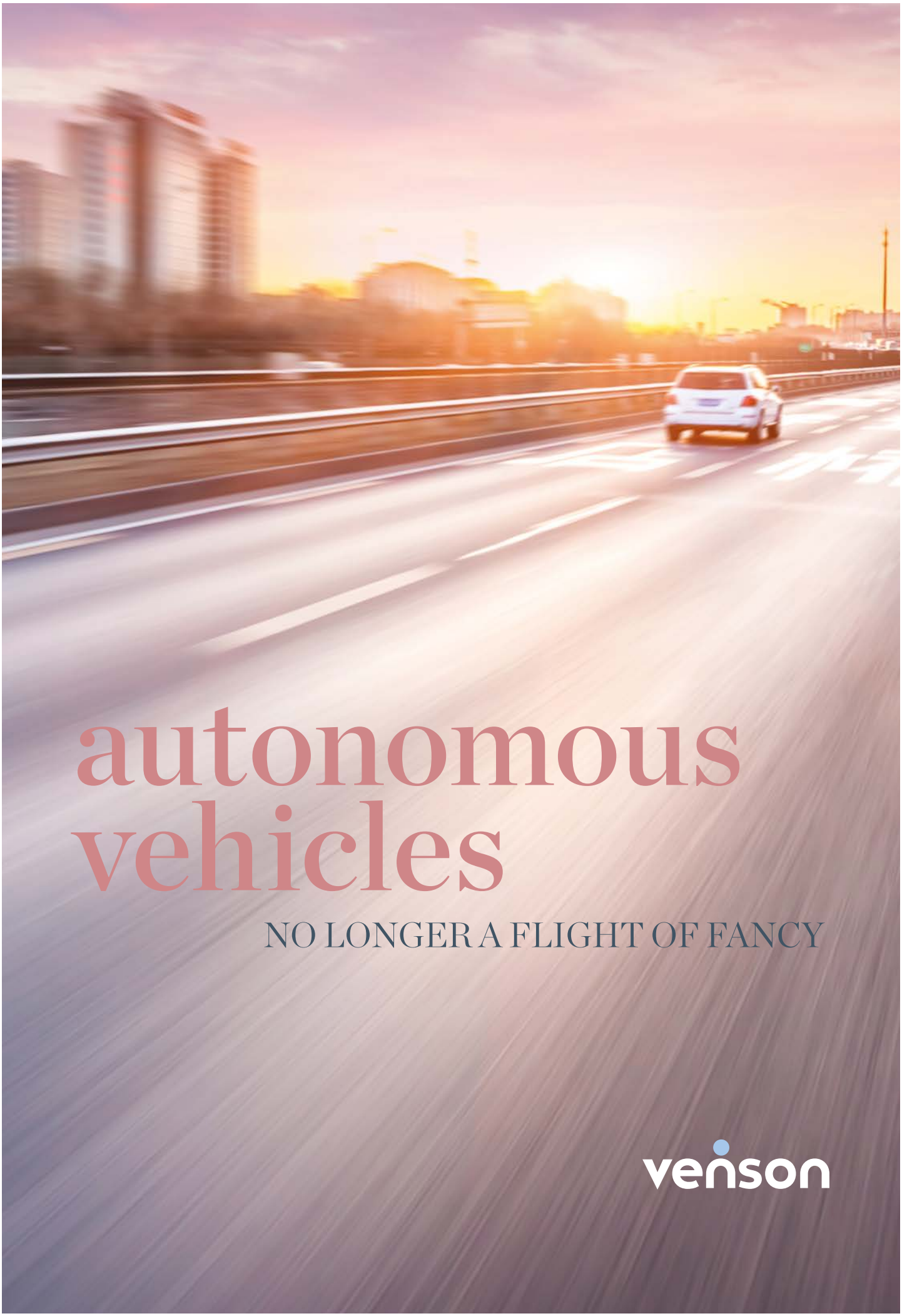


autonomous vehicles

NO LONGER A FLIGHT OF FANCY

venson

EXECUTIVE *summary*

Motor transport has changed the world but, if experts are to be believed, the sector is on the edge of a further huge transformation.

Autonomous vehicles are no longer the preserve of science fiction, but part of the real world and promise to transform fleet operations and mobility as we know it today.

The government has forecast that the UK will become world leaders in the field of autonomous vehicles thus benefiting from what is expected to be a £900 billion industry by 2025.

What's more driverless cars are not being tested in some far off land, but in the UK with numerous projects underway involving rafts of companies from motor manufacturers to telecommunication organisations and insurers to IT specialists as well as academia.

And the developments come with government backing as it is ploughing millions of pounds of money into autonomous vehicle trials and many other related projects.

So the autonomous vehicle is no longer a flight of fancy, but a continuation of the evolution of journey management that started with telematics and has continued with the emergence of the 'connected car'.

Nevertheless, for driverless cars – as well as trucks travelling in a platoon – to become a familiar sight on UK roads huge changes are required to the legislative and regulatory landscape.

However, if achieved, the future promises to be one of major improvements in road safety, increased mobility for all, potentially reductions in traffic congestion and vehicle emissions, and fundamental changes to the current fleet operation model in terms of vehicle ownership and operating costs.

Furthermore, there are suggestions that motor manufacturers may also substantially change and evolve from being solely product driven global businesses to becoming much more service centric with a focus on data acquisition and validation.

But, potential concerns also have to be addressed notably in relation to cyber security and liability in the event of a road crash.

What's clear is that, almost without knowing, we are already some distance into the journey towards autonomous vehicles being part of daily lives due to many features already available on today's company cars.

It is likely that early in the next decade highly automated vehicles will be on sale in the UK offering a driverless mode under certain very specific driving conditions such as motorway cruising or at low speed.

But, it could be 2030 or beyond before the word 'driver' is confined to history and 'occupants' of fully automated vehicles travel from A to B with the ability to undertake other tasks such as reading notes in advance of a business meeting or watching a film.

Autonomous vehicles will transform society, but there will be no defining moment when driverless cars appear in show rooms and the switchover is made. The development will be gradual with autonomous vehicles and 'normal' vehicles mixing on the UK's roads.

This white paper does not seek to answer every question, but aims to outline the journey to autonomous vehicles, what needs to change for the trip to be successful, the potential benefits of driverless vehicles and provide a glimpse into what the future may look like for fleet managers.

The start of the autonomous vehicle journey – ***PART 1***

tele*matics*

The word telematics was created from the words telecommunications and informatics and essentially embraces the sending, receiving and storing of information including to and from vehicles.

Vehicle telematics has its roots in the HGV sector but, in more recent years, has become a popular tool for LCV fleets and today the technology is increasingly finding its way into company cars.

Telematics is revolutionising the way in which companies run their vehicles and employees drive them.

Telematics systems monitor the location of vehicles and the way they are being driven to deliver a raft of essential operational real-time information to fleet decision-makers that enables them to take action to improve business efficiency, ensure legislative compliance and cut costs.

At the simplest level, data from the telematics device installed in a vehicle uses Global Positioning System (GPS) technology to determine a vehicle's position and then transmits information over the General Packet Radio Service (GPRS) network for fleet decision-makers to access on the internet via their PC or other communication device. Furthermore, today's sophisticated in-vehicle telematics devices are linked to satellite navigation and driver to office communication.

The disparate telematics market is moving at a rapid pace making what was considered the future of fleet management, now a central part of operations.

Until recently telematics was the preserve of aftermarket providers, but increasingly vehicle manufacturers, contract hire and leasing companies, telecoms specialists and the insurance industry are entering the fray.

Currently a myriad of telematics devices are on the market from a wide range of suppliers, but as the telematics sector becomes ever more mature consolidation inevitably will occur as will harmonisation around the type of data that's accessible and the format in which it is delivered.

Almost certainly within the next decade – and perhaps even sooner – the connected car will not be a creation of science fiction but reality, effectively putting fleet managers literally in the driving seat of a vehicle on the move without them having to leave their office.

The start of the autonomous vehicle journey – *PART 2*

The telemetry device is a 'black box' connected to a vehicle's on-board diagnostic port.

While 'black boxes' continue to be fitted to vehicles, the emergence of web-based apps available on smartphones and other mobile devices also linked to the on-board diagnostic port has led to the creation of the phrase 'the connected car'.

Irrespective of the device used the plethora of information available is similar, but a report by the British Vehicle Rental and Leasing Association (BVRLA) suggests that information delivered via employees' company smartphone can improve driver acceptance and dispel age old drivers fears of 'Big Brother' and the perception of having a 'spy in the cab'.

The BVRLA report suggests telematics-based technology is set for "widespread adoption" and concludes that as business buys significantly more than half of all new cars, vans and trucks sold in the UK annually "the fleet market is going to be a crucial driver of autonomous and connected vehicle technology".

Highlighting that by harnessing 'big data', the opportunities for safer, more cost-effective and sustainable transport will be nearly limitless, the report adds: **"The fleet industry – fleet managers, leasing companies and rental operators – will be largely responsible for ensuring that this new connectivity and web-based telematics reaches its full potential."**

THE connected car

Therefore, the accelerating growth of the 'connected car' market will deliver to fleet decision-makers a stream of reliable and robust data that will put an end to decisions being made on unreliable and potentially wrong information. The annual report on the 'connected car' by Strategy&, the consulting division of business services organisation PwC, suggested that the market is expected to grow 204% from 2016's €40.3 billion to €122.6 billion in 2021 with vehicle management and mobility management two of the seven functional growth areas.

The report defines the 'connected car' as "an automobile designed with direct access to the internet, enabling automated links to all other connected objects, including smartphones, tracking devices, traffic lights, other motor vehicles – and even home appliances".

It continues: **"Over the next five years, the 'connected car' could disrupt the entire automotive ecosystem. The industry will undergo fundamental change as semi-autonomous driving emerges, followed by an eventual shift to full autonomous driving.**

"Auto makers that have always seen themselves as product suppliers will take on a new identity as providers of mobility services. This will open the door to lucrative new digital revenue streams, especially as they begin to explore opportunities in other digital areas such as entertainment, commerce, and monitoring a driver's health and fatigue level."

