Introduction

Deloitte welcomes the opportunity to contribute to the House of Lords Science and Technology Committee’s inquiry into autonomous vehicles.

Deloitte works with central and local government transport bodies in the UK and around the world, as well as with private sector companies in both the automotive and technology sectors.

Deloitte’s submission draws on the thought leadership published and the work done on behalf of its clients, which includes central governments, local governments and businesses. This submission also draws on research conducted by Deloitte’s US member for client use. Full access to Deloitte publications on the topic can be found at: http://dupress.deloitte.com/dup-us-en/focus/future-of-mobility.html

1. What are the potential applications for autonomous vehicles?

1.1 Deloitte envisions that potential applications for autonomous vehicles will be widespread. Naturally the primary focus of the debate around autonomous vehicles has been on vehicles moving people and goods from place to place, especially in ‘last-mile’ delivery of people and goods in urban areas. However, they could also have much wider applications, such as transporting materials that might be dangerous to human drivers or operating in potentially hazardous environments, such as in mines or where toxic materials are present.

1.2 The most important application, in our view, will be as part of a mobility ecosystem that incorporates multiple modes of transport. Deloitte sees driverless vehicles playing a key role in larger trends that address population growth and rising urbanisation, promote asset efficiency and road safety, and reduce the environmental costs of more people and goods travelling from place to place.

1.3 Deloitte believes that change will happen unevenly, with different populations requiring different modes of transportation—which means that four future states may well exist simultaneously. Transport systems will need to factor in that different technologies may be in use on the same roads and the same time. These states are set out in the graphic below and range from driver owned and driven vehicles, where we are at the moment, through to shared ownership and machine driven vehicles.
2. What are the potential user benefits and disadvantages from the deployment of autonomous vehicles?

2.1 Deloitte’s research and insights to date have identified the following as potential benefits from a shift to autonomous vehicles:

a) Increased road safety: Autonomous vehicles remove human error which is the largest cause of most accidents.

b) Improved traffic management: guidance systems permit real-time awareness of congestion and sensors allow for less space between vehicles.

c) Traffic-related law enforcement decreases: autonomous vehicles are programmed not to exceed speed limits or otherwise violate traffic laws.

d) Productivity increases: there are fewer cars in circulation as asset utilisation increases. Users riding in autonomous vehicles are freed from the need to watch the road, thus allowing more time to spend on productive pursuits.

e) Reduced parking demand: the rise of autonomous-drive and car sharing models diminish need for parking space.

f) Energy demand drops: smaller mass and weight allow cars to be propelled by more compact, efficient, and environmentally friendly powertrains.

g) Speed of deliveries quickens and costs decrease: fully autonomous networks of long-haul trucks could operate for more extended time periods and cover longer distances with lower labour costs.

h) Infrastructure costs funded by charges for actual usage: connected-car technology allows systems to precisely calculate personal road use.
i) Trip costs decline: Deloitte research in the US has forecast that the average cost per passenger mile could drop from $1 per mile today to approximately 30¢ per mile, thanks to dramatically higher rates of asset utilization.

j) Expanded mobility access: Independent mobility for low income and non-drivers as costs decrease and transport becomes cheaper to operate over time. Mobility would therefore become a service.

k) New business ecosystems are created: the spread of transportation technology and social trends will open up growth opportunities and employment in various sectors. Further details are set out in the response to Question 3.

