



**Law  
Commission**  
Reforming the law



**Scottish Law Commission**  
*promoting law reform*

# **Automated Vehicles: Analysis of Responses to the Preliminary Consultation Paper**





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This publication is available at <https://www.lawcom.gov.uk/project/automated-vehicles/> and <https://www.scotlawcom.gov.uk/publications/>.

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# Chapter 1: Introduction

- 1.1 The Law Commission of England and Wales and the Scottish Law Commission are conducting a three-year review to prepare driving laws for self-driving vehicles. On 8 November 2018, we published our first Consultation Paper, which looked at issues of safety assurance and civil and criminal liability.<sup>1</sup> We asked for responses by 18 February 2019.
- 1.2 We received 178 responses from a wide range of consultees. This document analyses those responses. At the end of each chapter we also briefly take stock of what consultees have told us and indicate the next steps of the project.
- 1.3 We are very grateful for all those who responded to our paper and discussed the issues with us. In all, we received over 2,600 pages of discussion, much of it extremely detailed and closely argued.
- 1.4 We use brief excerpts from the responses to give a flavour of the debate. However, with so much material to work with, we have often extracted only a few phrases or sentences from the full response. Many arguments have not been quoted at all. We are therefore publishing the responses in full on our website, and readers are referred to the original documents for more detail.<sup>2</sup>

## WHO RESPONDED TO THE PAPER?

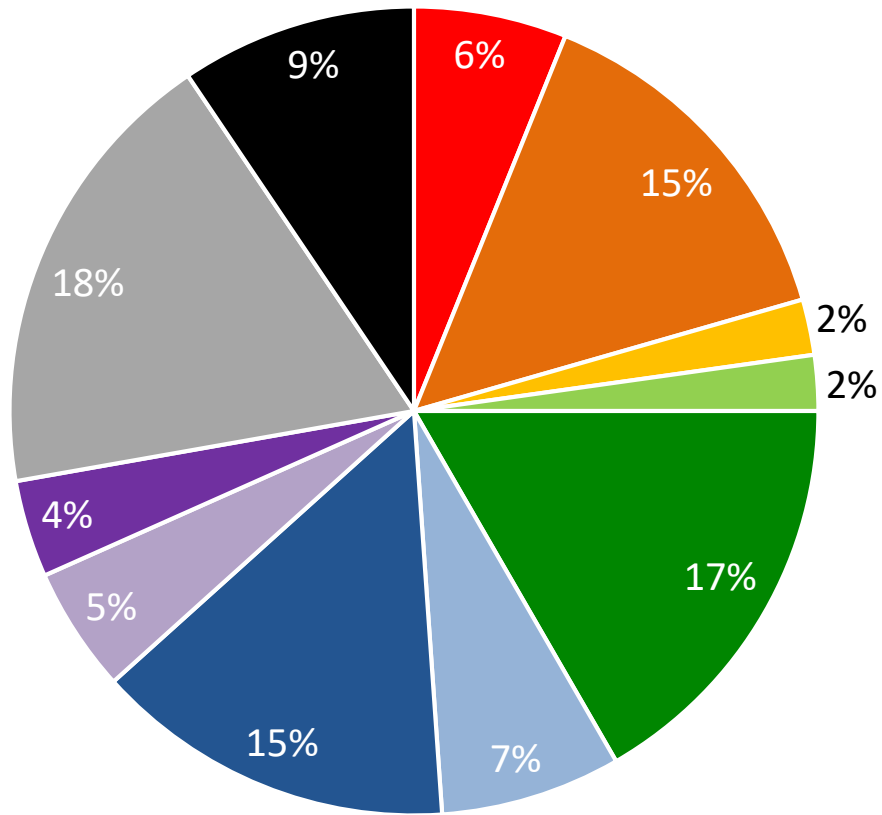
- 1.5 The pie chart below shows the variety of consultees who responded to the paper.
  - (1) The four largest groups (each comprising between 15% and 18% of overall responses) were: developers and original equipment manufacturers (OEMs); legal professionals; individuals; and transport research groups, consultancies and professional organisations.
  - (2) Safety and road user groups, academics and insurers each provided between 6% and 9% of the responses.
  - (3) We also received responses from disability groups, emergency services and the police, local government, highways authorities and local representative groups and public-sector organisations.
- 1.6 All consultees are listed in Annex 1, with a brief description of who they are.

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<sup>1</sup> The first Consultation Paper and a summary of that paper are available at <https://www.lawcom.gov.uk/project/automated-vehicles/>.

<sup>2</sup> Responses have been published in alphabetical order at <https://www.lawcom.gov.uk/project/automated-vehicles/>.

### Respondents by category



- academics
- OEMs and developers
- disability groups
- emergency services and police
- individuals
- insurance
- legal
- local government, highways authorities and representative groups
- public sector
- transport research, consultancy and professional organisations
- safety and road user groups



## KEY OUTCOMES

1.7 The key outcomes of the consultation were:

- (1) **Safety assurance scheme.** There was strong support for establishing a safety assurance scheme to complement the current system of international type approval. This would apply to automated driving systems (ADSs) which are installed as modifications or manufactured in small series. The safety assurance scheme will also need to deal with driver training, software updates, continuing roadworthiness and the management of data.
- (2) **Automated driving system entity (ADSE).** We proposed that all ADSs put forward for authorisation would need to be backed by an entity that vouches for the safety of the ADS. If a faulty ADS causes an accident, the ADSE could be subject to a range of regulatory sanctions. Most respondents agreed with this. We will go into more detail on the precise role of the ADSE in the third Consultation Paper.
- (3) **User-in-charge.** We proposed a new role of "user-in-charge", who is not a driver while the ADS is engaged but would take over from an SAE Level 4<sup>3</sup> system in planned circumstances or after the vehicle has come to a stop. Most consultees agreed with this. Our current thinking is that remote operators will not be users-in-charge but will be subject to a separate regulatory regime. We will elaborate on this in our second Consultation Paper.
- (4) **Conditional automation (SAE Level 3).** Issues around conditional automation proved controversial. Around half thought there should be no relaxation of the laws against distracted driving in vehicles with SAE Level 3 systems. There were calls for a clear dividing line between driver assistance and automated driving.
- (5) **Road accident investigation.** There was a general consensus that the focus of accident investigation needs to shift from allocating blame to learning for the future to improve safety. In the short term, there is a need to provide the police with specialist help, both to investigate individual accidents and to analyse patterns of cases to identify root causes.
- (6) **Criminal liability.** We proposed that a user-in-charge would not be liable for breaches of driving rules "committed" while the ADS is engaged. Instead, if the problem appears to lie with the ADS, the police should refer the matter to a regulatory authority, who could apply a range of regulatory sanctions to the ADSE. There was widespread agreement with this approach. There was also support for a review of the law on corporate offences where wrongs by the developer of an ADS resulted in death or serious injury.
- (7) **Automated and Electric Vehicles Act 2018.** This Act requires insurers to pay compensation to victims where an automated vehicle causes damage. We asked whether it was necessary to clarify the provisions in the Act on contributory

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<sup>3</sup> "SAE Level" refers to the system of levels devised by the Society of Automotive Engineers. See <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

negligence, causation and data retention. Reforming the provisions on contributory negligence and causation is not a priority at present. However, clarity is needed on what data need be retained, by whom and for how long.

- (8) **Product liability.** The consultation showed a need to review the way product liability law applies to "pure" software, sold separately from any physical product. This is relevant to "over the air" software updates which add or modify driving automation features. Such a review should be done generally, not simply for automated vehicles.
- (9) **Adapting road rules.** Developers and regulators need to collaborate on adapting road rules so that they can be applied by automated vehicles. We encourage Government to consider the feasibility of establishing a forum for such collaboration. Areas where work could be usefully undertaken include guidance on interpreting indeterminate terms in legislation and in the Highway Code and identifying possible additions to the Highway Code to assist in the more efficient and predictable behaviour by automated vehicles.
- (10) **Overarching themes: the importance of active travel and accessibility.** Many respondents emphasised the need to encourage active travel, such as walking and cycling. There was concern that automated vehicles should not make streets less accessible to non-motorised users. There was also concern that automated vehicles should improve the lives of people with disabilities, rather than introducing new threats into the environment.

## NEXT STEPS

- 1.8 Our second Consultation Paper will consider automated vehicles alongside and as part of the public transport network. It will explore the regulation of automated vehicles without a user-in-charge. We consider the needs of disabled users and measures to ensure accessibility. The paper will consider the range of traffic management powers available to local regulators to manage automated vehicles operating in their areas. We intend to publish the second Consultation Paper later this year.
- 1.9 In 2020, our aim is to provide a third Consultation Paper which will draw on responses to both papers to formulate more detailed proposals on the way forward.

## Chapter 2: Overarching themes

- 2.1 In this Chapter we look at five overarching themes which emerged from the consultation. These points were often made in initial comments or in response to the final question (on other issues), rather than as answers to the specific questions.
- 2.2 The five themes are: putting active travel first; the needs of people with disabilities; the role of international standards; connectivity; and data management.

### PUTTING ACTIVE TRAVEL FIRST

- 2.3 Many groups argued that public policy should encourage active travel, such as walking and cycling, in the interests of health and the environment. As Jonathan Flower of the Centre for Transport and Society (CTS), University of the West of England (UWE) Bristol,<sup>4</sup> put it:

*The vision we are heading towards needs to be an improvement for safety, the environment and active travel and so the application of policies need to bear all of these elements in mind.*

- 2.4 There was concern that any changes to encourage automated vehicles should not make streets less accessible to non-motorised users. Paths for All noted that “autonomous vehicles are still vehicles, and they impact on the quality of places for people”.

*There should be a presumption in favour of solutions that have a better impact on people and places – including congestion, air quality, public health, etc. Walking and cycling and public transport address this. Investment in infrastructure and behaviour change work to better support walking and cycling is almost certainly a better investment than adapting our streets for autonomous vehicles. [Paths for All]*

- 2.5 Cycling UK criticised the way in which past policy had often prioritised motor vehicles over vulnerable road users:

*The road safety profession has a long history of preferring to make the most vulnerable road users (including children, people with disabilities etc) responsible for avoiding the dangers imposed on them by the most dangerous vehicles – e.g. to be trained and to adapt to the flaws in the systems – rather than designing systems to be capable of accommodating human errors.*

- 2.6 Sustrans asked that “no measures should be implemented that imply precedence of vehicles that may not be accessible to the whole of society”. They flagged up the following concerns:

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<sup>4</sup> Responding in a personal capacity.

*There must be no creep towards preventing people from crossing roads where they wish, and AVs must stop for people in the carriageway in all circumstances. Obstruction of traffic by pedestrians can be dealt with through existing offences.*

*The introduction of automated vehicles must not be allowed to lead infrastructure change that is to the detriment of people travelling by other modes of transport. For example, it should not be a reason to increase the use of guard rails to prevent people from crossing roads in certain locations. Severance (in the sense of geographical impediment) is a major deterrent to active travel. Infrastructure changes to support automated vehicles must not happen at the expense of infrastructure that is vital to other users of the transport system users, such as appropriation of bus lanes, marginalisation of bus stops, removal of cycle lanes, or reductions in density of pedestrian crossing points.*

*The introduction of automated vehicles must not lead to additional responsibilities for pedestrians and cyclists, such as the need to wear hi-visibility clothing, or to carry a detectable smartphone or any other device to support detection.*

2.7 Transport Systems Catapult reinforced this message:

*If the Government is to encourage greener and healthier modes of transport such as walking, it is vital that AVs give priority to pedestrians and aren't seen as a threat that are taking over public spaces.*

2.8 Professor Phil Goodwin added:

*It would make people a lot less suspicious of them to state this clearly and unambiguously; there are some circumstances where automated vehicles simply don't belong.*

2.9 Living Streets Hackney, London Living Streets and the Road Danger Reduction Forum thought that the goal should be "to reduce and eventually eliminate private motor vehicle ownership". Therefore, the Law Commissions should distinguish between

*use of AVs by private individuals as a replacement for private cars, and use of AVs as a service 'mobility as a service'. The ownership and operation of the AVs providing 'mobility as a service' would be similar to that as a bus or train company with associated corporate duties and responsibilities. [Living Streets Hackney]*

2.10 The Transport Planning Society raised the effect on emissions:

*We are concerned that there has been no independent research into the effect of AV's on the amount of vehicle use, the impact on public transport use, and therefore on harmful emissions. We appreciate that this is not a legal matter although once the outcomes are forecast, they may impinge on the regulations covering AV use.*

2.11 There was also concern that automated vehicles would add more vehicles to already congested urban streets, rather than addressing the problems of rural transport. As Brian Watson put it:

*The issues that face rural transport where there are specific issues such as poor road surfaces, poor mobile connectivity, aging road signage (often hard to read), an aging population, etc. Most of the research and testing of autonomous vehicles and systems has been focussed on metropolitan and urban environments, whereas at least 50% of the UK population lives outside of such regions.*

### **Ensuring the safety of all vulnerable road users**

- 2.12 Allied to these concerns was a strong demand that automated vehicles should be trained to act safely around all vulnerable road users. As the Road Danger Reduction Forum put it:

*The challenge is how to ensure that pedestrians, cyclists and pets are sufficiently detected well in advance by AVs so that they are able to take preventative action in case of sudden movements by these users.*

- 2.13 Sustrans stressed the diversity of these users:

*A very particular example relates to bicycle users in particular. The diversity of bike types in use will need a very refined understanding if technologies are to be able to identify what is a bicycle. Tandems, recumbents, electrically-assisted bikes and children's bikes all constitute part of the 'fleet', and all differ in size and shape and presumably therefore detection parameters.*

- 2.14 Similarly, the British Horse Society emphasised that automated vehicles must be able to identify horses and take into account horses' sometimes unpredictable behaviour.

- 2.15 This has implications for both the safety assurance system and for adapting road rules. As discussed in Chapter 9, there were demands for codified rules on minimum distances for passing different categories of road user, and considerable concern that automated vehicles should never "edge through" groups of pedestrians.

### **MEETING THE NEEDS OF PEOPLE WITH DISABILITIES**

- 2.16 Similarly, there was concern that automated vehicles should be introduced in a way which would improve the lives of people with disabilities, rather than disadvantage them.

- 2.17 Consultees raised the needs of both disabled drivers and disabled pedestrians. As far as drivers are concerned, Richard Sarginson said:

*It must be possible for disabled drivers who are currently allowed to drive, to continue to drive; for example, those who are deaf. It would be discrimination of the worst kind if those who are deaf were excluded from this technology and became trapped, immobile, unable to use it because they could not hear essential instructions.*

- 2.18 He suggested "starting now" by "involving those who deal with, and are, deaf in discussions" to make sure that systems do not rely on audio information for drivers. He added:

*This type of discussion will also need to be undertaken for those with other disabilities who are allowed to drive.*

- 2.19 The Disabled Persons Transport Advisory Committee (DPTAC) believed that “ultimately the development of fully autonomous vehicles could open up personal mobility options for a number of disabled people who are currently unable to drive a motor car”. However, they said the search for level 4 automation should not obstruct more immediate improvements.

*Developments such as automatic transmission, power-steering, and fly-by-wire controls have all extended motoring to disabled people who had previously been unable to drive. Increased automation must continue this process...*

*DPTAC wishes to see a regulatory regime which permits the safe development and testing of bespoke technology to assist disabled drivers and does not rule out such options for fear of individuals or small companies developing or adapting autonomous vehicles which are unsafe.*

- 2.20 Respondents were also concerned about how automated vehicles would interact with disabled pedestrians, particularly those with visual impairments. The National Federation of the Blind UK wrote that:

*It is important that autonomous vehicle computers can detect blind or partially sighted people using a white cane who cannot see oncoming traffic.*

- 2.21 Similarly, DPTAC noted:

*We have seen the unease created by shared space developments which rely heavily on eye-contact between the driver and the pedestrian. This level of uncertainty must not be repeated with autonomous vehicles.*

## INTERNATIONAL STANDARDS

- 2.22 While groups representing vulnerable road users tended to argue for a national or local approach, which is sensitive to the nuances of different groups, the Society of Motor Manufacturers and Traders (SMMT) emphasised the importance of international harmonisation:

*Given the intense global competition, it is important to ensure that the outcome of this consultation **does not make it more onerous** to develop, test and deploy automated vehicle technology in the UK. In addition, the outcome of this consultation must also **support and align with international regulatory harmonisation** at the UNECE level instead of creating divergent, UK-specific regulation. [emphasis in original]*

- 2.23 The SMMT argued that “harmonised international and European regulatory frameworks are necessary for legal certainty with regard to deployment and cross-border interoperability, while also providing vehicle manufacturers with the confidence needed to invest”.

- 2.24 Aviva also stressed that minimum requirements should be set through the international system of type approvals:

*For the protection of consumers of automated vehicles, other road users, the public and insurers, it is imperative that technical standards clearly defining the minimum requirements are developed and form the basis of Type Approvals...*

*Work towards this goal has been progressing at international level (GRVA).<sup>5</sup> Such work should not be allowed to stall or be diluted.*

2.25 This view was echoed by others. Arcadis wrote that:

*There is a strong case to be made that whatever gets decided shouldn't be looked at in isolation (i.e. UK alone) or else applied towards a specific nation. A certain amount of commonality must be applied across all countries.*

2.26 The Bar Council of England and Wales said that there may possibly be “problems arising out of cross border uses of automated vehicles where other countries are not parties to international agreements regarding their use”.

## CONNECTIVITY

2.27 Many respondents raised the need to consider issues related to connectivity. Several were concerned that the proposals focused on single vehicles, rather than the full “ecosystem”, which would include dependence on high-speed, high-capacity network communication.<sup>6</sup>

2.28 Esure thought that it was a priority to develop connectivity with infrastructure, other vehicles and emergency services:

*This should include real time safety measures, route updates and interaction with a central database which transmits information such as temporary speed limits, diversions, major incidents, weather warnings and traffic congestion.*

2.29 AXA UK called on Government and Parliament to look next to the connected element of Connected and Automated Vehicles (CAVs):

*This is critical to the proper functioning of the CAV ecosystem and also to consumer trust in this new technology. The issue to focus on is two-fold, firstly security against cyber-attack and secondly, how data is shared and used in this ecosystem.*

2.30 The Faculty of Advocates pointed out that many systems would be designed to “interoperate with other vehicles, traffic lights and other road infrastructure”. Failures of interoperation would prejudice the safety of the automated driving systems (ADSs):

*The Law Commissions may wish to give consideration to how such breaches... are regulated, detected, investigated and (if appropriate) prosecuted.*

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<sup>5</sup> Groupe Rapporteur Vehicule Autonome, a part of WP29 in the UNECE.

<sup>6</sup> This issue was raised by Arcadis; Esure; and Professor David Metz, Centre for Transport Studies, University College London.

- 2.31 Transport for the West Midlands (TfWM) thought that the body responsible for supporting AV infrastructure should be “clearly defined and their liability understood”:

*This would extend to roadside infrastructure, digital legal records and rules of the road enforcement issues.*

- 2.32 Chartered Institution of Highways and Transportation (CIHT) also asked how the overall network would be managed:

*There is an argument for large automated fleet operators to bear some responsibility for overall network management as train operating companies do with Network Rail.*

- 2.33 Several consultees asked for a review of civil liability for incidents caused by failures of roadside infrastructure. Similarly, the Senators of the College of Justice asked, “where does liability attach if the network crashes and an accident ensues?” Professor Peter Osmon added that large-scale system failures “could seriously disrupt the life of the City”.

## MANAGING DATA

- 2.34 Issues around data management arose at each stage of the project. Many respondents thought that we should do more to consider how data produced by automated vehicles would be stored and shared, particularly with insurers, highway authorities and regulators.

- 2.35 Insurers were concerned to receive adequate data following a collision. As the joint response from the Association of British Insurers (ABI) and Thatcham Research put it:

*One of the most critical areas for insurers is the availability of in-vehicle data immediately following any crash or collision – this will enable the consumer to be looked after quickly and efficiently and ensure the Automated and Electric Vehicles Act operates in the way it was intended to.*

- 2.36 AXA XL said that it was “essential that this crucial accident data is standardised, so that insurers are able to interpret, compare and store this data easily”.

- 2.37 The need to share data with insurers was echoed by other insurers (including Zurich Insurance (UK), Aviva, Ageas and Esure). This point was also made by law firms, including Weightmans LLP, DAC Beachcroft LLP and Kennedys Law LLP. The British Insurance Brokers’ Association highlighted:

*the absolute need for FCA registered Insurance Intermediaries (brokers) and insurers relative to a claim to be given unhindered access to data which can help determine the cause and liability of a collision.*

- 2.38 Richard Sarginson argued that claimants would also need access to this data, so that they were not at a disadvantage in pursuing claims. He feared that much of this data might be unintelligible (particularly, in its unprocessed form). He suggested that:

*regulations and standards are needed to redress this imbalance. A ‘duty to supply’ may well be needed and enshrined in law.*



2.39 The CIHT raised the need to share data with highways authorities:

*We need to ensure that the proper legal framework is available to promote and require the sharing of data between highways authorities and vehicle providers to provide the best experience to all users of the network.*

2.40 McLaren Applied Technologies asked for data sharing between manufacturers to allow them to learn from incidents and significant near-misses:

*The process needs to be fair so that [manufacturers] can look at their own data first and only publish if there is a genuine value to everyone.*

2.41 Weightmans LLP thought that issues of data security, collection and access to that data were fundamental to the safe deployment of automated vehicles. They urged the Law Commissions to consider this issue as part of its wider review.

2.42 In a similar vein, KPMG LLP thought the Law Commissions should “outline how AV trial and deployment data will feed into the evolving regulatory framework”. They asked us “to propose an approach to ensure the findings are effectively captured and used to support policy”:

*It may be useful to consult and collaborate with relevant authorities in Singapore and South Korea, countries which have invested heavily in setting up testing centres and are drafting testing legislation.*

2.43 The Met Office wrote at length about how sharing observation data “could promote symbiosis between the mobility sector and weather forecasting capability”. For example, sensor information from automated vehicles

*could be used to improve our understanding of dynamically changing weather, at a resolution beyond that of present; which ultimately will have a benefit to all weather forecast users.*

2.44 Meanwhile, automated vehicles could make use of weather information to provide “weather geofences”. For example:

*it would be possible to use a weather forecast along a route to provide an indication that operating design domain conditions will not be exceeded along a planned journey. This in turn could provide a weather-based indication of whether the user-in-charge may be required at any point along the journey before setting off. [Met Office]*

## **THE WAY FORWARD**

2.45 In our next consultation we will consider automated vehicles in the context of public transport. Exploring the impact of automated road passenger services on active travel, and questions of accessibility will be central to our work. We will also consider the role of remote operators of automated road passenger services for which connectivity will play a key role.

2.46 Our remit to develop a framework for the safe deployment of automated vehicles in the UK is extremely wide, but does not cover every element of automated vehicle policy. Key issues such as cyber-security, for example, are being led by the Department for

Transport in conjunction with the Centre for the Protection of National Infrastructure (CPNI)<sup>7</sup>. Innovate UK is also funding research in this area.<sup>8</sup>

- 2.47 Policy on infrastructure, data management and connectivity is being led by Government directly and beyond our terms of reference. However, we will address issues which are critical to automated vehicle policy, such as access to in-vehicle data to deal with liability. We also recognise that clarity about responsibility for infrastructure will be important to safety, and plan to consider this issue in our next consultation.
- 2.48 On the international front, our Law Commission teams follow developments on vehicle standards and road traffic safety in the UNECE closely. We are also participating directly in meetings of the Informal Group of Experts on Automated Driving and of the Global Forum for Road Traffic Safety (WP1). We have contacts with regulators around the world and actively monitor current developments.

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<sup>7</sup> See for example [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/661135/cyber-security-connected-automated-vehicles-key-principles.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661135/cyber-security-connected-automated-vehicles-key-principles.pdf)

<sup>8</sup> For example, Flourish, a project having a focus on the cyber secure communication and transfer of data. The Flourish consortium's final report is available at <http://www.flourishmobility.com/storage/app/media/FLOURISH%20Final%20Report%20-%20Online.pdf>

# Chapter 3: The human in the loop

## OVERVIEW

- 3.1 Chapter 3 of the Consultation Paper discussed “the human in the loop”. At what stage will a human in the driving seat cease to bear the civil and criminal responsibilities of a driver? And how will any handover be managed?
- 3.2 The interaction between humans and automated systems is an issue of acute public concern. Consultees pointed out how quickly passive humans become distracted and how far distracted drivers lack the situational awareness to drive effectively. They also highlighted widespread consumer misunderstanding about the difference between advanced driver assistance and automated driving.
- 3.3 Society lacks a common terminology to discuss these issues. Although consultees often referred to SAE Levels,<sup>9</sup> the levels were interpreted differently, leading to some confusion. There remains disagreement about key boundaries: such as the distinction between “monitoring” and being “receptive” to a handover request (part of the boundary between Levels 2 and 3); and the nature of a “minimal risk condition” (Levels 3 and 4).
- 3.4 Chapter 3 proposed a new role of “user-in-charge”, who would take over from a Level 4 system in planned circumstances or after the vehicle had come to a stop. Most consultees (79%) agreed with the proposal. However, many asked how the concept would apply to remote operators. There was also some residual apprehension that a user-in-charge would not be a driver. When we asked about the label of “user-in-charge”, 12 out of 134 consultees preferred a term which included the word “driver” (such as “standby driver”).
- 3.5 We invited views about a possible new criminal offence. This would apply if a user-in-charge who is subjectively aware of a risk of serious injury fails to take reasonable steps to avert that risk. Consultees were split on this issue, with strong arguments made against such an offence.
- 3.6 Questions about conditional automation proved particularly controversial. A bare majority of consultees (52%) thought that there should be no relaxation of the laws against distracted driving for systems which relied on human intervention to be safe.
- 3.7 The Law Commissions’ review aims to provide an accepted taxonomy to describe the roles and responsibilities of all the various human players who interact with an automated driving system (ADS). This would include the entity which brings the ADS to market (ADSE), the fleet operator, the human supervisor in a remote-control centre and the registered keeper - as well as the human in the driving seat.

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<sup>9</sup> “SAE Level” refers to the system of levels devised by the Society of Automotive Engineers. See <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

- 3.8 We are encouraged that a large majority of consultees agreed with the concept of a “user-in-charge”. However, we accept the need to consult further on the role of fleet operators and remote supervisors. Our intention is to publish a second consultation paper this autumn about how those who operate automated passenger services should be licensed. We will draw on the results of both consultations to refine our taxonomy.

## THE CONCEPT OF A USER-IN-CHARGE

### Q1: Do you agree that

**(1) All vehicles which "drive themselves" within the meaning of the Automated and Electric Vehicles Act 2018 (AEV Act) should have a user-in-charge in a position to operate the controls, unless the vehicle is specifically authorised as able to function safely without one?**

**(2) The user-in-charge:**

**(a) must be qualified and fit to drive;**

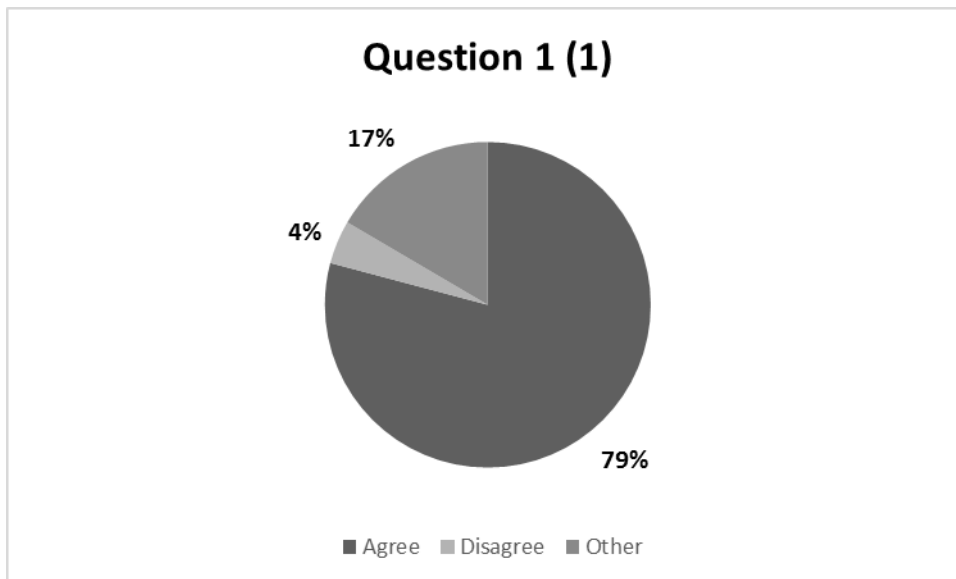
**(b) would not be a driver for purposes of civil and criminal law while the ADS is engaged.**

- 3.9 In the Consultation Paper we envisaged a vehicle which could safely drive itself and come to a safe stop if it encountered problems. However, it would still need a human driver to complete the journey if the vehicle exceeded its operational domain or was forced to stop.

- 3.10 We suggested a new role of a human “user-in-charge”.<sup>10</sup> A user-in-charge would not be a driver or expected to take control of a moving vehicle at short notice. However, the user-in-charge would still need to be qualified and fit to drive, so that they could complete a planned handover or drive a vehicle from a stopped position. The user-in-charge would also bear criminal responsibility for offences which do not arise directly from driving, such as those relating to insurance and maintenance, reporting accidents and ensuring that children are wearing seat belts.

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<sup>10</sup> We explore when a user-in-charge would not be necessary in Questions 5 and 6.



3.11 Of the 139 consultees who responded to Question 1(1), a great majority (79%) agreed. Only 6 consultees disagreed. However, many consultees asked for further clarity about how the idea would work, particularly if the vehicle was being supervised by someone outside the vehicle.

#### Agreement

3.12 Those who supported the idea of a user-in-charge saw it as a useful way of enabling the safe deployment of automated vehicles at one particular stage of development. This is the stage where an ADS is able to achieve a “minimal risk condition” (by, for example, coming to a safe stop) but may need a human driver to complete the journey. The Flook described the concept as:

*valued, useful, supported and preferential to other terminology. This status defines a role needed and supporting safety...*

3.13 Transport for London (TfL) saw merit in the role of a user-in-charge “as we enter a transitional phase before vehicle operating systems are deemed sufficiently mature” to drive without human intervention:

*Further, the “user-in-charge” could have an important role to play for discharging other human responsibilities, such as ensuring seatbelts are secured, helping disabled users or complying with the instructions of a police officer or traffic warden.*

3.14 Euro Car Parts described vehicles up to Level 4 as “not fully mature” so a driver is still needed. Brian Watson saw the user-in-charge as “analogous with the airlines where the pilot is essentially a user-in-charge, taking control of the aircraft at pre-defined times or under pre-defined conditions”.

3.15 Several consultees added that while a user-in-charge may be desirable initially, in the long term a user-in-charge may no longer be needed.<sup>11</sup>

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<sup>11</sup> This point was made by, among others, the Freight Transport Association (FTA), Amey and Richard Sarginson.

- 3.16 In a detailed reply, Burges Salmon LLP explained that there is likely to be a wide range of automated vehicles “from accessibility pods travelling at low speed to adapted goods delivery vehicles to full size and speed automated cars or lorries”. They regarded the requirement to have a “user-in-charge” as a “mitigation measure that may be necessary and/or proportionate to the hazards and risks presented by one type of automated vehicle and use case but not another”.
- 3.17 Police stakeholders supported the idea of a user-in-charge.<sup>12</sup> Police Scotland agreed “this would appear to be an essential fail-safe element, in the event of a malfunction or scenario that the vehicle cannot deal with automatically”.

#### Call for greater clarification

- 3.18 Many consultees agreed with a user-in-charge in principle but asked for further clarification.<sup>13</sup> As the Society of Motor Manufacturers and Traders (SMMT) put it:

*We agree in principle, particularly with the proposed role of the user-in-charge... “to take over in planned circumstances or after the vehicle has achieved a minimal risk condition and has come to a stop”.... However, the concept of user-in-charge must be better defined and clarified.*

- 3.19 The SMMT would prefer an international approach:

*International harmonisation is preferred to a UK-specific framework... It would be more desirable had the consultation proposed terminology and principles agreed in WP.1 discussions in Geneva. Creating multiple new concepts may win the UK plaudits, but may also create confusion internationally, particularly where other terminologies are already being discussed with a view to international harmonisation.*

- 3.20 Some called for an explanation of how the concept of user-in-charge fits into the scheme of the AEV Act.<sup>14</sup> Burges Salmon LLP argued that the AEV Act could be interpreted as applying to Level 3 vehicles. They stated that if the concept of ‘user-in-charge’ is to align with the AEV Act, there needs to be clarity on the scope of that Act.

- 3.21 The Disabled Persons Transport Advisory Committee (DPTAC) said that the role of user-in-charge should not discriminate against disabled users:

*Crucially the assessment of the fitness required to be a driver (for those parts of the journey where the [ADS] is not engaged) and to be a ‘user-in-charge’ must take account of how technology can assist a disabled person.*

- 3.22 Mills & Reeve LLP argued that the Law Commissions should focus on the responsibilities that need to be fulfilled. Not all these responsibilities necessarily need to be fulfilled by the user-in-charge:

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<sup>12</sup> Chief Inspector Adrian Davies, Warwickshire and West Mercia Police, personal response; Dean Hatton, NPCC Roads Policing, personal response; the Metropolitan Police Service (MPS); and Police Scotland all agreed with Question 1.

<sup>13</sup> Bentley Motor Cars; Richard Morris, Innovate UK, personal response; TRL.

<sup>14</sup> Zurich Insurance (UK); Burges Salmon LLP.

*For example, responsibility for being ready to take back control from the [ADS] (once automated driving is no longer available or once the vehicle has achieved its minimum risk condition) might fall to a remote operator, responsibility for ensuring the vehicle is insured might fall to the owner and responsibility for ensuring children are wearing seatbelts might fall to a responsible adult within the vehicle.*

## Remote operators

- 3.23 Several consultees said that users-in-charge should be allowed to operate remotely.<sup>15</sup> As Burges Salmon LLP put it:

*the concept does not necessarily exclude tele-operation where the individual that may be performing this role does so remotely (i.e. a human driver on standby but not on board). We consider that there could be more clarity around this point as some CAV manufacturers and operators are actively considering and testing such teleoperation models.*

- 3.24 Richard Cuerden of TRL distinguished between three different types of user:

*One can imagine an owner of a self-driving vehicle being literally in the driver seat waiting for hand-over of control back to a standard control interface (steering wheel and pedals).*

*One can also imagine a passenger in a shared automated vehicle who may be expected to raise an alert, e.g. pressing an alert button in certain situations (for example when stopped in minimal risk manoeuvre).*

*Finally, it is likely that the technology will develop to a stage where the ‘user-in-charge’ is a remote access supervisor of the vehicle.*

- 3.25 FiveAI said that for most “Path 2 vehicles” (in fleets providing passenger services) “we expect the operator to be situated outside the vehicle”. The operator would receive requests from vehicles and decide the best course from a list of options.
- 3.26 Dr Charles Fox of the University of Lincoln gave examples of three projects with remote users-in-charge.<sup>16</sup> He said that a remote user-in-charge would “enable coverage of many more AV types... such as minibuses, delivery robots and agricultural vehicles”. It would “also allow car AVs the option of professionalizing their users-in-charge so that a small group of highly trained emergency drivers could be the ones to take control in situations where the human in the car has no chance of doing so”.
- 3.27 Mobileye also envisaged that a user-in-charge might be in a control room. They did not see a user-in-charge as a standby driver: they would not engage in routine driving or intervene to avoid accidents. Instead, they would intervene only if the vehicle reached a full stop and was unable to make a decision based on available data. The person

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<sup>15</sup> Those making this point included Dr Chris Tennant; Meridian Mobility UK; IAM RoadSmart; AXA XL; Aviva; Florencio Cuervo; Pinsent Masons LLP; Mobileye; Peter Brown; techUK.

<sup>16</sup> EU CityMobil2, IBEX2 and the CAV3 NOHGV last-mile delivery vehicles project.

would then be able to make that decision from a pre-defined set of decision options. They added:

*Since the user-in-charge will have limited remote operational authorities only after the vehicle has reached a full stop, it should not bear criminal liabilities. The issue of accidents should be handled through the verification methodologies of allowing the vehicle to drive autonomously in the first place.<sup>17</sup>*

- 3.28 By contrast, the Magistrates Association thought that the user-in-charge should always be inside the vehicle, as they would “have clearer visibility of the situation, and a greater ability to intervene quickly and effectively”. TfL were concerned that if a remote user-in-charge was responsible for several vehicles simultaneously, they might need to resume control of multiple vehicles at once.

#### Taking over moving vehicles at short notice?

- 3.29 In the Consultation Paper we explained that a user-in-charge would only be required to take over vehicles in a planned way or from a stopped position. However, many consultees worried that a user-in-charge would be required to take control of a moving vehicle at short notice.<sup>18</sup>

- 3.30 The SMMT expressed concern that “the proposed role and scope of what constitutes a user-in-charge implicitly excludes SAE Level 3 as automated vehicles”.<sup>19</sup> They argued strongly that a fallback-ready user who responds to a request to intervene at Level 3 should be regarded as a user-in-charge:

*The fallback-ready user should also be considered a user-in-charge. When conditional automation is engaged, a fallback-ready user would not be a driver but must be qualified and fit to drive, and is still “in charge” for the purposes of any other responsibilities associated with operating a vehicle referred to in road traffic legislation.*

- 3.31 The SMMT opposed any attempt at UK level to pre-empt the issue of whether Level 3 vehicles should be permitted ahead of decisions at UNECE Working Party 29.