As mentioned vehicle management and mobility management are two of the key features of the 'connected car' revolution and businesses that have already introduced telematics devices are already reaping the benefits.

'Connected car' tools that could be delivered might include, for example: real-time vehicle tracking and performance monitoring, maintenance monitoring, scheduling and fuel usage data; remote software upgrades and recall notification; car usage data tracked and transmitted to insurance companies for usage-based pricing; navigation tools planning efficient routes based on real-time traffic information; and optimal speed based on traffic and roadway conditions.

The 'connected car' market is in its infancy and accelerating rapidly, but with smartphone penetration expected to be almost 100% by 2017 and in-built telematics an imminent feature of all vehicles, experts argue that the internet of cars is coming of age.

Alexander Nicholson, co-founder and managing director of embryonic company AutoTrip, one of six businesses currently being backed by Sustainable Venture Development Partners which works with investors, entrepreneurial managers and corporate partners to originate, build and grow sustainable companies, told Fleet News recently:

> **"The arrival of 'connected cars' gives fleet managers robust data on every aspect of their fleet and grey fleet. That data can then be used to allocate finance to support mobility needs in the knowledge that there will be a return on investment.**
>
> **The information available to fleet managers currently is not robust enough and not accurate enough and so uninformed decisions are being made. Data also needs de-coding, which is resource intensive.**
>
> **Fleet decision-makers should not be worried about the advance of data. They are going to enjoy working with the tools because they will make the designing of fleets for operational requirements enjoyable. Fleet managers will spend less time collating information and more time designing their fleet mission."**

The journey to the autonomous car is *already* **underway**

Company car and van drivers may not realise it, but the journey to the ultimate autonomous vehicle is already underway with most new vehicles featuring a wealth of technology that is already taking over functions from people at the wheel.

For example, recent data from the Society of Motor Manufacturers and Traders and JATO Dynamics revealed that more than half (1.53 million) of new cars registered in the UK in 2015 were available with safety-enhancing collision warning systems, and with other technologies such as adaptive cruise control, autonomous emergency braking and blind spot monitoring also surging in popularity (see chart below).

Semi-autonomous safety technology availability on new cars registered in 2015

	Fitted as standard		Optional fitment		Total	
Adaptive cruise control	147,476	**(5.6%)**	687,344	**(26.1%)**	834,820	**(31.7%)**
Autonomous emergency braking	474,030	**(18%)**	553,035	**(21%)**	1471,027,066	**(39%)**
Blind spot monitoring	89,539	**(3.4%)**	853,255	**(32.4%)**	942,794	**(35.8%)**
Collision warning system	808,485	**(30.7%)**	721,579	**(27.4%)**	1,530,065	**(58.1%)**

The analysis highlights the speed of development: Collision warning systems, which monitor the space ahead of a car using radar and cameras to provide obstacle warnings, were a feature on 58.1% of new cars registered last year compared with just 6.8% five years ago. Similarly adaptive cruise control, which automatically adjusts a car's speed to maintain a safe distance from vehicles ahead, was a feature on 31.7% of new cars last year compared with less than 10% five years ago.

Add in to the mix the availability of features such as self-parking and lane control and drivers have already handed over a degree of autonomy to the vehicle with parts of journeys autonomous as the individual behind the wheel is monitoring, as opposed to constantly operating, the steering and pedals.

What's more the range of autonomous features continues to grow with, for example, the all-new Mercedes-Benz E-Class saloon launched earlier this year having a Driving Assistance Plus Package that includes Drive pilot. It combines Distance Pilot Distronic – which can maintain the vehicle at a set distance behind other vehicles – with new functionality that allows it to follow the vehicle in front. In combination with Comand Online navigation, the system also has Speed Limit Pilot, which can adjust the vehicle's speed to camera-detected limits or those logged in the navigation.

Meanwhile, all-electric Tesla models feature Autopilot enabling a car to automatically steer within a lane, change lanes with the tap of a turn signal, and manage speed by using active, traffic-aware cruise control. Digital control of motors, brakes, and steering helps avoid collisions from the front and sides, as well as preventing the car from wandering off the road. Models can also scan for a parking space, alert drivers when one is available, and parallel park on command.

Tesla says that it is committed to "developing and refining the technologies to enable self-driving capability" which is a core part of its mission.

The company adds:

> **Tesla Autopilot relieves drivers of the most tedious and potentially dangerous aspects of road travel. We're building Autopilot to give drivers more confidence behind the wheel, increase safety on the road, and make highway driving more enjoyable.**
>
> **While truly driverless cars are still a few years away, Tesla Autopilot functions like the systems that airplane pilots use when conditions are clear. The driver is still responsible for, and ultimately in control of, the car. What's more, drivers always have intuitive access to the information their car is using to inform its actions.**

Furthermore the technology fitted to Tesla cars already on the road will continually be enhanced as new capabilities are developed with delivery through over-the-air software updates, keeping drivers at the forefront of driving technology in the years ahead.

Nissan has confirmed that its refreshed Qashqai will be its first car in Europe – and the first UK-manufactured car – equipped with autonomous technology in 2017 with ProPilot. The introduction, said the brand, marked an important step in its commitment to make autonomous drive technologies available to the mass market.

It will be produced at the company's flagship manufacturing plant in Sunderland and sold in the UK as well as markets across Europe. The multi-award winning Qashqai is the UK's fifth-highest selling car.

ProPilot, Nissan's stage one autonomous drive technology, enables a car to drive autonomously and safely in a single lane in heavy traffic conditions on roads.

Nissan said the introduction of ProPilot in Europe next year was the first step in its longer-term commitment to launch a range of vehicles with autonomous drive capabilities by 2020.

In 2018 'multiple-lane control' in Nissan cars would allow them to autonomously negotiate hazards and change lanes while driving. Meanwhile, 2020 will see the launch of 'intersection autonomy,' allowing cars to navigate busy city junctions and heavy urban traffic without driver intervention.

The Renault-Nissan Alliance has already announced it will launch more than 10 vehicles with autonomous drive technology by 2020 in Europe as well as the United States, Japan and China. The business said that the technology would be installed on mainstream, mass-market cars at affordable prices, with a focus on accessibility to all customers.

Paul Willcox, chairman of Nissan Europe, said: "We're excited to be debuting the first phase of our autonomous driving technology, ProPilot, on the Nissan Qashqai in 2017. The introduction of ProPilot technology will be an evolution not a revolution as the building blocks for this are already in place in many of our cars today through our Safety Shield Technology."

“high-performing computers *on wheels*”

Meanwhile, Hyundai has just revealed what is calls “its roadmap for connected car development”, which paves the way for innovations in vehicle connectivity, which the manufacturer says will “bring new values and efficiencies to the lives of customers”.

Billing tomorrow’s vehicles as “high-performing computers on wheels”, Hyundai says it will “connect cars to life” by linking in-vehicle technology to other cars, the office and the city and road infrastructure.

The roadmap outlines four main service fields that will help develop smarter, more intelligent cars that can receive and utilise data faster than ever before. The mid- to long-term development focus includes a range of key features, including: smart remote maintenance services, autonomous driving, smart traffic and a connected mobility hub that provides security and data management for all elements of the connected car.

Critical for fleet operators, the smart remote maintenance service will remotely diagnose and fix vehicle issues before they become apparent. Smart traffic will reduce congestion, speed-up journeys and minimise social costs by considering traffic and road conditions and the connected mobility hub will have strong computing power to make daily life and interaction with the car and its surroundings smarter.

Hyundai says that the car is the “last frontier to bridge the missing link in future connected life” and that in the short to mid-term it will concentrate on technologies related to smartphone connectivity and smart home services, while establishing the core infrastructure that will provide the foundation for future developments.

Mike Hawes, SMMT chief executive, said: **“Fully driverless cars are still a long way off from everyday use, but [our] data shows advanced autonomous technology is already making its way into the majority of new cars.”**

Against that background it is no surprise that far from being science fiction, experts expect the shift to autonomous driving to begin in earnest by 2020.

Strategy& has forecast that 20% of new cars sold are likely to have “significant autonomous capabilities by 2025”.

It’s a view shared by global research and consultancy Frost & Sullivan which in its latest report, ‘Strategic Outlook of Global Autonomous Driving Market in 2016’, claims that

80% of vehicle manufacturers will finalise their automation technology roadmap in 2016.

Although, its forecast as to the growth of the autonomous car market is less optimistic suggesting that one in seven cars will feature highly automated features by 2030.

But the trend is expected to pave the way for new business models in the automotive ecosystem. Frost & Sullivan intelligent mobility research analyst Arunprasad Nandakumar believes that once the market establishes a conducive testing environment and develops improved sensing capabilities, vehicle manufacturers’ focus will turn to augmenting data acquisition and validation capabilities.

He said:

> **“The participants that will enjoy success are not likely to be singular entities, but those with the strongest partnerships and ecosystems. These companies are expected to boast a robust product and service portfolio that best address the needs of next-generation drivers.”**

The consultants’ report added: **“Piloted driving will start in urban areas. At first, autonomous driving will not be fully autonomous. Although digital players are looking at radical innovations such as self-driving cars without steering wheels, for motor manufacturers the autonomous car will be seen as a bundle of driver-assistance features – from “passive” features such as the parking assistance systems available today, to semi-autonomous systems that allow drivers to take control at any time.**

“Yet the advances will be steady, and by 2030, we may see fully autonomous vehicles that may not even have steering wheels. Even the slower plausible scenarios show 15 to 20% penetration by autonomous vehicles in 2030, only 14 years from now.”

AUTONOMOUS VEHICLES – where are we

Former Business Secretary and current Secretary of State for Communities and Local Government Sajid Javid said:

> **To boost productivity, Britain will need to capitalise on new technologies like driverless vehicles, securing high skilled jobs for those who want to work hard and get on, and contributing to a more prosperous future for the whole of the country.**
>
> **Our world beating automotive industry, strengths in innovation and light touch regulatory approach to testing driverless technology combine to make the UK market competitive and an attractive destination for investors.**

Former Transport Minister Andrew Jones said: "Driverless cars will bring great benefits to our society and economy and I want the UK to lead the way in developing this exciting technology."