2.2 Deloitte’s research has also identified the following potential disadvantages to autonomous vehicles:

a) High initial costs delay adoption: infrastructure will need to be made fit for purpose to accommodate smart technologies. The cost per vehicle at the outset will likely be high and thus less widely adoptable in the early stages.

b) In addition to the infrastructure requirements (as described below) the government will need to formulate policies to deal with the increased electricity demand that autonomous vehicles would require. Research by Bloomberg New Energy Finance has suggested that the rise in electrical vehicles could add 8% to global energy demand by 2040.1

c) Security/data breaches: further details on this are set out below in response to Question 12.

d) Public sector finances suffer: traditional means of revenue – such as fuel duties, licensing costs, traffic enforcement, tolls and public parking fees – could diminish.

e) Disruption/dislocation to existing business models: autonomous vehicles could see changes to current employment models, impacting a wide range of employers and workers. For example, there is a large support network established in terms of hotels and maintenance services for HGV drivers that could be impacted by a widespread move to autonomous lorries.

f) Initial rise of safety problems: humans will need to learn how to interact with driverless vehicles, as passengers in other vehicles and as pedestrians and cyclists.

g) Change in driver skills: Operating autonomous vehicles will also require different or additional skills and hence additional driver training.

h) Technological limitations delay adoption: sensors must function in all weather and 3D mapping must be widely available.

i) Regulations and legislation do not keep up with technological advancements.

3. How much is known about the potential impact of deploying autonomous vehicles in different sectors?

3.1 Deloitte has not conducted analysis of the impact of the automotive sector specifically in the UK but colleagues in the United States have estimated that the automotive industry’s extended value chain generated $2tn in revenue in 2014—11.5% of US GDP. This extends across multiple sectors of the economy and includes areas not typically regarded as ‘automotive,’ such as the media industry, which generates advertising

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revenues through in-car radio, and the financial services sector, who market financial packages to drivers.

3.2 On this basis, Deloitte US has considered how various sector could be impacted by the deployment of autonomous vehicles with the following observations:

a) Automotive: Decrease in personally-owned vehicle sales and increase in fleet vehicle sales.

b) Energy: Decreased energy consumption from improved vehicle efficiency.

c) Finance: Growth in fleet financing in place of automotive loans and leasing.

d) Media: Increasing consumption of multimedia and information due to time not driving.

e) Medical & Legal: Reducing costs for emergency medical services and related legal fees because of fewer accidents.

f) Public Sector: Eroding tax revenues related to property and fuel taxes, vehicle registration, and traffic citations.

g) Retail: Increasing sales due to increased mobility of hard to reach demographic groups, such as elderly people.

h) Telecommunications: Additional bandwidth requirements to meet increased demand for connectivity and reliability.

i) Technology: Emergence of autonomous drive operating systems providers.

j) Transportation: Substitution of demand for traditional taxis, limos, and rental vehicles with shared fleet vehicles.²

3.3 Where applicable, a number of these trends could similarly affect these sectors of the UK economy.

10. Will successful deployment of autonomous vehicles require changes to digital or physical infrastructure?

10.1 Infrastructure will need to be at least maintained to a high standard, if not enhanced with ‘smart’ technologies, to allow autonomous cars to operate safely.

10.2 Driverless cars rely on on-board cameras, sensors and lasers to determine their location in relation to other objects. They require well-paved roads, clear signage, lane markings, and entry and exit points.

10.3 Connected cars require infrastructure to be ‘smart’ to enable vehicles to interact with other vehicles, the physical infrastructure and external factors such as pedestrians and cyclists.

10.4 From a digital perspective, there would need to be an extensive roll out of fibre optic networks capable of 5G wireless broadband. Full automation is highly likely to require ‘server-level’ processing capability within cars to enable frequent and timely communication.

10.5 Sensors will need to be embedded at intersections, on motorways, and in traffic lights, road signs, parking places and other spots. High-definition 3D mapping of most major infrastructure—more detailed than GPS—would need to be layered on top of existing maps and include factors such as the location of lanes, stop lines, guardrails, and the shapes of buildings, for example. Any changes in conditions can be updated in real-time through the 5G networks, then stored in the cloud and accessed via the vehicles’ telematics.

10.6 The private sector players have taken the lead on mapping, with a number of technology and automotive companies expanding their mapping operations or partnering on new initiatives. The government can assist this to speed up the adoption of autonomous cars and generate competition among data providers, who will be major players in the new transportation landscape.