- 3.32 Several individual respondents suggested that the human in the driving seat should continue to bear responsibility for a failure to intervene (as would be the case with SAE Level 2). For example, Jacob Hardy felt the user-in-charge should be the driver for the purpose of civil and criminal law, because otherwise they cannot be held to account for “their decisions not to take control”. Brian Ronald added:

*I’d go so far as to hold the driver responsible for the behaviour of the vehicle as long as they are even capable of taking over the controls.<sup>20</sup>*

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<sup>17</sup> Mobileye referred to their Responsibility Sensitive Safety (RSS) work discussed at p 148.

<sup>18</sup> Sasha Taylor; National Physical Laboratory (NPL); Adrian Payne; Peter Miller; Edward Christian Macfarlane, Abbott Risk Consulting, personal response.

<sup>19</sup> The same concern was expressed by BMW Group UK and Bentley Motor Cars.

<sup>20</sup> See also responses from Lyn Brayshaw, Al M Mann, and Alistair Chaplin.



## THE HANDOVER

**Q1(2)(c): Do you agree that the user-in-charge would assume the responsibilities of a driver after confirming that they are taking over the controls, subject to the exception in (3) below?**

3.33 This question raised issues about the handover between system and driver. When taken with Question 1(3) (below), it generated considerable concern. Many consultees worried that users-in-charge would intervene inappropriately to prevent accidents and (even when trying their best) might make things worse.

### A complex issue

3.34 Burges Salmon LLP explained that the “liability interface” on handover was complex. It needs to be mapped in each direction, from human to machine and machine to human. It also differs between planned and unplanned handovers. They suggested a set of principles which can be summarised as follows:

- (1) If there is a planned handover from human to machine within the operational domain, the human would cease to have responsibility at the point of activating the ADS.
- (2) If there is a planned handover from machine to human, the human would only become responsible once they had completed the protocol for safe handover.
- (3) If there is an unplanned handover from human to machine, in breach of the operational domain or when an accident is imminent, the human would retain responsibility.
- (4) An unplanned handover from machine to human should not happen at Level 4 and would be dangerous.<sup>21</sup>

3.35 In their joint response, the Association of British Insurers (ABI) and Thatcham Research stressed that the system must be designed in such a way that the user-in-charge fully understands the handover process:

*There must be a clear offer-and-confirm process during any handover of control to/from the human driver/[ADS]... If the user-in-charge fails to confirm that they are prepared to retake control, the [ADS] must be capable of continuing to drive safely to complete a minimal risk manoeuvre and find ‘safe harbour’.*

3.36 Several other respondents (including Centaur Consulting, Esure and Ageas) endorsed the ‘offer and confirm’ approach. The British Insurance Brokers’ Association (BIBA) added:

*In order to confirm awareness of the responsibility... the user-in-charge should log in to the vehicle systems using a credit card-style driving licence or similar.*

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<sup>21</sup> See further literature on handovers in Venturer reports (<https://www.venturer-cars.com/reports-and-findings/>).

## The dangers of human intervention

- 3.37 Many respondents expressed concern that users-in-charge would intervene inappropriately. As Mills & Reeve LLP put it:

*Any attempted human emergency evasive action would require the human to know that the vehicle driving itself is not itself going to carry out that evasive action... [This may not always be obvious] (for example, where a driver swerves off the road to avoid a collision that the vehicle has calculated can be avoided by braking alone).*

- 3.38 TRL gave an example of how human intervention could make the situation worse:

*A user on a motorway looks up, perceives a collision threat ahead and steers to an adjacent lane; this could mitigate a possible collision..., but risk side-swiping and killing a motorcyclist that they were unaware was in that lane (having not been... monitoring the driving environment). Therefore, it could easily be less safe to allow the user-in-charge to take control unless they have gone through a handover protocol that establishes that they have sufficient awareness of the situation.*

- 3.39 Dr Charles Fox also warned of the dangers:

*Unplanned emergency handovers to eyes-off users do not work, and create far more danger to all involved than continuation of autonomous control.*

- 3.40 Dr Chris Tennant of the London School of Economics reported that individuals want to be able to take over control at any point. However, he considered that “there are likely to be far more negative outcomes from users-in-charge seizing control mistakenly than from users-in-charge being prevented from intervening”.

- 3.41 The Parliamentary Advisory Council for Transport Safety (PACTS) also pointed to “legitimate concerns” that “users-in-charge may intervene unnecessarily due to lack of confidence in the system’s capability or lack of understanding of the system’s operations”.

- 3.42 The Met Office pointed out that in some weather conditions it may be particularly challenging for the user-in-charge to take over:

*For example, in an extreme low visibility situation, such as dense fog, correctly operating sensors would enable an autonomous vehicle to operate at a much lower visibility than a human driver.*

- 3.43 The Chartered Institution of Highways and Transportation (CIHT) drew an analogy with aviation:

*In the airline industry there are multiple examples of automated plane systems being overruled by pilots who then contribute to a crash, as occurred with Air France Flight 447 in 2009. In this case it appears that the pilot did not understand the steps being taken to prevent an engine stalling and it seems inevitable that we will see similar circumstances with autonomous vehicles, even if the vehicle is operating correctly.*

- 3.44 The CIHT explained how difficult it is to allocate fault in these situations:

*[B]oth the vehicle provider and driver will not feel at fault in this situation as both are taking the action they see fit. It will be important not to require impossible decision-making skills but also provide sufficient legal remedy for those affected by a user's action.*

#### Should the user-in-charge be prevented from taking control?

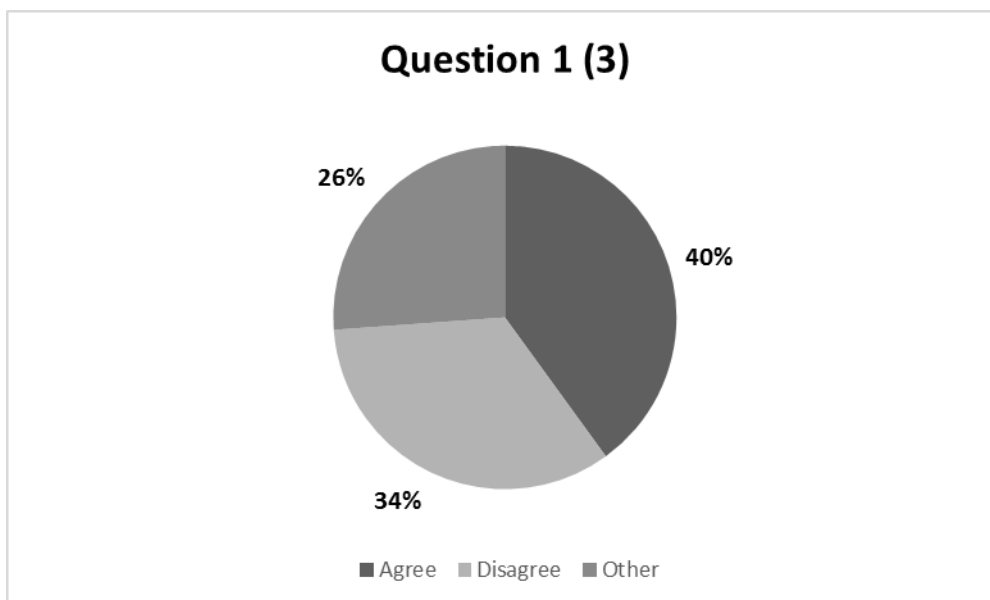
3.45 One option would be to physically prevent users-in-charge from assuming control of moving vehicles. For example, Burges Salmon LLP suggested that the human should only be allowed to request that the automated vehicle achieves a minimal risk condition. AXA XL and AXA UK suggested a safety button for exceptional circumstances “such as an AV driving towards a river”.

3.46 The ABI and Thatcham Research said that although, ideally, a user-in-charge should only be able to take over when the system regards it as safe, “it is currently unlikely to be practicable to deny the driver the ability to have instantaneous control of the vehicle”. In these circumstances:

*Any intervention in the driving task must go through the equivalent of an ‘offer and confirm’ process and must be by a method that cannot be implemented accidentally.*

#### LIABILITY FOR INTERVENTIONS TO MITIGATE THE RISK OF AN ACCIDENT

**Q1(3): Do consultees agree that if the user-in-charge takes control to mitigate a risk of accident caused by the ADS, the vehicle should still be considered to be driving itself if the user-in-charge fails to prevent the accident?**



3.47 Consultees were split on this issue. Out of 130 consultees who responded, 52 (40%) agreed that the automated vehicle system should bear responsibility for the accident. However, 44 (34%) disagreed and 34 (26%) ticked “other”.

### The ADS should bear responsibility

- 3.48 Three reasons were given for allocating responsibility for accidents to the ADS, even if the collision occurred after the user-in-charge had taken control. The first is that it would ensure that victims were compensated without unnecessary argument. As Stewarts Law LLP put it:

*Victims of such accidents should be compensated without being subjected to liability arguments about whether the user-in-charge could or should have prevented the accident.*

- 3.49 Secondly, respondents felt that the automated vehicle was at fault for allowing the situation to occur. As Adrian Payne argued:

*Even if the user-in-charge actually makes things worse... it must be questioned why did the user-in-charge think that they had to intervene, which would then raise questions about the autonomous vehicle.*

- 3.50 Thirdly, many respondents pointed out that interventions are difficult. The user-in-charge should therefore be given considerable leeway and should not be held to standards which few people would be able to meet. The Association of Personal Injury Lawyers (APIL) explained that:

*There needs to be time to realise that the car itself is not going to avoid the crash and then to take action. The user-in-charge cannot be expected to react within the same timeframe as if they were the driver of the car.*

- 3.51 TechUK added:

*We are also wary of encouraging human drivers to take over when required but then punishing them for a mistake that they made while originally intending to use an automated vehicle to its full potential.*

### The user-in-charge should bear responsibility

- 3.52 The Crown Prosecution Service summarised the argument against regarding the ADS as “driving itself” once the user-in-charge has taken control:

*If the user-in-charge takes control to mitigate a risk of accident caused by the [ADS], the user-in-charge will be driving... It is artificial to state that the user-in-charge is not driving when he or she has assumed the controls.*

- 3.53 The SMMT thought it would be unfair to blame the vehicle manufacturer or system developer where a “misguided intervention” by the user-in-charge makes the collision worse.

- 3.54 BMW Group UK also thought that the user-in-charge should be responsible “if an accident is caused by his/her intervention”. The user-in-charge should only avoid liability if interference with the ADS was “demonstrably required due to the failings of the [ADS]”.

- 3.55 Neckermann Strategic Advisors added

*If the user-in-charge... superimposes his own direction onto the vehicle, then the user-in-charge immediately assumes liability.*

- 3.56 The Flook suggested that making the system responsible would encourage users to take back control which is risky and could even lead to “cash4crash” frauds.

#### It depends

- 3.57 Many consultees agreed with the sentiment behind making the ADS responsible but argued against a blanket approach. As the Chartered Institute of Legal Executives (CILEx) put it, “a blanket approach is inappropriate”. Instead “liability should be decided on a case-by-case basis”.

- 3.58 Transport Systems Catapult accepted that in most cases

*It is perfectly reasonable for the user-in-charge to intervene where a crash is imminent, and the law should not discourage such interventions by rendering the driver liable.*

- 3.59 However, in some scenarios the answer is less clear-cut:

*[H]ow high does the risk have to be for the user-in-charge to be excluded from liability when they intervene?... If there is a 10% chance a situation would result in an accident, is that enough to intervene, bearing in mind that the system may be more capable of avoiding the accident than a manual driver, so the user may increase the risk? What if there was never any real risk, only a perceived risk, such as the vehicle driving very close to a hazard at high speed, but with near certainty that the hazard will be avoided? [Transport Systems Catapult]*

- 3.60 The Faculty of Advocates suggested that there should be a “legal presumption” that the vehicle is considered to be driving itself if the user-in-charge takes over control to mitigate the risk of an accident caused by the ADS. However, there may be exceptions where the user-in-charge wrongly takes control and drives negligently or recklessly, increasing the risk. Apollo Vehicle Safety Limited gave an example where the user-in-charge is drunk and makes the situation worse.

- 3.61 AXA XL and AXA UK suggested that if intervention was required, but the intervention made the situation worse, the user-in-charge could be contributorily negligent. However, if the user-in-charge intervenes without a request and the accident is not caused by the ADS, the user-in-charge should be held liable.

- 3.62 Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA) and Transport Systems Catapult suggested that liability should depend on the reasonableness of the action. Similarly, TRL emphasised reasonableness. They agreed that the user-in-charge should not bear responsibility “assuming that the intervention on behalf of the user-in-charge was either obviously requested by the system, or if there were reasonable grounds for the user-in-charge to assume that a collision was imminent”.

## THE LABEL OF “USER-IN-CHARGE”

### Q2: We seek views on whether the label “user-in-charge” conveys its intended meaning.

3.63 Current legislation places insurance and maintenance responsibilities on “users”, which is wider than just drivers. Similarly, prohibitions on being under the influence of drink or drugs (or being above the prescribed limit) apply not only to drivers but also to a person “in charge” of a vehicle. The term user-in-charge was intended to indicate, in a broad way, that the person was not a driver while the ADS is engaged but was subject to these other wider provisions. We asked if the term conveyed this meaning.

#### In favour of ‘user-in-charge’

3.64 Several respondents felt that the label ‘user-in-charge’ did convey its intended meaning, at least for consumer-owned vehicles.<sup>22</sup>

*[I]t conveys a responsibility onto that person but makes a clear distinction with responsibility for the driving task. [Direct Line Group (DLG)]*

*[T]he word ‘user’ draws a crucial distinction from the concept of a driver (i.e. a person responsible for controlling the dynamic driving task), and ‘in charge’ implies responsibilities on the part of the user vis a vis the maintenance and legal roadworthiness of the vehicle itself. [DAC Beachcroft LLP]*

*“User-in-charge” appears to convey the meaning that an element of responsibility and liability reside with that person. This could serve to ensure that users are aware that there are limitations to the vehicle’s “driverless” functions and as such may help to mitigate the “false trust” symptoms that allow users to believe a vehicle to be more capable than it is. [Meridian Mobility UK]*

#### Concerns about ‘user-in-charge’

3.65 Others thought that the term ‘user-in-charge’ was problematic. One concern was that the term “in-charge” suggests an immediate readiness to intervene. As Centaur Consulting said, “in charge” suggests “immediate control”.<sup>23</sup> TRL added:

*The user-in-charge is not, technically, in charge of anything if they are just a passenger in a vehicle which is driving using its automated functionality. The moment at which they are in charge (after handover) they are simply a driver or ‘operator’ again.<sup>24</sup>*

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<sup>22</sup> Meridian Mobility UK; Direct Line Group; DAC Beachcroft LLP; the ABI and Thatcham Research.

<sup>23</sup> Other respondents who thought that the term “in charge” suggested more responsibility than we intended included the Transport Safety Research Group; University of York; Parliamentary Advisory Council for Transport Safety (PACTS); George Economides; techUK; RAC Foundation; Brake; FiveAI; Burges Salmon LLP and Sheffield University law students.

<sup>24</sup> TRL.

3.66 By contrast, Burges Salmon LLP felt that the term “user” suggested too little responsibility, and failed to convey that the human may have to drive and needs to be competent and fit to do that.<sup>25</sup>

3.67 Volvo Cars expressed concern that the generic term ‘user-in-charge’ does not convey the way in which the user switches roles:

*in role-switching automation, the driver switches roles between being a driver and a passenger.... The human must know that there are clearly different roles as a passenger and as a driver.*

3.68 The ABI and Thatcham Research were supportive of the term, but expressed concern that it might not be clear to a non-specialist audience:

*Whilst we are supportive of the term ‘user-in-charge’, it may be appropriate to continue to refer to ‘drivers’ and ‘passengers’ in non-legal documents to clearly differentiate who is in charge of controlling the vehicle at any point.*

3.69 McLaren Applied Technologies thought that the term was unsuited to cover a remote operator, who may provide services to several vehicles simultaneously and would not be “users” of the vehicle.

#### Alternative terms

3.70 Consultees suggested 24 alternative terms, of which 12 included the word “driver”. Examples were “reserve driver”, “second driver”, “standby driver”, “co-driver” and “supervising driver”. Several consultees argued in favour of referring to the human in the driving seat as a driver.<sup>26</sup> For example, Burges Salmon LLP said:

*Designation of “driver” makes absolutely clear that the purpose of this human in the loop is, at points, to drive and reinforces that they will be expected to be competent and fit to do so even when it is not “their turn”. It also distinguishes the individual from other humans in the loop who may be more described as ‘operators’ or ‘attendants’ who oversee some aspects of the [ADS] but are not assuming or expected to assume control of the dynamic driving task.*

3.71 In contrast, others argued that it is important to avoid the word “driver” because it does not differentiate between the role of the person in charge of an ADS and the role of a driver of a conventional vehicle.<sup>27</sup>

3.72 Four consultees suggested terms which included the word “operator” (for example, “designated operator”, “responsible operator” and “operator in charge”). The Faculty of Advocates stressed that this person could either be an onboard operator or a remote operator. They would be responsible for appropriately engaging or disengaging the self-

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<sup>25</sup> Burges Salmon LLP.

<sup>26</sup> London Living Streets; Living Streets Hackney; Ben Phillips; Road Danger Reduction Forum; Richard Hindes; Anoop Shah.

<sup>27</sup> Alex Glassbrook; Dr Chris Tennant; Police Scotland.

driving system, or dealing appropriately with the vehicle after it reaches a minimal risk condition.

3.73 Other terms included “secondary controller” or “user-on-standby”. Cycling UK suggested pilot or co-pilot on the grounds that the user-in-charge is similar to an aircraft pilot.

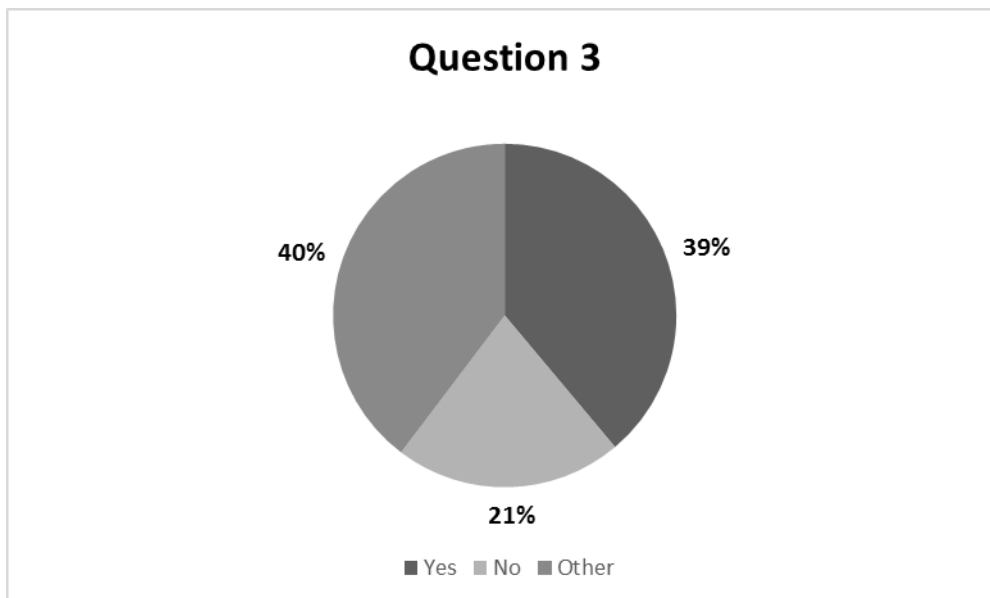
### A POSSIBLE NEW OFFENCE OF FAILING TO AVERT A RISK

**Q3: We seek views on whether it should be a criminal offence for a user-in-charge who is subjectively aware of a risk of serious injury to fail to take reasonable steps to avert that risk.**

3.74 Generally, where an ADS is appropriately engaged, the user-in-charge would not be responsible for any problems arising from how the vehicle was driving itself. However, we asked about a possible exception. If a user-in-charge is aware of a risk of serious injury and does nothing, should the user be guilty of a criminal offence?

3.75 The rationale is that an effective intervention could prevent an accident. On the other hand, this exception risks blurring lines of responsibility. Any suggestion that a human should intervene might lead developers to rely on human input and therefore not make the ADSs adequately safe. Furthermore, users-in-charge often lack the situational awareness to intervene effectively in an emergency. Their attempts to do so may make the situation worse.

3.76 We said that the issue was finely balanced and asked for views.



3.77 Views were split. Out of 126 respondents, 49 (39%) said it should be an offence, 27 consultees (21%) said it should not, and 50 responded ‘other’.

#### In favour of a new criminal offence

3.78 The main rationale for a new offence is that it would improve safety. As Transport for West Midlands (TfWM) said, it would “deter dangerous and irresponsible behaviour and keep road users safe”. It was therefore supported by several groups concerned with the



safety of vulnerable road users, including London Living Streets, Road Danger Reduction Forum, Cycling Scotland, and Living Streets Hackney.

- 3.79 It was also said that if a user-in-charge chooses to use the vehicle, they should take responsibility for its actions. For example, Sam Wakeling commented that if the user-in-charge “cannot keep others safe they should not use it”. McLaren Applied Technologies said that without this obligation on users-in-charge, “there is not much point in their role”.
- 3.80 Those who supported a new offence, however, did not necessarily agree about the elements of the offence. Some saw it applying only to serious cases. BIBA, for example, suggested that the failure to intervene should be reckless or deliberate. Others thought it would be sufficient if the behaviour was negligent.
- 3.81 There was particular disagreement about whether the offence should apply only to those who actually knew of the risk, or whether it should also apply to those who failed to monitor the risk. CILEx explained that over 86% of their members wished to see a new criminal offence. However:

*Member opinion was divided... as to whether this test of reasonableness ought to be one that is objective or subjective, and whether the user-in-charge should be considered a ‘driver’ for the purposes of criminal liability while the system is engaged.*

- 3.82 Several respondents thought that a user-in-charge should be required to monitor the vehicle at all times. For example, Trifords (trading as Auto Windscreens) said, “If the “ user-in-charge” is indeed in charge then they should not be in a passive role and therefore should be in a position to mitigate that risk”. Peter Brown suggested that the user-in-charge should have a duty of care similar to that of the pilot of a commercial aircraft.
- 3.83 Intelligent Transport Systems UK agreed with the principle behind the criminal offence, but suggested that it should apply to everyone, not just the user-in-charge.

*With regard to taking necessary steps to avoid an accident we respectfully suggest that responsibility should be placed on any citizen in any place, provided they are aware of the situation and that steps can be taken to avoid an accident.*

#### Against a criminal offence

- 3.84 As we have seen, many consultees expressed concern that a user-in-charge who intervened at short notice would be likely to make the situation worse. This led some consultees to strongly oppose the proposed criminal offence. In their joint response, the ABI and Thatcham Research said:

*We strongly oppose making it a criminal offence for a user-in-charge to fail to take steps to avert risks that they are subjectively aware of.... This risks blurring the lines of responsibility and would not be conducive to road safety and public acceptance of [ADSs].*

- 3.85 The main argument made against creating a new criminal offence is that it would encourage inappropriate intervention.<sup>28</sup> As CAVT said:

*Human factors research is consistent in illustrating that handover of control from automated to human driving involves a significant delay in reacting to a request to assume control, and that further delay in achieving appropriate and stable control can take a considerable time thereafter.*

- 3.86 The Faculty of Advocates put the argument as follows:

*Attaching criminal liability to intervene in a system, which should by definition require no intervention, would... have the undesirable effect of encouraging “users-in-charge” to intervene based on their own perception of risk. This perception may be wrong or (as they are not expected to maintain full awareness) based on an inadequate or flawed understanding of the driving environment. In our view, that may well create risk by leading to increased unsafe human intervention into systems operating safely.*

- 3.87 There was also concern that such an offence would dilute the responsibility of the manufacturer and consequently undermine public confidence.<sup>29</sup> If there is a risk obvious to a human, the ADS is at fault; there was concern that a human should not be held responsible for failing to correct a serious failure in the software. As Mills & Reeve LLP said:

*Making the “user-in-charge” criminally liable for failing to override the [ADS] risks confusing [lines of responsibility], potentially leading to a situation where both the [ADS] and the “user-in-charge” act as though the other is ultimately responsible for safety.*

- 3.88 DLG argued that the suggested offence could put the user-in-charge in a difficult position.

*If [the user-in-charge does] intervene and it is decided they shouldn't have then they could be held liable for the damages caused by the accident. On the other hand, if they don't intervene and it was determined that they should have, then they could be criminally liable for the accident.*

- 3.89 This could lead to unfairness:

*It opens the door to 20:20 hindsight; the analyst and critic is under no pressure and will have a very different perception of events from those of the [user-in-charge].*

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<sup>28</sup> This point was made by, among others, Weightmans LLP; Esure; FiveAI; The Floop; Aviva; DAC Beachcroft LLP; ABI and Thatcham; Ageas; CPS; CAVT; The Automobile Association; The Garage Equipment Association; and University of York. Transport for West Midlands said that this might be the case in the future.

<sup>29</sup> Law Society of Scotland; Esure; AXA XL; AXA UK; DLG; Aviva; Dean Hatton, NPCC Roads Policing, personal response; DAC Beachcroft LLP; Wayve Technologies; ABI / Thatcham; Ageas; Metropolitan Police Service; FiveAI; Mills & Reeve LLP; International Underwriting Association; Transport Systems Catapult; The Floop; Burges Salmon LLP (see Venturer trials and the Waymo example: <https://medium.com/waymo/the-very-human-challenge-of-safe-driving-58c4d2b4e8ee>).

### Subjective awareness of a risk of serious injury

- 3.90 Many thought that limiting the offence to subjective awareness was confusing. They were unsure about whether we were suggesting that users-in-charge *should* be subjectively aware of risks. The Automobile Association (AA) said that would “effectively imply that the user-in-charge is acting as fall back for an [ADS]”. It also conflicts with the ability of the user-in-charge to undertake secondary activities.<sup>30</sup>
- 3.91 On the other hand, if the offence only applies in the unlikely event that the user-in-charge *is* aware of a risk, the offence appears arbitrary. Burges Salmon LLP said that such a criminal offence may incentivise unhelpful behaviours e.g. encouraging users-in-charge to pay as little attention as possible since they are less likely to become “subjectively aware” of driving risks.<sup>31</sup>
- 3.92 Weightmans LLP suggested the opposite approach, namely that it should be an offence to intervene while the vehicle is driving itself. They also thought that the vehicle should not react to driver inputs until the handover process is complete.

### Does the existing law cover serious cases?

- 3.93 The Consultation Paper gave an example of a car edging forward but failing to perceive a casualty lying on the ground. A user-in-charge who deliberately refused to heed bystanders’ shouts would be seen as acting wrongly. The Faculty of Advocates thought that particularly serious failures of this type may already be an offence under Scots law:

*If a “user-in-charge’s” behaviour in not intervening is exceptionally blameworthy, it may (in Scotland) fall within the definition of the existing common law offence of culpable and reckless conduct. In our view, this is sufficient to address extreme cases of egregious or deliberate behaviour by “users-in-charge”.*

- 3.94 Professor Sally Kyd, of the University of Leicester, suggested that this situation could also be catered for under English law.

## AUTOMATED DRIVING SYSTEMS WITHOUT A USER-IN-CHARGE

**Q4: We seek views on how ADSs can operate safely and effectively in the absence of a user-in-charge.**

**Q5: Do you agree that powers should be made available to approve automated vehicles as able to operate without a user-in-charge?**

- 3.95 In the Consultation Paper, we said that many of the benefits of driving automation arise when vehicles are able to travel empty or carry occupants who are simply passengers. However, several challenges would need to be overcome to reach this stage. We sought views about meeting these challenges and tentatively proposed flexible powers to approve vehicles as operating without a user-in-charge.<sup>32</sup>

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<sup>30</sup> This point was made by, among others, FiveAI; DAC Beachcroft LLP; South Yorkshire Safer Roads Partnership; the Freight Transport Association.

<sup>31</sup> Burges Salmon LLP.

<sup>32</sup> This question also depends on the definition of a ‘user-in-charge’ and whether it covers persons outside the vehicle. Several consultees felt that the Consultation Paper was not clear on this issue.

## Overcoming the challenges

- 3.96 Several respondents pointed out the benefits of vehicles without users-in-charge. Meridian Mobility UK pointed to “a proliferation of beneficial use-cases and business models”:

*from reducing costs of running public services, to increasing personal productivity, from reducing mobility poverty to increasing social mobility. Each of these is enabled by lower cost transport services and more efficient and safer driving.*

- 3.97 Many respondents envisaged that such vehicles would be operated by a licensed organisation, with some form of remote control. DAC Beachcroft LLP anticipated that, at least initially:

*vehicles authorised to operate without a UIC will be localised ‘path 2’ vehicles – i.e. low volume pods designed for use in a very specific Operational Design Domain, most likely linked to a local geographic area. Such vehicles are most likely to be operated as a fleet by a licenced organisation.*

- 3.98 Similarly, the ABI and Thatcham Research expected that:

*Path 2 vehicles would be operated by a licenced organisation and be subject to requirements by local authorities to ensure that these systems are able to cope with the scenarios that they are likely to encounter in their particular operational design domain and be able to carry out a minimal risk manoeuvre. For these systems, a controller operating remotely would be able to substitute the user-in-charge.*

- 3.99 FiveAI wrote in detail about how they anticipated remote operation would work. They anticipated that the operator would only intervene “at the vehicle’s instigation and not under their own volition”.

*Only upon a request from the vehicle (i.e. not for the entire journey) there would be a human with, likely non-real time situational awareness of the vehicle in a position to advise the vehicle with plans to resume autonomous operation or to enact a ‘failover’ mission, i.e. a safe plan to achieve a lower risk ‘minimal risk condition’.*

- 3.100 Some suggested that vehicles without a user-in-charge should only be permitted in simple environments, such as motorways or dedicated roads, or private roads.<sup>33</sup> PACTS pointed to environments with “low speeds, lack of obstacles, and clearly defined space for vehicles to navigate”, giving an airport “apron bus” as an example.

- 3.101 The Met Office provided extensive guidance about how to ensure that such vehicles were not vulnerable to changing weather conditions. They pointed to the need for redundancy mechanisms, to guard against a single point of failure:

*For example, camera image analysis systems may be used to infer road surface condition, such as snow or ice cover. In some cases, such as glare from wet roads, auxiliary meteorological data may be used to improve confidence in on-board data*

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<sup>33</sup> Living Streets Hackney; London Living Streets; Burges Salmon LLP; John Rainbird; M Mann; Dean Hatton, NPCC Roads Policing, personal response; Stagecoach Group plc; Chief Inspector Adrian Davies; PACTS; Ordnance Survey; Visteon; RAC Foundation; and Amey.

*analysis from these systems. This ‘redundancy’ mechanism could come from additional on-board sensors and/or access to forecast model data that constrains plausible atmospheric and surface state conditions.*

3.102 Many consultees emphasised the importance of a rigorous testing regime to ensure that vehicles without a user-in-charge are safe.<sup>34</sup> Meridian Mobility UK described the need for “independent approval against a clear regulatory backdrop”.

3.103 Transport Systems Catapult suggested that the organisation operating the vehicles should submit a detailed safety case to an independent assessment panel. Jacobs drew parallels with automated rail systems, referring to examples

*such as the Public People Movers (PPMs) at Stansted Airport, Docklands Light Railway (DLR) in London and Rio Tinto's ATC (automatic train control) freight trains in Australia. Such systems have a Safety Case which has to be accepted by the national rail safety regulator (ORR in the UK).*

#### Concern about operating without a user-in-charge

3.104 By contrast, some consultees said that automated vehicles should always have a user-in-charge.<sup>35</sup> There was concern that vehicles without users-in-charge would not be accepted by the public<sup>36</sup> and that they would not be safe.<sup>37</sup> Cycling Scotland, for example, believed that a user-in-charge was necessary to ensure the safety of all road users, especially “vulnerable road users like people cycling and pedestrians”.

3.105 Others suggested automated vehicles without a user-in-charge would disrupt traffic flow. As Martin Scott said:

*automated vehicles without user-in-charge could cause gridlock when they meet at a mini roundabout and choose to all give way.*

3.106 The SMMT and Bentley Motor Cars argued that rather than creating exceptions for automated vehicles operating without a user-in-charge, the definition of a user-in-charge should be widened to include remote operators.

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<sup>34</sup> Meridian Mobility UK; University of York; Edward Christian Macfarlane; DAC Beachcroft LLP; Apollo Vehicle Safety; Michael David Crocker.

<sup>35</sup> It is not clear whether these consultees thought automated vehicles should have a user-in-charge inside the vehicle or whether a remote user-in-charge would suffice.

<sup>36</sup> David Salmon.

<sup>37</sup> Jacob Hardy; Stephan; James Geraghty; Bob Downie.

## CONDITIONAL AUTOMATION AND SECONDARY ACTIVITIES

**Q6: Under what circumstances should a driver be permitted to undertake secondary activities when an ADS is engaged?**

**Q7: Conditionally ADSs require a human driver to act as a fallback when the ADS is engaged. If such systems are authorised at an international level:**

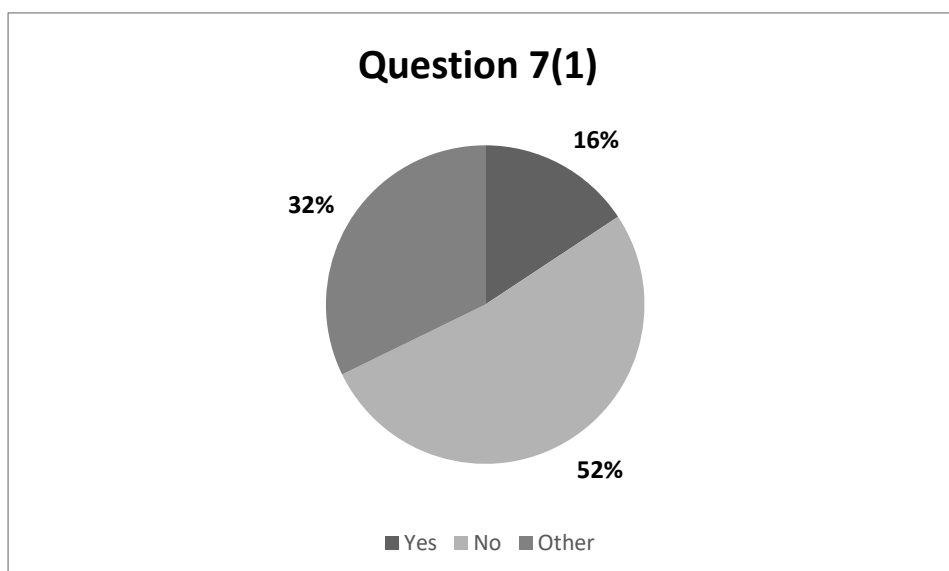
**(1) should the fallback be permitted to undertake other activities?**

**(2) if so, what should those activities be?**

3.107 SAE Level 3 describes “conditional automation”: drivers do not have to actively monitor the system, but do have to be receptive to a request to intervene.

3.108 In the Consultation Paper we said that conditional automation presented regulators with a difficult choice. One approach would be to treat Level 3 as a form of driver assistance in which the human driver would be legally responsible for monitoring the environment at all times. The laws restricting secondary activities (such as texting) would continue to apply. Drivers would retain all their current duties, under both civil and criminal law.

3.109 However, with sophisticated Level 3 systems, human drivers have very little to do and the less humans do, the more their minds tend to wander. The concern is that drivers will daydream or fall asleep, despite warnings to the contrary. An alternative approach would shift from viewing secondary activities as mere distractions and see them as a way of managing drivers’ attention. For example, a driver could be permitted to use the vehicle’s own “infotainment” system, which would cut out as soon as the vehicle issued a request to intervene. We introduced the discussion with a very open question: when should secondary activities be permitted? We then asked a more targeted question about conditional automation. Most consultees considered these questions together.



3.110 Consultees expressed considerable concern about allowing secondary activities in vehicles with Level 3 systems. Of the 121 consultees who responded to this question, only 19 consultees (16%) thought that secondary activities should be allowed. A narrow

majority (63 consultees, 52%) thought that they should not be allowed. The remaining 39 consultees responded 'other'.