The government has already introduced a 'code of practice' for the testing of automated vehicle technology and Mr Jones said: "[It] clearly shows that the UK is in the best position when it comes to testing driverless cars and embracing the motoring of the future. We now look forward to working with industry to make this a reality.

"A decade ago Britain's car industry was in decline, but it is now the most productive amongst the major European producers. New technology can help it improve its productivity and competitiveness in the future."

The 'code of practice' provides industry with a framework to safely trial cars in real-life scenarios, and to create more sophisticated versions of the models that already exist.

The Department for Transport and Department for Business, Innovation and Skills (BIS) have also established the new joint policy unit, the Centre for Connected and Autonomous Vehicles (C-CAV), which co-ordinates government policy on driverless cars and connected technology.

C-CAV is currently working on a range of new technological developments, including plans to test new roadside communication technology to improve traffic flow and safety through 'connected corridors'. It will pilot technology that will provide drivers with useful journey and safety information and will work at national and international level to review and amend national and international regulations relating to vehicle and road use and liabilities.

The UK government sees strategic importance in developing connected and autonomous vehicles – for reasons of safety, efficiency, mobility, and productivity.

However, there are challenges to overcome and the government has identified the main ones as being:

- **Legislation**
- **Privacy, personalisation and security of data**
- **Public acceptance.**

As a result, the government in the current session of Parliament is to introduce a Modern Transport Bill which, among other issues, will include new laws to make the UK ready to pioneer driverless cars; outline measures to encourage investment in driverless cars; and ensure insurance is available to users of autonomous vehicles.

Against that background, driverless cars trials are taking place in four cities – Bristol, Greenwich, Milton Keynes and Coventry (working together as one project). Autonomous vehicles are also being used at Heathrow Airport to shuttle passengers, although they are currently on designated tracks.

now?

The government and industry is collectively pumping hundreds of millions of pounds into ensuring that the UK is at the forefront of the intelligent mobility market – forecast is an expected worth of £900 billion by 2025.

Testing driverless cars in real-world environments will, says the government, lead to greater understanding of those vehicles.

Perhaps even more importantly, as driverless cars are considered to represent the most significant transformation in road travel since the introduction of the internal combustion engine, the trials will allow the public to accept how such vehicles will fit into everyday life.

In addition to the four city-based projects, eight consortium projects are being government backed to research and develop enhanced communications between vehicles and roadside infrastructure or urban information systems, including new 'talking car technologies'.

Those projects, which involve motor manufacturers, IT specialists, engineering firms, universities and local authorities, include:

- **Development of software-based tools to optimise autonomous vehicle fleet efficiency and reduce operating risk.**
- **Equipping more than 40 miles of urban roads, dual carriageways and motorways with 'talking car technologies' with the aim of improving journey time, reducing traffic congestion and providing entertainment and safety services through better connectivity.**
- **Driverless shuttles with advanced sensors and control systems being trialled in city pedestrian areas, with a particular focus on improving urban accessibility for disabled and visually-impaired people.**
- **Development of solutions to monitor commercial vehicle performance and predict safety risks based on analytics, which builds on a prototype that monitors tyre pressure and temperatures in those vehicles, combined with always-on network connections.**

Additionally, an £11 million programme jointly funded by Jaguar Land Rover and the Engineering and Physical Sciences Research Council is looking at some key technologies and questions that need to be addressed before driverless cars can be allowed on the roads without jeopardising the safety of other road users, including cyclists and pedestrians.

Involving TRL (Transport Research Laboratory) and a raft of UK universities, the programme has five separate projects:

- **To explore how increasingly automated and connected vehicles can operate safely and securely when connected to each other and, via the road infrastructure, to cloud-based resources. Ultimately the aim is to develop a secure framework that will enable the implementation of safe and robust semi-autonomous functions on future cars in the short term, and fully autonomous cars in the long term.**
- **The development of new radar sensors and advanced video analysis that will allow cars to better identify obstacles and hazards on the road.**
- **A study of drivers' reactions to autonomous vehicles, with the aim of designing the best driver-vehicle interaction.**
- **Investigation into the effects of automated driving on drivers' attention and cognition and their possible negative impact on driving.**
- **The development of a self-learning car that will minimise distractions, enhance safety and deliver a personalised driving experience.**

The UK's most ambitious

autonomous driving trial

Called 'Drive Me London', the trial will begin in early 2017 with a limited number of semi-autonomous driving cars and expand in 2018 to include up to 100 autonomous driving cars, making it the largest and most extensive testing programme of its type on Britain's streets.

The motor manufacturer says 'Drive Me London' will differentiate itself from other autonomous driving programmes by using real families driving driverless cars on public roads.

Volvo will source its data from the everyday users and use it to develop autonomous driving cars that are suitable for real world driving conditions, rather than what it claims are the more unrealistic conditions found on test tracks. Thatcham Research will be providing the technical data analysis and any professional test drivers need as part of the trial.

The Swedish motor manufacturer is pioneering the development of autonomous driving systems globally as part of its commitment that no one will be seriously injured or killed in a new Volvo by the year 2020.

"Autonomous driving represents a leap forward in car safety," said Håkan Samuelsson, president and chief executive. "The sooner autonomous driving cars are on the roads, the sooner lives will start being saved."

Furthermore, Volvo has announced that next year it will start what it claims will be "the UK's most ambitious autonomous driving trial".

However, driverless car research and development is not just taking place in the UK, but internationally. There is hardly a motor manufacturer that is not ploughing millions of pounds into such projects.

Indeed Volvo, which is one of the truck manufacturers heavily involved in platooning, recently announced plans to launch China's most advanced autonomous driving experiment in which local drivers will test autonomous driving cars on public roads in everyday driving conditions.

Volvo expects the experiment to involve up to 100 cars and will in the coming months begin negotiations with interested cities in China to see which is able to provide the necessary permissions, regulations and infrastructure to allow the experiment to go ahead.

Volvo believes the introduction of autonomous driving technology promises to reduce car accidents as well as free up congested roads, reduce pollution and allows drivers to use their time in their cars more valuably.

Meanwhile, Toyota has announced the opening in the United States of a third Research Institute, which will drive the manufacturer further along the autonomous vehicle route.

The aims of the Toyota Research Institute include: to enhance vehicle safety with the ultimate goal of creating a car that is incapable of causing a crash, regardless of the skill or condition of the driver and to work to increase access to vehicles for those who otherwise could not drive, including older people and those with special needs.

The manufacturer says: "**Toyota's goal is safe mobility for all, at any time, in any place, and the tremendous improvements in quality of life that such universal mobility can bring.**"

However, perhaps the best-known driverless car project – and arguably

the most advanced

– is that launched by Google in 2009.

It started testing its self-driving technology with a Toyota Prius on Californian freeways, moved on to modified Lexus RX450h SUVs and now the test fleet also includes prototype vehicles designed from the ground up to be fully self-driving and operating on public roads. The project has to date seen more than 1.5 million miles clocked up.

For now, safety drivers are aboard all Google vehicles to watch over how the cars 'drive', and to provide feedback to the engineering team. The vehicles are equipped with removable steering wheels, accelerator pedals and brake pedals that allow safety drivers to take over driving if needed. Google says it plans to eventually remove the manual controls because the vehicles are ultimately designed to operate without a human driver.

Google says it has 'taught' its cars to navigate through many complicated scenarios on city streets. The vehicles use sensors and software to sense objects including pedestrians, cyclists and other vehicles – or even fluttering plastic shopping bags and rogue birds – and are designed to negotiate them at a safe speed.

Google says: "We're going to learn a lot from our testing in the coming years, including how people might like to use self-driving technology in their daily lives. If the technology develops as we hope, we'll work with partners to bring this technology into the world safely."

Driverless cars are dependent on major improvements in mapping, which is one of the reasons behind Google's driverless vehicle project.

The company says:

A map for self-driving cars has a lot more detail than conventional maps – eg the height of a curb, width of an intersection, and the exact location of a traffic light or stop sign – so we've had to develop a whole new way of mapping the world.

Before we drive in a new city or new part of town, we build a detailed picture of what's around us using the sensors on our self-driving car. As we drive around town, our lasers send out pulses of light that help us paint a three-dimensional portrait of the world.

We're able to tell the distance and dimensions of road features based on the amount of time it takes for the laser beam to bounce back to our sensors.

Our mapping team then turns this into useful information for our cars by categorising interesting features on the road, such as driveways and intersections.

This level of detail helps our car know exactly where it is in the world. As our cars drive autonomously on the road, our software matches what the car sees in real-time with the maps we've already built, allowing the car to know its position on the road to within 10cm of accuracy.

That means we don't have to rely on GPS technology, or a single point of data such as lane markings, to navigate the streets.

Another benefit of knowing permanent features of the road is that our sensors and software can focus more on moving objects, like pedestrians, vehicles, and construction zones. This allows us to do a better job of anticipating – and avoiding – tricky situations.

Of course our streets are ever-changing, so our cars need to be able to recognise new conditions and make adjustments in real-time. For example, we can detect signs of construction – orange cones, workmen in vests, etc – and understand that we may have to merge to bypass a closed lane, or that other road users may behave differently.

To keep our maps up-to-date, our cars automatically send reports back to our mapping team whenever they detect changes like these. The team can then quickly update the map and share information with the whole autonomous fleet.

Projects

Driverless car projects lasting up to January 2018 are running in four cities – Bristol, Milton Keynes and Coventry and Greenwich.

Involving a wide cross-section of 27 different organisations, the projects are testing highly and fully automated vehicles in a real-world environment to gather greater detail of their operation.

The trials are required to operate to a Department for Transport code of practice while on the open road, allowing the vehicles to test automation but at all times with a 'steward' on board, capable of re-taking control.

The projects are:

The GATEway – Greenwich Automated Transport Environment:

It sees three public trials of zero emission, automated vehicles. The first is an automated shuttle transport on the Greenwich peninsula; the second an autonomous valet parking of cars, enabling users to exit their vehicle while it finds a specified parking space autonomously; and the third trial is focused on automated urban deliveries.

The lead participant is TRL (Transport Research Laboratory) and the trial also involves mobile phone operator Telefónica UK, the Royal College of Art, Royal Borough of Greenwich, University of Greenwich and RSA Insurance Group among others.