10.7 Most autonomous vehicles will be electrified and will therefore need a denser network of charging stations. As an example, Germany is expected to have just over 1 million charging stations by 2020, while the UK currently has around 12,500.

10.8 Longer term, a transition to autonomous vehicles as a major part of mobility would entail a rethink of how roads, residential, retail and office areas are designed.

11. How might a move from current levels of highly automated vehicles to their extensive deployment best be managed? What do you see as the key milestones?

11.1 The key milestones will come as a series of waves, part of the technology adoption cycle. Following the Society of Automotive Engineers (SAE) definition of automation, Deloitte uses five levels when thinking about autonomous vehicles, ranging from no automation (level 0) to driver assistance (1), partial automation (2), conditional automation (3) and high automation (4), through to full automation (5).

11.2 Most cars currently in use have little automation or driver assistance, some have elements of partial automation, but few have more advanced technology than this. As technology becomes more robust in the coming years, Deloitte would expect to see larger percentages of cars with more advanced levels of automation.

11.3 Research by Deloitte’s US team has forecast that driverless cars for shared use will make up 10% of US sales in 2030, 25% in 2035 and 50% in 2040. The research envisions initial roll-outs of fully autonomous vehicles to be shared fleets within contained areas in restricted urban or suburban settings. Sales of personally-owned autonomous vehicles may follow, but are expected to be adopted at a slower rate.

11.4 The government can set safety standards, require cars to come equipped with the latest driver assistance features and offer scrappage incentives (such as the HM Treasury Plug-In Car Grant) for owners of older models to trade in for newer models.

3 http://www.sae.org/misc/pdfs/automated_driving.pdf
Through such measures governments can speed up the number of cars with at least partial automation on the street.

11.5 Modelling the rate of adoption in the United States, Deloitte’s research envisioned that 50% of cars in circulation by 2022 would have at least some form of driver assistance, if not more advanced automation technology, and that fully driverless cars could be on the roads from 2025. However, with quicker adoption, the research also demonstrated that 45% could have high or full automation by 2040, with autonomous vehicles in use from 2021, with a faster replacement cycle of older vehicles.

11.6 Other milestones are extensive roll-outs of ‘smart’ infrastructure, such as embedded sensors, 5G networks, and detailed 3D maps of most roads. Conditional and high automation, unless contained within set geographic areas, will likely require extensive interactions between the vehicle and the physical infrastructure.

11.7 Deloitte’s US research expects a two-pronged approach the deployment of autonomous vehicles on a mass scale. There will be ‘geo-fenced’ areas where most or all vehicles in circulation are autonomous, such as shopping high streets or specific commuter corridors. The rest of the roads will see human-driven and autonomous vehicles ‘cohabiting’ until the majority of the cars in circulation are fully autonomous.

12. Does the Government have an effective approach on data and cybersecurity in this sector?

12.1 The government is in the process of assessing its approach to data and cyber security in this sector, with an eye to formulating more detailed policies in the near future. Through the work Deloitte has done with other national regulatory bodies, we believe that any approach should encompass the following:

   a) Creation of an information sharing centre: Its main role would be to collaborate with security experts, researchers and privacy professionals to actively develop and distil best-practice. It should coordinate efforts of any organisation whose remit touches on autonomous vehicles, such as the Automotive Council, the National Cyber Security Centre (NCSC), the Centre for Connected and Autonomous Vehicles (C-CAV) and Euro NCAP.

   b) Establish national data protection standards and regulations: the government should create an automotive cyber security rating system (like US NHTSA) to establish rules and guidelines for the safe development of new systems and develop imminent hazard protocols in the event of cyber security vulnerabilities or safety threats.

   c) Verify security design: The government needs to assess compliance with standards and enforce software verification and updates. It will need to perform its own security tests to check for cheating software (e.g. used to influence test results) or unwanted data capture.
d) Inform end-users: as part of the standards it establishes, the government can create the guidelines for a “cyber dashboard” that informs drivers about how well the vehicle protects drivers’ security and privacy beyond the minimum established standards. As part of its Responsible Disclosure mandates, it can create a list of (significant) components per car and their vulnerabilities.

e) Have independent parties verify the security: the approach should leverage specialist expertise to conduct security tests to identify and address vulnerabilities in software and firmware, such as through ‘bug bounty’ programs whereby people are incentivized to find and report flaws.