### The case for allowing a fallback to undertake secondary activities

3.111 The SMMT put forward a strong case that “secondary activities should be permitted when SAE Level 3 or Level 4 automation is safely engaged”. The SMMT stated:

*For Levels 3 and 4 with an on-board user-in-charge, these activities should be consistent with the **prescribed use** specific to the level of automation. The prescribed use takes into account a range of factors including, but not limited to, the level of vehicle automation, the nature of the secondary activities, the user-in-charge’s state of alertness and the external environment (e.g. traffic and road conditions, infrastructure, weather, unexpected obstacles such as police road blocks).*

3.112 The SMMT suggested that in many cases “the prescribed use” would only permit secondary activities to take place through the on-board integrated communication display. They explained how this might operate:

*Where there is a request for human takeover of the controls, the system will, for example, automatically switch the integrated display off, or show the request on the integrated display, thus prompting the user-in-charge to resume control of the dynamic driving task. The user-in-charge is given time to take over control while the ADS continues to operate until the user-in-charge fully resumes control or, should he/she fail to do so, until the minimal risk manoeuvre has brought the vehicle to a minimal risk condition.*

3.113 The SMMT went on to say that the “the prescribed use” would usually be managed through instructions provided by the vehicle manufacturer and through active management of the driver’s, or user-in-charge’s, attention and alertness. As an important safeguard, the driver would not be entitled to activate the ADS on a whim. Instead:

*Upon detection of the right conditions that satisfy the intended operational design domain, the system offers the driver the option to engage the ADS and thereafter the possibility to engage in secondary activities appropriate to the specific level of automation.*

3.114 Bentley Motor Cars and BMW Group UK supported this approach.

3.115 The CIHT addressed the issue pragmatically:

*... a wide variety of activities will be undertaken whether they are permitted or not; these will range from reading, putting on make-up, sending email; and performing these activities will likely be a major selling point of automated vehicles.*

3.116 Similarly, Neckermann Strategic Advisors argued that if Level 3 vehicles are to be permitted:

*... it's patently absurd to ask humans (who currently are not able to keep their hands off their smartphones when they ARE "in charge") to retain any level of attention.*

### The case for treating Level 3 as driver assistance

3.117 The ABI and Thatcham Research argued strongly that if a vehicle could not achieve a minimal risk condition it should be treated as driver assistance. Therefore secondary activities should not be allowed:

*Any vehicle that requires a human driver to act as a fallback system is not automated and should not fall under the definition of a vehicle that can 'safely drive itself' as defined in the Automated and Electric Vehicles Act 2018. If a human driver is relied on to take back control to guarantee road safety, the system is assisted and the driver bears responsibility for any accidents. Drivers of these vehicles should not be permitted to undertake any secondary activities.*

3.118 Burges Salmon LLP referred to the German Road Traffic Act (StVG). In principle, the StVG permits SAE Level 3 vehicles but appears to leave “the actual detail of what is or is not permissible by way of secondary activities” to vehicle manufacturers. Burges Salmon LLP expressed concern about allowing manufacturers to prescribe secondary activities:

*Given high profile awareness and habit-forming driving campaigns of the past focussed on discouraging unsafe and/or unlawful human behaviours on the road (e.g. tiredness, mobile phone use, lack of due care and attention, etc), it would seem unusual for UK law to leave the matter of defining acceptable human driver secondary activities solely to manufacturers.*

3.119 They suggested that “any system that did rely on manufacturers to define standards of safe conduct by users-in-charge would inevitably require a greater degree of regulation than exists currently”.

3.120 The National Federation of the Blind UK were concerned that drivers of Level 3 vehicles may:

*turn on their computer and then not be looking at the road ahead, so if the computer sounds a warning that the driver must take over instantly, this may take several seconds during which time the vehicle may be involved in an accident.*

3.121 Three further arguments were put against allowing secondary activities, as follows:

- (1) The law should combat distracted driving, not permit it;
- (2) The need for a clear line; and
- (3) The need to create incentives to develop safer vehicles.

3.122 These are elaborated below.

### The law should combat distracted driving, not permit it

3.123 Thompsons Solicitors LLP took issue with the idea that the vehicle’s infotainment system would “manage” a driver’s attention:



*Who will determine what is to be available on the infotainment system which is sufficient to keep the driver alert but not deemed so engrossing as to make the return to driving 'difficult'?*

3.124 Thompsons Solicitors LLP went on to say:

*In most other monotonous but dangerous jobs, say working heavy machinery or on meat cutting production lines, the answer is not distraction, in fact quite the reverse – the emphasis is on concentration with (sometimes) breaks from and/or rotation of tasks.*

3.125 Similarly, The Flook were concerned about reversing the global trend to combat distracted driving:

*Drivers embracing other tasks has long been associated with accident causation and current legislation for mobile phone use and distracted driving is becoming global.*

3.126 Transport Systems Catapult said that even though people are likely to flout the law and undertake lots of other activities, we should not legalise secondary activities because it would send the wrong message to the public and manufacturers.

#### The need for a clear line

3.127 Secondly, consultees were concerned that permitting secondary activities would mislead drivers into believing that the vehicle is automated. As DLG said:

*There needs to be a clear line between assistance systems and automated systems. Allowing secondary tasks for 'conditional automation' blurs the lines of responsibility and this would make these systems more dangerous than conventional vehicles.*

3.128 Volvo Cars strongly supported a clear line between assistance and automated driving:

*For Volvo Cars, if a vehicle is capable of resolving all conflict scenarios itself to an acceptable safety target level when in automated mode, then it is automated driving. If the system requires the driver to resolve conflict situations while in automated mode, then it is not. If a minimum risk manoeuvre is not offered, it is not an [ADS].*

3.129 Dr Chris Tennant highlighted human factors research, which “points to serious challenges in achieving safe transitions”:

*Our survey data suggests that members of the public both want the ability to retake control and (provided the individual is comfortable in principle with the idea of autonomous driving) the ability to undertake secondary activities. These issues emphasise (a) the need to define different in-the-driver's-seat roles carefully and (b) the risk that some of the boundaries between these different roles might be blurred by commercial pressures.*

#### Incentives to develop safer vehicles

3.130 Apollo Vehicle Safety thought that accepting secondary activities at Level 3 would remove economic incentives on manufacturers to develop safer vehicles:

*The functional difference between level 3 and level 4 may not be that great. For example, users may not see much difference in 99% of their usage of a motorway assist system at level 3 and the same system at level 4. However, the additional technology and redundancy required to make the change may be quite significant such that there might be a large step up in cost between the two. If all of the incentive (ability to do secondary tasks) is given at level 3, at relatively low cost to the consumer, what incentive is left for the consumer to spend considerable additional money to go to level 4?*

### Level 3 systems should not be permitted

- 3.131 Some consultees argued that, rather than treating Level 3 as a form of driver assistance, they should not be allowed at all. As Cycling UK said:

*The riskiest step in the progression towards full automation is when vehicles reach the 'conditionally automated' stage i.e. when they are largely capable of steering, accelerating and braking, and avoiding other motor vehicles, but still need human supervision in case danger arises. At this point, many drivers will find it very difficult to maintain concentration when the vehicle is largely 'driving itself', despite playing a potentially safety critical role. These vehicles should not be permitted for public use.*

- 3.132 The RAC Foundation thought it “complete madness for such systems to be authorised at all”:

*We doubt whether any prescription on 'other activities' would be realistically, universally respected and enforced. We are having enough trouble persuading drivers to stop using hand-held mobile devices to read and send texts in non-automated vehicles!*

- 3.133 Conversely, DAC Beachcroft LLP recognised that “if such systems are authorised at an international level then it will be practically very difficult for the UK to deviate from the recognised international standard”.

### Level 3 systems should be permitted only in limited circumstances

- 3.134 Others thought that Level 3 systems might be acceptable, but only in limited, low-risk environments. For example, Brian Watson suggested that secondary activities might be permitted “for traffic-crawling, platooning and other simple scenarios”.

- 3.135 Burges Salmon LLP queried the use of Level 3 beyond some systems such as traffic jam assist:

*The understanding of Level 3 systems from projects such as VENTURER is that unplanned handover is highly problematic from a safety and driving performance perspective, not least as the system may request handover in safety critical situations. Beyond very narrowly defined operational design domains (such as Audi's Traffic Jam Pilot which by definition operates at low speed), it is unclear how safe such systems can be. Further research is required.*

- 3.136 The Transport Safety Research Group also asked for further research. They said that “at the moment there is a strong body of evidence that engagement in secondary tasks

is distracting”. However, if it can be shown that secondary activities are beneficial in maintaining situational awareness, they “should not be prevented”.

### Secondary activities at Level 4

3.137 Several consultees addressed the issue of secondary activities at SAE Level 4, when the vehicle can achieve a minimal risk condition.

3.138 The ABI and Thatcham Research thought that even at Level 4, a user-in-charge should only be able to use devices that are connected to the vehicle system. They argued that “vehicle manufacturers should be encouraged to further improve integration of devices to enable a wide range of secondary activities via the vehicle system”. They were particularly worried about “laptops, phones and tablets positioned between the user-in-charge and the steering wheel” which “would be very likely to cause serious injury in the event of an airbag deployment”.

3.139 They also thought that secondary activities should cease before a planned handover:

*The vehicle should always monitor the user-in-charge’s status (such as driver attentiveness or drowsiness) and be able to calculate the appropriate handover time to enable a controlled handover. The appropriate time will depend on a number of factors, such as road conditions and the user-in-charge’s level of engagement. It may be, for example, shorter for a user-in-charge looking at the road ahead and longer where the user-in-charge is reading a book. Such driver monitoring technology already exists.*

3.140 TRL also addressed this issue:

*If the system is delivering a warning regarding handover many hours in advance, this essentially becomes a prospective memory task for the user-in-charge, which may require planning but no immediate response; the warnings, given the timeframe, may not require immediate attention, which means that a user-in-charge could be undertaking almost any secondary activity at this point (even sleep) so long as the system can gain acknowledgement by some defined time before the handover. On the other hand, warnings regarding more immediate handover will require a user-in-charge to be focusing their attention on the messages in real time, which probably rules out most secondary activities.*

## THE WAY FORWARD

### The concept of “user-in-charge”

3.141 The phrase “user-in-charge” is intended to describe the role of a human user at one particular stage in the development of driving automation. This is when a human does not need to monitor the environment or take over driving at short notice. However, the human may need to drive to complete the journey, either following a planned handover or after the vehicle has come to a safe stop.

3.142 We are encouraged by the support shown for this concept. We accept, however, that we need to provide greater clarity about whether it applies to fleets using remote operators. Our present thinking is that the label is best confined to users in the vehicle or in direct line of sight of the vehicle (as with remote parking). This is not to say that

remote supervision is undesirable - simply that it raises different issues. In our next Consultation Paper in Autumn 2019, we will consider services where all those carried in the vehicle are purely passengers. We will look in depth at the role of licensed fleet operators and vehicle supervisors working in remote control centres.

3.143 We then intend to bring both consultations together, to set out a full taxonomy of roles in connection with automated vehicles, including users-in-charge, registered keepers, ADSEs, fleet operators and remote supervisors. The aim will be to bring clarity to who is responsible for the various elements within the full range of duties, including updating software, maintenance and insurance. Our intention is to consult on specific proposals in 2020.

### Handovers

3.144 Questions of handover are complex. Our 2020 paper will consider in detail how civil and criminal liabilities change on handovers from human to machine and from machine to human, in both planned and unplanned circumstances.

3.145 We appreciate the concern that unplanned emergency handovers by “eyes-off” users are inherently dangerous and should not be encouraged. We will take this concern seriously in formulating further proposals, including proposals on criminal liability.

### Conditional automation (at SAE Level 3)

3.146 The consultation revealed a strong desire for a clear line between vehicles which can safely drive themselves and those which cannot. Many consultees expressed the view that if an ADS cannot achieve a minimal risk condition, it should be treated as driving assistance: the human in the driving seat should retain the full responsibilities of a driver and be subject to the same driver distraction laws.

3.147 Currently, there is a lack of clarity, about both SAE levels and what amounts to a minimal risk condition. For example, the SAE’s published materials refer to the fallback-ready user (rather than the system) as responsible for achieving a minimal risk condition at Level 3. By contrast, the EU’s Article 20 guidance refers to a “minimal risk manoeuvre” as something the “system” undertakes for both SAE Levels 3 and 4.<sup>38</sup> Uncertainties over whether a Level 3 user is a driver have been voiced in discussions over international regulation,<sup>39</sup> and can be seen in the literature.<sup>40</sup>

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<sup>38</sup> The Commission’s Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, responsible for EU policy on the single market, industry, entrepreneurship and small businesses, published guidelines on the exemption procedure for the EU approval of automated vehicles on 5 April 2019. See <https://ec.europa.eu/docsroom/documents/34802?locale=en>

<sup>39</sup> At the UNECE’s WP1 – WP 29 Joint Event on Automation in Transport: Safe Deployment of Automated Vehicles in Traffic in February 2019 Prof Bryant Walker-Smith emphasised that it is particularly important for regulators to “say what you mean and mean what you say”. See <https://www.unece.org/fileadmin/DAM/trans/doc/2019/wp1/ECE-TRANS-WP1-WP29-2019-Presentation-1e.pdf>

<sup>40</sup> In November 2018 the SAE published a further infographic explaining levels of automation in a more consumer-friendly manner. This includes a general demarcation between ‘you drive’ and ‘you do not drive’, which places SAE Level 3 in the latter category. By contrast, the ABI infographic places SAE Level 3 in the

3.148 It would be premature to decide whether Level 3 users should be given exemptions from driver distraction laws before systems have been approved, and before we know how they operate. We note, however, consultees' strong desire to err on the side of safety. The matter is also being considered by the UN's Global Forum for Road Traffic Safety.<sup>41</sup> Even if a "Level 3" system is approved at international level, amending driver distraction laws will be a matter for the UK Government, and we would expect the Government to take a cautious approach.

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'assisted driving' category: see Thatcham Research and Association of British Insurers, "Assisted and Automated Driving Definitions – Technical Assessment" (2018).

<sup>41</sup> Global Forum for Road Traffic Safety, 78<sup>th</sup> session, Geneva, 25-29 March 2019, Item 3(c)(i), Draft Resolution, "Automated driving: The concept of activities other than driving", available at [https://www.unece.org/fileadmin/DAM/trans/doc/2019/wp1/ECE-TRANS-WP.1-2019-\\_Informal-4-Rev1e.pdf](https://www.unece.org/fileadmin/DAM/trans/doc/2019/wp1/ECE-TRANS-WP.1-2019-_Informal-4-Rev1e.pdf)

## Chapter 4: Safety assurance

### OVERVIEW

- 4.1 A substantial majority of consultees supported our proposals on safety assurance before automated vehicles are allowed onto UK roads for use by the general public. Out of 129 responses to question 8 (1) (a new safety assurance scheme for modifications and small series), 108 (84%) agreed. Similar majorities exist for other proposals in this chapter.
- 4.2 Respondents argued that a new scheme was needed to ensure safety, increase public confidence and fill gaps in the current type approval process. It was also suggested that establishing a new scheme would enable the UK to gain expertise to contribute to international regulation.
- 4.3 However, several respondents (including manufacturers) stressed that a new safety assurance scheme should not replace international standards. There was also a concern that all vehicles should be subject to the same safety assurance procedures, regardless of how they were developed. Respondents also worried about duplicating responsibilities, with many suggestions that any new safety assurance scheme should be developed by existing agencies, such as VCA or DVSA.
- 4.4 Almost everyone agreed that unauthorised systems should be prohibited.
- 4.5 The concept of an automated driving system entity (ADSE) was backed by a substantial majority of respondents.<sup>42</sup> However, many wanted the idea to be fleshed out and the exact responsibilities clarified.
- 4.6 Most respondents argued for a mix of self-certification and third-party testing. Only one respondent felt that self-certification alone would provide adequate assurance. Others pointed to the “dieselgate” scandal as evidence that the industry could not be trusted to police itself. Respondents suggested a combination of approaches, including audits of self-certification; simulation; test track tests; and road tests.
- 4.7 We asked about working with local agencies, and this drew a mixed response. Many respondents felt that there should be co-ordination between the national scheme and local authorities to achieve safe outcomes. However, others stressed the need for national standards, arguing that local authorities lacked the resources needed to be involved in assessing automated vehicles.

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<sup>42</sup> See para 4.49 below.

## A NEW SAFETY ASSURANCE SCHEME

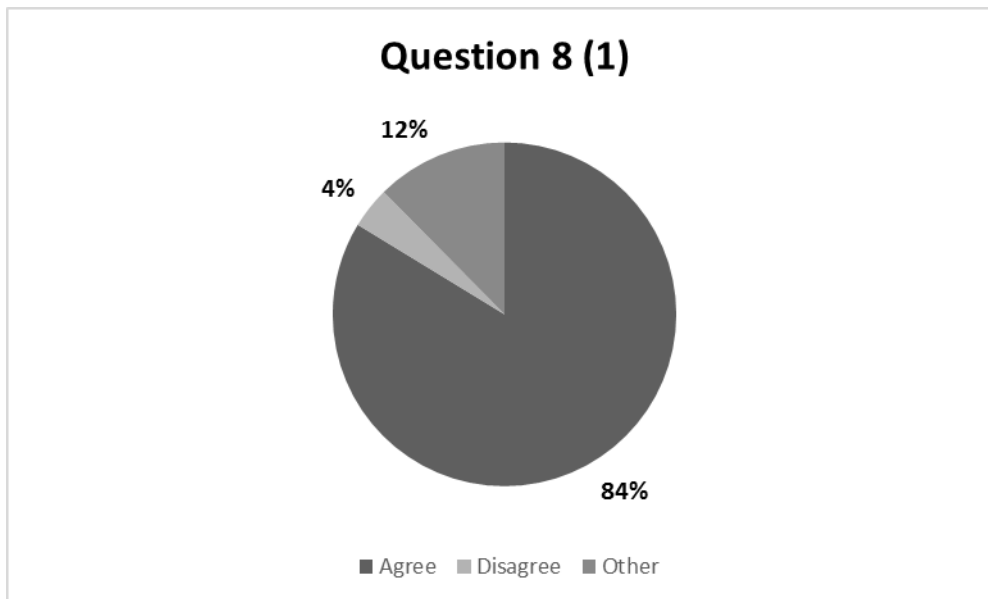
**Q8(1): Do you agree that, a new safety assurance scheme should be established to authorise automated driving systems (ADSs) which are installed:**

- (a) as modifications to registered vehicles; or**
- (b) in vehicles manufactured in limited numbers (a "small series")?**

4.8 In the Consultation Paper, we argued that the existing systems of international type approval worked well for mass market vehicles sold across borders to consumers (which we labelled "Path 1"). However, it worked less well for "Path 2", where ADSs are designed for limited local contexts. In particular:

- (1) Type approval does not apply where a vehicle is modified *after* it has been registered, allowing an ADS to be added to a pre-registered vehicle.
- (2) Under EU law, member states may give "national type approval" to vehicles produced in limited numbers (which, from September 2020, will be defined as 250 vehicles). Here developers might find a national process easier than applying for EU or UNECE exemption.

4.9 We provisionally proposed that the UK Government should establish a new safety assurance scheme to apply in these circumstances. We asked consultees if they agreed.



4.10 Out of 129 consultees who answered this question, a large majority, 108 (84%) agreed that a new safety assurance scheme should be established to authorise ADSs installed as modifications and small series. Only 5 (4%) disagreed and 16 (12%) answered "other".

### Agreement

4.11 Many respondents simply agreed outright with the proposal:

*We support the Law Commission's proposal to establish a new independent safety assurance scheme or agency to authorise automated driving. The challenge is to establish robust and cost effective regulatory standards that address the gaps in the present system identified by the Law Commission. [TRL]*

*Given that testing and approving the safety of [ADSs] will require highly specialised expertise, we believe that there should be a dedicated safety assurance scheme established for [ADSs]. [The Parliamentary Advisory Council for Transport Safety (PACTS)]*

*It is going to be important that no small series exemptions allow autonomous operating systems onto public roads without being subject to an appropriate type-approval regime, the same goes for post-manufacture modifications. [RAC Foundation]*

- 4.12 Respondents stressed the importance of safety and the need to establish public confidence in the technology. As the Magistrates Association put it, “the safety of those in the vehicle and the public is paramount so a robust safety assurance scheme should be implemented”. The Law Society of Scotland added:

*Confidence in [ADSs] is crucial: some of this will require public education around the capability and risks of these systems and some of this will require robust regulation.*

- 4.13 Several respondents asked for an opportunity to contribute to the work of the new body:

*The Metropolitan Police Service supports this suggestion and would welcome the opportunity to contribute to further work in this area. [Metropolitan Police Service]*

*We urge that any new body engages with DPTAC at the earliest stages to discuss how it will support and interact with people with disabilities. [Disabled Persons Transport Advisory Committee (DPTAC)]*

### **The need to fill gaps**

- 4.14 Many developers and researchers welcomed the proposal as filling gaps in the existing type approval system. For example, Visteon said “these areas previously fell 'between the cracks' so we agree that a safety assurance scheme makes sense”.

- 4.15 The Society of Motor Manufacturers and Traders (SMMT) emphasised that the proposal would sit alongside UNECE approval:

*A new safety assurance scheme that does not supersede, or indeed undermine, the work of the UNECE seems a suitable and sensible approach for the purpose of authorising post-registration vehicle modifications and small series vehicles with highly automated driving capabilities. A national safety assurance scheme may provide a safety-centric regulatory framework that enables and promotes the deployment of these vehicles in the UK.*

- 4.16 The SMMT thought that UK experience might contribute to international regulation:

*Furthermore, UK expertise and experience built from establishing and operating such a safety assurance scheme may become useful contribution to the development of new international regulation at the UNECE level.*



- 4.17 Transport Safety Research Group highlighted problems with the current type approval process:

*Existing small series approval including Individual Vehicle Approval (IVA) and EC Small Series Type Approval (ECSSTA) needs to be considerably enhanced because, a) safety levels can be very low/undemanding; b) they assume a human driver therefore there is no evaluation of sensing or control systems.*

- 4.18 Similarly, XPI Simulation said:

*Current type approval regulations do not adequately cover the use of [ADSs] and require new tests, standards and regulations in order to ensure the safe deployment of such technology.*

- 4.19 Several responses saw aftermarket systems (added post-registration) as particularly problematic. Apollo Vehicle Safety noted:

*in general, aftermarket systems might prove more technically difficult because of a lack of integration with the original vehicle design. Regulating this possibility would help ensure a level playing field and more consistent standards of systems.*

- 4.20 Some responses highlighted the distinction between the mass-produced “Path 1” vehicles, and more localised “Path 2” driving systems. Bentley Motor Cars agreed with the proposal provided it did not affect “Path 1” where

*the current Type Approval Framework with current agencies (or an extension of responsibilities of existing agencies) shall be sufficient. We do not need another agency that replicates or worse still, duplicates, the same functionalities and responsibilities.*

- 4.21 Humanising Autonomy thought that a safety assurance scheme should also have a role in supporting developers:

*This safety assurance scheme should focus on supporting developers in understanding regulations and which safety precautions they need to take to test their vehicles and bring them to market as fast as possible...*

### **Concern that safety assurance should apply to all automated vehicles**

- 4.22 Respondents who disagreed with the proposal thought that appropriate standards should be implemented for all automated vehicles:

*Irrespective of numbers, a safety assurance scheme should apply to all. [Richard Sarginson]*

*Such cars should go through the standardised safety testing regimes. [Jacob Hardy]*

*Both types of installation, and those in vehicles sold in large numbers should require authorization from well-informed authorities. [Heather G Bradshaw-Martin]*

- 4.23 The National Physical Laboratory (NPL) also wished to see a single system:

*There is a case to be made that all vehicles considered to operate an [ADS] (both Path 1 and Path 2) should go through the same safety assurance process. Regardless of how an autonomous vehicle has been developed, the same issues exist around how the vehicle sensors will perform under different environmental conditions.*

- 4.24 A few developers doubted whether a limited safety assurance scheme would be cost-effective. As stated in the joint response of Buchanan Computing and the Institute of Highway Engineers (IHE):

*The testing required to ensure safety needs to be very extensive and is therefore unlikely to be cost-effective for individual modification and small series vehicles.*

- 4.25 Similarly, BMW Group UK argued that the modification of registered cars would be technically unrealistic and that small fleet safety assurance should be comparable to that for a large fleet. They added that the “existing homologation processes for small series should be maintained for agile development”.

### **Expanding the remit of current agencies**

- 4.26 In their joint response, the Association of British Insurers (ABI) and Thatcham Research expressed concern about creating an entirely new safety assurance scheme which would circumvent existing processes. Instead, existing schemes should be enhanced:

*All vehicles produced in significant numbers must go through the proposed automated vehicle type approval process to ensure that the whole vehicle is of an automated integrity mechanically, electrically and electronically; and aligned to an internationally recognised standard. The existing Individual Vehicle Approval (IVA) scheme should be maintained and enhanced, and requirements added to consider low volume production of automated vehicles. This will require an enhancement of an existing authority’s (most likely the Vehicle Certification Agency) remit.*

- 4.27 The National Franchised Dealers Association also felt that such a scheme could be managed by the VCA and saw “no benefit to partitioning the responsibility of pre-deployment vehicle safety assurance between different agencies”.

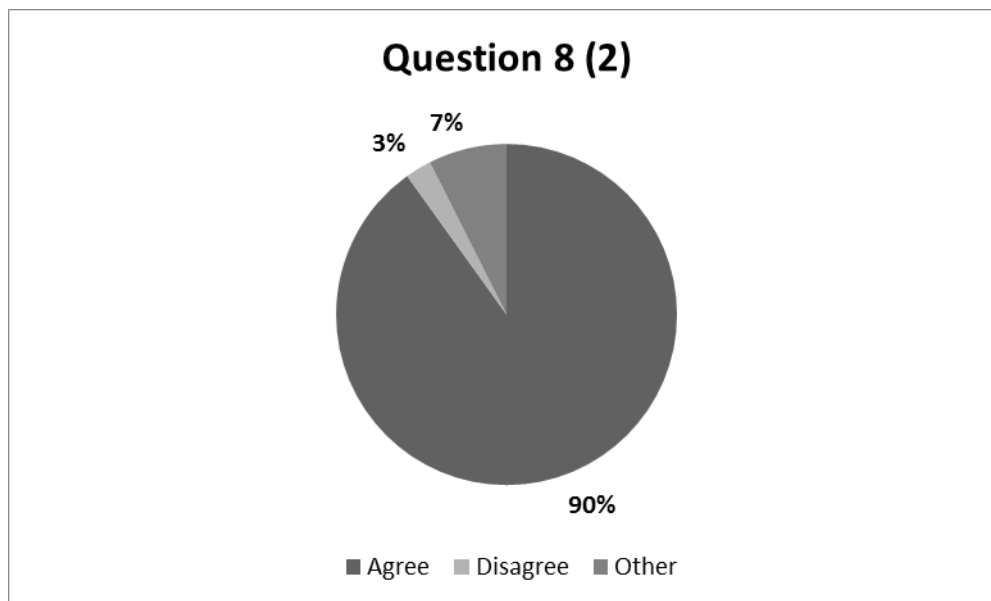
- 4.28 This was allied to a concern that using existing agencies would be more cost-effective. As the Chartered Institute of Legal Executives put it, any spending may be “better invested into resourcing existing bodies”.

- 4.29 Gowling WLG (UK) LLP also argued for using “an evolution of, or separate unit within, an existing authority such as the VCA or DVSA” on the grounds that it could be done more quickly:

*If we have an overarching concern it is – and naturally this implies no criticism of the Law Commissions – that the time taken for the current review, and the time necessarily required for subsequent legislation, means that this will not happen as early as it should.*

## PROHIBITING UNAUTHORISED SYSTEMS

### Q8(2): Do you agree that unauthorised ADSs should be prohibited?



4.30 A majority of consultees agreed that unauthorised ADSs should be prohibited. Out of 121 respondents answering this question, 109 (90%) agreed, only 3 (approximately 3%) disagreed, and 9 (7%) answered “other”.

#### Agreement

4.31 Most respondents regarded the need to prohibit unauthorised ADSs as self-evident. As the SMMT put it:

*unauthorised [ADSs] should not be permitted to be deployed on public roads or in public spaces, as they are unlikely to fully adhere to the safety requirements prescribed in relevant national and international frameworks.*

4.32 Others expressed a similar view:

*Just as human driving is, and should be prohibited in certain scenarios, so should uncertified and unauthorised automated driving be prohibited in others. [Neckermann Strategic Advisors<sup>43</sup>]*

*The technology is too high risk not to have a robust approval system in place. [Pinsent Masons LLP]*

4.33 The ABI and Thatcham Research agreed that “it should be a criminal offence to use an unauthorised ADS on roads or other public places”. They also suggested that “the Law Commission should further consider the merits of making it an offence to sell any unauthorised [ADSs]”.

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<sup>43</sup> A consultancy firm specialising in automated vehicles.

- 4.34 Richard Morris of Innovate UK noted that it was unrealistic to expect the lay person to know whether an ADS is safe:

*It is unrealistic to expect the lay person to determine what is sufficiently safe for them from a complex black box system, so the principle of “buyer beware” is wholly inappropriate in this context. There must be basic safety requirements and the purchaser / end user must have confidence that these are complied with.*

### **Concern about stifling development**

- 4.35 Several respondents expressed concern about how prohibiting unauthorised systems would apply to trials. For example, TRL (who replied “other”) noted “the distinction between production vehicles and trials with a safety driver”. Similarly, McLaren Applied Technologies stressed that “OEMS<sup>44</sup> must be able to develop the ADSs prior to authorization which they can do with a safety driver”.

- 4.36 Stagecoach Group developed this point:

*As far as trialling is concerned it will be necessary to recognise that there may be differing requirements to get to a point of general operational use, subject to the need to have appropriate standards and safeguards for trials in place. We believe that it is important that all companies should comply with the Government code of practice for testing these systems and vehicles.*

- 4.37 The road safety charity, Brake, agreed that there should be a limited exception for

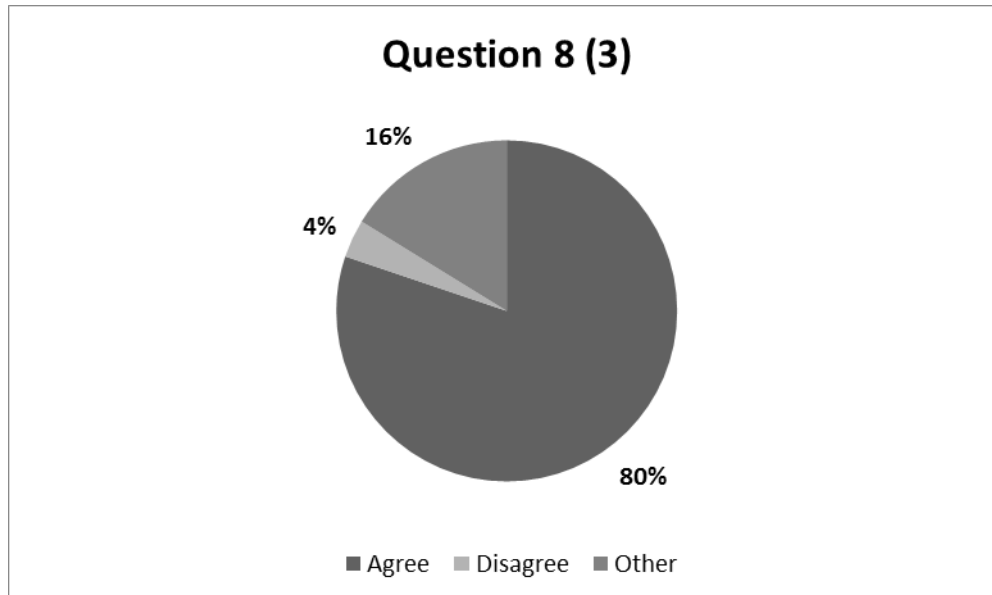
*vehicle prototypes undertaking controlled testing for the purposes of developmental research and authorisation. Their testing should be authorised within conditions that maximise safety to both occupants and people outside the vehicle, in other vehicles and people getting around in active ways (foot, bicycle)”*

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<sup>44</sup> Original Equipment Manufacturers.

## POWERS TO MAKE SPECIAL VEHICLES ORDERS

**Q8(3): Do you agree that the safety assurance agency should also have powers to make special vehicle orders for highly automated vehicles, so as to authorise design changes which would otherwise breach construction and use regulations?**



4.38 Out of 111 consultees answering this question 89 (80%) agreed. Only 4 (4%) disagreed and 18 (16%) answered “other”.

### Agreement

4.39 From a developer’s perspective, Wayve Technologies thought that “an expert body able to authorise breaches of these regulations could be very helpful”. They commented that “in a nascent industry such as this, the ability of developers to advance the technology is critical and potential regulatory blocks are not always clear to begin with”.

4.40 Similarly, BMW Group UK noted that that “the long-term goal” should be to create appropriate regulations for all vehicles. However:

*Due to the rapid evolution of the technology, special vehicles orders will be needed to bridge the gap until every applicable regulation has been updated.*

4.41 Cycling UK felt that such orders may speed up the process towards highly automated vehicles:

*Yes. The aim should be to bypass SAE level 3,<sup>45</sup> hence anything which enables progress towards zero-human vehicles should be enabled.*

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<sup>45</sup> “SAE Level” refers to the system of levels devised by the Society of Automotive Engineers. See <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

## Questioning the need for a new agency

- 4.42 Several responses repeated concerns about duplication of roles. For example, Apollo Vehicle Safety noted that although special vehicle orders were needed, this did not necessarily require a new agency:

*Vehicle special orders are an important way of retaining a flexible approach for research, development and new technology while retaining some control through evaluation on a case by case basis. The ability to register vehicles as a prototype with defined exceptions to the rules is also important. Whether or not this is administered by a separate dedicated agency seems less important than the need for those making the decisions to have the expertise required to do so, wherever they sit organisationally.*

## Maintaining safety standards

- 4.43 Several respondents agreed that special vehicle orders were needed but stressed that safety standards should be preserved. For example, Brake cautioned that:

*such design changes must not lessen safety. In other words, the automation or other aspects of design meet a safety standard that would have been met had C&U regulations been applied.*

- 4.44 The ABI and Thatcham Research also thought that maintaining safety standards was paramount:

*We believe that exemptions to vehicle types and regulations are undesirable and such vehicles should be considered under the appropriate regulations. Any vehicle that operates on public roads must be subject to the same design safety standards as manually-driven vehicles.*

- 4.45 NPL summarised the tension between consistent standards and enabling innovation:

*There is a case to be made that all autonomous vehicles, regardless of how they are developed, should be subject to the same safety assurance 'authorisation' process. However, this is balanced by the need to avoid stifling innovation and therefore a 'safety case' route may be more appropriate.*

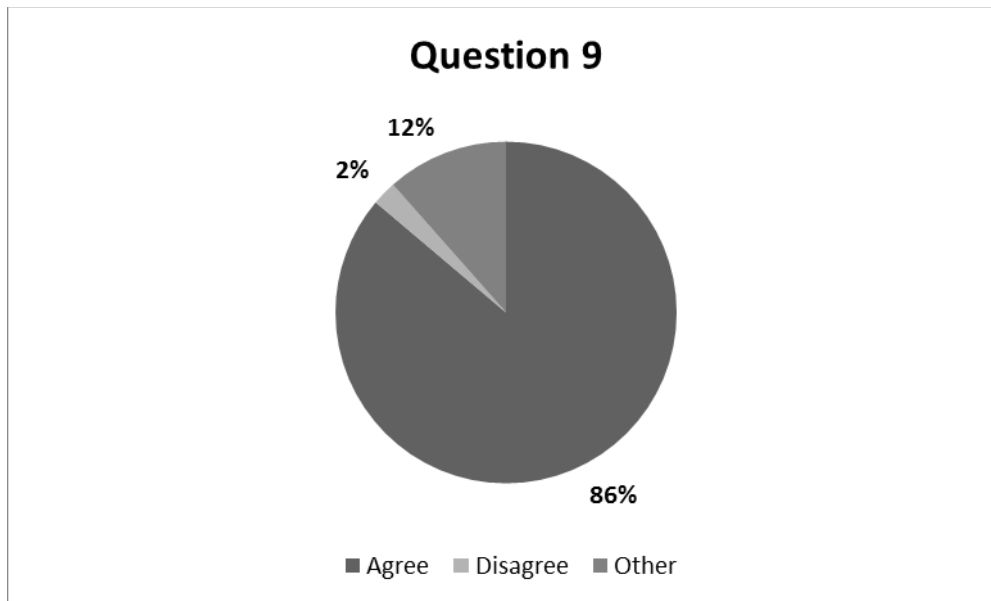
- 4.46 Transport for London (TfL) asked for "clear parameters over what was permissible", which "err on the side of caution (at least initially)". They also raised issues about how far vehicles which did not comply with existing regulations could be used as taxis or private hire vehicles (PHV):

*In terms of taxis and PHVs, we would require further information regarding the potential breach to construction and use regulations so we could assess any potential impacts on passenger safety and services.*

## AUTOMATED DRIVING SYSTEM ENTITIES

### Q9: Do you agree that every ADS should be backed by an ADSE which takes responsibility for the safety of the system?

4.47 In the Consultation Paper, we drew on the work of the National Transport Commission in Australia by proposing that every ADS should be backed by an ADSE. The entity would apply for authorisation and would be subject to a range of regulatory sanctions if things went wrong. We asked consultees if they agreed.



4.48 Out of 130 consultees who answered this question, 112 (86%) agreed that every ADS should be backed by an ADSE which takes responsibility for the safety of the system. Only 3 (2%) disagreed and 15 (12%) answered “other”.

