SmarterUK – Written evidence (AUV0089)

About SmarterUK

SmarterUK is the national champion for smart infrastructure development. We bring together companies from across the smart infrastructure value chain. Our vision is to connect parts of the UK economy on the cusp of the 'smart' revolution. In doing so, we hope to drive the uptake of solutions that will deliver a sustainable, low carbon transition that provides value to UK Plc and its citizens.

SmarterUK is a techUK initiative. techUK is the UK’s leading technology trade association, representing more than 900 companies which collectively employ approximately 800,000 people, about half of all tech sector jobs in the UK. These companies range from leading FTSE 100 companies to new innovative start-ups. The majority of our members are small and medium-sized businesses.

Executive Summary

SmarterUK welcomes the opportunity to respond to the House of Lords Science and Technology Committee inquiry into Autonomous Vehicles.

It is correct to identify the difference between Connected Vehicles and Autonomous Vehicles (CAVs). The two are not necessarily the same, nor even reliant on each other. However, it is the combination of the two technologies that are likely to unlock the full potential of both. This response will generally therefore refer to Connected and Autonomous Vehicles. We will be explicit where we will deal with either technology in isolation.

The UK has the potential to become a world leader in developing, producing and deploying CAVs. Major economic benefits come with higher levels of connectivity and autonomy. With almost 90% of new car sales expected to be connected by 2020, the SMMT estimate that CAVs will deliver a £51 billion1 boost to the economy, creating 320,000 additional jobs, and reducing serious road traffic accidents by more than 25,000 a year by 2030.2 The increased safety that will be a key feature of CAVs will also have a positive economic impact. Globally, the economic cost of crashes is estimated to range from 1% of GNP (low income countries) to 2% of GNP (high income countries).3

The deployment of autonomous vehicles will also lead to shift in how we view public and private transport. Not only will it enable greater mobility for those groups within society who currently have limited options; such as children, the elderly, and the disabled, increasing the welfare of these demographics; but it will also lead to a shift in business and delivery models, with citizens, particularly in urban areas, moving towards ownership models driven by the sharing economy (i.e Mobility-As-A-Service).

1 KPMG 2015
2 http://www.smmt.co.uk/2015/03/connected-and-autonomous-vehicles-the-uk-economic-opportunity
These new business models offer opportunities for more intelligent, reactive transport, supporting better transport planning within cities, reducing congestion and subsequently improving air quality. They also offer the opportunity for increased deployment of electric vehicles with individual costs reduced through shared access ownership models. The increased deployment of electric vehicles also opens up new models of energy supply/demand with vehicles offering power storage capacity.

These opportunities will however bring with them known and emerging new challenges that can only be mediated and shaped with Government, wider society and industry working together to address them.

A comprehensive and stringent testing environment is of critical importance. It will serve to ensure both that CAVs are as safe as possible, including from cyber-attack where an end-to-end systems approach needs to be taken to minimise and protect attack vectors to critical systems, and to build the public’s trust in them, without which the UK market will stall.

Surveys on public attitudes to autonomous vehicles are generally positive, with 71.8% believing that they would have a positive impact on everyday commuting, and a quarter believing that the biggest advantage will be fewer accidents\(^4\). However there are a number of deep-seated reservations related to unwillingness to give up control, and the ability of autonomous vehicles to integrate into the ‘social space’ that is the road.

The UK road network also has deficiencies in the connectivity and general infrastructure required to support both autonomous vehicles and driving. Significant differences between rural and urban areas, including the availability of data, will impact the availability of services and potentially limit the effectiveness of vehicles. More needs to be done to understand the impact of these differences and appropriate action must be taken early to address challenges.

Government will need to address these issues alongside promoting policy and regulatory regimes that keep pace with technological development. It is important however that at this time the UK does not move too quickly to introduce legal or legislative requirements on an industry and sector that is very nascent and developing.

**SmarterUK’s Response to the Committee’s Areas of Interest**

**Impacts and benefits**

1. **What are the potential applications for autonomous vehicles?**

1.1 There are a variety of applications for autonomous vehicles. Sectors which stand to benefit considerably from deployment are

- public transport,

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\(^4\) Imperial College, [Fewer road accidents biggest benefit of driverless cars](https://www.imperial.ac.uk/media/imperial-college/medicine/ioms/air-quality/01_safety_analysis.pdf), June 2016
• private motoring and mobility
• logistics,
• agriculture,
• and in manufacturing.

