are good, and car ownership has increased. Government needs to demonstrate the real-world benefits of all this,” says Stephen Bennett.

Tim Gammons of Arup adds:

“The government could invest in a well-thought-out education campaign because it is an opportunity to change people's dependence on their own vehicle. They must grasp this rather than leave it to the private sector to decide it for them. I think if the government can demonstrate that it wants to see a change and make our cities cleaner for example, then the younger generation in particular, would embrace this.”

Research by Cambridge University's Engineering Department and the Department of Psychology for UK Autodrive shows there is an opportunity. Their survey of nearly 3,000 UK residents showed that people living in the UK are highly familiar with the concept of “driverless cars”, but have not yet formed hardened opinions about the technology.

The responses reveal a remarkably open mind to the arrival of CAVs, with 35% of those surveyed saying they would use a vehicle without a driver or steering wheel, once one was available to them. Only 15% of the respondents expressed strong opposition to the idea.

— Stephen Bennett sums it up:

“There is a big difference between motor manufacturers flogging high-end CAVs for a healthy profit and a well-planned and thought-through central policy which can deliver real benefits to society. The government needs to be far more proactive in this area.”

He continues: “If we leave it to the market we could end up with an outcome we don't want i.e. more cars on the road. Perhaps we should start with assessing how we improve city life for people and where CAVs fit into this as part of an integrated strategy.”

Stephen Bennett believes this is an area where the UK could excel:

“I think a lot of the concerns around these vehicles are going to be associated with the legal issues and levels of public acceptance. It's not all about getting the technology, it's about the human interaction. So, it might be that as a country we can lead on developing the legal framework and on enhancing public acceptance.”

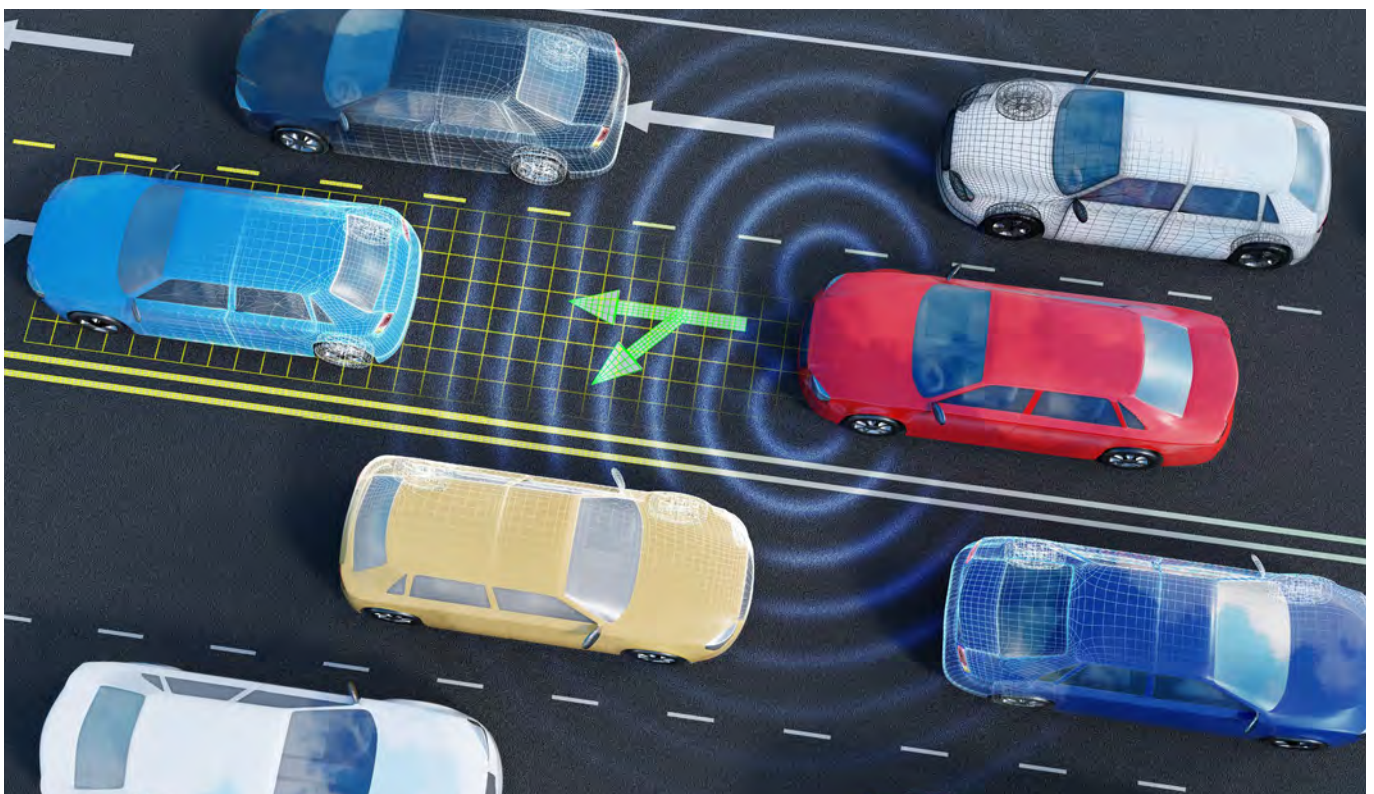
Martin Walters sees that there are great opportunities to grasp and that businesses need to collaborate to create new levels of service for personal travel:

“Maybe the businesses that will do really well in the future will be the ones who can make great alliances and take strong positions in terms of future envisioned services.