### Agreement

4.49 Most respondents saw this as a sensible step which would boost public confidence in automated vehicles:

*This feels like a sensible step that would provide reassurance to the public [TfL]*

*We agree with this proposal of the Law Commissions and consider that the concept will bring certainty for automated vehicle developers, authorities and the public. [Burgess Salmon LLP]*

*It would seem to be the most effective way of protecting the safety standards of automated vehicles and seems to be best practice across various countries. [South East of Scotland Transport Partnership (SEStran)]*

4.50 George Economides<sup>46</sup> described having an ADSE which takes responsibility for the safety of the system as “essential”.

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<sup>46</sup> From Oxfordshire County Council, responding in a personal capacity.

## How would an ADSE be structured?

- 4.51 Several respondents agreed with the principle behind an ADSE; some asked for more detail about how an ADSE would be structured. There was particular concern that an ADSE should have adequate capital and insurance, and should not simply be a shell company. For example Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA), commented:

*Yes, but we need to think how such entities need to be structured and underwritten. If the ADSE is nothing more than a shell company then liability may be inappropriately capped and the chain of responsibility could lead nowhere. How does the ADSE concept work if it is a tech company rather than a traditional vehicle OEM?*

- 4.52 Transport Systems Catapult asked whether this entity:

*has to be a single company, or whether it would be permissible for it to be a consortium, bearing in mind that autonomous vehicles will typically use technology provided by multiple companies.*

- 4.53 FiveAI thought that the emphasis should be on safety management and insurance, rather than the balance sheet. They suggested that:

*to avoid stifling innovation any requirements imposed on the ADSE should focus on adequacy of the safety management. Rather than establish criteria for trading history, size of balance sheet, number of employees etc, where any financial strength is a concern, insurance should be an adequate antidote.*

- 4.54 Living Streets Hackney expressed concern that the emphasis on corporate liability would reduce the incentives on individuals to maintain safety standards:

*What incentive is there for an employee to safeguard pedestrians if they are not directly liable for their safety? Individuals need to be liable - not large limited liability companies.*

## Clarity over roles

- 4.55 Several respondents asked for further clarity for how the responsibilities of an ADSE interacted with users-in-charge and vehicle keepers. As the Chartered Institution of Highways and Transportation put it:

*there must be clear lines between what an ADSE is responsible for compared with the user-in-charge or keeper of the vehicle, as when it comes to vehicle maintenance, software updates and similar activities.*

- 4.56 Two of the three respondents who disagreed with the concept of the ADSE felt that the user-in-charge would be the better person to hold liability. The third felt that although it seemed sensible, “issues will arise over the installation and maintenance of the system as a whole”. As such it would be “difficult to see how the ADSE could accept full responsibility” unless they were in control of both of these aspects.



- 4.57 Similarly, Uber (ticking “other”) thought that it would be difficult to allocate responsibilities to the many actors in the system, including rideshare platforms and late stage manufacturers:

*Various actors within the development cycle of an ADS may impact the ultimate use of an ADS without executing the requisite control over it to be deemed responsible for the functioning of the full system.*

*A rideshare platform may influence the route planning of an ADS equipped vehicle, or a late stage manufacturer may fit an ADS designed by another developer into a base vehicle but neither of these types of entities may be the appropriate party to back the safety of the system.*

- 4.58 The next Consultation Paper will look in more detail at the responsibilities of registered keepers and fleet operators. Our intention is to provide a full analysis of the all players within the system so as to clarify these issues.

## **SELF-CERTIFICATION AND THIRD-PARTY TESTING**

**Q10: We seek views on how far a new safety assurance system should be based on accrediting the developers’ own systems, and how far it should involve third-party testing.**

- 4.59 In the Consultation Paper we highlighted potential approaches to safety assurance. We noted developments in Australia and California and asked for views on the appropriate balance between self-certification and third-party testing.

- 4.60 Of the 114 responses to this question, the great majority thought that third-party testing should play some part in safety assurance (83%). Only one respondent argued that self-certification alone would be sufficient, and only if developers were prepared to accept the legal consequences. Several respondents noted the involvement of the auto industry in recent scandals such as “dieselgate”, which made third-party testing desirable:

*The motor manufacturing industry currently has low credibility when it comes to vehicle testing so there will be public and political demands for third-party involvement. [Transport Planning Society]*

*The incentives and pressures for manufacturers to abuse a self-accreditation system are very significant. Given that public safety is directly at issue, it would be rash to not provide a structure which strongly counters these incentives. [Heather G Bradshaw-Martin]*

- 4.61 Mobileye felt that self-certification should remain the governing framework in the USA and other countries where it has become the norm. However:

*With third-party testing linked to type approval in other UNECE member countries, this option should also be considered for the UK.*

## A mix of methods

- 4.62 Many respondents argued for a mix of both self-certification and third-party testing. As the ABI and Thatcham Research put it:

*The two approaches are not mutually exclusive and one is not inherently preferable to the other – a strong self-certification regime would likely lead to better outcomes than a weak third-party testing regime. We believe that there should be a balance between accreditation of the developers' own systems and third-party testing. To prevent developers from designing to a fixed set of tests, the third-party testing should use a randomised sample from an extensive set of test scenarios. This is usually referred to as the 'grid' method of testing. Vehicle simulation results must be validated physically using the final, complete, vehicle. The validation process should involve testing by external agents on test tracks and public roads.*

- 4.63 Similarly, Meridian Mobility UK commented:

*There is value in having an independent third-party involved in the safety assurance process is vital. This could either be by being involved in setting clear requirements for self-certification and then validating them, or to carry out independent testing.*

- 4.64 The SMMT also thought that “the solution will likely include a combination of self-certification and third-party testing”. They outlined a system which includes self-certification that the system had been tested against fixed criteria; simulation (or virtual validation); third-party assessment involving driving in real-world environment; and specific tests to demonstrate the ADS's capability to handle emergencies.

## Audited self-certification

- 4.65 Some respondents argued for a system where self-certification was checked by periodic audits of vehicles and self-certification procedures. The Bar Council of England and Wales observed:

*Self-certification may well not go far enough unless there is some form of independent verification of the product undergoing and passing certain tests.*

- 4.66 Some saw the role of the third-party tester as auditing developer data:

*Self-certification or third-party testing are not the only options for a safety assurance system. There is also the concept of a third-party audit. In this case, the testing activity is carried out by the developer (not by the third party), and an independent third party comes in to verify that policies and processes are in place, are being followed, and meet the requirements of a standard or code of practice. This covers not only testing but the entire development lifecycle, from initial concept to final disposal. [Eric Chan, CAVPoint]*

*We think it unlikely that a third-party could develop sufficiently comprehensive tests objectively to test the range of likely [ADSs]. The emphasis should be on auditing an ADSE's own testing procedure as part of the approval for ADSEs. [Faculty of Advocates]*

## The need for standard tests

4.67 Many respondents saw a need to develop standard tests:

*We recommend that a safety assurance system should include an accredited and standardised set of testing scenarios and reference datasets to be deployed across both physical and virtual testing environments. These scenarios should comprise a diverse range of geographic conditions and contexts, including the most challenging 'edge cases'. [Ordnance Survey]*

*As a backbone there must be a clear set of national standards and requirements which articulate the appropriate safety outcomes. Developers can make use of facilities such as TestBed UK to develop against these requirements and test and validate performance. [Meridian Mobility UK]*

*Future safety test procedures, performance criteria and/or guidelines should include observability of a repeatable and deterministic safety model for the vehicle under test in order to demonstrate safety assurance. For instance, a set of acceptable performance benchmarks could be defined for a given vehicle safety test. [Mobileye]*

4.68 McLaren Applied Technologies thought it would be appropriate for test data to be shared:

*The agency and industry must develop tools to measure safety through virtual simulation, track testing and real driving. The suite of test data needs to be publicly owned and populated from known safety cases, accident data and near missed observed by active ADSs.*

4.69 However, XPI Simulation thought that the exact test scenarios should be secret:

*To avoid systems being targeted to pass tests, the detailed content of these scenarios should be classified, although the overall use case would be known to vehicle manufacturers - e.g. an automated emergency braking test to evaluate the vehicle's ability to detect cyclists. The tests would be carried out by the safety assurance agency (or by an independent authority with appropriate delegation from the safety assurance agency).*

## Including the user within a “safe system”

4.70 The University of York outlined a “safe systems perspective”, whereby the system is understood not only from a design perspective but also from an operation perspective and the perspective of “what the operator or user believes the system to be doing”. They noted that:

*the possibility of a disjunction between these three factors is a vital consideration in safety assurance, and the extent to which the design of the system as well as the human-machine interface takes account of, and provides for, them should inform the way in which certification processes are carried out.*

## WORKING WITH LOCAL AGENCIES

### Q11: We seek views on how the safety assurance scheme could best work with local agencies to ensure that it is sensitive to local conditions.

- 4.71 Responses to this question were mixed. Some respondents identified a need for local authorities to collaborate with a national safety assurance scheme. Others stressed the need for a national system of approval that ensured the safety of all vehicles, regardless of location.
- 4.72 Of the 90 substantive responses, around half saw some role for local input, though this might be as simple as providing information about local road conditions. Almost all responses emphasised the need for incorporation of local data within national and international frameworks.

#### Arguments in favour of collaboration

- 4.73 The SMMT differentiated between “Path 1” and “Path 2” vehicles, commenting that this question was more aimed at the “Path 2”:

*The context for this is particularly relevant for highly automated Mobility-as-a-Service fleets operating in geofenced areas of a particular city.*

- 4.74 Here they thought that co-ordination between local authorities and the national safety assurance scheme would be useful:

*A coordinated approach with local agencies is needed to avoid divergent and disparate requirements, especially technical requirements. There may of course be specific requirements set out by some local authorities to account for the unique conditions in their respective local areas. These requirements shall be agreed with the safety assurance agency and annexed in the assurance scheme, indicating the specific operational design domain to which the additional requirements apply.*

- 4.75 The SMMT suggested that where the ADS is specifically developed to operate in a Mobility-as-a-Service fleet in a particular city, approval could involve “a graduated licensing scheme”. The national safety assurance agency would provide provisional permission to operate in the city, subject to confirmation by the local agency that it was operating safely. Bentley Motor Cars agreed with this approach.

- 4.76 The ABI and Thatcham Research also thought that local information would be particularly important for “Path 2” vehicles:

*The safety assurance authority will need to work with the relevant local agencies responsible for the roads on which these vehicles will operate. This may be a specific transport authority (such as TfL) or a local highways authority.*

- 4.77 The Transport Safety Research Group answered the question in relation to urban shuttles or pods. She noted that as local conditions can vary extensively it was necessary to do an assessment of the specific risks before deployment. The safety assurance scheme should work with local authorities to “identify specific risks” and undertake additional safety assurance before deployment. This would allow for a “holistic approach”.

- 4.78 FiveAI pointed out that, at least initially, the capacity of local authorities is limited. Therefore, the national agency would need to take the lead:

*A more realistic starting point may be for a national agency to develop some early capacity and then work in turn with the relevant local agencies to help them examine and evaluate proposed deployment environments in relation to the safety information provided by the ADSE.*

- 4.79 BMW Group UK thought that responsibility for taking account of local conditions should rest with the ADSE:

*As part of the type approval audit the ADSE shall provide evidence to the technical service and the singular type approval authority that all relevant local conditions are taken into account by the system.*

- 4.80 Richard Sarginson suggested keeping a “log book” of all that has been considered in relation to the system and making it available for public inspection and comment. In this way, local knowledge could be gathered and incorporated.

- 4.81 McLaren Applied Technologies suggested that local driving habits would need to be factored into the regionalisation process:

*The trick is finding a way to describe regional driving styles in a way that is accessible to any relevant party. This might be done by creating an example scenario to mark the line between good and bad.... It's important to measure what people actually do rather than think they should do, otherwise ADSs may be so cautious that they clog up the roads and other road users take unnecessary risks.*

### **Arguments in favour of national frameworks**

- 4.82 Other respondents stressed the need for national standards, irrespective of local conditions. They were concerned that some local authorities may accept lower standards. As the British Vehicle Rental and Leasing Association put it:

*Our view is that the safety assurance systems should be able to adapt to the change in localised conditions for specific towns and cities. We nevertheless feel it is paramount that there is a clear national framework for local agencies to adhere to, to ensure consistency and provide an appropriate balance.*

- 4.83 In this vein, TRL desired a solution that “leads to the same high levels of safety in all regions”. Whilst they acknowledged that bespoke solutions would have benefits, the ADS should have national standards. They foresaw a risk that local authorities with larger budgets could establish better safety programs, “introducing inequality of risk by postcode”. Equally there was the risk that some regions may be motivated by investment opportunities and may wish to make it easier for automated vehicles to operate on their roads.

- 4.84 Similarly Cycling UK feared that:

*the promise of investment or job creation may lead to local agencies welcoming technology developers to test under-developed systems in sub-optimal operational design domains on their networks, potentially placing other road users at risk. We*

*have already seen examples of this occurring in the US, where different states have offered lower regulatory hurdles to encourage companies to transfer their business.*

4.85 Several consultees commented on the lack of staff and other resources available to local agencies. Intelligent Transport Systems UK, for example, noted the sheer number of local authorities (150). Many did not have the resources to fix potholes or broken traffic signals so it was unreasonable to expect them to dedicate resources to AV localisation.

4.86 Dean Hatton, NPCC Roads Policing, responding in a personal capacity, felt that local variations could cause the public to be less confident in the safety assurance scheme as a whole:

*A scheme which has sufficient national recognition but with input from locally accountable highways authorities runs the risk of introducing significant variance on what is and what is not permitted for use across the UK. This is new technology requiring a new approach to governance. It could be that a 'council' of representatives is required to bring local context for consideration by any safety assurance scheme. The scheme itself will require very visible and accountable leadership.*

## THE WAY FORWARD

### Support for an AV safety assurance scheme

4.87 The responses to our consultation indicate strong support for:

- (1) establishing a safety assurance scheme to complement the current system of international type approval. This would apply to ADSs which are installed as modifications or manufactured in small series;<sup>47</sup>
- (2) prohibiting unauthorised ADS;<sup>48</sup> and
- (3) requiring every ADS to be backed by an ADSE which takes responsibility for the safety of the system.<sup>49</sup>

4.88 Establishing a safety assurance scheme is integral to our proposals for the commercial deployment of highly ADSs. Without an assurance scheme, it will be difficult to prohibit unauthorised systems, to implement the Automated and Electric Vehicles Act 2018 or to change the legal responsibilities of a driver. **We therefore regard a safety authorisation scheme as a priority.**

4.89 We encourage Government to take immediate steps to consider:

- (1) *the institutional arrangements for such a scheme.* Many stakeholders expressed a preference for using existing agencies such as the DVSA or VCA to run the scheme rather than setting up an entirely new agency. The Law Commissions do

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<sup>47</sup> Consultation Question 8(1).

<sup>48</sup> Consultation Question 8(2).

<sup>49</sup> Consultation Question 9.

not express a view on this; we leave decisions on the appropriate agency to the Department.

- (2) *The issues a safety assurance scheme would need to cover.* As we discuss in subsequent chapters, these go beyond the initial safety of the vehicle itself to include driver training, software updates, continuing roadworthiness and the management of data.
- (3) *Testing methods.* Most consultees advocate a mix of methods, such as audited self-certification; simulation; track tests; and road tests. To ensure public acceptance, the system will need to include some form of third-party testing in addition to self-certification.

4.90 This work will be needed in preparation for establishing a statutory framework for safety assurance in 2021/2022.

4.91 Under our proposals, all ADSs put forward for authorisation would need to be backed by an ADSE. The ADSE would be self-selected. It may be a developer or manufacturer or (possibly) a partnership between the two. Consultees pointed out that the ADSE would need to meet minimum capital and insurance requirements. We will consider this in our 2020 consultation. We will also make proposals to clarify how the responsibilities of the ADSE sit alongside the responsibilities of fleet operators running passenger services.

## Chapter 5: Regulating safety on the roads

### OVERVIEW

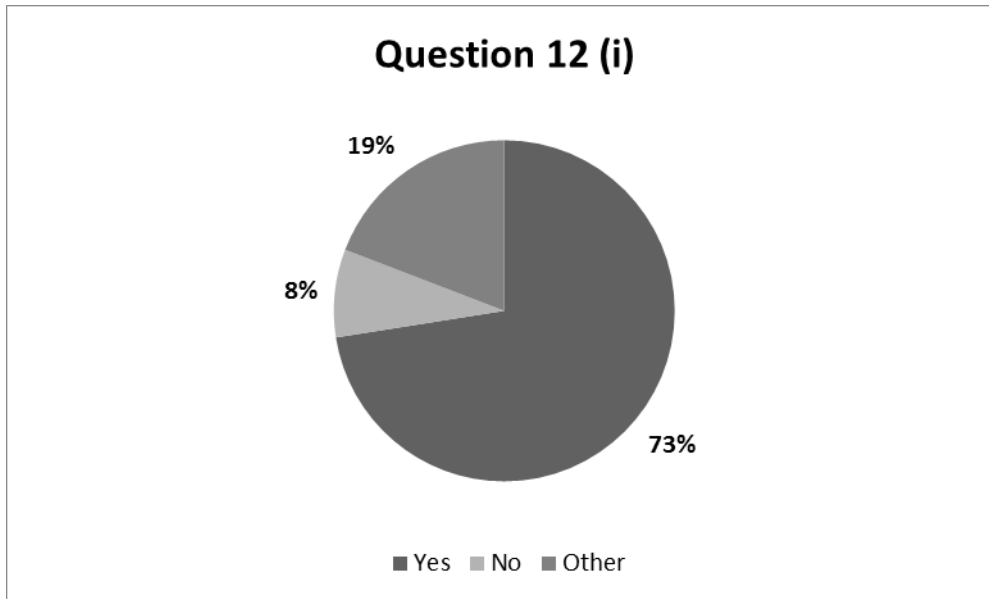
- 5.1 Most respondents thought that the safety assurance agency responsible for approving systems before deployment should also have responsibilities after deployment, when vehicles are being used on UK roads. This was felt to be logical, as the agency would have the relevant knowledge to assess automated vehicles on an ongoing basis.
- 5.2 The Law Commissions asked if the agency administering the safety assurance scheme for automated vehicles should also have responsibilities for regulating consumer and marketing materials, market surveillance, and roadworthiness testing. A majority answered yes to all three questions. However, a significant minority thought that it may be more efficient to give such responsibilities to existing agencies.
- 5.3 Most respondents also agreed that the safety agency's responsibilities should extend to advanced driver assistance systems (ADAS). There were thought to be key synergies between automated driving systems (ADSs) and advanced driver assistance features: it therefore made sense for one body to regulate both. Those that objected noted that such ADAS systems were already on the market. Therefore, they should continue to fall within existing regulation. Furthermore, it was important not to blur the line between ADAS, where the driver has responsibility for the system, and automated driving.
- 5.4 Most respondents thought that there would be a need to provide drivers with additional training on advanced driver assistance systems. However only a small minority felt that this could be done on a voluntary basis.
- 5.5 Responses varied on how accidents involving driving automation should be investigated. A majority of respondents argued for co-operation between agencies, with the police as a necessary part of any investigation. Many respondents also noted that authorities would need access to relevant data.
- 5.6 Many road user groups favoured a new Investigations Branch to look at the causes of road accidents rather than allocate blame. Some police respondents indicated their willingness to work with a new specialist organisation of this sort. However, several consultees (including the Society of Motor Manufacturers and Traders (SMMT) and the British Vehicle Rental and Leasing Association) were concerned that any new investigation branch would merely duplicate work already done by the police.
- 5.7 Most people could see a need to monitor the accident rates of highly automated vehicles and driver assistance features. However, many challenges would need to be overcome to provide meaningful comparisons with human drivers.



## A NEW ORGANISATIONAL STRUCTURE?

**Q12(i): If there is to be a new safety assurance scheme to authorise ADSs before they are allowed onto the roads, should the agency also have responsibilities for safety of these systems following deployment?**

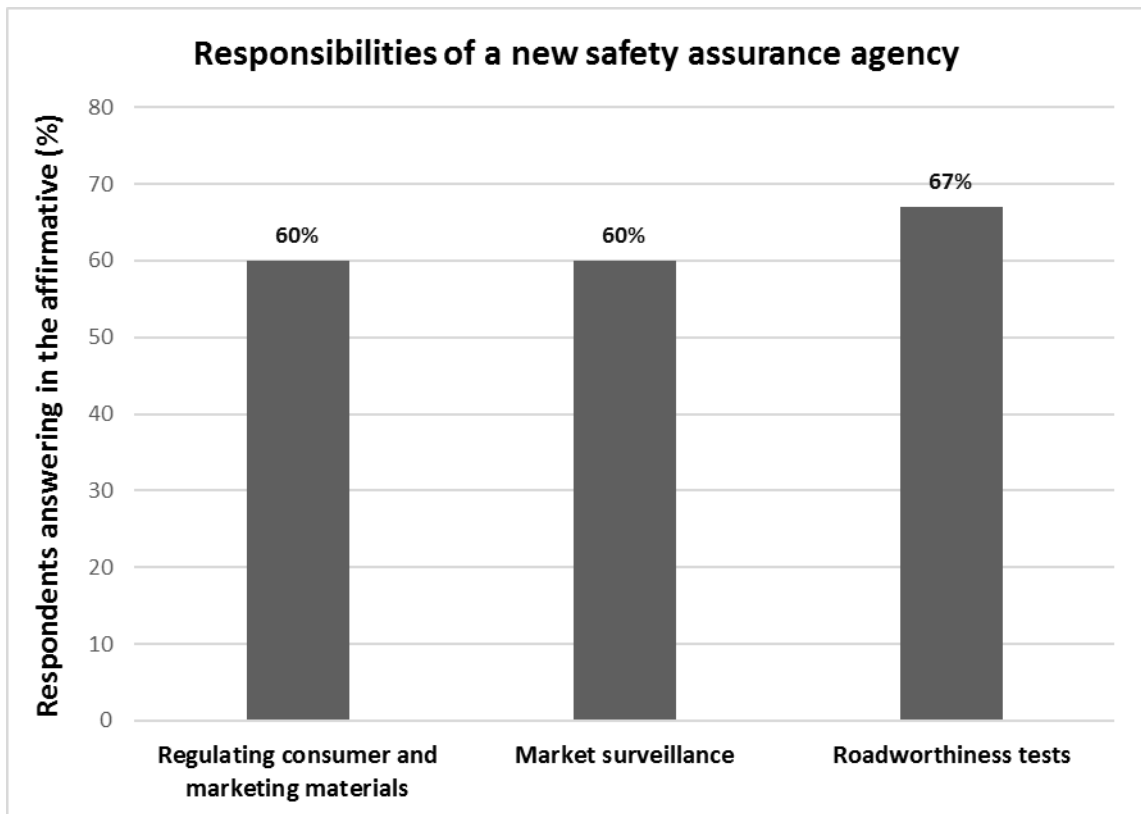
**Should the organisation have responsibilities for:**  
**(1) regulating consumer and marketing materials?**  
**(2) market surveillance?**  
**(3) roadworthiness tests?**



- 5.8 Out of 120 consultees who engaged with this question, 87 (73%) agreed that the new safety assurance scheme should include responsibilities for safety following deployment.
- 5.9 We asked about three specific responsibilities. Again, most consultees agreed with each responsibility, though numbers were lower: 81 (67%) for roadworthiness testing; 73 (60%) for market surveillance and 72 (60%) for regulating consumer and marketing materials.<sup>50</sup>

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<sup>50</sup> It should be noted though that the analysis of this question was somewhat complicated by the fact that many people who did not believe that a new safety assurance scheme should be established (in response to the previous question) still decided to give responses related to what it could cover.



### The case for combining pre- and post-deployment safety assurance

- 5.10 The first argument for combining responsibilities is that it would bring expertise together in one place. As Professor Bryan Reimer said:

*The agency should have oversight over all software, hardware changes, recalls etc. Only an agency that has records of testing during design and development can effectively assess if a software update or hardware change is being completed and tested according to the initial design tests or needs additional testing is needed etc.*

- 5.11 Similarly, Richard Sarginson said that “split responsibility seems likely to sow the seeds for mistakes and a lack of co-ordination”.

- 5.12 The Transport Planning Society liked “the idea of knowledge and experience in all these areas being vested in a single body”. They also saw “the possibility of the safety assurance body outsourcing some of these tasks subject to monitoring, quality assurance and oversight being retained”.

- 5.13 Secondly, respondents pointed out that with such a new technology, safety problems may only come to light following deployment. The Freight Transport Association (FTA) observed that:

*Deficiencies may only come to light after the systems have been in use for a while. It is therefore important for consumer confidence that there is a system in place to ensure the continued safe use of such systems.*

- 5.14 Burges Salmon made a similar point:

*It would make sense for the agency tasked with verifying safety and approving deployment onto roads to play a significant role in the safety assurance framework once those vehicles have been deployed. Indeed, and certainly in early phases of deployment of new technology, new vehicles and new models, approval of an [ADS] could be conditional on a period of enhanced monitoring and data feedback.*

### Software updates

- 5.15 The need for a single agency was thought to be particularly important for software updates. Cycling UK submitted:

*These systems will likely have continually updated software. We therefore expect the regulatory agency will need to have access to results of testing (and test themselves) for each update of the software to ensure vehicles are minimal risk capable.*

- 5.16 Similarly, DAC Beachcroft said

*It will be necessary to ensure that adequate processes are in place to issue over-the-air software updates to remove unsafe software and ensure that such driving systems are no longer capable of being used.*

- 5.17 The University of York and Edward Christian Macfarlane also argued that the safety assurance agency should have responsibility for verifying the safety of software updates.

### The case against post-deployment responsibilities

- 5.18 Ten respondents thought that the safety assurance agency should not have post-deployment responsibilities; and another 23 marked “other”, expressing reservations.

- 5.19 The SMMT saw the new safety assurance scheme as having a limited role, to authorise ADSs installed as modifications or in small series vehicles. However, the question seemed to imply the new safety assurance agency should also oversee type-approved automated vehicles. In their opinion:

*centralising both the pre-deployment approval and post-deployment regulation, surveillance and testing activities for both Path 1 and Path 2 automated vehicles under one unitary authority creates confusion and blurs the focus of this agency.*

- 5.20 Instead, the SMMT felt that proposed post-deployment responsibilities should be given to existing agencies:

*namely the Advertising Standards Authority (ASA) in respect of regulating consumer and marketing materials, the Driver and Vehicle Standards Agency (DVSA) and the Competition and Markets Authority (CMA) in respect of market surveillance, and the DVSA in respect of roadworthiness tests. If and when required, these agencies can draw on the expert input of the Department for Transport and the Vehicle Certification Agency (VCA).*

- 5.21 The SMMT added that:

*These agencies have a reputation for competence and fairness, which are essential for ensuring fair competition and adequate choice for consumers, including in*

*servicing and repairing automated vehicles. Duplication of roles and responsibilities is highly undesirable, as it creates confusion and economic inefficiencies.*

5.22 Similarly, the Association of British Insurers (ABI) and Thatcham Research thought that the safety assurance agency should concentrate on rigorous testing to ensure that ADSs are as safe as possible before they are used on roads or other public places. Thereafter, the existing MOT structure should be maintained; in addition, automated systems should be subject to “self-checks”.<sup>51</sup>

5.23 Several other respondents praised the high reputation of existing agencies and saw no compelling reasons for change.<sup>52</sup> For example, the RAC Foundation commented:

*There appears to us to be no compelling safety reason why these two functions should necessarily be combined in a single agency - they are akin to functions currently split between the DVSA and the VCA.*

5.24 However, they added that one might come to a different answer “as a matter of operational efficiency”, as the testing and auditing regime developed.

5.25 Uber “cautioned against moving too quickly to make major structural changes to regulate this technology while it is still under development”, noting that:

*establishing any such an agency... would require significant resources to implement in a way that does not delay the introduction of these safety-related technologies from being introduced onto public roads.*

5.26 Stagecoach saw benefits with both approaches. However, resourcing was the most important issue:

*Whichever agency administers the scheme, it will be crucial that it is fully resourced and equipped to make these assessments from the earliest stage prior to the deployment of the technology on the roads.*

#### A combination of agencies working together

5.27 The LAMBDA-V project made the point that that a “system” is not just the automated vehicle by itself. Rather it includes the road infrastructure and human drivers. Similarly, George Economides<sup>53</sup> thought a more holistic approach to safety was needed. He argued that the safety assurance agency should work:

*in combination with traffic management that will monitor and respond to how the road situation develops (system level, informed by changes in ODD, other road users' behaviour...)*

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<sup>51</sup> For example, using on-board diagnostics to monitor the status of the vehicle and the proper functioning of its sub-systems and the ability to report any problems if necessary.

<sup>52</sup> This point was made by Euro Car Parts and the National Franchised Dealers Association (NFDA).

<sup>53</sup> From Oxfordshire County Council, personal response.

## Regulating consumer and marketing materials

- 5.28 Many respondents agreed that there should be greater oversight of how automated features are marketed. KPMG LLP noted:

*the Commissions' thinking on issues such as marketing and product surveillance is commendable. While these points are often viewed as second or third-order questions, they are critical to investment and the safe deployment of AVs. In particular, from the Government's perspective, regulating the advertising of self-driving cars will ensure that consumer acceptance (and appetite to purchase AVs) – a component that is yet to be unlocked in the drive for automation – is not prioritised unduly over safety. From an international perspective, the UK is a thought leader on this issue as it has received limited attention from other administrations.*

- 5.29 The ABI and Thatcham Research felt that there was a “real need for more coherent messaging from manufacturers”, citing their own research:

*Seven in ten (71%) drivers globally and 53% in the UK believe that they can purchase a car that can drive itself today; and one in five (18%) British motorists think that a car marketed as being capable of automatic steering, braking and acceleration (i.e. an assisted driving system) allows them to “sit back and relax and let the car do the driving”.*

- 5.30 The ABI and Thatcham Research also mentioned a similar survey by AXA UK. This found that when consumers were asked to choose a definition that best described a “driverless” car from a list of SAE levels,<sup>54</sup> only one third chose Level 5 and 10% of respondents thought that SAE Level 1 was the best definition. They felt this was evidence that worrying misconceptions prevail about the current state of vehicle technology.

- 5.31 Apollo Vehicle Safety commented that it was important that “the people that understand the functionalities and limitations of the systems can also exert some control over how the systems are marketed”.

- 5.32 On the other hand, not everyone agreed that responsibility should be granted to a new agency. The ABI and Thatcham Research, for example, thought that specialist knowledge should be provided to existing agencies:

*Whilst it is our view that existing entities such as the Advertising Standards Authority and Trading Standards should be responsible for these areas, there is a need to bring in specialist knowledge and expertise to assist in assessing the validity and accuracy of materials, in respect of both automated and advanced assisted driving systems.*

- 5.33 The Bar Council of England and Wales (the Bar Council) also suggested “some formal liaison” between the specialist knowledge of the new agency and current organisation. Similarly, TRL recommended “an information sharing exercise with the ASA and potentially a small task force to ‘police’ the early ADS which come to market”.

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<sup>54</sup> “SAE Level” refers to the system of levels devised by the Society of Automotive Engineers. See <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

5.34 FiveAI thought that a “Kitemark” or some sort of equivalent would benefit consumers.

### Market surveillance

5.35 Under EU law, member states must appoint a “market surveillance authority” to monitor product safety and remove unsafe products from the market. Within the UK, surveillance of automotive products rests with the DVSA. The DVSA reacts to complaints, carries out tests and works with the industry to recall unsafe products.<sup>55</sup>

5.36 However, this important work is not well understood. The Transport Safety Research Group said, “we are not clear enough on the meaning of 'market surveillance' to provide an opinion”. The issue received relatively few comments, with respondents expressing varied opinions on what market surveillance entailed.

5.37 TRL described market surveillance as “a key part of the safety assurance scheme providing feedback on ADS real world performance”.

5.38 DAC Beachcroft LLP agreed that a new approach was needed, as safety concerns about automated vehicles may emerge in different ways from concerns about conventional vehicles. They thought that this should be within the remit of a new safety assurance agency:

*A new safety assurance agency would be best placed to co-ordinate any potential regulatory actions and issue product recalls or withdrawals where necessary as this will require a high level of technical understanding that is also required for the initial approval procedures.*

5.39 FiveAI gave one of the most detailed responses on this issue, arguing that market surveillance would:

*require a range of activities, including updating the STATS19 collision reporting system to document [ADSs] as potential contributory factors; data from insurance companies on non-injury incidents; (potentially) data from automated vehicles directly; as well as similar recalls and market issues for the hardware and software that DVSA is already established to deal with. Performing these activities effectively is likely to require multiagency collaboration and if so, there should be a single responsible organisation to lead coordination.*

### Roadworthiness

5.40 Eighty-one respondents thought that the new safety assurance scheme should cover roadworthiness testing. The main reason given is that the existing “MOT” test is unsuited to automated vehicles. The safety assurance agency would therefore need to be involved in devising a new method to ensure continuing roadworthiness.

5.41 For example, the ABI and Thatcham Research argued for “a more rigorous roadworthiness test” to ensure continuous promotion of vehicle safety:

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<sup>55</sup> For an account of the law in this area, see paras 5.13 to 5.18 of the Consultation Paper. Currently the focus of DVSA’s work is on exhaust emissions testing.

*We envisage that the safety assurance agency would have the appropriate expertise to devise and update the testing regime as necessary to uphold safety standards. Roadworthiness testing will further need to take into account software and should ensure that the latest version is installed.*

- 5.42 TRL considered ways in which the current “MOT” could be adapted for automated vehicles:

*Options will include establishing durability testing requirements prior to a vehicle being approved, for example this could include evaluation of the likely degradation of sensors and then statutory requirements to replace safety critical components at defined intervals (either based on miles driven and/or time elapsed since approval).*

- 5.43 TRL went on to suggest that “the real-time capture of data could be used to proactively require maintenance interventions”. They thought that these measures must be within the scope of the safety assurance scheme.

- 5.44 Transport Systems Catapult suggested that consumer vehicles may need to be treated differently from fleet vehicles. For consumer vehicles:

*An MOT-style test investigating the system in more depth would be very difficult to implement as the testing would have to be specific to each particular type of system, and would require detailed knowledge (including proprietary data about how the system operates, which manufacturers would not wish to share). Any fault would be likely to have an immediate impact and cause a very high risk of an accident (relative to corrosion and wear of parts, which can be tracked over a longer period), meaning that the testing would have to be very frequent.*

- 5.45 On this basis, Transport Systems Catapult thought that it would be difficult “to envisage any method of ensuring that privately-owned vehicles remain in-spec other than self-diagnosis managed by the system itself”. For fleet owned vehicles, however, “operators could be required to have maintenance procedures and schedules that are regularly audited”.

- 5.46 Richard Morris, Innovate UK, responding in a personal capacity, also saw self-diagnosis as the answer. He noted that the automated vehicle “must be able to perform many self-checks on a periodic basis”. On this basis “many of the aspects currently checked once a year on MOT could be self-checked every day or even every second”.

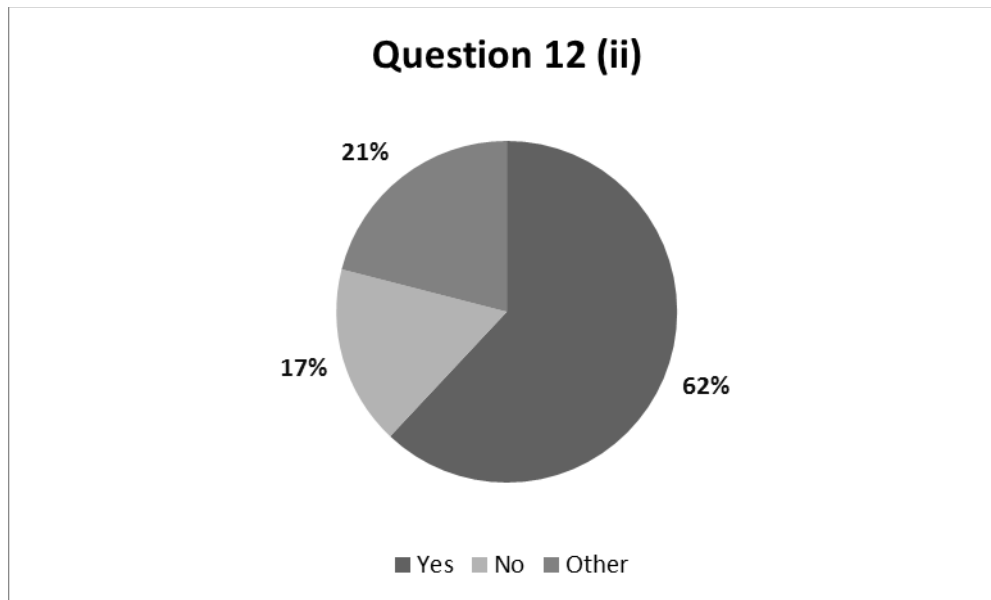
- 5.47 On the other hand, there was concern about interfering with existing structures. As the National Franchised Dealers Association (NFDA) said:

*Whilst a new safety assurance scheme could certainly assist in developing a roadworthiness standard for automated vehicles, the ongoing administration of those roadworthiness standards should continue to be the DVSA’s responsibility. We see no reason for authority over roadworthiness testing to be partitioned.*

## SAFETY ASSURANCE AND DRIVER ASSISTANCE SYSTEMS

**Q12(ii): We seek views on whether the agency’s responsibilities in these three areas should extend to advanced driver assistance systems.**

5.48 Most consultees (62 out of 100, or 62%) felt that the agency responsible for ADSs should also be responsible for ADAS. However, there were significant numbers of “other” (21%) and “no” (17%) responses.