These benefits also apply equally to connected vehicles.

2. What are the potential user benefits and disadvantages from the deployment of autonomous vehicles?

Advantages

2.1 The deployment of autonomous vehicles will lead to a shift in how we view public and private transport. Not only will it enable greater mobility for those groups within society who currently have limited options; such as children, the elderly, and the disabled, increasing the welfare of these demographics; but it will also lead to a shift in business and delivery models, with citizens, particularly in urban areas, moving towards ownership models driven by the sharing economy (i.e Mobility-As-A-Service).

2.2 These new business models offer opportunities for more intelligent, reactive transport, supporting better transport planning within cities, reducing congestion and subsequently improving air quality. They also offer the opportunity for increased deployment of electric vehicles with individual costs reduced through shared access ownership models. The increased deployment of electric vehicles also opens up new models of energy supply/demand with vehicles offering power storage capacity.

2.3 It is expected that autonomous vehicles will contribute to enhanced productivity. This includes industrial productivity through enhanced energy efficiency and just in time delivery through to professional productivity with people freed from having to control the vehicle using time in transit for other tasks. It was estimated that in 2015 £4.5 billion was lost in lost working hours due to congestion.5

2.4 Autonomous vehicles will also offer enhanced safety for road users, minimising the instance of car accidents resulting from human error. Driver error is believed to be the main reason behind over 90% of all crashes.6 In 2014 44% of road accidents in the UK were caused by a failure to look properly.7 Government backed policies such as Sweden’s Vision Zero,8 and the introduction of increasing automation through Advanced Driver Assistance Systems (ADAS) have already gone some way in minimising road traffic accidents, and it is anticipated that as we move towards full deployment and level 4 and 5 automation9 there will be further decreases. The SMMT estimate that CAV’s will reduce serious road traffic

5 https://www.lexautolease.co.uk/assets/Lex%20Autolease%20Report%20Motoring%202015_Interactive.pdf
6 http://deepblue.lib.umich.edu/handle/2027.42/64993
8 http://www.visionzeroinitiative.com/
9 http://www.sae.org/misc/pdfs/automated_driving.pdf
accidents by more than 25,000 a year by 2030.\(^{10}\) Increased safety will also have a positive economic impact. Globally, the economic cost of crashes is estimated to range from 1% of GNP (low income countries) to 2% of GNP (high income countries).\(^{11}\)

2.5 This increased safety, added to increased intelligence CAV’s will provide will impact the insurance industry. Allowing for better assessment of risk and as such leading to real-time insurance, which can lead to overall lower premiums for customers.

Disadvantages

2.6 A possible disadvantage of autonomous vehicles, particularly during initial rollout, will be related to skills. Current licence conditions will need to be adjusted to account for different levels of driving ability, similar to current procedures for manual and automatic vehicles. Until we reach level 5 autonomy, drivers will still need to be able to take control of the vehicle in certain situations. This will require drivers to have both traditional skills, in addition to the new skills needed to drive in an autonomous world.

2.7 Currently CAV technology is a luxury and with 15-year churn rates there is a risk that some people will be left out until new models of ownership fully take hold and/or mechanisms are put in place to support those who cannot afford to upgrade to newer, smarter vehicles. To achieve this, there will also need to be consistency amongst manufacturers, ensuring that a minimum level of automation is available to all.

2.8 During initial rollout there is a risk of adding a layer of complexity that doesn’t currently exist. By integrating autonomous vehicles into the ‘social space’ of the road, road users will need to navigate different types of vehicles, which may react differently. From a risk perspective a long term car mix of semi-autonomous, fully autonomous and legacy ‘dumb’ vehicles will lead to new types of danger. Non-autonomous vehicles with their human intuitive element will remain unpredictable compared to autonomous vehicles.

2.9 A further disadvantage of CAVs relates to increased cyber security vulnerabilities. However by addressing these security risks during initial development and ensuring due-diligence during system integration and upgrades these vulnerabilities can be minimised. An opportunity now exists for future technology installations to learn from prior mistakes, such as those experienced with blue tooth infotainment systems, as well as take advantage of new solutions such as satellite communications, which can play an important role in the connectivity and autonomy of intelligent cars with software updates and machine-to-machine (M2M) communications.