Those behind the project say: **"Results will help both industry and policy makers understand the implications of driverless vehicles and deliver a safe and validated test environment in the UK, driving job creation and investment in a rapidly emerging technology area."**

UK Autodrive

Milton Keynes in partnership with Coventry: On-road testing includes the real-world evaluation of passenger cars with increasing levels of autonomy, as well as the development and evaluation of lightweight fully autonomous two-seater electric self-driving pods designed for pedestrianised spaces.

The research team says that real-world testing on public roads will develop in-car, car-to-car and car-to-infrastructure technologies that will support autonomous driving and the development of new technologies on a semi-autonomous Range Rover research vehicle.

Tim Armitage, UK Autodrive project director from consulting group Arup, which leads the consortium, said: "The studies will provide insights for vehicle manufacturers, cities, commercial operators, legislators and insurers to develop the legal framework for the roll-out of autonomous mobility.

"Our plan with the practical demonstration phases is to start testing with single vehicles on closed roads, and to build up to a point where all road users, as well as legislators, the police and insurance companies, are confident about how driverless pods and fully and partially autonomous cars can operate safely on UK roads."

The government-backed Transport Systems Catapult, the UK's not-for-profit technology and innovation centre for intelligent mobility, harnessing emerging technologies to improve the movement of people and goods around the world, is a member of the consortium and is leading the LUTZ Pathfinder (Low-carbon Urban Transport Zone) initiative.

The project sees three automated two-seater pods travelling around Milton Keynes city centre. Findings will be fed into the UK Autodrive programme, which will deploy a larger fleet of 40 pods along with 'regular' road-based cars as part of the trial.

During the trial cars will be tested in mixed traffic, operating fully autonomously for part of the time.

Programme partners also include: Jaguar Land Rover, Tata, Ford, Oxford University, Cambridge University and the Open University.

Bristol and South Gloucestershire-based VENTURER:

It says the key barrier to public acceptance of driverless cars is lack of confidence in how people might respond to the type of events that can happen on real roads; including cyclists, pedestrians, and bad drivers.

Based on insurance expertise and social research, VENTURER is aiming to quantify the response of the public – passengers, road users, pedestrians – to increasing levels of driver assistance.

The focal point of the project is the testing of the consortium's autonomous vehicle, the BAE Systems Wildcat, on private and public roads. The trial includes the testing of a range of advanced wireless technologies in combination with other sensor technologies, as project supporters say car-to-car communications will play a key role in providing the safety and public trust levels necessary for autonomous vehicles to become a reality on British roads.

Trial partners include engineering and project management consultancy Atkins UK, University of Bristol, Williams Grand Prix Engineering, BAE Systems (Operations), University of the West of England, and Axa Insurance UK.

Shared ambition

European Union member states – including the UK – have backed a new initiative aimed at facilitating the smooth introduction of self-driving vehicles.

The shared ambition is to be ready in 2019 for the further roll-out of self-driving vehicles that can communicate with one another and with infrastructure.

Together, the member states have agreed that they will remove obstacles hampering the introduction of connected and automated vehicles.

National traffic and transport rules will be harmonised and coordinated work will be undertaken on a digital communication system so that cars in Europe can 'talk' to one another and to infrastructure.

In addition, European countries will cooperate on cross-border testing so that based on experiences in practice the right steps can be taken to support development. Together, the member states are also going to tackle issues regarding cyber security, privacy, liability and data protection.

The April 2016 initiative, known as the Declaration of Amsterdam, saw transport ministers from the European Union's 28 member states sign up to supporting and facilitating all forms of self-driving vehicles.

They will join forces and, together with the European automotive sector and supplying IT industry, the aim is to be ready for self-driving vehicles in three years.

Government of the Netherlands minister for infrastructure and the environment Schultz van Haegen said:

For the first time, we have talked at the European political level about self-driving vehicles and the measures required for their smooth introduction in Europe.

We want to pick up the pace because there are many gains to be made for mobility. Connected and automated vehicles will make our roads safer, more sustainable and more efficient.
By harmonising legislation and car systems, in the future self-driving cars and trucks will not require a new update at every border.

European Union transport commissioner Violeta Bulc said: "Connected and automated vehicles will make transport safer, more efficient and inclusive and offer great opportunities for the EU industry.

"The Commission will continue to work closely with the industry and European Union member states to create the conditions for connected vehicles to hit European roads ready in 2019. Building on the momentum of the Amsterdam Declaration, we will release a master plan on Cooperative Intelligent Transport Systems later this year. This will be an important step to ensure continuity of service from day one.

Erik Jonnaert, secretary general of ACEA, the European umbrella organisation of the 15 Europe-based car, van, truck and bus makers, said: "Connected and automated vehicles promise to make road transport more sustainable and efficient in the next decades.

"But even though this revolution is shaping our industry at a rapid pace, there are many challenges on the road ahead."

In welcoming the Declaration of Amsterdam, Mr Jonnaert added: "We see it as a milestone, promoting much-needed cooperation between automobile manufacturers, national governments and the European institutions."

Following the meeting, the European transport ministers were taken across Amsterdam in self-driving and highly automated vehicles under an exemption permitting the vehicles to drive on public roads.

Some 20 cars were involved, manufactured by: Volvo, BMW, Daimler, Audi, Jaguar, Land Rover, Tesla, Renault, Peugeot/Citroen (PSA) and the research institutes Vedecom (FR) and the TNO/Dutch Automated Vehicle Initiative (DAVI).

Rémi Bastien, head of prospective autonomous driving, Renault-Nissan Alliance, said the Declaration marked "a new chapter in the potential for autonomous driving vehicles on the road".

At the event Renault revealed three Espace Autonomous Drive demonstrators which have already been trialed for several hundred hours in ordinary traffic across Europe.

The French marque says it is committed to introducing autonomous driving vehicles by 2020, with the ambition to become the first to offer 'eyes-off/hands-off' technology on mainstream vehicles at an affordable price with the technology having a goal of making the road safer, more enjoyable and maximising time for drivers while driving.

Beyond 2020, drivers, says Renault, will gradually be able to optimise their time in order to take advantage of in-car connectivity in total safety when conditions permit and in total compliance with legislation.

Jaguar Land Rover says it will have an 'intelligent vehicle' within 10 years and that it will start testing the real-world technology this year.

Dr Wolfgang Epple, director of research and technology, Jaguar Land Rover, said: "We are all working on exciting autonomous driving technologies. To successfully deliver these technologies industry needs a common approach between carmakers, mobile telecom providers and providers of roadside infrastructure systems.

"This will allow standardisation and harmonisation, enabling cars to communicate with each other and the roadside infrastructure around them efficiently and effectively. It allows Jaguar Land Rover to deliver technologies that are relevant, accessible and affordable to customers."

A report by KPMG for the SMMT calculated that there will be 25% penetration in the UK of fully autonomous vehicles by 2030 with 75% of cars featuring a level of automation that only requires the driver to be in position to resume control. With corporates responsible for the purchase of the majority of new cars it is therefore virtually certain that it will be fleets in the vanguard of driverless cars just as they have been with the introduction of other new technologies including, currently, plug-in vehicles.

AUTONOMOUS VEHICLES – the future

Cars of the future will be equipped, says the government, with the technologies that will make travelling from A to B safer, faster and cleaner.

What's more they will alert drivers of accidents ahead and be able to receive information from their surroundings about hazards, increasing the safety of drivers, passengers, other road users and pedestrians.

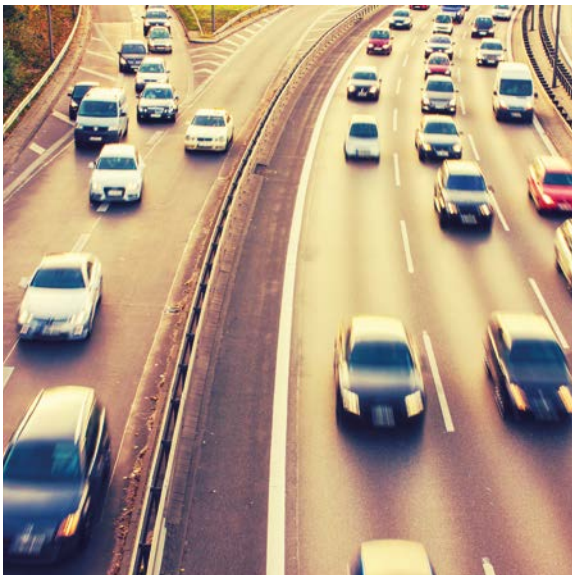
As well as improving road safety, tomorrow's cars will enable traffic to flow more freely thus there is an expectation of a reduction in today's congestion levels and air quality improvements.

The government says different levels of automation may be available – what it calls 'high' and 'full' automation.

'High' automation is defined as a vehicle in which a driver is required to be present and may need to take manual control for some parts of the journey. Under certain traffic, road or weather conditions, the vehicle's automation systems may request the driver to take control.

Early highly automated vehicles may only offer a driverless mode under certain very specific driving conditions such as highway cruising or in low speed conditions and self-parking. However, as the technology develops, vehicles will be able to undertake driving duties autonomously for a greater and greater proportion of the time.

That means a vehicle in which a driver is not necessary because it is designed to be capable of safely completing journeys without the need for a 'driver' in all normally encountered traffic, road and weather conditions. Consequently, occupants of fully automated vehicles will be able to engage in tasks other than driving for the entire journey. Fully automated vehicles may still offer a full set of controls to allow a driver to resume manual control if they so wish, but that would be entirely optional.



Thatcham, the insurance industry's motor research centre, has identified what it called "the key stages of automation" and believes that 2018 will be a "landmark year".

Cars, it says, will become a lot smarter than today's with even more advanced driver comfort features and with regulations permitting hands-off driving on motorways.

However, drivers would will retain responsibility and would be expected to take over control in case of unanticipated situations or system failures.

For motorway driving, some cars will feature an 'auto pilot' function, automatically driving the vehicle and allowing hands to be taken off the steering wheel for around three minutes at a time.

That, says Thatcham, might allow drivers to check the sat nav or to look at an important email, but after three minutes the system will warn drivers that they need to re-engage with the car in some way usually through putting their hands back on the steering wheel. If that doesn't happen the system will disconnect and the car will perform a minimum risk manoeuvre to bring itself to a controlled safe stop, although the driver will remain in control.