### The case for extending agency responsibilities to ADAS

5.49 Many respondents mentioned commonalities between assistance and automation. As Professor Bryan Reimer of MIT said:

*All ADS and ADAS systems share core synergies in hardware and software.*

5.50 On this basis, it made sense for the same agency to regulate both. The National Physical Laboratory (NPL) stated:

*Advanced driver assistance systems and autonomous vehicles will be using similar technologies but with different degrees of integration. Many may see advanced driver assistance systems as the stepping stone towards autonomous vehicles. Therefore, the remit of any designated agency for automated/autonomous vehicles should extend to this area also.*

5.51 OmniCav said that ADSs would ultimately be comprised of a number of ADAS systems. Therefore, the same agency should regulate both.

### The case against extending to ADAS

5.52 The SMMT argued strongly that the agency’s responsibilities “must not extend to ADAS”.

*In order to avoid scope-creep, which is highly undesirable, the agency must abide strictly by its remit to cover only automated vehicles. ADAS fall under SAE Levels 1*



*and 2, and are covered by UNECE regulations.... Furthermore, the intended distinction between ADAS and ADS in the minds of the public might be lost if the same agency is responsible for approving and monitoring both.*

- 5.53 The same argument was put by Bentley Motor Cars. BMW Group UK simply stated that “today’s responsibilities work very well”.
- 5.54 These arguments were picked up by others. Neckermann Strategic Advisors felt that, for ADAS, the “cat was out of the bag already”. TRL thought that ADAS were adequately covered by the European Type approval process and the General Safety regulations. Olivier Raemy, Federal Roads Office (FEDRO) Switzerland, who was responding in a personal capacity, observed that “these systems don’t have the same impact and the driver is still responsible” and therefore felt that “product liability is enough for these systems”.

### **Where to draw the line?**

- 5.55 Many respondents asked where one would draw the line between systems in and outside the new remit. Alistair Chaplin, for example, said he was “unsure where the limit would be, ABS? Cruise control?”
- 5.56 Several respondents thought that there was a need to make a sharp distinction between ADAS (which was the responsibility of the driver) and automated driving. As Mills & Reeve LLP said:

*It is crucial that the public appreciates the importance of the distinction between advanced driver assistance systems and [ADSs], and this might be lost if the same body is responsible for approving/monitoring both.*

- 5.57 Others, however, suggested different distinctions. The Transport Safety Research Group suggested a distinction between SAE level 1 and 2 systems on the one hand and Level 3 on the other hand. Apollo Vehicle Safety Limited drew a distinction between crash avoidance systems (which do not count as automated driving under the SAE’s approach for example) and those operating on a sustained basis (which do count as automated driving):

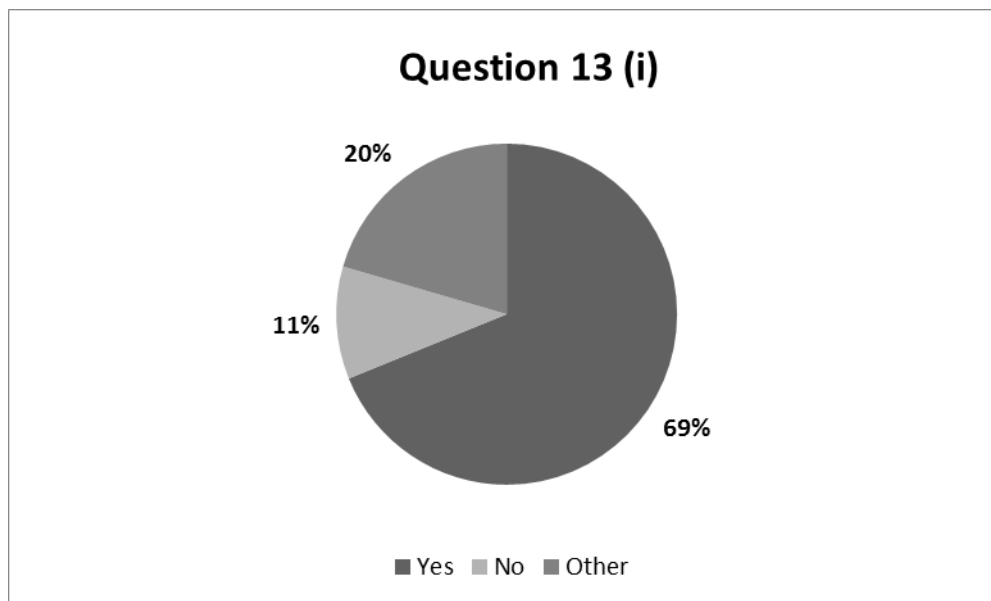
*Generally, systems such as automated emergency braking (AEB) are referred to as driver assistance systems. However, these are very different to a motorway assist system such as Tesla’s autopilot or Traffic Jam Assist. Crash avoidance systems activate only in the seconds before a collision and are invisible to most drivers, the vast majority of the time. Thus, the risk of adverse behavioural change is much smaller than for systems that intervene in normal driving.*

## DRIVER TRAINING

**Q13(i): Is there a need to provide drivers with additional training on advanced driver assistance systems?**

**Q13(ii): If so, can this be met on a voluntary basis, through incentives offered by insurers?**

5.58 Most respondents (84 out of 122, or 69%) felt that there was a need to provide drivers with additional training on advanced driver assistance systems. Only 13 (11%) said that there was no need for additional training whilst 25 (20%) answered “other”.



### The need for training

5.59 Consultees thought drivers needed training to understand handovers and the limitations of systems. Professor Bryan Reimer described driver training for both ADAS and ADS as “critical”:

*Drivers need to fully understand where and when the systems are designed for operation etc. When they are operating within design boundaries, what to do if not etc.*

5.60 The Garage Equipment Association (GEA) saw a need for training not only to explain the limitations of the system and the handover, but more fundamentally.

*New technologies and new driving control situations require a re-education of ‘normal’ driving standards.*

5.61 By contrast, those who argued against training saw it as premature.<sup>56</sup> Burges Salmon LLP, for example, thought that there was no need to mandate additional driver training now. Instead, the more pressing issue was to “reinforce to drivers that ADAS is not autonomy”, which could be tackled through manufacturer marketing approaches.

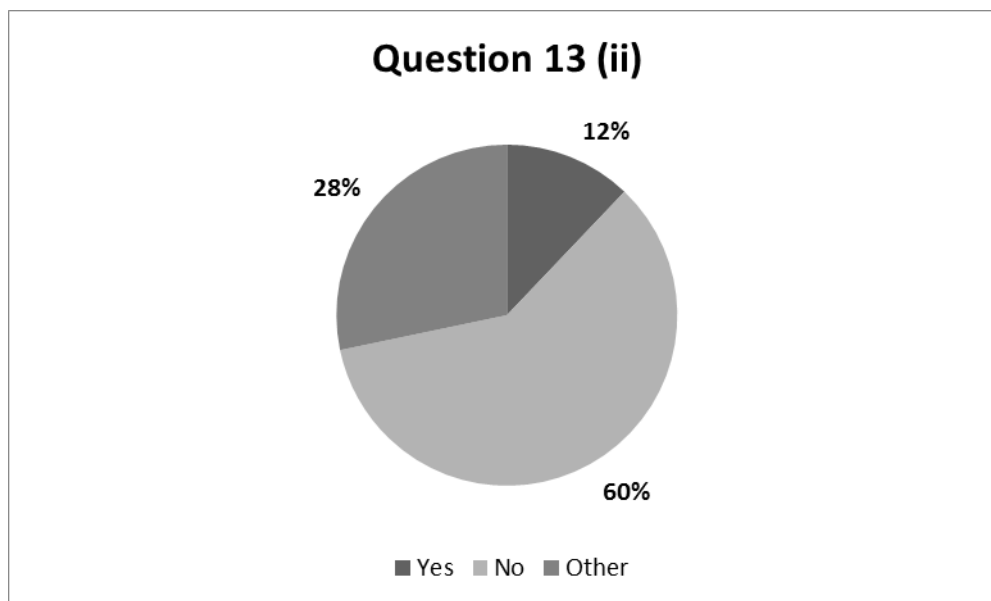
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<sup>56</sup> See, for example, responses from the Automobile Association and Amey.

5.62 Transport Systems Catapult thought that “the onus should be on manufacturers to provide a user-friendly and clear Human-Machine Interface”, which did not rely on training.<sup>57</sup> The Freight Transport Association saw an increased requirement to provide information to drivers rather than additional training.

### How should training be provided?

5.63 Those who saw a need for training differed on how it should be provided. Out of 99 consultees who addressed the second part of the question, only 12 (12%) thought that the need for driver training could be met on a voluntary basis, through incentives offered by insurers. Significantly, many insurers argued against such incentives. Other suggestions included placing the onus on manufacturers; adding questions to the current theory test; or requiring new forms of licencing.



### The case for voluntary training

5.64 Apollo Vehicle Safety said that a voluntary scheme “might be a good way to begin”. However:

*the effectiveness of any scheme should be carefully monitored and for a voluntary scheme the monitoring must account for the possibility of self-selection bias.*

5.65 The Road Haulage Association (RHA) observed that for vehicles under 3.5 tonnes this voluntary scheme could be done through dealership networks.

5.66 Sheffield University Law Students thought that all additional driver training should be voluntary, but believed that “the costs of training should be borne solely by manufacturers and therefore included in a vehicle’s purchase price”.

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<sup>57</sup> Enterprise Holdings highlighted that interfaces may be customisable. This could create issues in vehicles that are rented or leased. They suggested that vehicles may need a “reset” button for their interfaces.

### The case for mandatory training

- 5.67 Many respondents felt that if a scheme is voluntary “then folk will ignore it” (Martin Scott). If training is necessary to ensure safety then it should be mandatory.<sup>58</sup> As the University of York put it:

*In our view, these issues go to the heart of what the licensing system for drivers is supposed to assure, namely, that a licensed driver possesses an appropriate standard of skill at the tasks of monitoring and control with which he or she is expected to engage.*

- 5.68 Dr Chris Tennant of the LSE, commented that commercial organisations “will – correctly – identify mandatory training and testing as disincentivising consumer take up”. However:

*This is not a good reason for preferring a voluntary regime. A voluntary regime would not communicate the seriousness of this issue. Regulators and commercial organisations know that consumers will overtrust the system: both must do everything they can to minimise the scope for this to happen.*

- 5.69 The Transport Planning Society added that if training is needed, “it should be mandatory and not undertaken to suit the financial whims of insurance companies”.

### Insurer incentives are not appropriate

- 5.70 The Consultation Paper suggested that insurers could encourage training by offering discounts to drivers who completed courses. Most insurers argued against such an idea. For example, Aviva did not “necessarily agree” that insurers were the right organisations to incentivise training in isolation:

*Insurance premiums will reflect the risk and it may be that insurers will consider a driver who has undertaken such training to be a better risk and therefore offer incentives in the way of premium discounts. However, this would require the full co-operation of motor manufacturers to provide data to help us analyse how risk is affected by such training.*

- 5.71 AXA UK thought that even with reductions in insurance premiums take up would be low:

*In our experience, most drivers are unlikely to pay for any additional training if it is voluntary, for example Government research found that only 3% of new drivers have taken their voluntary Pass Plus. Unless additional training becomes mandatory for existing drivers and included into the mandatory driving test for new drivers, it is expected that there would be little take-up for further training schemes.*

- 5.72 Other respondents agreed that a voluntary scheme would have poor uptake, particularly among those drivers who most needed training. The Bar Council said:

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<sup>58</sup> See, for example, responses from SEStran, Dean Hutton, David Salmon, Anoop Shah, NFDA and Living Streets Hackney.

*some people may never do the voluntary training and be prepared, for example, to pay higher premiums if cost is the only incentive. We are aware that only a minority of drivers do the “voluntary” advanced driving test.*

- 5.73 FiveAI pointed out that insurance incentives are “typically most effective with younger drivers who stand to benefit from reduced premiums which are often set very high initially”. However, they would be less effective for:

*older and/or wealthier consumers (and probably more experienced drivers) who are either likely to be paying less for insurance already or who are not motivated by the saving on offer. Uptake would probably be low.*

- 5.74 FiveAI also made the point that “the whole market may not choose to incentivise use of automated assistance until there is a proven safety benefit/ reduction in claim frequency and severity”.

### Manufacturers

- 5.75 Several respondents pointed to variation in functionality and design, which make it difficult to provide standard tests. Therefore, responsibility for driver training should rest with manufacturers. As the ABI and Thatcham Research said:

*Given the high degree of variation in functionality and design between different systems, it may be difficult to specify this in a regulatory framework and we believe that it would be appropriate for vehicle manufacturers / system developers to take primary responsibility for this task. This could potentially be supported by in-car safety videos similar to flight safety videos mandated for all passenger aircraft.*

- 5.76 The RAC Foundation thought that it would be better to mitigate risk via the design of vehicle systems rather training. However:

*it would be highly desirable for drivers to have access to training on systems that might be novel or unfamiliar, which could form part of the sale process, though we can see practical issues with cascading this into the second-hand market*

- 5.77 Esure thought that training should be built into the “purchase/driving process”. It might also be possible to use technology such as automatic number plate recognition to monitor that the training had been completed.

- 5.78 Zurich Insurance (UK) pointed out that the provision of training was relevant to whether a vehicle was defective under product liability law:

*We anticipate that this training will potentially inform user expectations around vehicle performance, quality and safety. Accordingly, they would likely be relevant to any consideration of whether the vehicle is defective for the purposes of the Consumer Protection Act 1987. To take one example, we would expect some form of training to be helpful following significant system updates, which may make significant changes to vehicle performance. It therefore seems incongruous to allow training on advanced driver assistance systems to sit outwith a regulator’s remit.*

- 5.79 Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA) suggested an approach based on computer training modules. For

example, it might be possible to only unlock features on the car once the relevant computer based training module had been completed.

- 5.80 IAM Roadsmart suggested that, whilst insurance incentives would be important, there was “also a key role for manufacturers to provide better training”. For example, “there could be opportunities to provide online learning and refresher courses when purchasing a new vehicle or at licence renewal time”. They also suggested a role for the National Driver Offender Retraining Scheme for “those who wilfully ignore automated vehicles operating instructions”.

#### Driving theory test

- 5.81 SMMT and Bentley Motor Cars suggested including “some basic questions on generic ADAS functionalities in the driving theory test”:

*For example, the syllabus may explain what generic “autonomous emergency braking” technology does, rather than focus on the product terminology chosen by specific manufacturers, such as “City Braking Activation” or “Low-Speed Forward Automatic Braking”. This would mean that all new drivers would gain a basic understanding of ADAS, and the information provided in the syllabus could be easily updated to account for technological developments.*

- 5.82 The Institute and Faculty of Actuaries also suggested that “some aspects of ADA systems should be covered in the theory part of the driving test”.

- 5.83 The International Underwriting Association (IUA) thought that the primary responsibility should lie with the manufacturers and system developers (possibly using an online test registered with the DVLA). However, in the long-term:

*When there are a substantial number of AVs in use on UK roads, it would be appropriate to include questions regarding AVs, such as relating to the responsibilities of user types and SAE levels, in a DVLA Driving Theory Test.*

#### A new category of driving licence

- 5.84 A few respondents suggested that, in the long term, a new category of driving licence should be considered. For example, Nicholas Bevan said that “every driver skill, standard or theory that is safety critical should be incorporated within the compulsory driving test syllabus” and be subject to mandatory testing. Therefore:

*It may be necessary to issue new vehicle categories for the driving licence and to require additional training to qualify to drive certain classes of automated vehicle.*

- 5.85 The Institute and Faculty of Actuaries also suggested that “a compulsory test could be set for anyone who wished to gain a licence to drive such a vehicle”.

## ACCIDENT INVESTIGATION

### Q14: We seek views on:

(i) how accidents involving driving automation should be investigated;

(ii) whether an Accident Investigation Branch should investigate high profile accidents involving automated vehicles? Alternatively, should specialist expertise be provided to police forces.

5.86 The Consultation Paper explained that specialist units investigate the causes of aviation, maritime and rail accidents, but not road accidents. We noted calls for a new “investigation branch” for road accidents, aimed at understanding the causes of incidents rather than allocating blame. We said that automated driving would raise new challenges and asked for views about how these challenges should be met.

5.87 Views were mixed. Many safety groups repeated calls for a new investigations branch while motor manufacturers suggested that no new systems were required. Police stakeholders emphasised their existing expertise, national coverage, and ability to attend the scheme quickly. However, some police responses were cautiously supportive of some form of new specialist centre to interpret data and to analyse trends. A majority of responses saw a need for agencies to work together to learn lessons.

### The case for a new “Accident Investigation Branch” (AIB)

5.88 The RAC Foundation and Brake said they had both long argued for a new system for the investigation of the causes of road crashes. The introduction of automated vehicles provided a new impetus to the debate.

5.89 Cycling UK said only a national body would have the resources to analyse data from ADAS and AV systems:

*We strongly agree that a dedicated Road Accident Investigation Branch (AIB) is needed, in conjunction with local policing. Only a national level organisation would be able to have the resources to analyse the data from ADAS/AV and draw conclusions. It should certainly have the ability to issue product suspensions and recalls.*

5.90 Cycling Scotland said that “police force accident investigation capacity has reduced over the years”. Given the impact of road crashes on individuals and wider society, significant new resources were needed.

5.91 GoBike pointed out that road traffic accidents “occur daily on the roads of the UK, causing death and injury and all attempts should be made to reduce these incidents”. Therefore:

*Such a body is most definitely required in our view and should investigate all road traffic accidents of a serious nature, and all incidents involving automated vehicles.*

5.92 The ABI and Thatcham Research accepted that “many police forces have built up considerable expertise in the investigation of accidents”, which should be retained. However, an AIB would establish the cause of accidents rather than allocate fault:

*There has long been a case for high-profile motor accidents (e.g. those leading to large number of injured parties) to be investigated via an Accident Investigation Branch and the introduction of automated vehicles provides a welcome opportunity to take this forward. This would be driven by the need to establish cause and to produce recommendations to prevent similar accidents in future, which is the way other accident investigation authorities operate, rather than to establish fault and/or lay criminal charges, which would naturally tend to be the focus of police investigations.*

- 5.93 Heather G Bradshaw-Martin said that the nature of incidents would change:

*Road accidents will become more similar to air or maritime accidents where the causes are often mistakes within the interactions of the human operators with a complex control system. In contrast police investigation is more appropriate where the cause of accidents is more directly related to human intentions and motivations.*

- 5.94 The main advantages of a new body were seen as specialist expertise, the ability to analyse trends and a non-blame culture. The Chartered Institution of Highways and Transportation (CIHT) stressed the need for specialised knowledge:

*CIHT argues that it is not practical for the approximately 50 police forces in the UK to hold the specialist knowledge required to investigate collisions by AVs or to hold the various international entities to account. Therefore, there will need to be a national level body given the task of monitoring and investigating collisions involving automated vehicles.*

- 5.95 Meanwhile, Transport for the West Midlands (TfWM) emphasised a non-blame culture:

*The organisation must adopt a culture of positive feedback and leniency, with issues shared amongst all manufacturers to encourage transparency and a legal framework which allows for this.*

### **The case against an AIB**

- 5.96 Several responses thought that an AIB was unnecessary. The SMMT said that “creating a brand new, stand-alone Accident Investigation Branch (AIB) is expensive and may duplicate some of the investigatory work the police forces already undertake”. It would be particularly disproportionate, given that the “raison d’être” of automated vehicles is to reduce accidents. Instead, procedures should follow those for conventional vehicles:

*Should there be an accident involving an automated vehicle, which may not necessarily be the fault of the ADS, investigation should follow the same procedures for conventional vehicles although assisted to a greater extent by the data stored in both the Data Storage System for Automated Driving (DSSAD), which will be regulated at the UNECE level, and the vehicle’s event data recorder (EDR).*

- 5.97 Weightmans LLP noted that the system of police investigation had been improved. Furthermore, police could attend the scene quickly:

*There is now a national head of Collision Investigation and ISO standards governing police forces. Abandoning this would risk the loss of specialist expertise. It should also be noted that the presence of non-automated vehicles and likelihood of incidents involving both automated and non-automated vehicles will remain high for some time.*



*Investigation of accidents will therefore continue to require forensic examination of the scene and the need to call a specialist Accident Investigation Branch could result in substantial delays in reopening of roads.*

## Police responses

5.98 Police groups and those with policing experience expressed reservations about an entirely new body. They highlighted the experience of the police in collision investigation and the need to attend the incident scene quickly. However, there was also cautious support for a new centre of expertise.

5.99 Police Scotland outlined the advantages of police investigation:

*Currently, Police Scotland investigate road collisions, which involves collating all the available evidence and, if appropriate, submitting a report to the Procurator Fiscal's office. These investigations often involve utilising other expert witnesses, e.g. DVSA officers, to examine tachograph equipment, download telematics data, conduct mechanical examination of HGV's and buses, etc.*

*Police Scotland would suggest this process should continue with automated vehicles, and when required, the police would utilise suitably trained expert witnesses to conduct examination of automated vehicles and their software systems.*

*It may be that a number of police officers would be suitably trained to deal with the preliminary stages of collisions involving automated vehicles which would ensure evidence is secured, the correct procedures are adhered to and the correct persons liaised with. A similar situation currently exists with officers trained as air or rail collision investigators.*

*Ideally, Collision Investigation trained Police Officers would have the equipment and training to download and interpret all available data from the vehicle. This would involve what the sensory input was, what decision-making process was executed and what the outcome was.*

5.100 However, they also said, in relation to an AIB:

*Agree. Given a single software package may be installed in a large number of vehicles, any systemic failure has the potential to pose a huge risk to a huge number of people. To ensure any single failure is appropriately investigated across the entire fleet, an Accident Investigation Branch would be essential to ensure problems are rectified immediately and any learning is incorporated into any software updates etc. without delay.*

5.101 The Metropolitan Police Service said that, whilst police should remain the primary investigators, they would be cautiously supportive of a Collision Investigation Board:

*Only police forces currently have the resources to attend the scene of all road traffic collisions involving injury. The creation of another agency with national 24/7 coverage would be hugely expensive and involve unnecessary duplication. Collisions are often golden opportunities to identify non-motoring criminality, which would be missed if attended by a non-police agency. However, the Metropolitan Police Service is cautiously supportive of a Collision Investigation Board (both the police and road*

*safety groups prefer the term “collision” over “accident”), which focuses on the current gap in technical [Connected and Automated Vehicle] expertise. As a parallel, consider the Forensic Science Service, which provides expert independent services to the police.*

5.102 Dean Hatton, of the National Police Chiefs Council (NPCC) Roads Policing, responded in a personal capacity. He agreed that there may be a place for a new investigation department and suggested how it might be implemented:

*I think there is a case to create a new investigation department, this could be operated on a tiered approach, for example:*

*a. All collisions involving injury / death or high profile – (high profile needs to be properly defined) should be referred to the ‘accident’ investigation branch (Automated Vehicle Collision Branch) who should make a determination as to whether they launch an independent investigation, or require a local investigation but with their scrutiny.*

*b. An advisory service should be provided for technical support to all ‘local’ investigations, injury / death and non-injury, as a single source of expertise.*

5.103 Chief Inspector Adrian Davies said that initially “significant collisions involving automated vehicles may have to be jointly investigated”, as Police Vehicle Examiners will not have this expertise. However, in the long term a national team would be problematic and instead expressed a preference for training Police Vehicle Examiners:

*To have a nationwide investigation teams for serious collisions involving automated vehicles sounds a great idea but how quickly will they attend the scene, how would this impact on the CLEAR principles and what would the terms of reference be if the automated vehicle was not the cause... Why not just train all Police Vehicle Examiners and allow them to work closely with manufacturers to develop competence and confidence.*

#### Data access

5.104 Many respondents stressed that accidents involving automations would require access to in-vehicle data. RACE said that understanding and analysing such data would require specialist support:

*it is unlikely that all Police forces will be able to access a consistently high level of support. Hence it is logical to suggest the establishment of a central team that has the critical mass needed to build required expertise and then offer this to local counterparts.*

5.105 NPL have been looking at the format of such data, holding discussions with various stakeholders, including the police. They see a need for new regulations around standard approaches for “data quality, sharing, access, and ontologies”. They also recommend that:

*there is a secure database, managed so that incident data can be compared to identify future risk mitigation strategies. It is recommended that the autonomous decision-making systems should be available, and able, to be interrogated post-incident.*

*Similar to GDPR, decisions by automated systems must be explainable and key data streams stored in the run up, during and after any accident.*

#### Just high-profile cases?

- 5.106 Several respondents queried the suggestion that the new branch would only investigate “high profile” incidents. For example, the Magistrates Association said they would be “concerned if expertise was focused only on ‘high profile accidents’”.

*Police and other investigating agencies must be able to gather all relevant information – including whether the automated system was live at the point of an accident or whether the user-in-charge was driving at the time.*

- 5.107 Similarly, Buchanan Computing and the Institute of Highway Engineers (IHE) said all accidents should be analysed:

*For the initial stages of highly automated vehicles (perhaps for 10 years) it should be mandatory to report any accident (even a damage-only one) for which the automation or assistance was at least partly responsible. These reports should be analysed centrally, largely on a statistical basis, rather than examining each individually, unless of a higher severity or representative of a worrying trend.*

- 5.108 Thompsons Solicitors LLP made a comparison with the Health and Safety Executive, which investigates “near misses”:

*In properly operated health and safety systems within a workplace and as required by law in certain circumstances, near misses are required to be reported and records maintained. We say as a minimum that should be the case with AV. There is a role for the equivalent of the Health and Safety Executive so that national statistics are maintained and reported on.*

#### The need for co-operation

- 5.109 Many consultees highlighted the need for co-operation between agencies. Centaur Consulting felt that the first point of investigation should clearly be the police. But that beyond the initial analysis there was a good case for a specialist agency “either within the police service or as a separate road AIB”.

- 5.110 BMW Group UK said that co-operation was particularly important in the “introductory phase” of the technology:

*We would expect detailed investigations of any accident during this introduction phase and believe it would be executed in the most effective way by cooperation between authorities and [Automated Driving System Entity (ADSE)] experts.*

- 5.111 Addison Lee Group thought that an independent panel should devise protocols to investigate accidents involving AVs, in conjunction with the police:

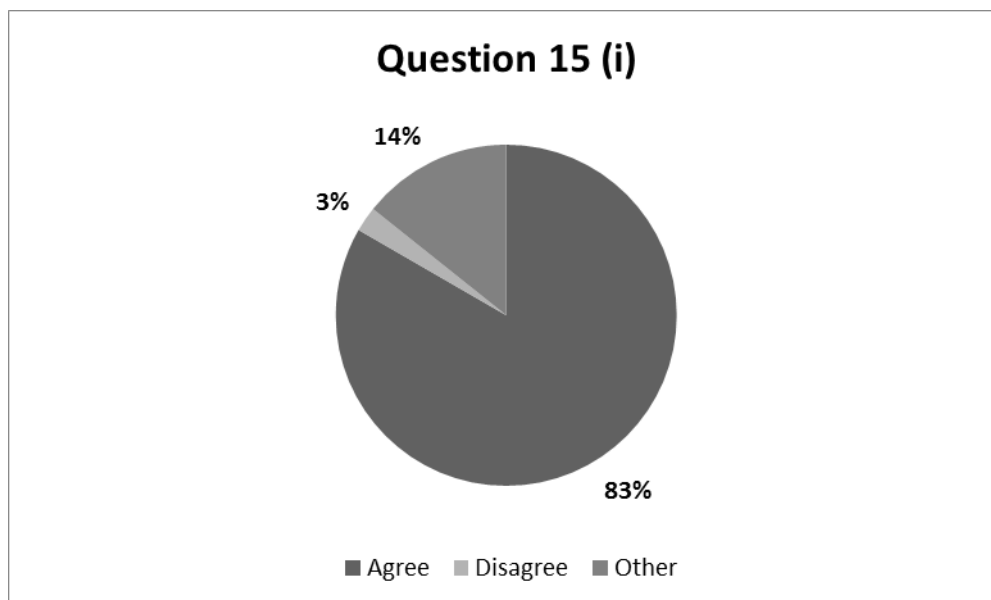
*The panel needs to include CAV representation and needs to understand the CAV proposition and the technical and societal journey we are undertaking. Police need to be involved in the construction and governance of the panel.*

5.112 Burges Salmon LLP were concerned that the question suggested that the AIB would displace the police in some situations. They stressed that the conceptions of the AIB, as put forward by Burges Salmon and the RAC, envisaged a parallel agency assisting and working with the police:

*It is important to note firstly that, as in other modes, a Highways Accident Investigation Branch (HAIB) would not be intended to displace the existing police framework for investigating criminal acts. The HAIB would be a parallel investigation process focussed on safety so it is not a case that such a body would be an alternative to the police as the question suggests.*

## SETTING AND MONITORING A STANDARD

**Q15 (I): Do you agree that the new safety agency should monitor the accident rate of highly automated vehicles which drive themselves, compared with human drivers?**



5.113 In the Consultation Paper we argued it was necessary to compare accident rates between automated driving and human drivers to ensure that automated driving does not reduce safety. We also saw comparisons as vital to allay public concerns: in the wake of an inevitable tragedy, it will be important to remind the public how many lives have been saved by driving automation.

5.114 Out of 126 responses to this question, 105 (83%) agreed that the new safety agency should the monitor the accident rate of highly automated cars, to provide a comparison with human drivers. Only 3 (3%) respondents disagreed and 18 (14%) answered "other".

### The case for monitoring accident rates

5.115 Monitoring was thought necessary for public trust and to back up the assertion that automated vehicles were safer than ordinary vehicles with hard facts. Most responses

were quite strong on this point. Sascha Taylor stressed that we need to gather as much data as possible from the start. Amey argued that the data should be published, so that AVs could be rated. This view was also held by Florencio Cuervo, who stressed the need to know how different systems were performing.

5.116 That said, several respondents noted that comparisons would be difficult. FiveAI drew attention of the difficulties in drawing “direct, scientifically and statistically valid comparisons”, seeing a need for a “competent body” with the correct expertise to undertake this task.

5.117 Respondents also suggested that comparisons would require some allocation of fault. As TRL said:

*It will also be important to be able to determine causation in collisions, because a highly automated [vehicle] may be involved in no-fault collisions and this should be accounted for.*

5.118 Similarly, Transport Systems Catapult said it was vital to understand “the types and reasons for the automated accidents”, rather than just the number.

5.119 The Flook agreed that “surveillance and monitoring is essential”, but cautioned against the suggested “direct numeric comparison”:

*A simple metric with autonomous functionalities operating in differing operating styles, domains, times and conditions must be checked like for like against human and other machine “drivers” statistics to enable true comparison.*

5.120 Living Streets Hackney argued that it was crucial that incident data should be collected to monitor the effect on other road users, such as pedestrians and cyclists.

### **No need for a new agency?**

5.121 Several respondents agreed that accident rates should be monitored, but did not think this task required a new agency. For example, the RAC Foundation said:

*The question of whether these vehicles turn out to be inherently safer is bound to be asked, so the data should be captured. Exactly who should capture it, to whom it should be reported and how then analysed depend on the eventual design of the whole system architecture.*

5.122 The ABI and Thatcham Research made the point that extra data on the number and severity of accidents involving ADSs may be sensibly collected “as part of the Department for Transport’s statistics and data about reported accidents and casualties on public roads in Great Britain (STATS19)”.

5.123 Cycling Scotland felt that any such monitoring should be done by the police “to ensure adequate evidence is collected”.

5.124 NFDA (answering no to this question) did so on the ground that the task could be performed by the Department for Transport (DfT).

## The case against comparing automated accidents with those of human drivers

5.125 Only two respondents disagreed with the idea of comparing accident rates between automated vehicles and human drivers. The University of York and Dean Hatton, NPCC Roads Policing, responding in a personal capacity, thought that automated driving would be very unlikely to be more dangerous than human drivers. Therefore, efforts would be better spent on improving the safety of automated vehicles:

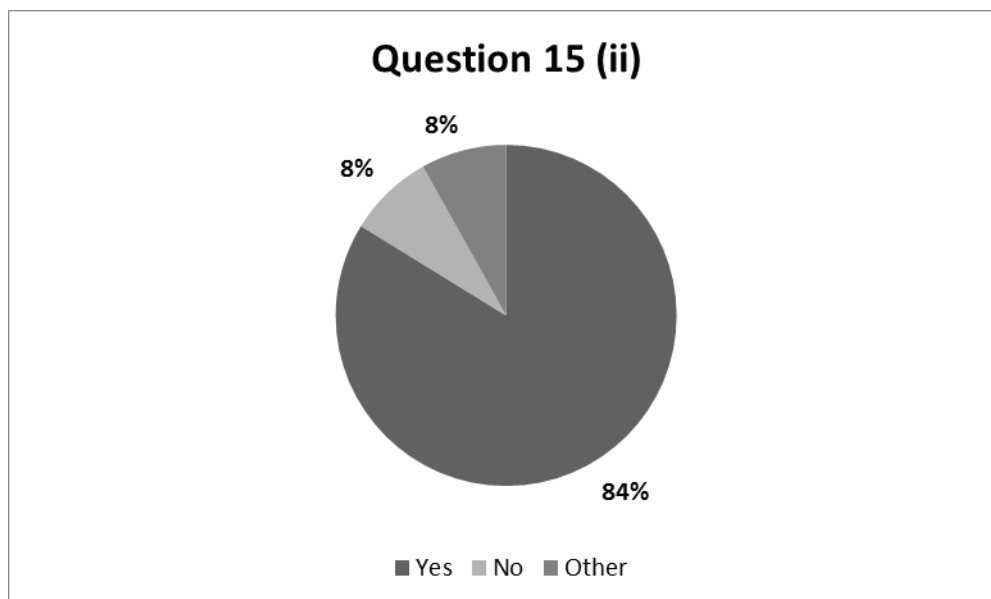
*Unless the minimal risk condition is set very badly, it is quite unlikely that the accident rate of highly automated vehicles will be worse than that of human drivers. The purpose of monitoring the accident rate should be to identify potential vulnerabilities or shortcomings in [ADSs], which is unlikely to be helped by comparisons with human drivers. [The University of York]*

*The aspiration must be for automated vehicles to be 100% safe and progress towards this should be the most important measurement. [Dean Hatton]*

5.126 RACE also queried the advantage of a direct comparison, stating that “it would seem more rational for there to be analysis of AV accident modes in their own right”.

## A NEED TO MONITOR ADVANCED DRIVER ASSISTANCE SYSTEMS

**Q15 (ii): We seek views on whether there is also a need to monitor the accident rates of advanced driver assistance systems.**



5.127 Most consultees saw a need to monitor the accident rate of ADAS. Out of 111 responses, 93 (84%) said “yes”. Nine responses said “no” (8%) and another nine said “other” (8%). This suggests a slightly higher level of controversy over monitoring ADAS compared with monitoring highly automated driving systems.

## The case for monitoring ADAS accident rates

5.128 The main reason given for monitoring ADAS is that these systems have the potential to confuse human drivers. There is therefore a need to learn how the interaction is working in practice. As Heather Bradshaw-Martin, said:

*There is a continuity between existing ADAS and novel automated driving features. This has the potential to confuse users in the short and medium term and monitoring both technologies will be necessary to identify particular features and designs which need to be changed to minimise the dangers of confusion in understanding the relative limitations of the systems.*

5.129 Other respondents made similar arguments:

*To exclude these transitional stages of automation would be anomalous, particularly as the human machine interaction is not well understood and may, in conjunction with other unknowns, present an even greater hazard to public safety than the far more advanced (as yet unrealised) forms of automation. [Nicholas Bevan]*

*We must avoid a scenario (that we may already be in) whereby a transition phase with increasing level of 'advanced driver assistance systems' leads to more collisions rather than fewer collisions. [Jonathan Flower, of the Centre for Transport and Society (CTS), personal response]*

*This area is also advancing and we need to ensure that they are safe and drivers do not become too distracted as they rely more on the vehicle to drive for them. [Chief Inspector Adrian Davies]*

5.130 Several consultees pointed out that monitoring ADAS would be even more difficult than monitoring highly automated vehicles, given a lack of information about whether ADAS is fitted or engaged. TRL noted:

*This is very challenging because it is difficult to know which vehicles are fitted with which ADAS systems, and whether the system was enabled or disabled by the driver. A central database of vehicle fitment is essential in order to monitor the collision rate of ADAS and to facilitate adequate collision investigations.*

5.131 The Flook also pointed out that “no list exists currently to declare which vehicles have assistive system availability”.