2.10 Finally it must be acknowledged that the deployment of autonomous vehicles will result in job losses for those who are currently engaged in roles that are linked to vehicle ownership and use. This will arise not only from changes in how vehicles are operated but also from a potentially reduced number of vehicles on the road. This will include those

\(^{10}\) [http://www.smmt.co.uk/2015/03/connected-and-autonomous-vehicles-the-uk-economic-opportunity](http://www.smmt.co.uk/2015/03/connected-and-autonomous-vehicles-the-uk-economic-opportunity)

employed in logistics, public transport, manufacturing and related services such as MOT servicing.

2.11 The challenge in any area that is disrupted by technology is how to mitigate the impact of job losses. This needs to be focused on retraining and where appropriate up-skilling. But just as the past 150 years have seen incredible leaps in technology and disruption the overwhelming evidence points to innovation creating far more jobs than they destroy\textsuperscript{12}.

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

3.1 The impact of Connected and Autonomous Vehicles (CAVs) is hard to fully understand. They are likely to revolutionise our concept of mobility. Its impact on the automotive industry, in particular, will be significant. Jobs and growth will abound. With almost 90\% of new cars expected to be connected by 2020, the SMMT estimate that CAVs will deliver a £51 billion boost to the economy, creating 320,000 additional jobs, and reducing serious road traffic accidents by more than 25,000 a year by 2030\textsuperscript{13}. Most of these benefits accrue from the increases to productivity accrued by users who experience a step-change in the ease at which they can travel.

3.2 However, they will also have a disruptive impact across a range of sectors as diverse as agriculture, enterprise, social care, insurance, public transport, and the structure of cities, if consumer adoption of Mobility-As-A-Service results in greater utilisation of vehicles and a reduced need for parking outside offices or shopping and entertainment facilities. More needs to be done to understand the negative impact autonomous vehicles and accompany service models will have on those whose employment is linked to current forms of vehicle ownership and use.

3.3 To look at agriculture, connected tractors – linked to the cloud-enabled data analytics and GPS controlled – could be a significant stepping stone to a smart agriculture revolution. Even on their own they can help reduce fuel costs and soil erosion and increase yields, leading to over £1500 annual savings for the average UK farm\textsuperscript{14}. In the longer term automation may lead to changes in the efficiency and operating models of other industries – for instance automated freight could change the delivery methods and systems of retailing. In a city such as London scheduled deliveries may be shifted to night-time as a means of reducing congestion and fuel costs, which would have a knock on impact for a 24-hour service economy. Autonomous vehicles also offer an opportunity for high-risk industries such as mining where companies, who in the face of falling commodity prices, are looking for ways to dramatically reduce overheads costs whilst still maintaining site safety and integrity.

4. How much is known about public attitudes to autonomous vehicles?

\textsuperscript{12} https://www2.deloitte.com/uk/en/pages/finance/articles/technology-and-people.html
\textsuperscript{13} KPMG, Connected and Autonomous Vehicles – The UK Economic Opportunity, March 2015
\textsuperscript{14} Nesta, Precision Agriculture, October 2015
4.1 Surveys on the public’s attitudes to autonomous vehicles are generally positive, with 71.8% believing that they would have a positive impact on everyday commuting, and a quarter believing that the biggest advantage will be fewer accidents.\textsuperscript{15}

4.2 Research has however identified a number of deep-seated reservations related to unwillingness to give up control, and the ability of autonomous vehicles to integrate into the ‘social space’ that is the road. 34% of road users agreed that they did not like the idea of mixing human drivers and autonomous vehicles.

4.3 Research has also shown a correlation between ‘driving sociability’ and ‘openness to autonomous vehicles’. Those road users who were more cooperative were less open to autonomous vehicles, whilst 64% of combative road users were more comfortable with the technology.\textsuperscript{16}

4.4 As with any technology development it is critically important to build and retain public trust in it in order to drive widespread adoption. Focusing simply on the benefits of increased safety, lifestyle enhancements or economic efficiencies will not give autonomous vehicles the required traction unless they fit within the public’s idea of what they should be like to drive on. That is why we support the inclusion of work around public attitude into UK pilots in London, Coventry, Greenwich and Milton Keynes.