By 2021 the move to full autonomy is forecasted to be well underway and on defined segments of the motorway cars will be able to take complete control allowing drivers to disengage from driving and to do other, unrelated and more time consuming tasks such as reading a book.

With a full sensor pack including radars, cameras and laser scanners cars will be able to build up a complete picture of the immediate road and traffic environment and to use lateral steering adjustments and longitudinal braking and acceleration inputs to navigate safely within it. Such a vehicle is also likely be equipped with high specification Advanced Driver Assistance Systems to aid the driver at the times when they are in control.

By 2025, it is envisaged that cars will be able to drive themselves, fully hands free from door to door.

That will include the whole range of typical driving environments in cities and in urban environments as well as main arterial routes and with the ability to negotiate traffic lights, junctions and roundabouts, where the road infrastructure permits.

Such vehicles would have full connectivity with each other and with the road infrastructure itself which would allow the vehicle not just to navigate through its immediate environment but to plan ahead effectively taking real time traffic conditions into account. At that stage drivers would not need to touch the controls during the course of the journey.

Meanwhile, critical to enable autonomous vehicles on the UK's roads is the sweeping away of regulatory barriers such as vehicle construction and use regulations and concluding with the Highway Code being changed.

Denis Naberezhnykh, head of ultra-low emission vehicle and ITS technology at TRL, said: "Regulation will need to be updated to ensure vehicles are safe and fit within all relevant regulatory frameworks."

The 'Highway Code' currently says: "You must exercise proper control of your vehicle at all times. Do not rely on driver assistance systems such as cruise control or lane departure warnings."

The government will start the legislative amendment process this summer with a consultation that will detail the way forward in terms of changes to the Road Traffic Act, The Road Vehicles (Construction and Use) Regulations, the rules governing drivers, use of the road network and vehicle licensing.

Highways England says autonomous vehicle trials will be taking place on motorways by the end of 2017 to start to collect real world data on performance and potential impacts on road capacity and operations.

A spokesman for Highways England said it was too soon to identify the types of vehicles that would be involved, where the trials would take place and how long they would last.

Although, he said much of the project would be in partnership with motor manufacturers researching and building the next generation of vehicles.

As to what the roads of the future may look like, Highways England is keeping a totally open mind.

The spokesman said:

> **It all depends on the trials taking place and public acceptance. Some people may not want to 'drive' an autonomous vehicle for many different reasons so roads may feature a mix of driverless and driven vehicles.**
>
> **Roads could look completely different from today or very similar – for example there may be no white lines or systems may need white lines to help with vehicle location on the road.**
>
> **Highways England is working with many different partners and technical specialists – we are facilitators. We are currently engaging with car manufacturers and undertaking feasibility studies to inform our plans to trial connected and autonomous vehicles on our network, investigating different technologies, infrastructure and data requirements.**

Nevertheless, last year the government published a Code of Practice for the Testing of Automated Technologies and The Pathway to Driverless Cars which provide some clues as to what can be expected by way of regulatory change by summer 2017.

The government said on:

Clarification of liabilities –

"There needs to be greater certainty around criminal and civil liability in the event of an automated vehicle being in a collision."

Amending regulations on vehicle use –

"Existing regulations governing how vehicles are used and maintained will need to be revised to allow the use of automation technology without a test driver and to ensure that the technology is maintained correctly. This may involve changes, for example, to the MoT test to check roadworthiness. It may also be appropriate to revise 'The Highway Code' to include a section on automated vehicle technologies."

Promoting safety –

"Safety is of paramount importance. The government will consider whether a higher standard of 'driving' should be demanded of vehicles operating in an automated mode than would be expected of a conventional driver. Government will also consider how the existing regulatory framework may be developed to ensure automated vehicle technologies are protected from possible cyber threats."

Vehicle type approval –

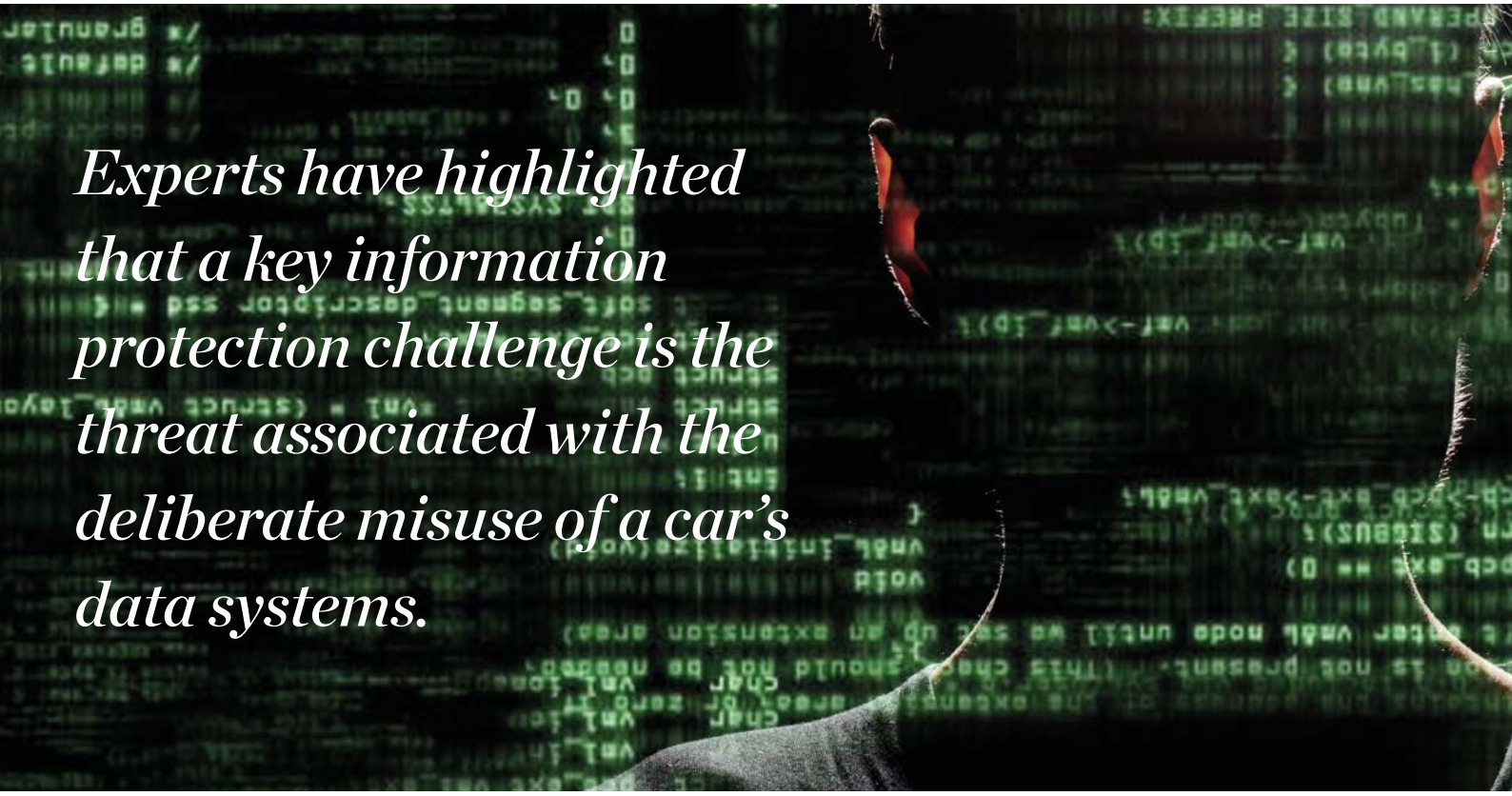
"There will need to be changes made to the European standards – known as type approval – with which mass production vehicles are required to comply prior to sale, as well as to ISO (International Organisation for Standardisation) standards such as that on symbols and driver warnings. Developing these standards is likely to take several years."

Cyber security fears

must be allayed

As autonomous systems will rely heavily on internet connectivity making them intrinsically vulnerable to cyber manipulation, hackers may be able to override a car's system to re-route it toward a particular destination, or overwhelm it with high volumes of internet traffic.

And by intercepting and tampering with mobile communications and vehicle software updates, cyber-criminals could transmit malicious code or, in the worst case scenario, send new and dangerous instructions to the vehicle's software systems, according to the Association of British Insurers (ABI).



Experts have highlighted that a key information protection challenge is the threat associated with the deliberate misuse of a car's data systems.

It concludes: "The task for everyone with an interest in promoting the benefits of driverless cars is to find and close the vulnerabilities now before the technology is integrated extensively into mass market vehicles."

Establishing standards to promote consumer confidence around vehicle cyber security is high on the agenda for Thatcham Research, as the British insurers' research centre turns attentions to combatting future car crime.

A member of the Cyber Security Consortium for Connected Vehicles (CCV), it says that connected vehicle technology provides the basis for many emerging driver assistance and comfort systems yet it's that convergence between automotive and computer technology that could also provide opportunity for cyber attackers.

However, according to Thatcham's chief technical officer Andrew Miller, the key to keeping thieves at bay is in a joined up approach to creating robust standards.

Calling cyber security "one of the biggest risks because it translates into every area of life in the digital age" he said:

There are a wide range of stakeholders with an obvious interest in this area from the likes of Google and Apple which are increasingly moving into the automotive space to the more traditional vehicle manufacturers.

With this mix of interested parties it's critical to quickly establish a set of robust security standards and protocols around cyber security that everyone can agree and work to and which will avoid the kind of fragmented approach that hackers could exploit.

Suggesting that the idea of a third party being able to 'hack' in and take over a vehicle's controls was a terrifying prospect, Mr Miller said: "No connected computer system can be 100% guaranteed, and as technological development in the automotive industry continues at pace so the security threat potentially increases.

"But it is not just an automotive industry problem; it's a digital age problem. It is a very difficult to see what the fix is; but it will require a full range of measures across a range of sectors to make vehicles resilient."

As part of the CCV Thatcham will provide its experience in the development of new standards around cyber security, as well as in its influence on vehicle and product manufacturers to establish a coordinated approach to future security solutions.