5.132 Brake said that the issue highlighted the importance of a Road Collision Investigation Branch:

*Only through an RCIB can a vehicle’s capabilities be considered a vital part of the crash investigation. Such capabilities are inevitably less relevant in a police investigation usually regarding driver culpability.*

5.133 Similarly, Richard Morris, Innovate UK, commented:

*Monitoring these will be a bit of a nightmare and realistically, only RAIDS in the UK (and GIDAS in Germany) will give any useful indications about what is happening,*

### **The case against monitoring ADAS**

5.134 The SMMT replied that that many ADAS features (such as collision warning systems and autonomous emergency braking) are now common and have been shown to reduce collisions. Therefore “creating a new remit to monitor accident rates of ADAS is unnecessary”. Furthermore:

*The symbolism of this itself may be misconstrued by the public as a long-standing technology that has suddenly been deemed “unsafe” by the authorities. Furthermore, it would be difficult to associate root causes of accidents with ADAS, leading to incomplete or inaccurate analysis. In any case, vehicle manufacturers already monitor their own ADAS performance for product improvement purposes in conjunction with suppliers and partners.*

## **THE CHALLENGES OF MONITORING ACCIDENT RATES**

**Q16(i): What are the challenges of comparing the accident rates of ADSs with that of human drivers?**

**Q16(ii): Are existing sources of data sufficient to allow meaningful comparisons? Alternatively, are new obligations to report accidents needed?**

5.135 Most consultees agreed that comparisons present many technical challenges. Professor Bryan Reimer of MIT summarised the crux of the issue:

*Humans and robots will make different types of mistakes.*

5.136 Aviva provided the following list of challenges:

*There [are] challenges in comparing automated driving & human driver accidents including, a current dependency on specialists or VMs to access vehicle data, no enforced mandatory reporting of non-injury accidents. There will not be sufficient volumes of data on autonomous vehicles involved in accidents for some considerable period to make meaningful data comparisons. Where accidents involve more than one vehicle and only one of those vehicles was driving in autonomous mode, it will need to be decided how this should be reflected in such statistics.*

5.137 Many themes emerged from the responses, including the need to review the current STATS19 form; to extend reporting requirements to minor collisions; and to collect usable mileage information. Nevertheless, the RAC Foundation was confident that the challenges could be overcome:

*Our view is that there are several challenges as your paper outlines, but none that couldn't be resolved by people with the appropriate statistical knowledge and qualification.*

### **Reviewing the STATS19 system**

5.138 Currently, road accident reporting relies on police forces to submit information about personal injury accidents on public roads using the STATS19 reporting form. The CIHT highlighted the complexities of this system:

*Stats19 has a component form which is a grid of 76 possible contributing factors, adding more technological factors to this will increase the difficulty and time required for the police officers fill it out. There is also a mix of reporting methods, with some forces providing the forms to local highways authorities to enter the data into the online database, others do it themselves, some report weekly and some monthly. It is estimated that this costs £2.6 million per annum across Great Britain.*



5.139 Transport Systems Catapult felt that there was a need to review this system, “bearing in mind that the current approach is optimised towards manual drivers”.

*For example, angle and brightness of sunlight could be of increased interest if lens glare or image washout due to intense light is a potential cause of an AV making an error. It would also be necessary to collect evidence from an EDR (Event Data Recorder) to fully understand why an incident occurred.*

5.140 Transport for the West Midlands (TfWM) mentioned several problems with the current system to overcome, including “delays in reporting, accuracy and mixed standards”. There were also “many unreported accidents”.

5.141 BMW Group UK thought that only “minor extensions” to existing data would be needed, (such as adding the metric “accident in automated mode: yes/no”).

### **Keeping track of minor collisions**

5.142 The ABI and Thatcham Research mentioned the need to extend data collection to more minor collisions. They explained that “STATS19” statistics:

*are based on road accidents that are reported to the police and may therefore not provide an adequate analysis of low-impact and low-severity accidents, which may not be reported to the police.*

5.143 The Motor Accident Solicitors Society thought that there should be new obligations on drivers/operators and insurers to notify all collisions to a central database.

5.144 Addison Lee Group suggested a new obligation for autonomous vehicles to report collisions. They added that “maybe insurers need to be mandated to provide additional information from current drivers”.

5.145 Transport Systems Catapult said, “to actually improve the system, one would also want near-miss data”, adding:

*Naturalistic driving studies have developed methods for determining and detecting near-misses.*

5.146 Heather G Bradshaw-Martin, however, raised privacy concerns. She pointed to “an ethical imperative not to increase surveillance” of those who choose not to use automated technologies, just to assist those who do use them.

5.147 The SMMT also felt that it was difficult to predict at this stage what additional data may be needed. However, they noted that a new obligation to record and store data for automated driving (i.e. SAE level 3 and above) was being discussed at UNECE level.

### **Collecting data on miles driven**

5.148 Several respondents pointed out that comparing data requires accurate data on miles driven, by both ADSs and human drivers. Direct Line Group said, “consideration will also need to be made to the mileage driven in AV mode compared to manual mode and this data may not be readily available”. Direct Line pointed out that this mileage will need to be collected for different domains:

*Any comparison between AVs and human drivers will need to consider the domains within which AVs are operating. It is expected that for consumer owned AVs these will be limited to motorways in the first instance and so any comparison would need to be made to accident rates on those roads.*

5.149 Similarly, the ABI and Thatcham Research said:

*Generally, the mileage driven is the most accurate indicator of exposure. While insurers are well-placed to interpret relative accident rates and costs, they do not accurately know the mileage driven on different road types by individual manually-driven vehicles with the exception of vehicles insured on telematics/usage-based policies.*

5.150 The need for mileage information would suggest new obligations on manufacturers of automated vehicles to report mileage in different domains, coupled with survey information of mileage by conventional drivers in those domains.

## **THE WAY FORWARD**

5.151 There was broad consensus that the safety assurance scheme would need to cover issues arising after deployment, to ensure the continued safety of automated vehicles on the road.

5.152 In Chapter 4 we urged the Government to prepare for a new safety assurance scheme by, among other things, considering the full list of matters the scheme would need to cover. Issues emerging from this chapter include:

- (1) *Software updates*: consultees stressed the need for guidance about when and how software updates would be approved.
- (2) *Continuing roadworthiness*: As consultees described, automated driving presents new challenges in this area, with less scope for human checks and a greater need for automated “self-diagnosis”. The safety assurance scheme will need to consider the effectiveness of these diagnostic systems. If safety critical components require replacement at defined intervals, thought will need to be given to how these intervals are set and communicated to owners and operators.
- (3) *Information and training*: many consultees saw this as an essential part of marketing a safe product, with the onus on the ADSE to explain what these needs are and how these will be provided.

5.153 In the long term, investigating accidents caused by automated driving will be less about prosecution and more about learning for the future. In the shorter term, there is a need to provide the police with specialist help, both to investigate individual accidents and to analyse patterns of cases to identify root causes.

5.154 We also need to think carefully about what data the safety assurance scheme will need in order to monitor the safety of automated driving (including a comparison of injury rates between automated and human driving). One possibility would be to prescribe new reporting requirements in the statute establishing the safety assurance scheme.

## Chapter 6: Civil liability

### OVERVIEW

- 6.1 In Chapter 6, the Consultation Paper considered civil liability. It provisionally concluded that the Automated and Electric Vehicles Act 2018 (AEV Act) does what is required, by providing the necessary basis for compensating victims where automated vehicles cause damage. However, some aspects of the AEV Act are uncertain. We asked whether further guidance or clarification was needed on contributory negligence, causation and data retention.
- 6.2 The AEV Act requires insurers to pay compensation to victims. They then have the right to bring secondary claims against manufacturers. We looked briefly at the law on manufacturer's liability, focusing on product liability under the Consumer Protection Act (CPA) 1987. On balance, we did not think that reforming the law of manufacturer's liability was a priority at this stage. However, we identified one area of concern: the application of the 1987 Act to over-the-air software updates. We also asked if other areas needed to be addressed.
- 6.3 These questions generated considerable interest, with many insurers and law firms writing at length about both the AEV Act and product liability.
- (1) On **contributory negligence**, views were split. Although many consultees thought that the issue could be expressed in a simpler way, most insurers thought that the intent was sufficiently clear. There is therefore no pressing need for reform.
  - (2) On **causation**, most insurers and insurer solicitors wanted further guidance, while many legal groups thought the issue could be left to the courts. There were suggestions that the issue should be reconsidered in the light of practical experience.
  - (3) **Data retention** is an issue that generates considerable concern. Several developers asked for standards on the "minimum data set" that must be retained for insurance purposes.
- 6.4 We asked if **claimants should be required to notify** the police or insurer within a set period so that data could be preserved. Most respondents expected automatic reporting of collisions, as occurs with eCall. However, insurers expressed concern about the minority of cases where automatic reporting did not take place (such as where the automated vehicle caused others to collide, but did not collide itself). They thought it would be difficult to defend claims in the absence of retained data, allowing fraudsters to make allegations months (or even years) after the event.
- 6.5 On the other hand, the issue was highly controversial. Many lawyers thought that it was wrong to change limitation periods just for automated vehicles, given the many reasons why victims might fail to report incidents.

- 6.6 Several respondents thought that victims should be encouraged to report incidents as soon as possible, but failure to do so should not preclude a claim. Instead, the courts would need to weigh the available evidence. The issue should be re-examined in the light of practical experience.
- 6.7 There is currently uncertainty over how **product liability law applies to “pure” software**, sold without a physical medium. Most consultees thought that the law in this area should be reviewed. However, we received strong representations that the issue should be addressed generally, not just for automated vehicles. There were also calls for the Law Commissions to await the outcome of the European Commission’s Expert Group on Liability and New Technologies, which aims to report later this year.
- 6.8 We asked if there were other issues in product liability law which need to be addressed. In response, consultees raised a range of issues, including the exclusion of damage to commercial property; the exclusion of damage to the vehicle itself; and the state of the art defence.
- 6.9 Consultees also raised other issues about the AEV Act. These included: whether the Act should extend to “semi-autonomous” vehicles operating at SAE Levels 2 or 3;<sup>59</sup> who had responsibility for safety critical updates; and the need to extend the MIB agreements to cover uninsured automated vehicles.

## CONTRIBUTORY NEGLIGENCE UNDER THE AEV ACT

**Q17: We seek views on whether there is a need for further guidance or clarification on Part 1 of the AEV Act in the following areas:**

### **(1) Are section 3(1) and 6(3) on contributory negligence sufficiently clear?**

- 6.10 Under the AEV Act, damages are reduced by any contributory negligence on the part of the victim. In the Consultation Paper, we commented that the Act approached this area in a rather complex way. We asked if the provisions were sufficiently clear and certain to work in practice, or if further guidance is needed,
- 6.11 Views on this issue were split. Out of 79 respondents who engaged with this question, 29 respondents thought that these two sections were sufficiently clear, whilst 31 respondents thought they were not. The remaining 19 respondents answered “other”.

### **Arguments that the sections are sufficiently clear**

- 6.12 Most insurers thought that the sections were fit for purpose. For example, the Motor Accident Solicitors Society (MASS) wrote that:

*Sections 3(1) and 6(3) are quite convoluted but we feel the intention is clear and would enable the courts to draw reasonable parallels under existing contributory negligence case law.*

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<sup>59</sup> “SAE Level” refers to the system of levels devised by the Society of Automotive Engineers. See <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

- 6.13 Similarly, the Association of British Insurers (ABI) and Thatcham Research said the sections “are sufficiently clear for the time being”:

*While the wording may not be ideal, the intent is reasonably clear and the view across the motor insurance market is that the provisions will work in practice.*

- 6.14 Alex Glassbrook commented that, although the sections “require deep exploration”, they worked:

*CP 240 describes the way in which the AEVA treats contributory negligence as “counter-factual”. I agree with that label. However, after much reflection, I am not convinced that this is in fact a criticism, given the current state of knowledge as to the working of AV systems (a technology still under development).*

- 6.15 Transport Systems Catapult feared that reform could result in “unintended consequences whereby the law becomes less effective when applied in permutations that are currently unforeseen”. The Forum of Insurance Lawyers (FOIL) also cautioned against hasty changes:

*Until the capabilities of the technology are fully understood, to amend or refine the law would risk any proposals being out of date by the time they became relevant.*

- 6.16 The law firm Allen & Overy LLP addressed the example of an unlit cyclist at night, who would not have been seen by a human driver but who should have been detected by an automated vehicle. They thought the Act did not necessarily require the issue to be judged by the standard of a human driver. The courts could, for example, use:

*a variable standard, comparing the automated vehicle’s conduct to the hypothetical reasonably competent driver with access to the same information as the automated vehicle.*

- 6.17 Allen & Overy LLP went on to say that “as a matter of principle, we do not consider that contributory negligence can be a 100% defence to a claim”. If another road user was 100% responsible, the accident would not have been caused by the automated vehicle and liability would not arise.

### **Arguments for redrafting**

- 6.18 Those who answered “no” to question 17(1) generally thought that the policy could be expressed in a simpler way. As Aviva said, the issue “could be explained much more simply”.

- 6.19 Andrew Catlin described the sections as “confusing and borderline anthropomorphic”:

*There needs to be a clear distinction between an accident arising as a result of the intervention of a human, or through a human interfering with or modifying the autonomous system, and the failure of an autonomous system to perform correctly or effectively.*

- 6.20 The Senators of the College of Justice suggested “a new bespoke provision” that did not attempt “to shoehorn this very new situation into the 1945 Act”. The Bar Council of

England and Wales (the Bar Council) would also favour a review “to be done in conjunction with any reform of the Law Reform (Contributory Negligence) Act 1945”.

- 6.21 The Society of Motor Manufacturers and Traders (SMMT) thought that the words “against a person other than the insurer or vehicle owner” should be removed from section 3(1):

*the existing phrase creates confusion in identifying the defendant(s) when the conduct of the injured party outside the vehicle is what causes the accident and should therefore result in a reduction in liability.*

## CAUSATION

### Q17(2): Do you agree that the issue of causation can be left to the courts, or is there a need for guidance on the meaning of causation in section 2?

- 6.22 For the new liability to apply, the accident must be caused by the automated vehicle. There has been debate about how far causation implies some form of fault. We asked if guidance was required.
- 6.23 Again, responses were mixed. Out of 80 respondents who engaged with the question, almost half (39) said that there was a need for guidance. Slightly fewer (33) said that the question should be left to the courts, and eight did not express a firm view.
- 6.24 Insurers were more likely to ask for guidance: out of 13 insurers addressing the question, 12 said that there was a need for guidance. By contrast, nine legal respondents (mainly professional groups) wished to leave the issue to the courts. This compares with seven legal respondents who asked for guidance.

### The case for guidance

- 6.25 AXA UK and AXA XL both wrote that clearer definitions were needed:

*The clearer the definitions are on causation, the easier the legal process will be going forward. There will inevitably be a requirement for case law, but this should be minimised.*

- 6.26 The ABI and Thatcham Research were concerned that uncertainty over causation would make it more difficult to price the risk:

*Causation in relation to the Automated and Electric Vehicles Act is an area that has generated much debate in the insurance industry and we believe that further guidance ... would be helpful. Leaving the question of causation to the courts may lead to a considerable degree of uncertainty and insurers may be less able to price accurately to reflect the risks they will be liable for.*

- 6.27 FiveAI also stressed that the insurance market needs certainty:

*Insurers need certainty to price their products, so that they may take an informed view of the level of risk. Therefore, if the Act is intended to create strict liability, this should be clarified and guidance issued in accordance.*

- 6.28 FOIL thought that it will be difficult to apply a “common-sense” approach to causation to such a new technology:

*Although judges are used to addressing issues of causation, using, as the Consultation Paper indicates, a broad common-sense approach, it is not clear what the common-sense approach will be seen to be in the light of the new technology.*

This uncertainty would create problems for insurers and “make it difficult for practitioners to predict liability with any confidence”.

- 6.29 The National Farmers Union Mutual Insurance Society (NFU Mutual) highlighted the cost of litigation:

*We agree that the decision as to accident causation is ultimately for determination by the Court, however reliance upon the courts will both increase claim costs and delay resolution and settlement of claims.... This will particularly be the case for low value claims (e.g. those which would be decided in the small claims court).*

#### What should the guidance say?

- 6.30 Those who argued for greater guidance did not necessarily agree about what the guidance should say. Direct Line Group (DLG) wanted clarification that the Act is fault-based:

*DLG fully supports the principles of the AEV Act and was of the understanding that the intent was not to create a strict liability for AVs; the usual rules surrounding ‘fault’ would apply. However, there has been a significant amount of debate around the interpretation of the Act which suggests that this is far from certain and views differ considerably, with some considering the Act to place a strict liability on the insurer of the AV.*

- 6.31 The Consultation Paper considered a scenario in which an automated vehicle operated as intended, by avoiding a cyclist and hitting a parked car: should the insurer compensate the owner of the parked car? In this case the SMMT questioned:

*why an [ADS] performing a necessary evasive action in the future should be treated differently from the perspective of causation to a driver performing that same evasive action today, particularly if the laws of physics mean a collision (as a result of the evasive action) is unavoidable.*

- 6.32 Others feared that the courts would be too inclined to apply human standards of fault. For example, Kennedys Law LLP said:

*Judges are very likely, for the sake of expediency, to adopt a similar standard of driving for the artificial intelligence in an autonomous vehicle as of a driver in a manually-controlled vehicle. Doing so could risk miscarriages of justice / unfairness (and therefore satellite litigation).*

- 6.33 Stewarts Law LLP wanted clarification that the Act creates a strict liability regime:

*Section 2 of the AEV Act should be redrafted to ensure it provides true strict liability. The current reference to ‘caused by’ including ‘partly caused by’, by interpretation in*

s8, leaves scope for insurers to argue against compensating victims on the grounds that the accident was unavoidable by the AV. It also, by default, requires the victim to prove causation, which could be difficult and costly in an AV context. Similar challenges have defeated numerous product liability claims under the notoriously difficult “strict liability” regime of the Consumer Protection Act 1987.

- 6.34 BMW Group UK said that guidance would be useful on when a user-in-charge is responsible for an accident:

*The guidance to court may include the point at which the user-in-charge, rather than the autonomous driving system, is responsible for the operation of the vehicle and causing an accident.*

- 6.35 BMW Group UK added that Original Equipment Manufacturers (OEMs) could also assist the courts to know “how safety critical software updates are to be installed and the prior warnings given by the Automated Driving System (ADS) to the user-in-charge instructing the UIC to update the software”.

### **The case for leaving causation issues to the courts**

- 6.36 Generally, lawyers and judges trusted the courts to determine causation appropriately:

*Courts should decide causation on a case by case basis.* [Magistrates Association]

*The courts are well placed to deal with causation on a fact sensitive and principled basis.* [the Bar Council]

*Where... litigation is necessary, the courts will apply general causation principles as the issues that require to be addressed become apparent.* [Senators of the College of Justice]

- 6.37 The Law Society of Scotland thought that the law might evolve differently in Scotland, which they saw as appropriate:

*We note that jurisprudence might develop separately in England and Wales on the one hand and Scotland on the other in this case but this would properly reflect the different legal systems in each. At the same time, we expect that reasoning from one jurisdiction would be likely to be persuasive if a case were to arise on similar points in the other.*

- 6.38 Alex Glassbrook wrote that the complexity of automated vehicle cases is an argument for leaving them to the courts to determine:

*Causation would be better determined by the Courts, because it is (a) a legal issue, and a complex one when it involves (as seems likely in the AV context) scientific uncertainty as to causative mechanisms (b) fact-sensitive, so better dealt with on a case-by-case basis, on ascertainable past facts, than on a generic, predictive basis. That is not to suggest that comment on the causative issues under the AEVA should be restricted; legal academics and practitioners should take every opportunity to discuss and teach this issue.*



6.39 Transport Systems Catapult thought it “appropriate to leave further interpretation and clarification, including the issue of causation, to the courts, such that the further guidance will come from the ratio of real-world cases”.

6.40 The law firm DAC Beachcroft LLP cautioned that creating guidance would be difficult and that the guidance would be non-exhaustive:

*In practice it will be difficult to identify an exhaustive list to cover all potential scenarios and the civil courts are used to adjudicating on issues of causation. Over time, case law will develop to inform how causation is interpreted in respect of specific incident scenarios which will mitigate this issue.*

6.41 IAM RoadSmart describe the range of cases as unforeseeable.

*IAM RoadSmart does not believe that there is a need for guidance on the meaning of causation in section 2. This is because no one can foresee the full effect of automated vehicles, or the many different possible circumstances surrounding the accidents which might result. We also agree that the courts have long experience of dealing with causation issues to provide fair, common sense outcomes.*

### Reviewing the AEV Act

6.42 Some respondents queried whether a review of the AEV Act should take place in the absence of any practical experience. Following a survey of their members, the Chartered Institute of Legal Executives (CILEx) suggested that the AEV Act be reviewed after it has been applied to real-world scenarios:

*More than half of all respondents agreed that at present, the issue of causation would be best left to the courts to determine, as it is still unclear whether existing legal principles would be applicable or whether additional guidance is warranted. It was suggested that further review of this issue, and of the Act as a whole, should take place a few years after automated vehicles have been on the roads, so that the effectiveness of this new law can be better assessed.*

6.43 Similarly, Alex Glassbrook queried whether it was right to determine complex issues in the absence of real world experience:

*... my view is that pretending that there is certainty as to how these complex factual issues would be adjudicated, before the facts are known, would be the more hazardous legal approach. I have also described the AEVA as going as far as it should and no further ... That approach seems better to serve the core purpose of the Act (seeking to secure payment of compensation for injury caused by an insured AV) than multiplying complex arguments as to the reasonableness of non-human decisions.*

## RETAINING DATA: SHOULD CLAIMANTS BE REQUIRED TO NOTIFY THE POLICE?

**Q17(3): Do any potential problems arise from the need to retain data to deal with insurance claims? If so:**

**(a) To make a claim against an automated vehicle's insurer, should the injured person be required to notify the police or the insurer about the alleged incident within a set period, so that data can be preserved?**

**(b) How long should that period be?**

6.44 In the Consultation Paper we commented that automated vehicles generate large amounts of data, possibly too much to store. This leads to questions about what data needs to be preserved to defend claims. We did not think that there would be a problem where the system detects that a collision has taken place. However, the appropriate data may not be stored where the incident does not involve a direct collision.

6.45 Under the AEV Act, normal limitation periods will apply. Generally, personal injury claimants have three years to make a claim, though the period may be longer (for example, for children). We asked whether a claimant should notify the police or the insurer about the alleged incident within a set period, so that data could be preserved.

### Problems with data retention

6.46 Many respondents raised problems over data retention, which went further than those in the Consultation Paper.

6.47 Unusually, Wayve Technologies wrote that, as a technology developer, it was seeking "to retain the data indefinitely to improve our technical performance and ensure the incident is not repeated." Others described retention of even limited data as "impractical".

6.48 Allen & Overy LLP said that to understand why an automated vehicle acted as it did, one would need to consider machine learning based on all data it had gathered:

*The relevant window for the accumulation of data is arguably the lifetime experience of the automated vehicle. Such volumes of data are unquestionably unmanageable.... Storage of even a few days' worth of data would be wholly impractical. We see this evidential gap as a real issue that needs to be considered and addressed in the liability analysis.*

6.49 Richard Sarginson wrote it is not just the data that must be retained, but the software systems that were used at the time to read the data:

*The regulatory authority will need to keep an archive of all versions of software that have been used and all that continue in use.*

6.50 Several developers asked for more guidance on data retention. BMW Group UK set out the reasons why indefinite retention of data is "inadvisable". These includes privacy concerns. Much of the data is sensitive confidential information and "under GDPR the data should be retained for as limited a period as possible". Furthermore

*The amount of data an autonomously driven car and all of its electronic control units will generate will be very significant. The retention and storage of such data will be costly and also at risk of corruption, loss or theft.*

6.51 BMW Group UK thought that a minimum data set should be standardised:

*We also believe industry participants should have alignment on the “minimum data set” that must be retained for insurance purposes. This may include for example, time and location of accident, whether the ADS system was on or off, speed of the vehicle, time when control of the vehicle was handed over by UIC to the ADS, basic record of the driver and time since last input action from the driver and whether the driver was wearing a seat belt.*

6.52 Similarly, FiveAI thought that extensive data retention requirements could have a prohibitive effect:

*The volume of data produced by a single automated vehicle is so large that the complexity of storage infrastructure and cost of storage required to store all available data about every journey for the 3+ years required in case of a claim, would effectively prohibit widespread day to day use of automated vehicles. In addition, there is a significant procedural overhead for the vehicle manufacturer / owner / operator to retrieve comprehensive data from the vehicle... As it stands, even storing much more limited data for much shorter durations is burdensome both procedurally and financially.*

6.53 FiveAI described the issue of data preservation as “complex”. They thought that regulators should establish clear guidance:

*There should be clear guidance (or regulations where appropriate) for the industry concerning which information should be retained, acceptable formats, levels of fidelity, frequency of capture, etc. This will also establish a level playing field for all automated vehicles by giving all manufacturers / owners / operators the same core guidelines and avoiding a situation where those with lesser resources could face accusations that they have failed to store enough data compared with others with more resources at their disposal. The Department for Transport’s Code of Practice includes some guidance on this and would be an appropriate place to communicate any future amendments.*

6.54 The Chartered Institution of Highways and Transportation (CIHT) suggested a tiered data retention scheme:

*There may be an argument for retaining data on a tiered basis to avoid data bottlenecks, with full audio-visual data retained for 24 hours, full sensor data retained for one month, and basic geographic and speed data retained for three months.*

*Once an [Automated Driving System Entity (ADSE)] has been notified of a collision or the vehicles internal sensor determine one has occurred the vehicle should automatically retain data for a longer period, or until the ADSE informs it to destroy the data. Legislation should also be clear that storing of this data is a legal obligation under the 'right to erasure' contained within GDPR to avoid legal challenges.*

6.55 The International Underwriting Association (IUA) suggested that:

*it may be reasonable for in-vehicle data to be continually held for an extended 'buffer period' ... to potentially be determined by the proposed new safety assurance agency, during which time it could be expected that a vehicle involved in an incident could be located by the police / Accident Investigation Branch.*

6.56 Zurich Insurance (UK) argued that data should be retained not only to allow insurers to deal with claims under section 2 of the AEV Act. It was also needed to deal with secondary claims against manufacturers:

*To this end, there is an argument that the requirement to retain data should subsist beyond the settlement of a primary claim arising under s 2 of the [AEV] Act to prevent prejudicing the rights of claimants/pursuers, as well as defendants/defenders in any subsequent secondary claim.*

6.57 Aviva was also concerned that vehicle manufacturers “may be obstructive when accident investigations require diagnostic evidence”. However, secondary claims would depend on such data. Therefore, diagnostic equipment needs to be robust, data retained in the event of an accident and independent analysis to be carried out to identify the nature of the failure.

6.58 On the other hand, Uber described any new requirements on data retention as “premature”. They thought that the liability provisions in the AEV Act provided “strong incentives for vehicle owners and their insurers to retain sufficient data to determine the location of a vehicle while operating in an automated mode in order to adjudicate a claim”:

*Given these considerations as well as the current state of AV development, we believe it would be premature to establish particular requirements on the retention of data to deal with insurance or other claims, as well as any requirements that would mandate sharing such data with insurance companies or other private third parties.*

### **Automatic reporting by the vehicle**

6.59 Several technology firms thought that automatic notification would remove the need for human notification. Wayve Technologies referred to “a straightforward, automated process” whereby insurers and police were automatically informed of incidents, and the required data was preserved.

6.60 Similarly, the Floow thought that automatic reporting should be a condition of system approval. They saw relying on human reporting as “very problematic” given the opportunities for failure and delay. Ordnance Survey wanted standards outlining the triggers for the recording of data.

### **The case for a notification requirement**

6.61 Insurers and insurance solicitors thought that automatic notification would be the norm, but expressed concern about the minority of cases where it did not take place. The ABI and Thatcham Research wrote:

*We would expect that the [ADS] would automatically and immediately notify the insurer when an accident occurs; and that the data necessary to establish liability is transferred to the insurer. However, it may be the case that some accidents do not trigger the vehicle's data transfer mechanisms either because of their low impact or because the vehicle itself is not directly involved in an accident. In those scenarios, it would be our preferred approach to require injured parties to notify the police immediately. This would also act as a powerful safeguard against potential unmeritorious claims.*

- 6.62 FOIL also “expected an [ADS] to notify insurers in the event of a collision”. In such circumstances, FOIL agreed with the ABI and Thatcham Research “that a DSSAV<sup>60</sup> packet of important data should be sufficient in these circumstances to assist in establishing liability”. They pointed to the success of e-call:

*A system such as e-call has been shown to operate in newly-released manually operated vehicles, and therefore, it is not unreasonable to expect a similar system to operate in automated vehicles.*

- 6.63 However, where the automated vehicle was not involved in the collision, FOIL thought that claimant notification would be necessary to prevent fraud:

*A ‘non-collision’ incident may, perversely, require greater sets of data/information in order to establish liability, such as sensor information, images and possibly cam footage.*

*Under these circumstances a notification requirement of an injury following an incident with an autonomous vehicle is wholly necessary.... Without a notification requirement there is an increased risk of fraud, in circumstances where a motorist brings a claim six months after the accident... Such a claim would be very difficult or impossible to defend without data from the automated vehicle, which, without notification, could be lost by the time the claim is brought.*

- 6.64 DAC Beachcroft LLP also saw the advantages of automatic notification, provided that “the UK’s network infrastructure is improved to facilitate this”. However:

*There will be occasional incidents whereby the automated vehicle does not register a collision, for example where the velocity of the impact is very low, or where the automated vehicle causes, but is not involved in a collision. As such, there should, other than in exceptional circumstances also be a duty on the injured party (or in the case of a minor, his or her parent or guardian) to report the incident involving the automated vehicle to the police and, wherever possible, to the insurers of the automated vehicle within a specified time.*

### **The case against a notification requirement**

- 6.65 The Magistrates Association thought that the same rules should apply, irrespective of the nature of the vehicle:

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<sup>60</sup> Data Storage Systems for Automated Vehicles.

*Although we appreciate that an automated vehicle would generate a large amount of data, and there would be complications in storing three years of data, it would seem to create unfairness for any victims if a different time period was put in place in relation to automated vehicles in comparison with normal vehicles. It may not even be immediately obvious to anyone injured in an accident that a vehicle had an [ADS] installed.*

- 6.66 Similar arguments were put by a range of claimant representatives and legal groups:

*There may be many valid reasons why an injured person would fail to report the incident to the police, for example the severity of their injuries could prevent them from making such notification. It would be unreasonable to prevent an injured person from bringing a claim in this scenario. [Weightmans LLP]*

*To effectively introduce a different limitation period for one type of claim, caused by one type of vehicle, would be wholly inappropriate, and will lead to huge injustices, causing confusion and difficulties for claimants. There might be good reasons why a claimant does not notify police or their insurer within a set period. They may not have the capacity to do so. They might be under a mistaken belief the injury was not serious, only to find out later that it was life changing. [Association of Personal Injury Lawyers (APIL)].*

*The responsibility to store relevant data should lie with the operators and insurers for the vehicle. We accept that this could cause evidential problems in the very small percentage of cases where a valid claim is brought towards the end of a limitation period, but the victim of the accident should not be penalised. [MASS]*

- 6.67 This view as shared by others. For example, The University of York thought that limitation periods

*represent a balance that has been reached after considerable thought, and that in general functions effectively. We do not think the difficulties of proof highlighted in the report justify such a serious departure, particularly given that if the claimant is a credible witness then the burden will largely fall on insurance companies who are in a better position to manage the financial risk than the victims of the accident will be.*

- 6.68 DLG pointed out the gap between the short period before data is overridden and the longer period needed to be fair to claimants:

*It is highly unlikely that standard vehicle data will be held for any great length of time, unless an event has been triggered. Therefore, it could be extremely punitive to require potential claimants to notify an incident involving an AV within a timeframe that would mirror the data retention period for standard vehicle data.*

### **A “soft” requirement to report**

- 6.69 FiveAI suggested that claimants should be encouraged to report incidents quickly, to establish a claim as easily as possible. However, a failure to report would not preclude a claim:

*A middle ground might therefore be a ‘soft’ requirement to report, but which does not preclude a party from bringing a claim if they failed to do so. If the incident is not*

*reported, the automated vehicle manufacturer might as a consequence be less able to effectively defend themselves in court but in those circumstances, that could be taken into account and the courts would balance whatever evidence were available and place appropriate weight.*

6.70 The Bar Council took a similar approach.

*We would favour an injured person being required to notify the police about an alleged incident within a set period, such as 6 months, from the date of the occurrence of the incident, so that data can be preserved. The police should then immediately notify the insurer shown on DVLA records.*

6.71 However, the Bar Council argued that a failure to notify the alleged incident within a set period should not bar a claim for personal injuries.

### **How long should the period be?**

6.72 Views on the appropriate length of time to notify an accident varied from 12 hours to 6 months. Richard Morris suggested that, ideally, video data should be captured within an hour:

*Realistically, this needs to be within about 1 hour of the event to be sure of no accidental over-write. If greater video data storage requirements are mandated on AVs, this might be extended out to 12 hours.*

6.73 Several respondents suggested a 24-hour time-frame.<sup>61</sup> As DAC Beachcroft LLP argued:

*Other than in circumstances where the third party is catastrophically injured..., it is reasonable to expect an injured party to report an alleged incident to the police and, wherever possible, to the insurers of the automated vehicle involved within 24 hours. This will also serve to mitigate the risk of fraudulent claims being presented to insurers of automated vehicles, in the knowledge that any evidence to defend the claim will have been deleted.*

6.74 Several respondents suggested periods between 7 and 14 days.<sup>62</sup> Transport Systems Catapult thought that the period should be at least one month, and possibly up to six months:

*The duration allowed for reporting of incidents ... needs to be sufficiently long to allow for those with extremely busy lives, or those who do not detect the incident immediately (e.g. someone coming back from holiday to discover damage to their car, and identifying the autonomous vehicle from CCTV footage). The period allowed should therefore be at least a month, and possibly as much as six months.*

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<sup>61</sup> Other consultees arguing for a 24-hour reporting period included BMW Group UK, Aviva, the Garage Equipment Association (GEA) and Nicholas Bevan of Nota Bene Legal Consulting.

<sup>62</sup> For example, the British Vehicle Rental and Leasing Association (BVRLA) and Heather G Bradshaw-Martin, suggested seven days; Lesley Vernon suggested “within 10 days”; and James Geraghty 14 days (except in extreme scenarios, such as the claimant becoming hospitalised).

6.75 By contrast, London Living Streets and Living Streets Hackney thought that the period should stay the same at three years.

6.76 Finally, John Rainbird suggested a statistical approach, based “on the period within which 95% of claims are presented to insurers”. The CIHT suggested further research on:

*The average length of time before road users report incidents, which may be delayed as they initially think damage is minor, but later find out repairs are more expensive expected or that there was unseen damage.*

6.77 This question also drew responses on how to replace the current obligations on drivers to report accidents under section 170 of the Road Traffic Act 1988. We discuss this issue in Chapter 7.<sup>63</sup>

## **PRODUCT LIABILITY AND SOFTWARE**

### **Q18: Is there a need to review the way in which product liability under the Consumer Protection Act 1987 applies to defective software installed into automated vehicles?**

6.78 The Consultation Paper pointed to uncertainty over how the Consumer Protection Act (CPA) 1987 applied to “pure” software, sold separately from any physical product. We asked if there was a need to review this issue.

6.79 Out of 87 respondents who engaged with this question, most (53, amounting to 61%) agreed that there was a need for a review; 10 respondents argued against a review; while 24 respondents replied “other”.

#### **The case for a review**

6.80 There was widespread concern about how the CPA 1987 applies to intangible software.<sup>64</sup> As Kennedys Law LLP put it:

*Questions arise as to whether the software technology supplied to an automated vehicle (a non-physical product) is a product in its own right or part of the vehicle product as a whole.*

6.81 Consultees felt that the law had failed to move with technology. As FOIL said:

*At the time the European Product Liability Directive was adopted in 1985, and the CPA was enacted in 1987, the impact of computers and artificial intelligence on everyday life in 2018 could not have been envisaged. The application of the Directive and CPA to things such as over-the-air software updates was inconceivable.*

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<sup>63</sup> See answers to Questions 29 and 30, pp 125 and 126.

<sup>64</sup> Those expressing this concern included the Law Society of Scotland; the Forum of Insurance Lawyers (FOIL); the Forum of Complex Injury Solicitors (FOCIS); Weightmans LLP; BTO Solicitors LLP; IAM RoadSmart; AXA XL; Aviva; DAC Beachcroft LLP; CIHT; CILEx; Burges Salmon LLP; Bar Council of England and Wales; Professor Phil Goodwin; Kennedys Law LLP; Heather G Bradshaw-Martin; and the International Underwriting Association (IUA).



6.82 CILEx referred to the “changes in consumer behaviour and technological developments” since one of the leading cases in 1996.<sup>65</sup> The majority of its members thought that “the law needs to be updated to move with the technology”.