5. What is the scale of the market opportunity for autonomous vehicles?

5.1 The market opportunity for autonomous vehicles in the UK is significant, with a variety of applications providing benefit across the economy. It is likely that the market for autonomous vehicles will develop in two phases with enterprise applications being realised ahead of consumer. In addition there will be levels of scale within each market. Deployment will be driven by a variety of needs such as efficiency, cost savings, and enhanced service delivery. In addition the environment in which the vehicles are deployed will have an impact on timing. There is added complexity to deployment on public highways meaning applications where vehicles are using private roads within confined tracks/purposes such as within factory grounds are already in use.

5.2 There remains however a need to invest in infrastructure and the additional services, which will provide the future of driving tomorrow – both in a consumer and commercial sense. The insurance and legal industries will also need to have time to respond, adjusting, for example, approaches to liability to fit new classifications of driver or product liability. Given the additional role of software in this ecosystem clarity is needed for all parties on who is liable for what, and when. Including when, if at all, third party actions void liabilities.

5.3 Further an overhaul of how OEMs, suppliers, and technology companies operate, separately and together, within the emerging business ecosystem will be key. Companies will need to reassess the strategies they use to create value, the capabilities needed to carry out those strategies, and even the corporate cultures that underpinned their traditional,

\textsuperscript{15} Imperial College, \url{Fewer road accidents biggest benefit of driverless cars}, June 2016

\textsuperscript{16} London School of Economics and Goodyear, \url{Think Good Mobility Survey}, 2016
5.4 There is a need for OEMs and industry, particularly insurers, to come together under common standards for data access, usage and security.

Creating an enabling environment

Research and development

6. Is the scale of current and planned demonstration facilities for autonomous vehicles sufficiently broad and ambitious?

6.1 The UK has a good market for the testing of CAV systems with projects looking at connectivity, automated performance, interoperability\(^{17}\) and real world testing.\(^{18}\) In addition facilities such as those at Warwick enable the testing of real-world robustness and usability of any vehicle or prototype.

6.2 Technology neutrality is important in ensuring innovation so it is imperative that a variety of different connectivity solutions are tested. Currently the European Commission strongly promotes a hybrid connectivity model (cellular + ITS-G5) which industry are looking at especially for safety related use cases. Ideally it would be very beneficial for industry if the facilities allowed testing of the ITS service(s) with different radio access technologies running in parallel. This approach would allow industry to compare their performance, validating theoretical simulation results. It could also allow the testing of novel services which will require a hybrid based approach in the future.

6.3 It is also important that the facilities enable the testing of additional connectivity options such as satellite-based networks. Satellite-based communications can help reduce the attack surface, minimising the number of ‘entry points’ and ‘exit points’ and enhancing system integrity. When these systems are attacked they also offer a global and unified response which can be seen as attractive to automotive companies. Further benefits of satellite communications include global coverage, which is fundamental to achieve truly pan-European services. Immediate full coverage, which combined with a complementary ground network ensures vehicles are connected everywhere. Additionally, it means that a larger users’ base can immediately access the service, ensuring a better market penetration.

6.4 To build consumer trust it is important that vehicle systems are robust and vulnerabilities to cyber-attack or system failures are limited. In addition to testing which looks at the use of vehicles on roads sufficient focus must also be placed on testing security and developing minimum standards.

6.5 A further consideration for Government when planning future demonstrations should be an understanding of how vehicles are driven within the UK. This includes an assessment of

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\(^{17}\) Facilities such as those operated by Millbrook and Hiroba Mira

\(^{18}\) LUTZ Pathfinder, Volvo’s Drive Me London
the impact vehicles will have on mobility in rural areas. Currently testing is focused on urban centres, despite a significant proportion of miles being driven outside of these areas. To fully realise Government’s ambition significant investment in rural infrastructure will be key. More needs to be done to fully understand the requirements and business models however. As stated in the Exec summary, the connected and autonomous aspects of vehicles are not necessarily dependant on each other but without the connected element an autonomous vehicle in an area of poor coverage would presumably have restricted services. Current testing does not sufficiently analyse how infrastructure should be built and who pays the bill.