"Thatcham having been instrumental in driving down traditional forms of vehicle crime, so it's imperative that we're now at the table taking a leading role in developing and coordinating future preventative measures on behalf of our members," said Mr Miller.

AUTONOMOUS VEHICLES – the benefits

The government says the introduction of autonomous vehicles offer **"enormous opportunities"** making driving easier, improving road safety, reducing emissions and easing congestion.

It will also, says the government enable people to choose to do other things than driving during a journey.

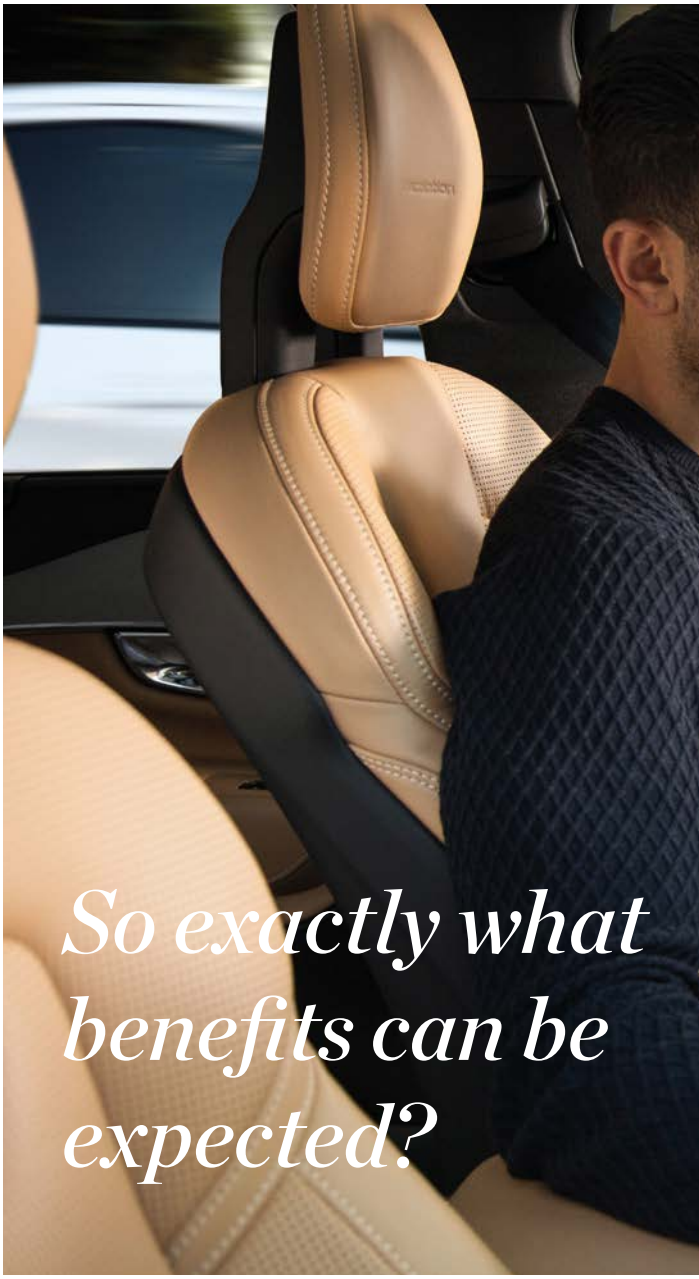
Furthermore driverless vehicle technology will improve mobility for those unable or unwilling to take the wheel, enhancing their quality of life. As a result, concludes the government: "Driverless vehicles could provide significant economic, environmental and social benefits."

The government calculates that the average driver spends 235 hours – or six weeks driving every year and concentrates on the task 100% of the time.

Automated vehicles will change that with 'drivers', says the government, being able to choose whether they want to be in control, or to hand the task of driving over to the vehicle itself.

That will enable 'drivers' to safely use journey time however they wish, from working to reading a book, to surfing the web, watching a film or just chatting face to face with other passengers.

What's more, the KPMG report commissioned by the SMMT calculated that the annual economic benefit of connected and autonomous vehicles will grow to £51 billion by 2030 and more than double to £121 billion by 2040 as an ever-increasing number driverless cars appear on the roads. The majority of the benefit is due to a transformation in the ease of travel, according to the report, such as fewer accidents, reduced congestion and improved productivity.



ROAD SAFETY IMPROVEMENTS & *transfer of*

Autonomous vehicles are forecast to have a major impact on safety as 94% of road accidents are caused by human error and therefore potentially deliver insurance premium savings, according to the Association of British Insurers.

That's because failing to look properly, misjudging other road users' movements, being distracted, careless or in too much of a hurry are the most common causes of collisions on the UK's roads, but automated vehicles equipped with a plethora of sensors to monitor surroundings will not make those mistakes.

liability

A report commissioned by the SMMT found that serious accidents could fall by more than 25,000, saving 2,500 lives every year by 2030, as a result of driverless vehicle technology.

And Highways England has set a target to "reduce the number of people killed or injured on the road network as close as possible to zero by 2040".

It says that "connected and autonomous vehicles could be the breakthrough innovation that we need to achieve the 2040 safety ambition".

A group of 13 UK motor insurers, led by the ABI and Thatcham Research, the motor insurers' automotive research centre, was formed early in 2016 to consider key issues relating to automated driving on UK roads, particularly concerning insurance and liability.

The Automated Driving Insurer Group will feed into ABI policy and work with the government on shaping the future of automated vehicle use in the UK.

Key issues identified by the group include:

- **Who could be held liable after an accident – drivers, vehicle operators, manufacturers, system developers, car dealers, service providers, data providers, car maintenance firms or a combination?**
- **How to cope with vehicles at different levels of automation**
- **How data from individual vehicles will be recorded and used to improve safety and clarify liability**
- **Whether there needs to be changes to existing road traffic laws and what those changes might be.**

James Dalton, ABI director of general insurance policy, said: "The presence of driverless cars on UK roads would be life-changing in many ways, and one of the business sectors likely to be most affected is insurance."

He says insurers are looking to support progress and innovation and added:

> "The developments we've seen towards increasingly autonomous vehicles are already reaping rewards – with autonomous emergency braking reducing collisions and injuries and helping to bring down insurance premiums.
>
> "Truly driverless cars have the potential to dramatically reduce deaths and injuries on the roads and could revolutionise what we think of as public transport. The role of motor insurance in such a future will be very different to what it is today, but insurance will be part of the picture."

Thatcham's Mr Miller agrees that it is widely expected that autonomous vehicles will be involved in fewer crashes per mile than those with a driver. As a result, overtime the repair frequency of company vehicles will reduce and therefore that alone is likely to have an impact on fleet claims experience and therefore insurance premiums.

Highlighting that driverless cars will be more expensive when first appearing in showrooms as motor manufacturers seek to recoup costs, he explained that the future was about "clever programming". Get that right and one of the benefits may well be reduced insurance premiums.

Who is liab in the event

One of the major issues to be resolved before driverless cars take to the road is who is liable in the event of a crash.

The ABI says that as vehicles become increasingly connected with other vehicles – and as the control input transfers from human to computer, it is possible that liability will follow that transfer of risk.

There is therefore the potential for the vehicle manufacturer to become liable for an accident, as opposed to the driver, if the driver is unable to override the system.

The ABI says that the insurance industry is working with government, vehicle manufacturers, regulators, the legal community and Thatcham, on this "potentially life-changing and life-saving technology".

Today crash liability rests with drivers. However, with less reliance on a driver's input and more on sophisticated car technology, what happens when the car's computer systems fail? And in the event of an accident, does liability rest with the driver or the hardware and software found in the car itself?

Suggesting that the development of increased automation within aviation could set a precedent, the ABI says:

> **It is likely that the driver will continue to be held liable in the event of a crash if they are able to step in and intervene, overriding the technology by making control inputs themselves.**
>
> **As with pilots, effective system monitoring for drivers will become a skill and a key safety net in the prevention of accidents, requiring modifications to the way people learn to drive."**

However, says the ABI:

The key change – and the potential shift to product liability – comes when cars not only become driverless but when they become 'connected' and the driver is not expected to oversee or monitor the vehicle, relying instead on the car to make its own decisions such as planning a route using its internet enabled on-board computer that is also connected to other vehicles.

So as vehicles become increasingly connected with other vehicles – and as the control input transfers from human to computer – it is possible that liability will follow that transfer of risk.

In the coming years insurers will be watching the development of this technology very closely, with a particular eye on system reliability, ensuring that the reasons for system failures are fully understood and the technology is tried and tested.

Emphasising that manufacturers of autonomous vehicle technology will have "a very strong set of incentives to make their products as safe as possible", the ABI says:

> **Despite these efforts, there will inevitably be some accidents attributable in whole or in part to defects in future vehicle automation systems.**

It is possible that manufacturers will be brought in to legal proceedings following an accident involving an autonomous vehicle by either the insured driver or someone they have injured. Whether or not there is a complete shift in liability from driver to vehicle is likely to depend on whether there is a clear option for human intervention.

While the position is unclear, and as the technology develops, insurers may consider continuing to settle claims on behalf of the insured driver but then seek to reclaim the damages paid from manufacturers. While this will raise complex new liability questions, there is no reason to expect that the legal system will be unable to resolve them.

The group is chaired by David Williams, head of underwriting at AXA, and consists of representatives from 13 UK motor insurers: Admiral, Ageas, Allianz, Aviva, AXA, Co-operative Insurance, Covea, Direct Line Group, esure, LV, RSA, Zurich and the Lloyd's Market.

A spokesman for AXA, which is also a member of the consortiums involved in the driverless car projects in Bristol and Milton Keynes, said: "If, as widely predicted, semi-autonomous and autonomous vehicles reduce the number of collisions then motor premiums would absolutely reflect that."

What's more one of the government-backed driverless car trials is examining how data can best be collected and used in the event of accidents. Working out the best approach for that will be a key part of establishing a simple and straightforward insurance system which can get help to those affected as quickly as possible, says the ABI.

Vehicle emissions and traffic congestion *expected to*

By communicating with their environment and other vehicles, automated and driverless vehicles offer the promise of better use of road space, reducing congestion and providing more consistent journey times, through the use of connected vehicle technologies, says the government.