6.83 BTO Solicitors LLP explained the nature of the problem:

*The existing definition of product is directed at tangible things. We agree that there is some question as to whether that definition would apply to an over the air update.*

6.84 They referred to a 2015 case which described a product “a tangible and moveable item which can be transferred from one person to another”.<sup>66</sup> This is not an issue if the software is incorporated within a physical product such as a car at the time it was sold. It is then part of the larger product. However, it becomes an issue if the software is supplied later, particularly if it is supplied by a different entity. BTO Solicitors LLP said:

*It is currently a defence for a party faced with a claim under the CPA that the defect which makes the product less safe... was not incorporated within the product at the “relevant time”.*

6.85 The “relevant time” is defined under section 4(2) of the CPA 1987. Normally it means the time when the producer supplied the product to another. Thus, “where a software update compromises safety in a previously safe AEV, it cannot be said that there was a defect upon first supply”.

6.86 FOIL raised a further point: the manufacturer would not be liable for software updates ten years after the product was first supplied:

*Limitation for a product liability claim is currently 10 years from the date the product is put into circulation. Does that mean after 10 years there can be no liability on the part of the producer? Is that appropriate where an OTA software update issued after that point causes the defect in the product?*

6.87 Many consultees thought that software should be considered in the same way as other products:

*We do need to bring software under the same liability structure as any other product sold. [Heather G Bradshaw-Martin]*

*The ADSE should be liable for software defects that result in harm to other users. [CIHT]*

*IAM RoadSmart believes that the main vehicle manufacturer should be liable for any defect in a component part, though the manufacturer should be able to bring a further claim against the component manufacturer for negligence. [IAM RoadSmart]*

6.88 AXA XL suggested that the Law Commissions should consider the provisions on digital content under the Consumer Rights Act 2015:

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<sup>65</sup> *St Albans City and DC v International Computers Ltd* [1997] FSR 251.

<sup>66</sup> *Aspen v Adanna Construction* [2015] EWCA Civ 176, per Clarke LJ at [42].

*The Consumer Rights Act 2015 introduced a new regime for 'digital content'. The Law Commission should consider the application of, interaction between, and concepts used in these statutes to automated vehicles.*

- 6.89 By contrast, the SMMT and BMW Group UK did not see this as an issue. The SMMT said that “where defects concern product safety, the General Product Safety Regulations 2005 apply”.
- 6.90 Normally, the 2005 regulations are regulatory, enforced through criminal sanctions. They do not create civil liability. However, BTO Solicitors LLP highlighted that section 41 of the CPA creates “a right of civil action” for anyone who may be affected by a breach of product safety regulations. BTO Solicitors LLP noted that this provides a “route to claim damages which is often ignored”.

*Actions for breach of statutory duty under S.41 of the CPA are not restricted to claims for injury or damage caused by “consumer products” but rather any product to which the relevant safety regulation applies and as such they provide a right of action to anyone who sustains losses in consequence of a Safety Regulation breach.<sup>67</sup>*

### **The European Commission’s work**

- 6.91 Several consultees mentioned the work of the European Commission’s Expert Group on Liability and New Technologies. As DAC Beachcroft LLP said:

*It is understood that the question of whether software should be defined as a product under the CPA is likely to also be addressed by the European Commission’s Expert Group on Liability and New Technologies, which aims to publish guidelines on the European Product Liability Directive in mid-2019.*

- 6.92 Some consultees thought that the Law Commission should wait for the Expert Group’s work before considering the issue further. Burges Salmon LLP stressed “the international nature of the products and their manufacturing supply chain”. Zurich Insurance (UK) suggested that:

*while the UK’s product liability regime flows primarily from the EU law, it may be worth delaying any legislative changes pending the outcome of the EC’s review.*

- 6.93 The Association of Personal Injury Lawyers (APIL) said that with the uncertainty of Brexit, now is not the right time to review the CPA 1987.

- 6.94 However, FOIL disagreed:

*The European Commission may provide this through their Expert Group but FOIL considers that it is of sufficient importance to warrant consideration by the Law Commissions as part of the automated vehicles project.*

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<sup>67</sup> BTO Solicitors LLP referred to *Stoke-On-Trent College v Pelican Rouge Coffee Solutions Group Limited [2017] EWHC 2829 (TCC)* as an example of breach statutory duty relating to products, though the case does not refer to s 41 specifically.

## Not just automated vehicles

6.95 Many consultees pointed out that the issue of software liability is not confined to vehicles but arises in many different areas. Zurich Insurance (UK), for example, pointed to “the Radio Equipment Regulations 2017 and the recently agreed Directive to establish a European Electronic Communications Code”.

6.96 FiveAI thought that any review should cover product liability law as a whole:

*Whilst we appreciate the scope of this particular review is limited to automated vehicles, we think it would be undesirable to single the automated vehicle industry out to be subject to a more stringent regime than other industries where software controls physical systems... In our view, it would be preferable for product liability laws to be reviewed and reformed as a whole, rather than on an industry specific basis.*

6.97 Similarly, Allen & Overy LLP were “concerned that a different approach for automated vehicle liability may create an uneven playing field, creating an economic drag on the introduction of this technology”.

6.98 The Institute and Faculty of Actuaries said that it would not support changes to product liability to give different treatment for automated vehicles unless it can be shown that automated vehicles are fundamentally different from other products.

## The difficulty of showing that software defects caused the accident

6.99 Even if software updates are considered to be products with the scope of the CPA 1987, many respondents were concerned about the difficulty of establishing a claim for defective software.<sup>68</sup>

6.100 The Faculty of Advocates explained that it was necessary not only to show that the software was defective but also that the defect caused the damage.

*Causation does require to be proved, and the tendency has been for courts to seek to identify what exactly has “gone wrong” in order to establish the necessary causal connection... [W]here there is a possibility of more than two causes only one of which gives rise to liability, then the court will not draw the inference of liability because the pursuer has eliminated only one of the other possible causes. This applies even if the pursuer has eliminated an identified cause, but there remains the possibility of another and unidentified cause.<sup>69</sup>*

6.101 The Faculty explained that the issue of causation had “added bite” because:

*although it might be possible to identify an error in conventional algorithms, it is of the nature of a neural network that it is impossible to determine how the network acted as it did.*

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<sup>68</sup> Those raising this concern included Allen & Overy LLP, Burges Salmon LLP, Weightmans, Aviva, ABI and Thatcham Research, DLG, and Ageas and the National Farmers’ Union Mutual Insurance Society (NFU Mutual).

<sup>69</sup> The faculty referred to *Rhesa Shipping Co SA v Edmunds* [1985] 1WLR 948 per Lord Brandon at pp 955 – 956.

6.102 Allen & Overy LLP pointed out that the fact that the vehicle caused injury does not necessarily indicate a defect:

*The action taken by the automated vehicle might have been the “correct” choice (in the sense of minimising harm) in 99% of cases, just not in the case before the court. That means the possibility of causing loss is inherent in such systems. Under the 1987 Act, dangers inherent in the nature of the product are not defects.*

6.103 Allen & Overy LLP also asked how a defect would be proved:

*Generally, the issue of whether there is a defect is addressed by expert evidence... If the algorithm’s decision making is no longer open to human scrutiny, no witness could ever satisfy [the test under section 3 of the Civil Evidence Act 1972].*

6.104 AXA UK and AXA XL asked the question of whether an automated vehicle (AV) that acts in a way which was unintended could be said to be defective:

*If an AV which acts in a way which was unintended (from the perspective of the user, or the OEM, or the designer of the code) it is uncertain if this can be said to be ‘defective’ in the first place. This issue becomes further complicated if the AV is capable (either alone or through connection with other automated vehicles) of ‘learning’ to modify its behaviour by reference to its experience in the real world – independent of the user, the OEM or the designer.*

#### Reversal of the burden of proof

6.105 The Faculty of Advocates suggested “a statutory presumption that where a vehicle caused an accident whilst under automatic control, then the accident was caused by the functioning of the automatic system”.

6.106 Aviva, Ageas, the ABI and Thatcham Research and DLG also said that the burden of proof should be reversed, to make it easier to show that software was defective and that the defect caused the accident. As Weightmans LLP said:

*a reversal of the burden of proof, where an automated vehicle when driving itself has been involved in an accident, would simplify matters substantially. It would also act as a significant deterrent to bringing any system to market where safety concerns had been identified during development and/or failing to notify the relevant authorities of concerns regarding systems already in use.*

## OTHER ISSUES WITH PRODUCT LIABILITY

### **Q19: Do any other issues concerned with the law of product or retailer liability need to be addressed to ensure the safe deployment of driving automation?**

6.107 This question drew a wide variety of replies, including some detailed discussions of product liability. Three issues stood out: the exclusion of damage to commercial property; the exclusion of damage to the vehicle itself; and the state of the art defence.

#### Damage to commercial property

6.108 In the Consultation Paper we explained that the CPA only covers damage done to individuals and their property. It excludes damage to commercial property. Thus, the

CPA would apply where an automated vehicle damages a consumer car or home, but not where it damaged a lorry or a shop.<sup>70</sup>

6.109 Some consultees (including the Law Society of Scotland, BTO Solicitors LLP and Weightmans LLP) expressed concern that insurers would be forced to bring claims against manufacturers under the law of negligence/delict. BTO Solicitors said:

*Where negligence must be established, the exercise of establishing the precise mechanism of what went wrong with the AEV, who was responsible and whether or not this was negligent will be prohibitively time consuming and expensive.*

### **Damage to the vehicle itself**

6.110 The CPA does not cover damage to the vehicle itself. AXA UK and AXA XL thought that the Law Commissions should consider whether the incorporation of defective software code into an automated vehicle constitutes damage. They felt this issue would be important for insurers.

6.111 FOIL accepted that the AEV Act does not require insurers to insure the vehicle against damage to the vehicle itself. However

*in practice it is expected that insurers will continue to offer fully comprehensive insurance to cover the owner for such loss.*

6.112 They were concerned about the difficulties of recovering damages from manufacturers in these circumstances.

6.113 Weightmans LLP described the exclusion of liability for damage to the vehicle itself as “counter-intuitive”. They asked for “a straightforward right of recovery against OEMs”. It thought that this “would represent a powerful disincentive to manufacturers bringing systems to market which have not been fully tested”.

### **State of the art defence**

6.114 Under section 4(1)(e) of the CPA 1987, a producer has a defence to the claim if “the state of scientific and technical knowledge at the relevant time” would not have enabled the defect to be discovered.

6.115 Several respondents, including the FOIL, Ben Phillips, Kennedys Law LLP, Weightmans LLP and Burges Salmon LLP were concerned about how this defence would apply to defects in automated vehicles. John Rainbird said that the state of the art defence should only be permitted if there is evidence of extensive testing.

### **Producer insurance**

6.116 Aviva queried whether vehicle manufacturers (VMs) would carry adequate insurance:

*Claimants unlikely to be fully compensated if subrogation successful but products liability insurance limits are inadequate. Additional burden on VM's and component manufacturers to buy unlimited or significantly higher limits.*

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<sup>70</sup> For the law on this issue, see Consultation Paper para 6.68.

6.117 The Institute and Faculty of Actuaries asked what would happen if the manufacturer stopped trading but their vehicles continued to operate on the roads:

*The recourse of the insurer to recover against that manufacturer will be curtailed, and may depend upon exactly what insurance policies the manufacturer has itself historically purchased.*

6.118 NFU mutual were also concerned about suppliers going into liquidation. In such circumstances, they thought it important to clarify where responsibility for the system may lie.

## **OTHER ISSUES WITH THE AEV ACT**

6.119 In the Consultation Paper, we did not ask about other issues concerning the AEV Act. However, there is substantial interest in this legislation, and we received many comments on a wide range of subjects. Three issues stood out: whether the Act should extend to “semi-autonomous” vehicles operating at SAE Levels 2 or 3; who had responsibility for safety critical updates; and the need to extend both MIB agreements<sup>71</sup> to cover uninsured automated vehicles.

### **Extending the Act to cover SAE Levels 2 and 3 vehicles**

6.120 Nicholas Bevan expressed concern at the “recovery gap for victims of vehicles operating at Levels 2 and 3”. This concern was shared by the Forum of Complex Injury Solicitors (FOCIS), the Association of Personal Injury Lawyers (APIL) and Stewarts Law LLP.

6.121 FOCIS said:

*Those injured by automated vehicles where there is no evidence of fault on the part of a driver currently on the roads will be required to pursue costly and complex product liability claims.*

6.122 Stewarts Law LLP saw this as a “serious gap” in the AEV Act, leading to complex liability disputes and in injustice in some cases:

*The existing law may allow insurers to suggest that the blame for an incident or injury lies with the manufacturer, or whoever performed the last service in failing to calibrate sensors or update software. The victim may be required to consider a highly technical Consumer Protection Act claim for product defect in tandem with negligence claims against both the driver and the servicer; so incurring costs and risk of pursuing three or more defendants.*

6.123 Nicholas Bevan highlighted article 3 of Motor Insurance Directive 2009/103/EC. This requires compulsory motor insurance for any civil liability “in respect of the use of vehicles”. This would appear to include the civil liability of the manufacturer or repairer as well as the driver.

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<sup>71</sup> The MIB agreements are Untraced Drivers Agreement 2017 and the Uninsured Drivers Agreement 2015.

## Responsibility for installing safety critical updates

6.124 Many respondents felt that software updates and their status in relation to civil liability should be examined in further detail.

6.125 Aviva simply asked, “how is software updated and by who?”. The Freight Transport Association (FTA) wanted more clarity about who was responsible for installing updates and what amounted to a “reasonable time”:

*This brings into question who is responsible for ensuring the updates are installed and functioning correctly. Also, the question about "reasonable time" would need to be answered - what is a reasonable time within which the software should be installed after it has been released? The answer to that may be dependent upon the severity of operating an AV without that updated software!*

6.126 The British Vehicle Rental Leasing Association (BVRLA) noted that in the context of a rental vehicle the registered keeper of the vehicle may not be the person renting the vehicle. They suggested that a vehicle should be prevented from operating without a safety critical update:

*In addition, clarity will also be needed as to whether the vehicle would be able to ‘drive itself’ if a software update/detect was alerted, or if the vehicle would go into ‘sleep mode’ until the software was updated, enabling the vehicle to be fit for use.*

6.127 Kennedys Law LLP thought that the law should be amended to require this:

*We suggest the legislation be amended to place the onus on the OEM or manufacturer to ensure, by design, that autonomous vehicles cannot start their journey until safety-critical software updates are uploaded or it is confirmed that such software is already up to date, in much the same way that many vehicles will not allow the driver to set off if their seat belt has not been put in place. It makes no practical real-world sense to place this onus on the user-in-charge or driver or owner.*

6.128 Zurich Insurance (UK) raised issues of network liability, pointing to:

*uncertainty around the liabilities relating to defective post-supply system updates, the role of 5G and Spectrum and, given that Wi-Fi provision is typically deemed a service rather than a product, system failures caused, wholly or in part, by poor connectivity.*

## Motor Insurance Bureau agreements

6.129 The Consultation Paper explained that liability under section 2(1) of the AEV Act only arose where the vehicle was insured. We noted that the Government is currently in discussions with the Motor Insurance Bureau (MIB) to provide cover for victims where the vehicle is uninsured.<sup>72</sup>

6.130 Nicholas Bevan thought that this deficiency “should be addressed immediately”.

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<sup>72</sup> Consultation Paper paras 6.18 and 6.19.

*The MIB has a history of obfuscation and delay and the Government should take the initiative by dictating appropriate amendments to be agreed forthwith.*

6.131 He emphasised the need to consider how the Act interacts with the Untraced Drivers Agreement 2017 and the Uninsured Drivers Agreement 2015.

6.132 Thompsons Solicitors LLP also raised this issue.

## **THE WAY FORWARD**

6.133 We are grateful for the many detailed comments we received on the AEV Act 2018. Our overall conclusion is that it may be “good enough for now”. In other words, reform is not a priority at this stage, though its workings will need to be reviewed in the light of practical experience.

6.134 The greatest concerns were about data retention. Before an ADS is authorised, the safety assurance scheme will need to be satisfied that the system can recognise collisions. The system will then need to respond by storing data. We appreciate concerns about fraudulent claims where relevant data to defend the claim is unavailable. However, we do not wish to curtail limitation periods at this stage. Rather, the public should be encouraged to report incidents involving automated vehicles as quickly as possible. In the case of late claims, the courts will need to weigh the available evidence.

6.135 There does appear to be a need to review the way that product liability law applies to pure software. However, we accept that this should be done generally, not simply for automated vehicles. We hope that the Government will consider this issue in the light of the forthcoming report of the European Commission’s Expert Group on Liability and New Technologies.<sup>73</sup>

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<sup>73</sup> <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3592>.



## Chapter 7: Criminal liability

### OVERVIEW

- 7.1 Chapter 7 looked at a wide range of criminal offences. The central proposal was that users-in-charge would need to be qualified and fit to drive but would not be liable for breaches of driving rules “committed” while the automated driving system (ADS) was engaged.
- 7.2 Instead, if the problem appears to lie with the ADS, the police should refer the matter to a regulatory authority, such as the safety assurance scheme, for investigation. The authority would be able to apply a range of regulatory sanctions to the entity behind the ADS (the automated driving system entity (ADSE)). These would include improvement notices, fines or withdrawal of approval.
- 7.3 Most consultees agreed with this approach. Two-thirds of consultees agreed that a user-in-charge of a highly automated vehicle should not be considered to be “driving” while the ADS was engaged, while 89% of respondents agreed that a regulatory authority should be able to apply a range of sanctions to the ADSE. That said, the issue generated considerable discussion.
- 7.4 We gave the example of a registered keeper who receives a notice of intended prosecution for speeding. We envisaged that the registered keeper would state that the ADS was engaged at the time and authorise data to be provided to the police. Many consultees said that the police should have access to the data without involving the registered keeper. They pointed out that the keeper might not know whether the ADS was engaged at a particular time and would not necessarily “own” the data. Consultees suggested a defined data storage system to ensure these data were available.
- 7.5 The next stage would be for the police to refer the issue to the regulatory authority. There was some discussion about how this might work, with suggestions for a pre-defined protocol or memorandum of understanding.
- 7.6 As far as sanctions were concerned, many consultees stressed the need to apply these proportionately, to deal with patterns of incidents, not single occurrences. They emphasised a co-operative approach, allowing developers the chance to put things right. Others were concerned that the sanctions should be a sufficient deterrent. Cycling UK, for example, emphasised that the threat of suspension must be real, despite “the huge inconvenience it might cause”.
- 7.7 The great majority of consultees agreed that a user-in-charge should be responsible for the vehicle’s insurance and roadworthiness and for removing vehicles which have stopped in prohibited places. However, there was some discussion about how a user-in-charge would know if the vehicle was roadworthy. There were suggestions that automated vehicles might expand the range of on-board diagnostic systems, whereby they can check themselves.

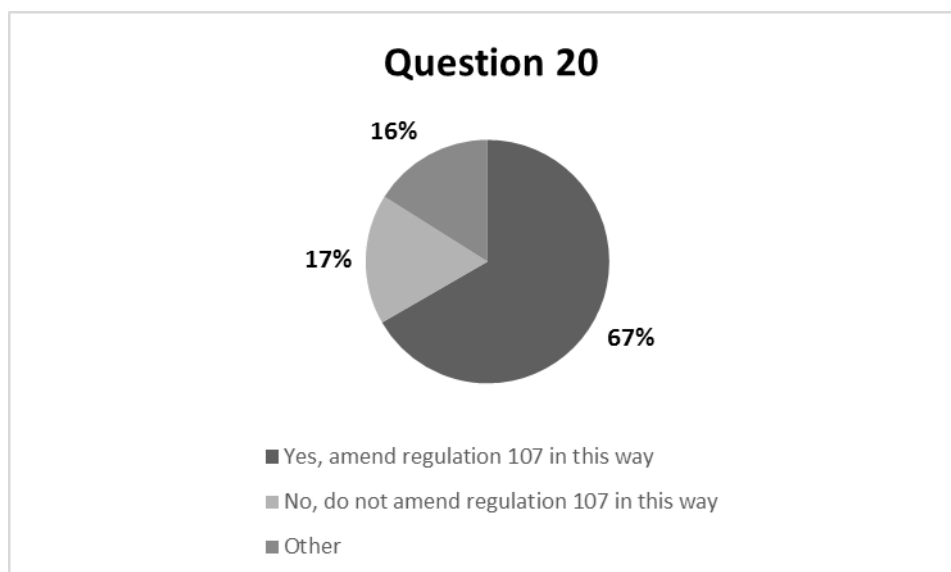
- 7.8 Chapter 7 discussed duties following an accident; complying with the directions of a police or traffic officer; and ensuring that children wear seatbelts. Most consultees agreed that these responsibilities should fall on the user-in-charge, where such a user was in the vehicle. In the absence of a user-in-charge, the most common suggestion was that the issues could be resolved through technological solutions or managed by a remote operation centre.
- 7.9 We asked about a possible new offence of causing death or serious injury by unlawful interference with roads, traffic signs or vehicles, contrary to section 22A of the Road Traffic Act 1988. Most consultees thought that this would act as a useful deterrence, though a few said that the current law was adequate.
- 7.10 Finally, we asked whether the Law Commissions should review the law on corporate offences where wrongs by an ADS developer resulted in death or serious injury. Most consultees (84%) argued for a review. They pointed to the limitations of the law of corporate manslaughter: that it does not apply to non-fatal injuries, and is difficult to use against large companies, where senior managers are far removed from decision-making. That said, a review was opposed by four manufacturers and developers, who did not see why automated driving was different from any other potentially dangerous product.

## **OFFENCES INCOMPATIBLE WITH AUTOMATED DRIVING**

**Q20: We seek views on whether regulation 107 of the Road Vehicles (Construction and Use) Regulations 1986 should be amended, to exempt vehicles which are controlled by an authorised ADS.**

**Q21: Do other offences need amendment because they are incompatible with automated driving?**

- 7.11 In the Consultation Paper, we did not find any offences which completely prevent automated driving. However, we highlighted potential problems with Regulation 107 of the Construction and Use Regulations 1986. This prohibits leaving on a road a motor vehicle which “is not attended by a person licensed to drive it”, unless the engine is stopped and the parking brake applied.
- 7.12 This does not necessarily require a licensed person in the vehicle. A vehicle could be “attended” by a person nearby or in a remote-control centre. However, it would prevent some forms of highly automated vehicles which were not “attended” in this way. We asked if Regulation 107 should be amended.



7.13 Two thirds of consultees thought that Regulation 107 should be amended. Of the 81 consultees who engaged with this question, 54 consultees (67%) said yes and only 14 (17%) said no. The remaining 13 consultees responded “other”.

#### The case for amending regulation 107

7.14 There was concern that regulation 107 might inhibit autonomous driving. As Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA) said: “without this amendment emergence of level 5 vehicles will be blocked”. The International Underwriting Association (IUA) commented:

*It would be necessary to amend Regulation 107 to ensure that authorised highly-ADSs that do not require a user-in-charge and are not controlled by a remote-control centre are exempt.*

7.15 The Crown Prosecution Service (CPS) argued in favour of amending regulation 107 but pointed to some of the complexities:

*Would vehicles only be exempt if the [ADS] is ‘switched on’? If so, who is deemed responsible for switching this mode on or off – a user-in-charge? .... As with the United States mooted approach, a person should still remain liable if the vehicle poses a risk to the public or obstructs other road users.*

7.16 Mills & Reeve LLP expected that “the process of judicial interpretation” might make amendment unnecessary, but nevertheless thought that statutory clarification would be beneficial”. Similarly, the Bar Council of England and Wales (the Bar Council) said:

*It could be argued that the software in some way attends the vehicle but the law will achieve greater clarity if authorised [ADSs] are exempt from this offence.*

#### The case against amending regulation 107

7.17 Those who cautioned against amendment were concerned that it might lead to inappropriate parking (for example with the engine on or the parking brake off). For

example, Cycling Scotland are concerned that amending regulation 107 would remove liability from the driver and the manufacturer, such that no one is criminally liable.

### **Do other offences need amendment?**

- 7.18 In all, 43 consultees suggested other issues to be addressed. Most of these are discussed elsewhere in this paper (including secondary activities, UNECE type approval, dynamic driving offences, parking offences, interference with automated vehicles and the Highway Code).
- 7.19 The Consultation Paper considered Regulation 104 of the Road Vehicles (Construction and Use) Regulations 1986. This provides that no person shall drive a motor vehicle on a road without proper control of the vehicle or a full view of the road ahead. We said that this provision did not necessarily require a driver: instead it provides that *if* a vehicle has a driver, the driver must have proper control and a full view. We welcomed observations on this point.
- 7.20 Five respondents specifically commented on Regulation 104. Kennedys Law LLP argued that the reference to “no person shall drive” did not limit the provision to cases where a person was driving: instead it went further and imposed a requirement to have a person with proper control of the vehicle.
- 7.21 Three consultees thought that “full view” needed to be clarified, particularly to cover remote supervision:

*We can envisage a scenario where an automated vehicle has turned into a blind alley and its only way out is to reverse back onto the main road and it needs the intervention of a remote operator to do so. In this case, a view of the road and traffic behind would be required. [The Association of British Insurers (ABI) and Thatcham Research and Ageas]*

*Even without telematic operation it is possible that exterior views will be provided through VR headsets and/or screens. Whether or not this is classed as having a “full view” or not needs clarifying. [RACE]*

### **THE USER-IN-CHARGE IS NOT A DRIVER**

**Q22: Do you agree that where a vehicle is:**

**(1) listed as capable of driving itself under section 1 of the Automated and Electric Vehicles Act 2018; and**

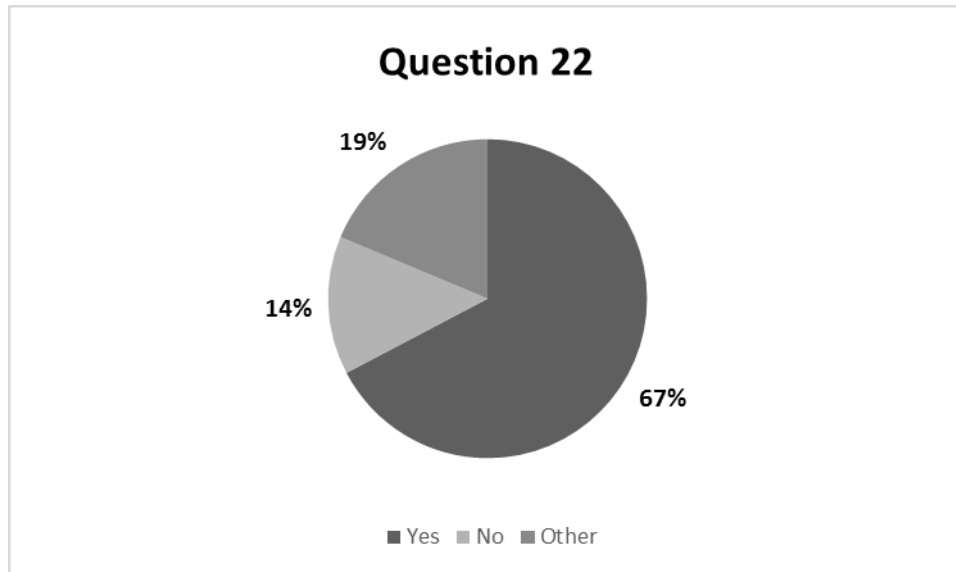
**(2) has its ADS correctly engaged;**

**the law should provide that the human user is not a driver for the purposes of criminal offences arising from the dynamic driving task?**

**Q23: Do you agree that, rather than being considered to be a driver, a user-in-charge should be subject to specific criminal offences?**

- 7.22 In the Consultation Paper we proposed that where a highly automated driving system is correctly engaged, the human user should no longer be liable for criminal offences which arise directly from the dynamic driving task. Instead, compliance would become

an issue for the ADSE. Rather than treat the user-in-charge as a driver, we thought that they should be subject to specific offences.



7.23 Two thirds of consultees agreed. Of the 107 consultees who responded to this question, 72 consultees (67%) agreed; 15 consultees (14%) disagreed; and 20 said 'other'.

#### The case for clarifying that a user-in-charge is not a driver

7.24 Those who agreed with the proposal saw it as logical, as the human user did not have control over the driving.

*The human user cannot be responsible as the driver for something they are not controlling or directing.* [Andrew Catlin]

*It is the vehicle that is undertaking the driving, not the human.* [Freight Transport Association (FTA)]

*Because he doesn't need to monitor the driving environment and he doesn't influence the behaviour of the vehicle in these cases, so how can he be called a driver and having responsibilities.* [Olivier Raemy, FEDRO Switzerland, personal response]

7.25 This clarification was also thought necessary to encourage users to use highly automated systems:

*Fundamentally without such comfort to users they will simply not choose to utilise a fully AV.* [International Underwriting Association (IUA)]

7.26 Richard Sarginson was concerned about the phrase "correctly engaged". If a human believed the system was correctly engaged when it was not, he felt this should not expose the human to liability.

#### The case for retaining driver responsibilities

7.27 Some respondents were uneasy about abandoning the idea of a human in control. The Magistrates Association felt the human should be the driver because it makes clear that they are expected to take reasonable steps to avoid accidents. The Transport Planning

Society was concerned that the human might allow the vehicle to speed and not be held accountable. Amey said the human should be classed as the driver because they “must still be able to take control of the vehicle”.

- 7.28 Furthermore, some individuals felt that, by using an automated vehicle, the user-in-charge chose to impose risks on others and should be liable for the consequences:

*If you choose to use a vehicle in an area where it imposes risk on others, you should be criminally liable for any problems caused. [Alistair Chaplin]*

*Ultimate responsibility must lie with the user-in-charge. [David Salmon]*

## Exceptions

- 7.29 A few respondents agreed that the user-in-charge should not be considered a driver, but argued for some exceptions to this principle. Centaur Consulting gave the following example:

*If the user wrenches the steering wheel to point at pedestrians, but then lets the system revert to automated driving, in such a way that the [ADS] cannot safely avert an incident, the human user should be criminally culpable.*

- 7.30 Richard Morris of Innovate UK, responding in a personal capacity, suggested there may be an emergency feature which allows the vehicle to drive faster, go through red lights and make more risky manoeuvres (e.g. to avoid “ambush or assassination”). He thought that it should be a criminal offence to use such a feature inappropriately.
- 7.31 Zurich Insurance (UK) argued that even if the system has been engaged, there should still be criminal liability if the vehicle is used with muddy sensors or outdated software.

## A NEW SYSTEM OF SANCTIONS

**Q24: Do you agree that:**

**(1) a registered keeper who receives a notice of intended prosecution should be required to state if the vehicle was driving itself at the time and (if so) to authorise data to be provided to the police?**

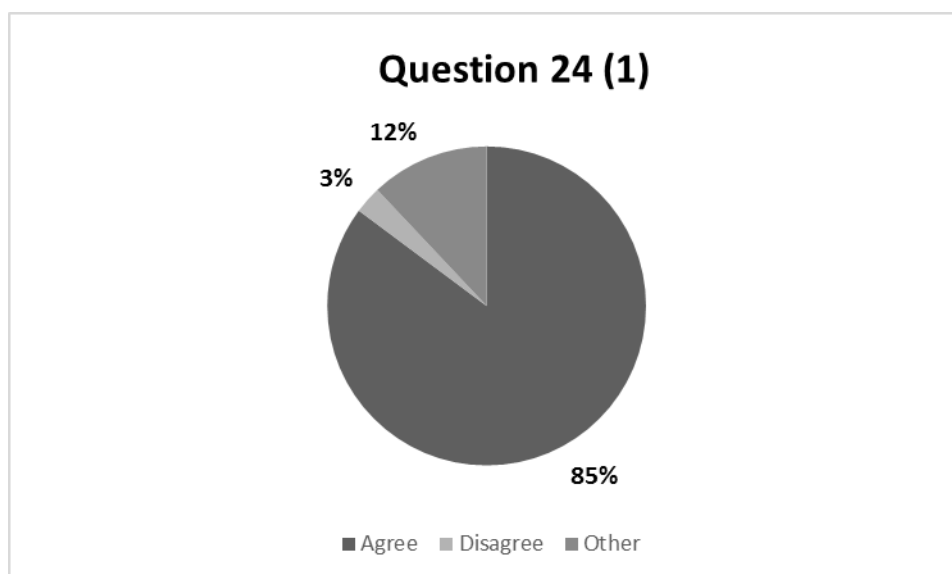
**(2) where the problem appears to lie with the ADS the police should refer the matter to the regulatory authority for investigation?**

**(3) where the ADS has acted in a way which would be a criminal offence if done by a human driver, the regulatory authority should be able to apply a range of regulatory sanctions to the entity behind the ADS?**

**(4) the regulatory sanctions should include improvement notices, fines and suspension or withdrawal of ADS approval?**

- 7.32 In the Consultation Paper we suggested a new system of sanctions where a highly automated vehicle acts in a way which would currently amount to a criminal offence.
- 7.33 We used speeding as an example. Under the current law, if a speed camera detects a vehicle driving at 37 miles an hour in a 30 mile an hour area, the police serve “a notice of intended prosecution” on the registered keeper. We suggested that if a vehicle was

driving itself at the time of the speeding, the registered keeper should be required to say so, and to provide the relevant data to the police.



- 7.34 The police would then investigate why the infringement occurred. If the problem was with the software (rather than, for example, a failure to update software) the issue should be submitted to the safety assurance scheme. The scheme would then investigate what has gone wrong and would have the power to impose a range of sanctions on the ADSE.
- 7.35 The great majority of consultees agreed that there should be a new system of sanctions. For example, of the 102 consultees who responded to Question 24(3), 91 consultees (89%) agreed and only 4 consultees (4%) disagreed. As discussed below, similarly high proportions agreed with the other elements of the proposal.
- 7.36 That said, the issue generated a great deal of discussion, with many queries about the details of the proposals.

### **The need to consider civil enforcement**

- 7.37 The Parking and Traffic Regulations Outside London (PATROL) joint committee and the Traffic Penalty Tribunal (TPT) said that we should not just be considering criminal liability; we also need to consider civil enforcement of other traffic contraventions by local authorities. PATROL and TPT emphasised that civil enforcement was not confined to parking but also includes the use of bus lanes, moving traffic restrictions (e.g. box junctions) and failures to pay road charges and tolls.

*Liability for both compliance and penal measures will remain for some years, whether it is attached to the owner of the vehicle, the driver or the 'user-in-charge'.*

### **Problems with requiring the registered keeper to authorise data release**

- 7.38 Many respondents thought that the police should have access to the data without having to involve the registered keeper:

*Yes, initially, though we believe that the police and insurers should be able to access this data as a matter of course and not have to rely on the registered keeper providing this information. [Esure]*

*The [Original Equipment Manufacturer (OEM)]... etc should have standard agreements that data should be made available if needed by authorities. [George Economides]*

*Yes, but surely the vehicle should be able to tell you that itself through automated means and therefore would need no human interaction [South Yorkshire Safer Roads Partnership]*

*There is potential to automate part of this system, where police could go directly to the manufacturer to determine whether the vehicle was in fully automated mode. [Police Scotland]*

*If a registered keeper claims that the vehicle was driving autonomously, then the data should by default be available to the police, who may choose to obtain expert evidence from the data. [Metropolitan Police Service]<sup>74</sup>*

#### Ownership of data

7.39 One perceived problem was that the registered keeper would not own the data.<sup>75</sup> Therefore, they would not be in a position to authorise its release. As the CPS said:

*It is more likely that the data being recorded and stored by the ADS is in fact owned by the entity behind the ADS, not the registered keeper.... If it is the entity that owns the data, then they could claim it is proprietary information and attempt to prevent release of such. This could frustrate a criminal investigation and allow human users and entities to avoid liability.*

7.40 Other respondents also made this point. For example, Richard Hinds said:

*It seems that, if the registered keeper were not driving at the time of the incident, he would effectively be authorising the release of someone else's data to the police. Is this perhaps out of step with privacy laws?*

#### The registered keeper might not know which mode the vehicle was operating in

7.41 The next issue is how the registered keeper would know which mode the vehicle was operating in at the time.

*A registered keeper might not know whether the vehicle was in AD mode, if he was not present (or even if he was). [Centaur Consulting]*

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<sup>74</sup> Similar points were made by a wide range of respondents, including the International Underwriting Association, DAC Beachcroft, Richard Morris, Transport Systems Catapult, RAC Foundation, Weightmans and Professor Sally Kyd.

<sup>75</sup> Zurich Insurance (UK) referred us to the European Commission's report on Access to In-vehicle Data and Resources.



*It is very possible that, unless the registered keeper was in the vehicle at the relevant time or has direct access to the [ADS] data, the ability of the registered keeper to state with certainty if the vehicle was driving itself at the time may be limited. [Burgess Salmon LLP]*

- 7.42 The Association of Local Bus Managers (ALBUM) were concerned that the obligation might require additional record keeping:

*There should be no need for additional record keeping by an operator. This would only serve to increase operating costs with the consequential effect on service levels or prices charged.*

- 7.43 FiveAI thought there may be some difficulty in determining which mode the vehicle was operating in at a given time:

*If the clock in the vehicle is not synchronised with the clock in any speed capture equipment, a difference of even a few seconds could lead to practical difficulties in clarifying the vehicle's mode of operation (i.e. ADS engaged or not) at the time of the offence...The response form would need to be set up to allow a response of "not certain".*

#### A definitive data storage system

- 7.44 Burgess Salmon LLP expected the ADS to record definitively whether or not it was activated at a given time:

*We note that the CCAV Code of Practice provides that this is the type of data which should be captured on event data recorders even at trialling stage.*

- 7.45 The Society of Motor Manufacturers and Traders (SMMT) agreed that there should be a definitive record, commenting that "this is indeed one of the reasons automated vehicles should have a Data Storage System for Automated Driving (DSSAD)":

*Through the objective information that is recorded and stored, the DSSAD gives certainty to the driver or user-in-charge, the vehicle manufacturer and the authorities.*

- 7.46 The ABI and Thatcham Research suggested that in time one might be able to use V2X communication<sup>76</sup> as a more efficient means of informing the police.