6.6 Finally testing needs to keep pace with technology development, in particularly AI and related ethics development work. These will be fundamental to ensuring we can actually deliver and deploy autonomous vehicles.

7. Is the Government doing enough to fund research and development on autonomous vehicles, and to stimulate others to do so? Should it be doing more to coordinate UK actions?

7.1 No answer.

8. How effective are Innovate UK and the CCAV in this area?

8.1 InnovateUK and CCAV have been an important contributor to the success of the UK so far in developing a market for CAV technologies. CCAV have been fundamental to shaping the environment within which we view autonomous vehicles, publishing a number of documents that have moulded the regulatory and market discussion. InnovateUK and related catapults have played an important role in building R&D capacity, supporting innovation not just in technology but also in standards.

8.2 However there is a risk that pilots and projects currently underway in the UK may not join up. InnovateUK will need to understand how projects like those in Milton Keynes and Greenwich link up, not just together, but also with those undertaken by private consortiums to ensure that what is being demonstrated can actually be scaled up. As projects are still in their early days this is hard to capture however it will be fundamental to ensuring long-term success and growth.

9. Is the environment for small and medium-sized enterprises (SMEs) working in this sector sufficiently enabling?

9.1 More could be done to support start-ups and SME’s within the market. The creation of accelerators targeting specific sectors, similar to Cylon, could help grow and develop the CAV ecosystem. Creating an effective market of companies with sufficient expertise to drive the agenda forward.

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19 Road Traffic Estimate: Great Britain 2015

20 BSI CAV Standards Scoping Project
Real world operation

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

10.1 It is expected that autonomous vehicles won’t need to be connected all of the time in order to operate safely, but they will still have connectivity requirements which will challenge the current coverage on UK roads where, even major roads maintained by Highways England.

10.2 Government and industry must work together to utilise existing assets to increase this coverage to ensure that connected and autonomous vehicles deliver their full benefits to users. This is a complicated area but will likely require a mix of technologies.

10.3 See also answer to question 3.

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 To support a move from current levels of autonomy to extensive deployment, Government needs to undertake continuous review of the regulatory framework, ensuring change keeps pace with the technology, as well as enabling and accelerating underlying support infrastructure such as Smart Highways and Smart cities.

11.2 A UK Standards body should govern a rolling programme reviewing standards and regulation in line with international developments. This should feed into updates of the Modern Transport Bill

11.3 Universally agreed minimum and maximum technical requirements for different levels of advanced driver assistance systems and automated driving systems. Alongside universally agreed and easily understood consumer-friendly definitions will encourage a smoother transition to extensive deployment.

11.4 As mentioned elsewhere in this submission there is a need to update driving test protocols to reflect the different skills required for different level of automation. Managing this at an early stage will be important in ensuring vehicles can actually be used by the general public.

11.5 Geo-fencing deployment of autonomous vehicles with controlled “meshing” with less technological advanced vehicles over defined timelines, alongside future restrictions of certain roadways to fully autonomous vehicles only, will support a rollout which manages the complex interaction of ‘dumb’ and ‘smart’ vehicles in the same space.

12. Does the Government have an effective approach on data and cybersecurity in this sector?
12.1 There is more that the Government could do to enhance the automotive sectors approach to data and cyber security. Given the number of companies involved in the supply chain, some of which have no current engagement with data and security, a coordinated approach that takes account of minimum standards is important.

12.2 Government will also need to support the supply chain in understanding the implications of CAV technology for data protection, clearly addressing complex questions around what is classed as personal data and where liability sits. Current regimes are not mature enough to deal with the increasing intelligence of vehicles nor can they handle the new ownership models that are expected to grow. CCAV should focus significant attention to dealing with these issues now; ensuring regimes keep pace with technology development.

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

13.1 The EU has issued the Intelligent Transport System (ITS) Action Plan and an ITS Directive. These documents call for European-wide deployment before 2017, and national implementation preparations have already started. In enabling the environment for autonomous vehicles significant work will need to be undertaken to modernise supporting frameworks, policy and regulations.

13.2 Government should continue its full review of all regulation and legislation in relation to all vehicles, including commercial, consumer, private and public use.