Vehicles will communicate with each other and their surroundings to identify the optimum route, helping to spread demand for scarce road space and thus journey times will become more consistent.

reduce

Vehicles could also communicate with roadside infrastructure such as traffic lights and use of that information will help to minimise fuel consumption and emissions.

One of the government's Budget 2016 announcements on driverless cars included establishing a £15 million 'connected corridor' from London to Dover to enable vehicles to communicate wirelessly with infrastructure and potentially other vehicles.

The trials will be overseen by Highways England, which is responsible for modernising, maintaining and operating England's motorways and major A roads. One of its tasks from the trials will be to start to collect real world data on performance and potential impacts on capacity and operations.

The trial will see information sent wirelessly to specially adapted vehicles on the A2/M2 between London and Kent. The on-road technology will wirelessly transmit the latest journey information directly to vehicles which, depending on the circumstances, could suggest changing lanes or taking an alternative route.

Experts have also highlighted that because of improvements in traffic flow and road safety there will be a reduction in the requirement for traffic police and road signage.

It will take many years for autonomous vehicles to become widespread so roads will continue to look "broadly familiar" and people will continue to have the choice of whether to drive a manual or automated vehicle – although for insurance reasons the former may be more expensive. Additionally, there are other users of the road space such as pedestrians, cyclists and motorcyclists.

However, experts anticipate that the roadside infrastructure will evolve as information is delivered digitally to vehicles and their occupants rather than physically as currently.

For the foreseeable future autonomous vehicles will mix with 'traditional' vehicles such as milk floats, 'normal' cars and vans, motorcycles, bicycles and classic cars and other road users so there will be little change in road design, layout and signage, according to Mr Miller.

Once automated vehicles dominate, changes could be dramatic with, for example, lane markings disappearing as vehicles are guided digitally rather than by white lines on the roads. What's more there could be a greater number of lanes on roads – five lanes taking up the same space as three lanes presently – due to the accuracy of technology guiding vehicles according to TRL academy director Professor Nick Reed.

However, some experts have suggested that autonomous vehicles could actually increase traffic congestion as demand for travel will rise as the development will open up roads to people who previously couldn't operate a vehicle.

As a result, consultancy firm Arup, which is a member of one of the government-backed UK driverless car projects, speculates:

> **In this context, the whole experience of congestion might shift dramatically: instead of feeling enraged by traffic delay and the ensuing lack of productivity, [vehicle occupants] could simply use the Wi-Fi, continue working, make calls, or engage in social media much as they would at the office or home. Congestion might not even be that much of a hassle if only because people won't experience it in the same way.**

Vehicle accessibility TO IMPROVE

'...could revolutionise transport for people who currently have difficulty getting around'

In a fully autonomous vehicle, the driver is redundant and therefore their ability to drive is irrelevant – potentially making a driving licence unnecessary.

It is therefore suggested that an autonomous vehicle could have occupants of any age with any physical impairment as a vehicle is automatically programmed to travel from A to B selecting its own route according to traffic conditions.

What's more parking would no longer be an issue as cars could drop off occupants, park where space is available and return to pick up passengers when required.

The ABI believes that driverless cars "could revolutionise transport for people who currently have difficulty getting around".

That will ultimately mean that one day there could potentially be no requirement for a driving licence with Mr Miller explaining: "If an individual is not controlling a vehicle in any way then they do not need to know how to drive and so will not require a licence. But until then a driver must be capable of operating a vehicle so will require a licence."

The government said:

When automated vehicle technologies develop to the extent that vehicles which can undertake door to door journeys without the need of a driver at all, they could improve mobility for the elderly and disabled and those without a driving licence enhancing their quality of life.

The law currently states that a driving licence is required to drive a car, but says the government: **It would seem reasonable to allow ownership or use of a fully automated vehicle without the need to hold a driving licence. If the vehicle was designed to allow the driver to elect to control the vehicle manually or to take over control of the vehicle in the event of failure of the automated systems, then it would be appropriate to require that the occupant should hold a full driving licence.**

DEMAND TO INC

The arrival of automated vehicles could drive up the popularity of car sharing and vehicle rental, depending on a future regulatory framework.

That's because the government believes that driverless car will increase "social inclusion". Hinting that mobility for people without a driving licence or access to their own vehicle could increase, gives credibility to the idea that car sharing, car clubs and car hire could all increase in popularity in a world of autonomous vehicles.

Indeed, the government predicts the word 'driver' will become redundant in a world of autonomous vehicles with occupants simply being referred to as 'vehicle users'.

What's more numerous motor manufacturers and vehicle rental companies are already preparing for the 'new world' with the launch of new mobility-focused operations that have car clubs and car sharing as their focus.

Furthermore, the government has speculated that leasing and renting, rather than ownership, could become far more prevalent in a world of autonomous vehicles thus allowing manufacturers to retain control and specify conditions, such as requiring repairs or servicing to be performed only by the manufacturer themselves, or other parties that they specify (see Page 39).

After several years of usage and wear, the autonomous vehicle could then be taken back by the manufacturer from the customer, and refurbished or dismantled and recycled.

Another option would be for vehicles to be designed on a modular basis with easily exchangeable components, using industry standard communication protocols but controlled by specific software. That could allow easy upgrading of the electronic components and software while leaving the vehicle bodywork and seating unaffected.

REASE *for* car sharing, car clubs, vehicle rental and leasing.

Meanwhile, consultancy firm Arup, which is a member of one of the government-backed UK driverless car projects, says:

> **More efficient driving patterns will free up some space, but what will really make the difference is combining automated vehicles with car sharing and new approaches to vehicle parking and maintenance.**

For example, when you've finished with a car, you wouldn't leave it parked and idle for hours. Instead, the car would drive itself straight to its next customer – according to real-time consumer demand and travel hotspots.

Widespread adoption of autonomous vehicles delivered through car sharing solutions would free up an incredible amount of space in our cities. Although it's hard to calculate precisely, conservative estimates put the amount of land in the United States taken up by surface car parks at roughly the size of Puerto Rico. And Siemens estimates that as much as 40% of inner city traffic consists of vehicles looking for somewhere to park.

> **Imagine what we could do with this space if shared driverless vehicles solved the problem of parking and reduced car ownership in cities.**

What's more Arup speculates that autonomous vehicles will accelerate demand towards mobility as a subscription service.

It says: "An autonomous vehicle subscription should be cheaper than a car lease – most of the costs will be 'shared' with other users – and offer the advantage of a choice of vehicles delivered to your door, at a time to suit. Autonomous vehicles as a subscription service could cause a paradigm shift in personal mobility."

Service, maintenance and repair costs *to reduce*

The lack of human intervention in the 'driving' of autonomous vehicles means that journeys will be smoother with incidents of harsh acceleration and braking as well as speeding confined to history.

As a result, it can be expected that vehicle operating costs will radically change. Not only will fuel economy improve and emissions reduce, but it can also be forecast that service, maintenance and repair (SMR) costs will be significantly cut as a consequence, particularly in respect of friction items such as tyres and brake parts.

Furthermore, as driver intervention becomes a thing of the past so 'bent metal' repairs as a result of crashes on the road and when making low speed manoeuvres such as parking are likely to be significantly reduced and perhaps may not occur at all.

However, according to Mr Miller future SMR costs will depend on how autonomous vehicles are engineered.

He highlighted as an example the current debate in the vehicle windscreen industry around the recalibration of cameras and radar heads after any operation that can affect the aim of Advanced Driver Assistance Systems' components. Apart from windscreen replacement that includes wheel alignment, replacement of suspension components, body repairs and even wing mirror renewal.

Recalibration is required because the cameras and sensors use the windscreen to view the road ahead and that is adding to fleet operating costs.

With a spike in windscreen costs at the moment due to the recalibrating requirement, Mr Miller said: "It is all about how vehicles are engineered. If cameras and sensors are mounted poorly they will be vulnerable to damage in a crash and that may impact on costs."

Meanwhile, the government speculates that as vehicles become more complex, there will be an increasing concern as to the ability of parties other than franchised dealers to repair them, and that is likely to have an impact on the costs of repair.

This highlights the role that organisations such as breakdown operators, fast-fit chains and independent garages play in the SMR sector, along with the European Union Access to Repair and Maintenance Information requiring that manufacturers commit to making repair information available on a non-discriminatory basis to official dealerships and independent repairers alike, and certain minimum information having to be included on websites as part of vehicle type approval, the government speculates:

> **An automated vehicle is likely to be particularly complex and utilise proprietary technology extensively so manufacturers may not wish to permit or enable repair by other parties.**
>
> **They may be concerned that their intellectual property will be stolen if they reveal programing code and they might also be concerned with the potential for those of criminal intent to gain knowledge that enables them to hack into vehicles. This is certainly a pertinent issue that will need to be addressed as automated vehicles become more prevalent.**

As a result, the current model, supported by European legislation, of fleets and consumers having a choice of where their vehicles are serviced – inside or outside of the franchised dealer network – may have to change.

Truck platooning – a group of trucks travelling safely and automatically in convoy, a short distance apart – is to be trialled in the UK.

PLATOONING

A platoon comprises at least two but no more than three trucks, although the optimum length of a convoy has to be investigated.

Platooning projects have been taking place on the continent for a number of years and recently the first European Truck Platooning Challenge was held marking the start of the next stage in launching the initiative Europe-wide.

Meanwhile, Highways England is to work with the Department for Transport and the freight industry, including truck manufacturers, to deliver platooning. A Highways England spokesman said it was too early to say where and when the trials would start, although speculation has suggested they could take place on a northern section of the M6 perhaps in Cumbria.

Insurer AXA UK, which is involved in the government-backed driverless car trials, last year published a report, 'The Future of Driverless Haulage', which calculated that autonomous HGVs could deliver nearly £34 billion in savings to companies using haulage, and potentially as high as £47.5 billion, in the 10 years after the technology had been adopted.

David Williams, technical director at AXA UK, said following the government's truck platooning trial announcement: **"Trialling truck platooning on the strategic road network is the first step to full autonomous haulage on UK roads. This will lead to lower costs and critically, a significant reduction in road accidents. Driverless technology has the potential to all but eradicate human error."**

The report also calculated that using driverless haulage vehicles could save UK households £150 a year on their grocery spend as hauliers' savings were passed on to consumers in the form of lower retail prices.