13. Are further revisions needed to insurance, regulation and legislation in the UK to create an enabling environment for autonomous vehicles?

Insurance
13.1 Once autonomous vehicles are widely adopted, the motor insurance industry is likely to shrink—there will be fewer cars on road to insure, fewer of them will be personally owned and more of them will have advanced safety features, so there will be fewer accidents. This means a decrease in the motor insurance market size. More of the business will shift from personal lines to commercial lines, currently about 80/20 and expected to flip to 30/70 by 2040.

13.2 Insurance will focus on covering product liability—the vehicles, rather than the driver, will become the source of the accident—or misuse of data/personal privacy violations. More non-traditional players will seek to enter this market, leveraging their direct relationship with consumers and their advantages in data and analytics. The government will need to set prudential standards for the new entrants.

Regulation
13.3 One of the key enabling factors for the successful safe adoption of autonomous vehicles in the UK is having a citizenry that is trained and competent in operating such vehicles.

13.4 The current framework to drive a car/motorcycle/heavy goods vehicle is based on individuals passing a one-off theory and practical test set by the DVSA with no subsequent interactions with the government on driving competency unless it is for disciplinary reasons, such as having to take a driver awareness course.

13.5 Therefore, after passing their driving test, individuals can spend a lifetime of driving without receiving any formal training on new technological developments in vehicles that could impact upon driving competency. Even the current system of driver testing does not examine correct use recent technological developments such as automatic braking, assisted parking and lane change assistance, which are commonplace in newer cars.

13.6 As autonomous vehicles become more common, even if the practical and theory tests are updated to accommodate the new skills required to operate these for new drivers,
there will be large numbers of older drivers who will not have been formally trained to operate autonomous vehicles. Assuming a separate licence to operate autonomous vehicles is not required, this could result in many drivers purchasing and operating autonomous vehicles without having had any formal, dedicated training.

13.7 The extent to which this is a road safety risk will depend, in large part, on whether operating autonomous vehicles is fundamentally different to operating non-autonomous vehicles. If there are key differences, and different or additional skills are required, there may be a public safety argument to requiring drivers either to have additional training before they operate an autonomous vehicle or having additional training whenever they have to renew their licence. This additional training could be provided by vehicle manufacturers (as a means of stimulating demand) or by other third parties.

13.8 Agencies such as the DVSA and DVLA will need to work closely with autonomous vehicle manufacturers to understand the skills sets required to safely operate them and the most effective touch points to use to reach out to drivers.

Legislation
13.9 Laws will need to be enacted to define negligence and determine penalties for cybersecurity and privacy breaches.

15. What does the proposed Modern Transport Bill need to deliver?

15.1 A range of issues need to be addressed in any transport bill that covers autonomous driving. These include regulation of data recording, sharing and protection; safety systems; post-crash procedures; liability; education and training; and insurance, among others.

15.2 The US is seen to be the furthest ahead in terms of developing automated vehicle legislation. In September 2016, the US Department of Transportation issued comprehensive guidelines for federal policy for automated vehicles. These guidelines establishes expectations of industry by providing detailed performance guidelines that manufacturers, suppliers, and other entities should follow when designing, developing and testing autonomous vehicles, prior to commercial sale or operation on public roads; ensures a consistent national framework that delimits where new issues fit within the existing federal/state structure and provides states with model policy guidelines; reaffirms motor vehicle safety agency’s existing regulatory tools and provides instructions, practical guidance, and assistance to entities seeking to employ those tools, and identifies potential new tools, authorities and regulatory structures that expedite deployment of new technologies by enabling the agency to be more nimble and flexible.

26 October 2016