13.3 See also answer to question 15.

14. What, if any, ethical issues need to be addressed in the substitution of human judgement in the control of vehicles by algorithms and Artificial Intelligence?

14.1 One element of autonomous vehicles worth further research is the public expectations of the ethics of the Artificial Intelligence software in charge of the vehicles. Particularly in relation to how autonomous vehicles interact with other road users and pedestrians, including accident avoidance strategies. There is a need for universal standardisation in dealing with these complex questions and concerns, allowing industry and stakeholder to grapple with aim towards a solution.

14.2 techUK's Big Data, Cloud and Mobile programme is currently looking into the subject of AI and ethics.

Wider governance

15. What does the proposed Modern Transport Bill need to deliver?
15.1 It will be important for the Modern Transport Bill to deliver appropriate legislation to support not just the testing of CAVs but to deliver deployment. This includes a full overhaul of related policy and regulation including a review of insurance protocols, clarification of civil and criminal liabilities, revisions to the Highway Code and a review of how the existing regulatory framework may be developed to ensure automated vehicle technologies are protected from possible cyber threats.

15.2 New rules related to how software is maintained and repaired are also needed. Malfunctions which arise due to outdated software cause significant risk and can affect questions of liability. There is a need for the Bill to address this question determining who bears ultimate responsibility for upgrades and within which parameters. It is unrealistic to expect consumers to bear full responsibility.

15.3 Further adjustments to DVLA protocols related to licensing will also be needed. This will be important as we move toward level 4 and 5 automation, providing clarity people’s rights to drive different types of vehicle.

15.4 The Bill should look to support wider Government actions around machine learning and data ethics. This is in regard to both situations where AI will need to make a proactive decision during an emergency situation (ie a trolley scenario) and in the more general sense of what data can and cannot be used for. At this time the UK must be careful not to move too quickly to introduce legal or legislative requirements on an industry and sector that is very nascent and developing.

15.5 Clarity around data and data ownership will be fundamental. Not only is this important for the market to understand new liabilities but it will be central to the offering of new services within insurance (data stored in apps can be used in the event of an accident) and infrastructure (real time city, environment and transport data can be shared to improve journey decision making). Data underpins the whole concept of autonomous vehicles and the goal for policy-makers and industry alike must be for a secure, widely-accepted and trusted legal framework for data privacy that allows for business innovation in these emerging fields while ensuring a culture of data confidence.

15.6 Any new legislation proposed in the Bill must work to drive forward economic and social opportunities, whilst ensuring that we don’t cocoon ourselves from wider European and global markets. The nature of the automotive industry and vehicle use means any and all advancements will need to account for cross-border implications.

16. How effective is the UK’s education system in delivering people with the right skills to support the autonomous vehicles sector?

16.1 As we move towards an increasingly digital economy it will be important that the digital skills gap is addressed. This includes addressing not just basic education within schools, but also across workplaces and into advanced technical roles with high digital intensity.
16.2 In July 2015, techUK published a paper *We’re Just Not Doing Enough – Working Together to meet the Digital Skills Challenge*\(^\text{21}\)* which focused on what needs to be done to deliver the digital skills children and young people need in a digital world.

16.3 In October 2016, techUK published a paper *The UK’s Big Data Future: Mind the Gap*\(^\text{22}\)* which focused on how to combat the current lack of big data and data analytics skills.

17. *Is the Government’s strategy and work in this area sufficiently wide-reaching? Does it take into account the opportunities that autonomous vehicles offer in a wide range of areas, not just on the road?*

17.1 There is potential for government to look further at how improved safety and convenience applications extend beyond driver and passenger to vulnerable road users such as pedestrians cyclists and motorcyclists. More can also be done to understand how personal connected devices can be leveraged to provide additional benefits in the broader CAV ecosystem.

18. *What are the implications of exit from the European Union for research and development and the autonomous vehicle industry in the UK? Are specific actions from the Government needed to support or protect the autonomous vehicles sector in the short term or after the terms of Brexit have been negotiated?*

18.1 The UK Government needs to continue to manage expectations and reassure European partners that the UK is still open for business and will continue to engage collaboratively to deliver solutions which will engage cross-border. By signifying a commitment to innovation through legislation and funding as well as taking the lead on standards work the UK can address negative perceptions and protect the sector going forward.

4 November 2016

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