The report explained: **"If the cost of haulage decreases dramatically as a result of driverless technology, it stands to reason that the cost of many goods will also fall."**

From the road users' perspective truck platooning will not mean a new outlook on a day-by-day basis as trucks typically already drive in a row.

However, with truck platooning there can be a smaller distance between vehicles as they travel at a constant speed and accelerating and braking are synchronised making it safer for HGVs to drive close together. Additionally, platooning trucks do not overtake one another.

Human error is responsible for more than 90% of traffic accidents. With trucking, driver reaction and concentration being the critical risk factors. Truck platooning and the combination of WiFi, radar and camera systems is expected to reduce the number of road traffic accidents.

For example: if the first truck in a platoon brakes, all the following trucks will also brake in real time and at the same level; the reaction gap in the systems is almost zero.

That, says experts, has the potential to bring dramatic improvements to road network capacity and the management of traffic with improved flow and reduced accident levels all of which should cut congestion and increase safety for other road users.

A platoon determines its own speed and the distance between trucks. The HGV at the head of the platoon acts as the leader, with the vehicles behind reacting and adapting to changes in its movement. Each driver maintains control over their own truck at all times and can always take the decision to leave the platoon and continue independently. Trucks in a platoon are not subject to 'robot' control.

The Government of the Netherlands, which held the European Presidency for the first six months of 2016, hosted the European Truck Platooning Challenge.

The event's aim was to accelerate the introduction of truck platoons by putting the subject high on the agenda of European Union policy makers and to foster European cooperation between truck manufacturers, member states, logistics service providers, road operators, road and vehicle approval authorities, research institutes and governments.

The Government of the Netherlands says it wants truck platooning to be possible throughout the European Union with as many transport laws, rules and standards as possible harmonised. That, it says, will help make logistics more efficient including delivering a potential 5-15% fuel saving as well as reducing truck emissions by up to 10%.

When trucks can drive closely behind one another, fuel economy is improved as a result of the reduction in drag. Drag accounts for up to 25% of a truck's total fuel consumption and so the closer the trucks drive to each other, the greater the fuel-saving potential. Using wireless technology, trucks can drive with only about a one-second gap between the vehicles in a platoon.

While the widespread introduction of self-driving trucks will probably take several years, safety and fuel efficiency are viewed as the chief benefits ultimately enabling haulage companies to transport goods faster through fewer traffic jams as roads will be used more efficiently.

What's more, the AXA report also suggests that when platooning progressed to driverless trucks there would be improvements in vehicle utilisation as driverless HGVs would be free from the restrictions of driver working hours.

The first European Truck Platooning Challenge – and the world's first ever cross border truck platooning initiative – involved six platoons from six HGV manufacturers (DAF, Daimler, Iveco, MAN, Scania and Volvo) departing from their home base or production location and coverging on the Port of Rotterdam. The convoys platooned on motorways in normal traffic conditions, while local conditions dictated the ability to platoon for the whole route.

Violeta Bulc, European transport commissioner, said:

"This initiative perfectly illustrates the learning-by-doing principle. I have no doubt that the lessons learnt thanks to the Challenge, in terms of road safety, fuel efficiency, environment and social aspects, will help truck platooning get closer to deployment.

And it will feed our current thinking on connected, cooperative and automated driving, and therefore support our efforts towards a general roll-out of intelligent transport systems resulting in smarter roads."

Anders Kellström, project manager for Volvo's participation in the Challenge, said: "We believe that platooning offers major advantages, mainly for our customers, but also for society in general in the form of fuel savings, reduced emissions and enhanced transportation efficiency. Together with the rest of society, the transportation industry needs to tackle such challenges as the harmonisation of legislation and in so doing promote the introduction of platooning in Europe."

Steve Phillips, secretary general of the Conference of European Directors of Roads, which helped to organise the Challenge, said: "I'm fairly sure we will see this fairly routinely in the next few years in certain countries on certain designated routes.

"In terms of cross-border regular operations, I think we're probably a number of years away, unless it's on a regional basis. There's clearly some concerns from some countries about how cars in particular will enter and leave motorway junctions when these platoons are going through. The process of doing that needs to be fully worked through."

CONCLUSION:

The future of fleet

Company car and van fleet operations as we know them today will be virtually unrecognisable in a world of autonomous vehicles.

The role of the fleet manager will become far more strategic – and in many ways is already heading along that road as the 'connected car' becomes more commonplace – as they become the ultimate mobility manager.

Fleets will be among the early adopters of fully autonomous vehicles particularly because of the likely, but yet to be proven, safety benefits, according to Professor Nick Reed, academy director, TRL, and technical leader of the GATEway autonomous vehicle project.

In a world of autonomous vehicles fleet managers will continue to select vehicles as they do today, according to Professor Reed, but the management function will fundamentally change.

He said: "A single car may not be allocated to a single employee. Instead fleet managers will be looking to optimise vehicle use and they will need to know the mobility requirements of their own employees and possibly engage with other people."

That could mean, for example, sharing vehicles and thus mobility with neighbouring companies or a car taking an employee to a railway station and instead of being stationary in a car park for many hours used by other people both inside and outside of their organisation.

Professor Reed, who joined TRL in 2004 and has been a champion in the area of vehicle automation, said: "Fleet managers' key responsibility will be optimising journeys around vehicle users and making best use of mobility options – bicycle, train or automated car.

"Smarter mobility will be the future role of the fleet manager. They will become the gatekeeper to the service."

The arrival of 'connected cars' gives fleet managers robust data on every aspect of their fleet and grey fleet. That data can then be used to allocate finance to support mobility needs in the knowledge that there will be a return on investment

Some providers argue that the information available to fleet managers currently is not robust enough and not accurate enough and so uninformed decisions are being made. Data also needs de-coding, which is resource intensive.

But the advance of data means fleet managers will spend less time collating information and more time designing their fleet strategies and objectives.

What's more today's whole life cost operating model will also need to be radically reformed due to huge predicted savings in key operating areas: fuel costs as vehicles will be on 'cruise control' 100% of the time; insurance savings due to improved safety performance and fewer accidents; and SMR costs as without driver involvement vehicle wear and tear will reduce.

Additionally, depending on how the autonomous vehicle market develops, it could be that the established model for buying or leasing new vehicles is transformed with a huge knock on effect in terms of fleet vehicles 'feeding' the used car market.

Furthermore, fleets may not have their own vehicles. Instead of a car or van being parked, it could be utilised by another organisation hence a potential proliferation in vehicle rental, car clubs and car sharing.

Indeed, a number of motor manufacturers are already developing car sharing solutions with Jaguar Land Rover the most recent. It has announced the launch of InMotion, an independent start-up business that will focus on "helping customers to overcome travel and transport issues" with the creation of a range of different on-demand services including car sharing and car ownership solutions.

With technology changing the way people travel and providing access to vehicles at the swipe of a screen, more and more people are looking for ways to improve their commute to work or to access the car they want, when they want to, says Jaguar Land Rover.

Professor Reed said: "Fleet managers will have the flexibility to offer employees the most appropriate vehicle for their journey. Vehicle utilisation will improve and operating costs will reduce."

Indeed the Organisation for Economic Co-operation and Development (OECD) has predicted that autonomous vehicle fleets will ultimately deliver the same mobility with 70% fewer vehicles, but they will travel further than currently.

Additionally, there has been speculation that employees will become more productive as they will be able to work in their cars en-route to work and meetings instead of undertaking the driving task.

The OECD figure may or may not be correct but there is no doubt that improving fleet optimisation will be critical in ensuring that autonomous vehicles – which will almost certainly initially be more expensive than today's vehicles due to their costly functionality – have a positive impact on pollution and congestion, as well as potentially creating significant operating savings for fleet managers.

As Professor Reed said: "The next five years will see more changes than the last 50 years. We are working very hard and undertaking a lot of research to understand the future landscape and how it will work."

It maybe 15-20 years before autonomous vehicles have the capability to complete every single journey undertaken today, with the transformation taking place at different rates in varying environments starting with slow-moving urban journeys, lengthy monotonous journeys and platooning.

Much of the impact on the way autonomous vehicles will impact on peoples' mobility and fleet operations maybe speculative, but one thing is certain that change is coming because driverless cars, vans and trucks are the future.

Sources:

AXA UK: The Future of Driverless Haulage – http://www.axa.co.uk/newsroom/media-resources/resources-and-publications/

British Vehicle Rental and Leasing Association: Fleet Technology White Paper – http://www.bvrla.co.uk/sites/default/files/u43/fleet_tech_congress_white_paper.pdf and Policy Paper: Intelligent Mobility – http://www.bvrla.co.uk/2016-policy-papers

Department for Transport: Driverless Cars in the UK: a regulatory review – https://www.gov.uk/government/publications/driverless-cars-in-the-uk-a-regulatory-review

Fleet Industry Advisory Group: Telematics Explained – The Fleet Industry Advisory Group guide – www.fiag.co.uk

Frost & Sullivan: Strategic Outlook of Global Autonomous Driving Market in 2016 – http://ww2.frost.com/news/press-releases/growing-acceptance-autonomous-driving-allows-growth-opportunities-and-prompts-automobile-oems-develop-new-business-models/

KPMG and the Society of Motor Manufacturers and Traders: Connected and Autonomous Vehicles – The UK Economic Opportunity – http://www.smmt.co.uk/2015/03/connected-and-autonomous-vehicles-the-uk-economic-opportunity/

Morgan Stanley: Autonomous Cars: Self-Driving the New Auto Industry Paradigm – http://www.advancedmobilityproject.org/report-autonomous-cars-could-save-5-6-trillion-per-year/

Strategy&: Connected Car Study 2015: Racing ahead with autonomous cars and digital innovation – http://www.strategyand.pwc.com/reports/connected-car-2015-study

Venson Automotive Solutions Ltd
Venson House
1 A C Court
High Street
Thames Ditton
Surrey KT7 0SR
Tel: 08444 99 1402

www.venson.com

email: sales@venson.com

@venson_Fleet