This is how the iPhone was developed. Apple wasn't the first to market but they were the first company to really understand and envision the user experience and brought individual technologies together that made their product more desirable than others.”

— Stuart Young said:

“While we recognise the value in the Government's 'near-to-market' approach to regulating this new technology, we also strongly believe that a broader view needs to be taken to ensure that the long-term benefits of CAVs are delivered. If not, there's a danger that we could see a small market in autonomous vehicles as an evolution of high-end vehicle features but no real improvement in safety, congestion and the environment. Government, by controlling the regulatory framework and being responsible for infrastructure, has a unique ability to ensure that broader societal benefit.”

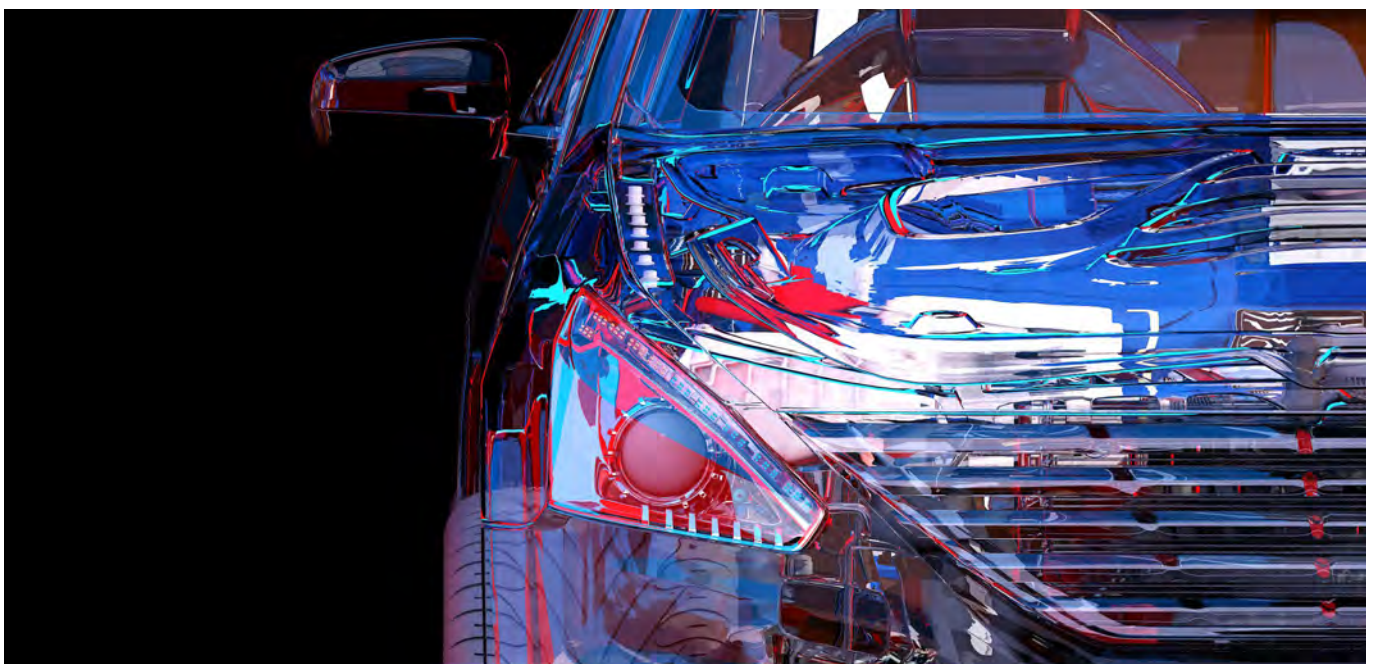


CONCLUSION

Far from being just about getting from A to B, CAVs could completely change our attitudes to travel. And there are opportunities to reshape the way society provides infrastructure for and makes use of road transport.

In particular, this report recommends that:

- Both the public and private sectors need to be open to new ideas and ready to support new technologies. Technology developed behind closed doors is unlikely to work well in conjunction with other rival technologies that have been similarly developed. The infrastructure must keep pace and be developed at the same time.
- Central government investment and changes to legislation (including through international standardisation) are needed to make sure developments are coordinated and deliver benefits to all sections of society.
- There needs to be further research done into the impact of CAVs and what we, as a society, want those impacts to be. We cannot just let the private sector decide for us. And this research cannot be only desk-based. More experimental projects producing practical results and recommendations should be commissioned.
- Research into new business models covering innovations like car sharing and in particular ULEVs should be undertaken. New projects such as those beginning in Singapore could provide a basis for further study.
- Government should consider conducting a major “hearts-and-minds” campaign. Explaining the benefits of AVs and CAVs to the individual and society.
- The benefits of the door-to-door solutions promised by AVs and CAVs must be weighed against the potential health impacts of a population which no longer walks to and from the railway station, for example.
- AVs and CAVs present significant opportunities associated with the production of Big Data for the transport sector. Both the public and private sectors could, and should, benefit.





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