#### Referring from the police to the regulatory authority

- 7.47 There was widespread agreement that where the problem appeared to be lie with the ADS, the police should refer the matter to a regulatory authority for investigation. Of the 101 consultees who responded, 84 consultees (83%) agreed. Only 6 consultees (6%) disagreed.

#### The case for referring

- 7.48 The first reason was that the regulatory authority would have specialist expertise. The Transport Planning Society thought that referring matters to a regulatory authority would mean that "a body of understanding can be established within the regulatory body". The

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<sup>76</sup> V2X communication refers to communication between the vehicle and other objects.

Freight Transport Association (FTA) said that it would facilitate “a centralised understanding of issues”. Police Scotland agreed that it would be a highly technical area where engineering specialisms will be required to properly investigate the matter.

- 7.49 The second reason is that it would allow quick improvements in the system. DAC Beachcroft LLP commented that “safety is paramount” and we should “ensure that the ADSE takes any necessary remedial action timeously”. Andrew Catlin agreed:

*If an automated system is malfunctioning it is important that the problem is quickly identified and the relevant information fed back to the designer to enable prompt correction and any necessary system update.*

- 7.50 Jacobs commented that this is similar to the rail sector, where if there is a problem, the regulator investigates.

### The need for co-operation

- 7.51 Some respondents agreed in principle but raised concerns about how it would work in practice. For example, the police might not know that the problem lies with the ADS. Visteon suggested that “knowledge needs to be developed in this area or a third-party technical resource used”. FiveAI said that the police would have to carry out extensive investigations before they could determine whether the matter needs to be referred.

- 7.52 Several respondents explained how they envisaged co-operation would work:

*The criminal and regulatory regime should operate in parallel and complement each other when it comes to safety-related offences with system-level implications... As with other modes, a memorandum of understanding would need to be in place between the accident investigation body and the police.*<sup>77</sup> [Burgess Salmon LLP]

*Police and the regulatory authority should liaise and share their findings to ensure that the full picture of liability is understood.* [CPS]

*Where the vehicle and/or software is determined to be at fault, there should be a pre-defined protocol for the police to refer the incident to an appropriate regulatory body for investigation. This ensures that if there are fundamental or widespread issues with a particular technology or software, these can be investigated and rectified.* [British Insurance Brokers' Association].

### Concerns about references from the police to the regulatory authority

- 7.53 Several respondents thought that the police should deal with the matter. For example, Living Streets Hackney said that it should be a criminal matter not a regulatory one. The Road Danger Reduction Forum said it “should be treated as a criminal offence for any vehicle at Level 3 and below”. The SMMT agreed with our proposal, but thought it would be more efficient for the police to investigate.

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<sup>77</sup> See for example: *Memorandum of Understanding Agreed Between the Rail Accident Investigation Branch, the British Transport Police, Association of Chief Police Officers and the Office of Rail Regulation for the Investigation of Rail Accidents and Incidents in England and Wales* (April 2006), available at [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/383440/ORR-RAIB-BTP-ACPO-MOU\\_April\\_2006.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/383440/ORR-RAIB-BTP-ACPO-MOU_April_2006.pdf).

- 7.54 The Chartered Institution of Highways and Transportation (CIHT) was concerned that the regulatory authority may not have sufficient investigatory power and resources. By contrast:

*There is a democratic element of interaction with local police forces, local councils and Police & Crime Commissioners (including elected Mayors) who have a duty to their residents and voters.*

- 7.55 Brake thought that investigating criminal offences should fall within the remit of “the independent [Road Collision Investigation Board]”.
- 7.56 John Rainbird asked what would happen if the police refused to refer the matter to the regulatory authority: “should anyone else have the right to do so?”.

## **A RANGE OF SANCTIONS**

- 7.57 The Consultation Paper proposed that if an ADS acted in a way which would be criminal if done by a human driver, the regulatory authority should be able to apply a range of regulatory sanctions to the ADSE. These should include improvement notices, fines and suspension or withdrawal of ADS approval.
- 7.58 There was widespread agreement. Of the 102 consultees who responded, 91 (89%) agreed and only 4 disagreed.

### **The case for a range of regulatory sanctions**

- 7.59 The main reasons given for this approach were to ensure that ADS manufacturers maintain the highest standards<sup>78</sup> and to encourage confidence in the systems.<sup>79</sup> The SMMT said:

*This is reasonable as the [ADSE] is the entity submitting and receiving authorisation for the ADS and has ongoing legal responsibilities to ensure that the ADS is safe.*

- 7.60 Similarly, Uber agreed that there should be a range of sanctions because this allows regulators to “take the appropriate action tailored to the particular nuances of the case”.
- 7.61 Many consultees emphasised that responses should be proportionate, while others stressed that they should be sufficiently punitive to ensure safety (and supplemented by criminal offences where necessary). There was also concern about using human behaviour as the standard, and about the role of the ADSE in relation to others in the supply chain.

### **Sanctions should be proportionate**

- 7.62 Transport Systems Catapult thought that the regulatory authority should apply enforcement measures to a “clear pattern of incidents”, not isolated occurrences:

*It must also be recognised that even the best systems will occasionally make errors, and therefore action should be taken for a pattern of incidents indicating an underlying*

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<sup>78</sup> E.g. International Underwriting Association.

<sup>79</sup> E.g. Robert Hudleston of HAUC(UK).

*problem, not for isolated cases.... This is not to say that fines shouldn't be imposed – the prospect of heavy fines would help incentivise companies to take a responsible approach, but the fines should be levied for a cluster of issues and commensurate with the ADSE's openness and proactivity in addressing the underlying problem.*

- 7.63 Intelligent Transport Systems (ITS) UK said that the authority should start with a co-operative approach:

*If the ADS has not been modified or amended since it was approved plus it incorporates all known and approved updates, then clearly the ADSE did not knowingly cause an infraction. In this case we would suggest that the law should support and encourage a cooperative approach between the ADSE and the regulator to improve the ADS and prevent future problems.*

*On the other hand, if the ADSE changed the ADS and did not seek the consent and/or approval of the regulator then regulatory sanctions should apply.*

- 7.64 Andrew Catlin pointed to the dangers of stifling innovation:

*If regulatory sanctions are applied whenever there is a system malfunction or a vehicle behaves in a way that would be unreasonable with a human driver this could have a highly negative impact and delaying effect on innovation and development that will ultimately be responsible for saving thousands of lives.*

- 7.65 To this end he suggested a notification stage before the improvement notice, “whereby the ADS designer is provided with the relevant data and given time to present a suitable solution”.

- 7.66 There was also concern that if approval was suspended it should be reinstated as soon as possible. FiveAI said “it should be possible to reinstate a withdrawn approval as soon as the ADSE is able demonstrate effective corrective action”. Richard Morris of Innovate UK suggested there should be “temporary suspension of approval pending improvement actions depending on the severity”.<sup>80</sup>

#### Applying a human standard

- 7.67 FiveAI were concerned about the proposed standard, namely that the action would be a criminal offence if done by a human. This “misdirects the attention of the regulator when it comes to assessing safety and wrongly equates an ADS system with a human”:

*We would suggest that the performance of the ADS should be judged against the standard it ought to achieve to be safe as an ADS, not a human driver.*

- 7.68 Andrew Catlin also argued that an “ADS systems will be capable of safely acting in a way that would be considered a criminal offence for a vehicle controlled by a human driver”. Mills & Reeve LLP added:

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<sup>80</sup> Robert Hudleston of HAUC(UK) Training and Accreditation also argued for this addition.

*The majority of human driver criminal offences are unlikely to be straightforwardly translatable to the [ADSE] as they generally relate to the inferred awareness/mental state of the driver rather than just whether a particular act has been carried out.*

### The role of the ADSE

7.69 Jacobs said that it should not just be the ADSE which is sanctioned; the manufacturer or designer should also bear some responsibility.

7.70 BMW Group UK said that many different companies work together to produce an ADS:

*We agree. However, we believe a number of clarifications may be needed particularly in connection with the reference to “entity behind the ADS” and “range of regulatory sanctions”... There will be many different component suppliers that are “behind the ADS”. We understand the Law Commission would want in all likelihood to have one “producer” of the ADS as the entity to whom liability should attach. However, any law should recognize the component parts of the supply chain as it is most relevant to how sanctions may most effectively drive improvements in autonomous driving systems.*

7.71 ITS UK pointed out that the ADS could have been developed by a non-UK organisation.

### A sufficient deterrent?

7.72 Heather G Bradshaw-Martin argued that “penalties should be sufficiently punitive to have commercial effect”. Several others reiterated this point. The RAC Foundation pointed out that a penalty might not impact a large multi-national corporation.

7.73 Cycling UK were concerned that a system of fines, sanctions and withdrawal of approval is “an inadequate safeguard for the very high risks that might accompany the use of millions of moving vehicles in urban areas”. They added that regulators may be reluctant to withdraw the approval for a large operator because “they serve crucial mobility links, or are built into critical public services”. The upshot is that “dangerous systems might be allowed to continue to operate”:

*The threat of suspension needs to be real, despite the huge inconvenience it might cause, and the regulatory body should not be afraid to use it.*

### The role of criminal penalties

7.74 Many respondents thought that a system of regulatory sanctions should sit alongside criminal offences. Weightmans LLP thought that the crime of corporate manslaughter should be available.

7.75 Many responses thought that there should be an option of charging individuals and entities with criminal offences.<sup>81</sup> For example, the Bar Council suggested that perhaps “the ADSE’s failure to operate a working system or failure to apply software which meets legal requirements should also be a criminal offence”. They added that the criminal

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<sup>81</sup> Those making this point included Brake, Chief Inspector Adrian Davies, Professor Goodwin, Professor John Parkin and Alistair Chaplin.

liability of the ADSE could extend to its directors and managers “if the offences were committed with their consent, connivance or neglect”.

7.76 Living Streets Hackney and London Living Streets disagreed with the proposal because it should “be a criminal offence, not a matter for regulation”. Similarly, Road Danger Reductions Forum said:

*Regulatory sanctions will not be sufficient on their own to ensure safety on our streets. There needs to be criminal charges if faulty vehicles cause injury, death or alarm on the streets.*

7.77 We explore the issue of criminal offences against developers and manufacturers in response to Question 32 below.<sup>82</sup>

## **CRIMINAL RESPONSIBILITIES OF THE USER-IN-CHARGE**

**Q25: Do you agree that where a vehicle is listed as only safe to drive itself with a user-in-charge, it should be a criminal offence for the person able to operate the controls (“the user-in-charge”):**

- (1) not to hold a driving licence for the vehicle;**
- (2) to be disqualified from driving;**
- (3) to have eyesight which fails to comply with the prescribed requirements for driving;**
- (4) to hold a licence where the application included a declaration regarding a disability which the user knew to be false;**
- (5) to be unfit to drive through drink or drugs; or**
- (6) to have alcohol levels over the prescribed limits?**

### **Agreement**

7.78 There was widespread agreement that a user-in-charge should be fit and able to drive, and liable to criminal prosecution if they were not: 96 respondents agreed with all six criminal offences.<sup>83</sup>

7.79 It was thought that clear criminal offences would promote safety:

*If there is any chance of the user-in-charge being required to take over control of the vehicle at some time during the journey i.e. because the vehicle is operating outside of its design domain or because the vehicle has come to a safe stop following a fault or incident then it follows that the user-in-charge must meet the requirements for a fit and capable driver. [The Automobile Association (AA)]*

*The duties of a user-in-charge should be properly set out in legislation. [Senators of the College of Justice]*

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<sup>82</sup> Page 128.

<sup>83</sup> Where consultees did not tick a box, it is not clear whether they were disagreeing with the proposal or not answering the question.

*These may need to be specific criminal offences. They are also necessary if we are going to require users to take control of vehicles to avoid the risk of serious injury and/or death. [CPS]*

*All the above necessary for safety. [Buchanan Computing and the Institute of Highway Engineers (IHE)]*

*We propose for intoxication to remain a crime for the user-in-charge of an autonomous vehicle. [Big Voice - Model Law Commission]*

- 7.80 Some suggested that the legislation should go further. The Magistrates Association suggested that the user-in-charge should also be “qualified specifically to deal with ADS”. Similarly, Centaur Consulting said:

*It might even be appropriate to require more stringent requirements on a user-in-charge, given the new challenges of handover (specific certified training, lower blood alcohol limits, length of holding a full licence etc).*

- 7.81 Richard Morris suggested including “driving (or monitoring) whilst tired” as a criminal offence.

- 7.82 Some consultees asked how these offences would apply to remote operators. Dr Chris Tennant said there may need to be some variation for remote users-in-charge e.g. a different form of driving licence.

### **Disagreement**

- 7.83 The only controversial issues concerned (3) and (4), relating to eyesight and disability. Heather Bradshaw-Martin was concerned that people with disabilities should benefit from automated vehicles.

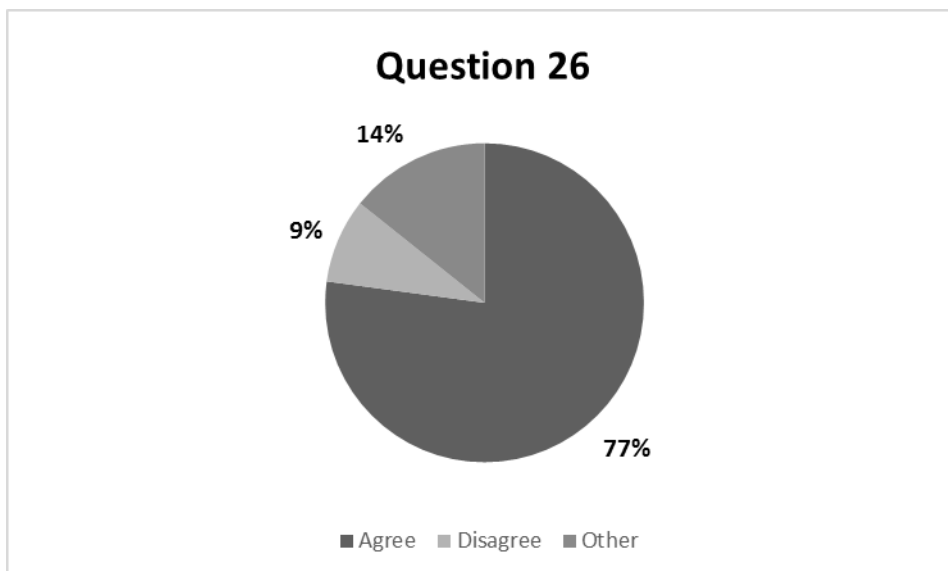
- 7.84 Peter Brown said, “the eyesight requirement is not so critical in a vehicle which is already equipped with cameras and sensors”. Richard Hinds thought that (4) should only apply if their disability makes it dangerous for that person to be in control.<sup>84</sup>

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<sup>84</sup> These concerns were also raised by the Garage Equipment Association, Peter Brown, Esure, Weightmans LLP and AI (individual).

## A CRIMINAL OFFENCE OF BEING CARRIED WITHOUT A USER-IN-CHARGE

**Q26: Where a vehicle is listed as only safe to drive itself with a user-in-charge, should it be a criminal offence to be carried in the vehicle if there is no person able to operate the controls?**



7.85 There was widespread agreement that this should be a criminal offence. Out of 105 consultees who responded to this question, 81 (77%) said yes, 9 said no and 15 responded 'other'.

7.86 However, some caveats were raised. Police Scotland and the Transport Planning Society foresaw difficulties where each passenger claims that someone else was the user-in-charge.

7.87 There were also concerns that a passenger might not know that there needs to be a user-in-charge (as a matter of law) or might not know that there is no user-in-charge on board (as a matter of fact). Consultees queried how this offence would apply to:

- (1) "a child or someone unfamiliar with the vehicle systems" [Weightmans LLP];
- (2) a blind person who was not aware that the user-in-charge was absent [Richard Morris, and Andrew Catlin]; and
- (3) a person who is very drunk [Centaur Consulting] or unconscious or asleep [Andrew Catlin].

7.88 The Association of Local Bus Managers (ALBUM) added that:

*In a remote-control scenario, passengers will not be aware whether the user-in-charge is at his post or not.*

7.89 The Law Society of Scotland suggest two alternative approaches. First, there could be a rebuttable presumption that if the registered keeper was in the vehicle, the keeper was the user-in-charge. Alternatively:



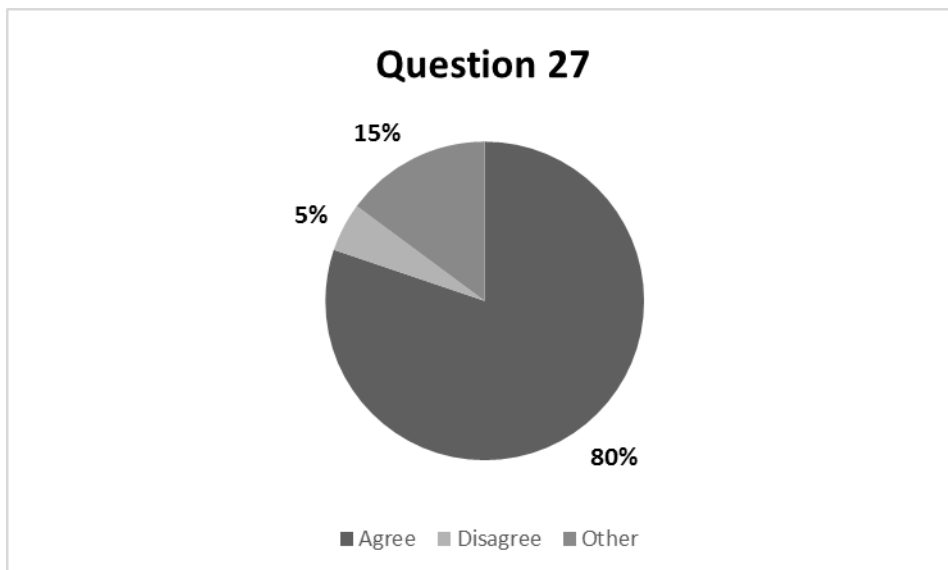
*any offence could be restricted to situations in which a passenger knowingly allows him or herself to be carried in a vehicle where there is no user-in-charge lawfully able to discharge these duties.*

- 7.90 The Forum of Complex Injury Solicitors (FOCIS) and Stewarts Law also suggested that the offence should apply only if the passenger knew or ought to know that a user-in-charge is required.
- 7.91 The RAC Foundation said the offence should apply to “whoever triggered the automated system”, if they knew that there was no user-in-charge in the vehicle.
- 7.92 Several consultees suggested a technological solution to this issue, so that the vehicle would only be able to drive if the user-in-charge is in position.<sup>85</sup>

## **INSURANCE, ROADWORTHINESS AND REMOVING VEHICLES**

**Q27: Do you agree that legislation should be amended to clarify that users-in-charge:**

- (1) Are “users” for the purposes of insurance and roadworthiness offences; and**
- (2) Are responsible for removing vehicles that are stopped in prohibited places, and would commit a criminal offence if they fail to do so?**



- 7.93 There was widespread agreement that the user-in-charge should be responsible for insurance, roadworthiness and removing vehicles from prohibited places. Of the 101 consultees who responded to this question, 81 (80%) agreed, 5 (5%) disagreed and 15 responded ‘other’.
- 7.94 As SMMT said:

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<sup>85</sup> Those making this point included the Magistrates Association, Transport Systems Catapult, Brian Watson, the Garage Equipment Association and Burges Salmon LLP.

*Removing any ambiguity in what is expected of a user-in-charge is important for widening public acceptance of automated vehicles.*

- 7.95 Those who disagreed were those who did not accept the concept of a user-in-charge. For example, Cycling Scotland argued that users-in-charge should continue to have the same responsibilities as drivers at present, so no amendments were required. However, some caveats were raised in relation to each of the obligations, which we discuss below.

### Insurance

- 7.96 FiveAI suggested that under a car club model, it might be more appropriate for the club to take responsibility for insurance and roadworthiness. For passenger or freight services, they suggested that responsibility should lie with the licensed operator.
- 7.97 Brake and BTO Solicitors LLP thought that these responsibilities may be more appropriate for owners. Andrew Catlin and CIHT said that the relevant actor should be the keeper of the vehicle.

### Roadworthiness

- 7.98 Cycling UK pointed out that a user-in-charge may find it harder to know whether an automated vehicle is unroadworthy than a conventional vehicle.
- 7.99 This was particularly true where the problem lay with a software update. Richard Sarginson asked:

*How are UICs to know if the software load provided and installed is genuine and roadworthy?*

- 7.100 Similarly, Euro Car Parts said that if an over-the-air update makes the car unroadworthy, the user-in-charge should not be liable.
- 7.101 Richard Morris of Innovate UK, responding in a personal capacity, provided a detailed exploration of which faults a user can be expected to detect and those which cannot be detected:

*Most human drivers will notice substantial roadworthiness failings but often, in practice, miss more subtle failings. E.g. A flat tyre is usually noticeable, but a tyre slightly below recommended pressure may not be...*

*Concealed issues may be determined in some cases by better instrumentation on the vehicle (oil state, oil level, brake pad wear, etc.) but issues like worn steering joints or split CV boots would be more difficult and similar to the problems a normal driver faces – in practice they are left to servicing / MOT checks. Issues like failed indicator or other light bulbs can be sensed automatically, but broken lamp lenses or cracked glazing will be more problematic.*

- 7.102 Richard Morris argued that greater vehicle self-checking is quite feasible and “something we should encourage anyway”. For example, “direct tyre pressure monitoring systems...could be mandated”:

*Driving automation justifies pushing this forward to become the norm. The residual issues could be the responsibility of the user-in-charge, if there are sufficient to justify*

*this. Possibly, and hopefully, there may not be, with servicing / checks at suitable intervals dealing with the remainder.*

## Removing vehicles

7.103 Professor Goodwin agreed in principle that the user-in-charge should be responsible for removing vehicles that are stopped in prohibited places, but thought that there should be an exception where there is a genuine malfunction:

*There have been cases for example where software updates render the vehicle undriveable for a period. In this case it will be the people operating the software updating who should be liable.*

7.104 Several other respondents were concerned that the vehicle may be immobilised such that it is impossible to move.<sup>86</sup> FiveAI referred to situations in which the user-in-charge does not feel safe or confident to move the vehicle, suggesting that the user-in-charge could transfer their responsibility to an organisation or summon support (e.g. tow truck, emergency services).

7.105 These comments might reflect a misunderstanding. In the Consultation Paper we explained that this responsibility could be discharged in a variety of ways. For example, where manual driving was not possible, the user-in-charge might be expected to call a tow truck.

## DRIVING IN A PROHIBITED PLACE

**Q28: We seek views on whether the offences of driving in a prohibited place should be extended to those who set the controls and thus require an automated vehicle to undertake the route.**

7.106 Out of 91 responses, 52 (57%) agreed that this should be an offence. However, this overstates the level of agreement. Those agreeing generally simply ticked yes, while strong arguments were put that responsibility should lie with the ADSE rather than the individual who sets the controls.

### Responsibility should lie with the ADSE

7.107 Many consultees did not see this as a real issue. Instead automated vehicles should be geo-fenced to ensure that they could not drive in a prohibited place. Therefore, if the vehicle drives in a prohibited place this would indicate a system failure and responsibility should lie with ADSE or the developer/manufacturer.

7.108 Richard Sarginson pointed out that setting the destination is not the same as selecting the route: the precise route will be determined by the route mapping software. Therefore, driving in a prohibited place indicates a software failure, for which the developers should be held responsible.

7.109 The Law Society of Scotland said that it would be unfair to criminalise an individual where the offending driving was caused by a system malfunction.

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<sup>86</sup> See, for example, responses from SMMT, Esure, CILEx Richard Sarginson, Euro Cars Parts and Trifords (trading as Auto Windscreens).

## **Responsibility should lie with the user**

7.110 Some were sceptical about the practicality of geofencing. CIHT said geo-fencing is imprecise because GPS has a 5-metre error range.

7.111 The Mid and West Berkshire Local Access Forum (M&WBLAF) were concerned about encroachments by AVs onto rights of way and common land. They pointed out that although the public are not allowed to drive on private rights of way, landowners are - so one could not place the same geofencing restrictions on all vehicles.

7.112 Esure suggested a nuanced approach:

*If the user deliberately programmed the vehicle to drive in a prohibited area and ignored or overrode the warning given by the vehicle then they are at fault. If the vehicle entered a prohibited area as part of a journey requested but of its own accord, this would be a manufacturer/system fault and no blame should be apportioned to the person who set the controls.*

## **USER-IN-CHARGE RESPONSIBILITIES FOLLOWING AN ACCIDENT, COMPLYING WITH DIRECTIONS AND ENSURING CHILDREN WEAR SEAT-BELTS**

**Q29: Do you agree that legislation should be amended to state that the user-in-charge is responsible for:**

**(1) duties following an accident;**

**(2) complying with the directions of a police or traffic officer; and**

**(3) ensuring that children wear appropriate restraints?**

7.113 At present, these duties are placed on the “driver”. As we explore below, a majority of consultees agreed that these duties should apply to a user-in-charge.

### **Duties following an accident**

7.114 In all, 100 respondents agreed that the user-in-charge should be responsible for duties following an accident. SMMT agreed, but asked for clarification about how this would work for remote users-in-charge.

7.115 Mills & Reeve LLP noted that the eCall system would deal with major accidents, so the user-in-charge’s role would be mainly in relation to minor incidents. They queried whether this was realistic where the user-in-charge is engaged in secondary activities:

*The “user-in-charge” may be unaware of the sequence of events and not in a position to make an informed report.*

7.116 Cycling UK and CIHT also ask whether the user-in-charge will have sufficient awareness to report an accident.

7.117 Burges Salmon LLP said that placing responsibilities on the user-in-charge should not absolve the ADSE of “parallel (but different) responsibilities in the same instance”. They suggested that the ADSE should be obliged to act on the data it receives about an accident.

## Complying with the directions of a police or traffic officer

7.118 In all, 91 respondents said the user-in-charge should be responsible for complying with the directions of a police or traffic officer.

7.119 Andrew Catlin and the Transport Planning Society said the user-in-charge might not be aware of the directions of a police officer if the system has not requested them to resume control.

7.120 The SMMT agreed that a user-in-charge who is no longer monitoring the environment cannot be expected to notice a signal from a police officer. Instead, the ADS will recognise the signal and either comply with it or request the user-in-charge to resume control:

*Where directions from a police officer supersede those from traffic signals, the [ADS] must be able to detect these... The ADS must then be capable of safely complying with the directions of the police officer, or, as is more likely to be the case, request the user-in-charge to resume control of the vehicle in order to comply with the directions. However, it should be pointed out that non-uniformed personnel may be a challenge for humans, let alone the ADS, to recognise as genuine police officers.*

7.121 Cycling UK suggested that the police could have a “technological means” to communicate with AVs and bring them to a minimal risk condition.

## Ensuring that children wear appropriate restraints

7.122 Ninety-five respondents said that the user-in-charge should be responsible for ensuring that children wear appropriate restraints.

7.123 A few disagreed: Mills & Reeve LLP said that this does not necessarily have to be done by the user-in-charge. It could be done by another responsible adult in the vehicle.

7.124 The Confederation of Passenger Transport (CPT) and Association of Local Bus Managers (ALBUM) were concerned about how this would work in a public transport setting, pointing out that in buses and coaches children are not required to wear seat belts. ALBUM suggested that the obligation should fall on accompanying adults.

7.125 SMMT agreed in principle that users-in-charge should be responsible for children wearing seatbelts, but added that technology may make this otiose. The vehicle may refuse to move unless everyone is strapped in. Cycling UK make a similar point.

## WHAT IF THERE IS NO USER-IN-CHARGE?

**Q30: In the absence of a user-in-charge, we welcome views on how these duties might be complied with.**

**Q31: We seek views on whether there is a need to reform the law in these areas as part of this review.**

7.126 This question asked respondents to look into the future. It asked about the previous issues: duties following an accident; complying with directions of a police officer; and ensuring that children wear appropriate restraints. How may these issues be dealt when users-in-charge are no longer necessary?

7.127 The most common suggestion was these issues could be resolved through technological solutions or managed through centralised operation centres:

*We suggest that this could be managed through centralised operation centres and response teams, though the specifics of this are coupled to technical performance and scope of operations, which are currently unclear. [Wayve Technologies]*

*They may potentially involve dedicated humans in the loop (remote or despatched to site) with roles which are not associated with driving as such but for example customer care, liaison with police or providing human input into the overall automated vehicle response. [Burgess Salmon LLP]*

7.128 Richard Morris thought that technological solutions would mean that very little reform would be needed: eCall technology could be expanded to include near-misses; traffic officers could communicate with vehicles electronically; wearing of seatbelts could also be automatically detected.

7.129 Similarly, the Faculty of Advocates thought that these issues could be dealt with through the authorisation scheme.

*For instance, it could be specified that self-driving vehicles will not operate if they detect that passengers are not appropriately restrained. Equally, a route by which the authorities can alert the remote operators of vehicles without a “user-in-charge” may need to be part of an authorisation scheme.*

7.130 It was also variously suggested that the responsibility could rest with one of the following actors: the owner, keeper, operator, ADSE, OEM, manufacturer, software provider or the vehicle or the person who set the vehicle in motion.

7.131 Some respondents said that these obligations are impossible to fulfil without a user-in-charge.<sup>87</sup> Others thought we should postpone consideration of these issues until the technology was more developed.<sup>88</sup>

7.132 Most specific comments centred on duties following an accident and children’s seatbelts, rather than complying with the directions of a police or traffic officer,

### **Duties following an accident**

7.133 The CPS said that an essential element of being “safe” is that the automated vehicle must stop following an accident, notify the owner or responsible person who must report the accident within a certain time. They also said that the “vehicle must have a facility for two-way communication when it stops to permit the other driver to contact the owner or person responsible for the vehicle”.

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<sup>87</sup> See responses from Buchanan Computing and the Institute of Highway Engineers (IHE); and the Chartered Institution of Highways and Transportation (CIHT).

<sup>88</sup> See responses from Jennie Martin, ITS UK; Mark Cartwright, Centaur Consulting; Alan Nettleton, Transport Systems Catapult; Law Society of Scotland; and John Rainbird.

7.134 By contrast, several consultees suggested that if the vehicle fails to detect an accident, witnesses should be able to make a report. It would be necessary to identify the vehicle from the outside:

*If the vehicle does not detect the accident there needs to be some external mechanism whereby persons outside the vehicle can activate this process. [Heather G Bradshaw-Martin]*

7.135 IAM RoadSmart said that the vehicle could be required to stop to allow other road users to record the details of the vehicle. Similarly, Thompsons Solicitors LLP commented that “all AVs should be sufficiently marked with contact details”.

7.136 The Freight Transport Association (FTA) thought that the police or emergency services should comply with duties following an accident.<sup>89</sup> Similarly, the Confederation of Passenger Transport (CPT) suggested that the police will need to “contact the controlling entity, for example by more detailed registration requirements linked to the number plate”.

7.137 The ABI and Thatcham Research and Ageas added:

*There will also need to be some safeguards to discourage fraudsters from notifying non-existent collisions with automated vehicles, particularly where there are no (human) witnesses.*

### **Ensuring that children wear appropriate restraints**

7.138 Some were horrified that children would travel without a user-in-charge:

*You envisage a scenario in the foreseeable future where you'd entrust an AV without a UIC to transport kids? Jeez.. these proposed laws are bonkers. [M Mann].*

7.139 Several respondents suggested the accompanying adult/parent or guardian should be responsible for ensuring that children wear appropriate restraints.<sup>90</sup> IAM RoadSmart added the following caveat:

*However, for unaccompanied children IAM RoadSmart do not believe that it would be fair to make parents criminally liable for events that happen when they are not there, and over which they have no control.*

7.140 Esure and John Rainbird thought that children should not travel without a responsible adult. Richard Morris suggested that the individual who requests or authorises the journey could be responsible.

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<sup>89</sup> See also Trifords trading as Auto Windscreens.

<sup>90</sup> Transport for London; South Yorkshire Safer Roads Partnership (SYSRP); Thompsons Solicitors LLP; British Vehicle Rental and Leasing Association; DAC Beachcroft LLP; Motor Accidents Solicitors Society(MASS); IAM Road Smart.

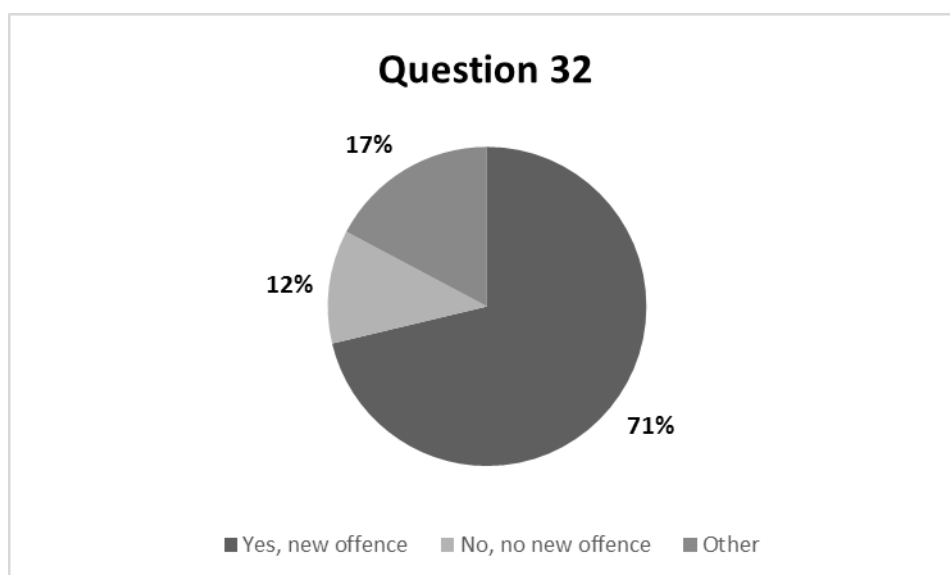
## DEATH OR SERIOUS INJURY CAUSED BY UNLAWFUL INTERFERENCE

**Q32: We seek views on whether there should be a new offence of causing death or serious injury by wrongful interference with vehicles, roads or traffic equipment, contrary to section 22A of the Road Traffic Act 1988, where the chain of causation involves an automated vehicle.**

7.141 In England and Wales, interfering with roads or vehicles is prohibited under section 22A of the Road Traffic Act 1988. The offence can be committed in three ways: by causing anything to be on or over a road; by interfering with a motor vehicle; or by interfering with traffic signs or other equipment. The act must be:

- (1) done “intentionally and without lawful authority or reasonable cause”; and
- (2) in such circumstances that it would be obvious to a reasonable person that doing so would be dangerous.

7.142 We asked if there should be a new aggravated offence, where a breach of section 22A caused death or serious injury. As the review is only concerned with automated vehicles, we limited the question to where an automated vehicle was involved.



7.143 Most consultees agreed that there should be a new aggravated offence. Out of the 87 consultees who responded, 62 (71%) agreed, 10 (11%) disagreed and 15 said ‘other’.

### The reasons for a new offence

7.144 The main argument in favour of a new aggravated offence was the need to deter potentially dangerous behaviour such as interfering with white lines, road signs or traffic lights.

7.145 The International Underwriting Association (IUA) thought that a new offence would “act as a deterrent and hold individuals responsible for such wrongful interference”. Burges Salmon LLP wanted “to reinforce the messaging on such dangerous prohibited behaviour” and to reassure users and the public. They referred to a gap in the law, which could eventually be filled by the law of manslaughter “but only ever in respect of deaths”.



7.146 The Senators of the College of Justice saw advantages in a bespoke offence:

*With such a significant change in technologies for road traffic users a bespoke offence is necessary to properly set parameters for a new criminal offence, together with appropriate penalties.*

7.147 The CPS said that the phrase ‘lawful authority’ “appears to permit the owner to interfere with their vehicle”. They considered that it should be a criminal offence for anyone, including the owner, to modify the settings of the automated vehicle, unless “permitted by the manufacturer”.

7.148 The Flook strongly support a new offence but would prefer “a single operating framework” for all vehicles, both automated and conventional.

### **No new offence**

7.149 Those who said there should be no new offence reasoned that the issue could be dealt with under the current law.<sup>91</sup> The SMMT, for example, referred to section 22A itself, and thought that this adequately covered causing death or serious injury. Professor Sally Kyd said that she would like to see manslaughter reformed to cover this eventuality.

7.150 The Law Society of Scotland said that a new offence is not needed in Scotland because the mischief is covered by culpable homicide.

7.151 Others were concerned that the new offence might cover those who had lawful authority to affect automated vehicles (such as repairers or developers), which was not our intention.

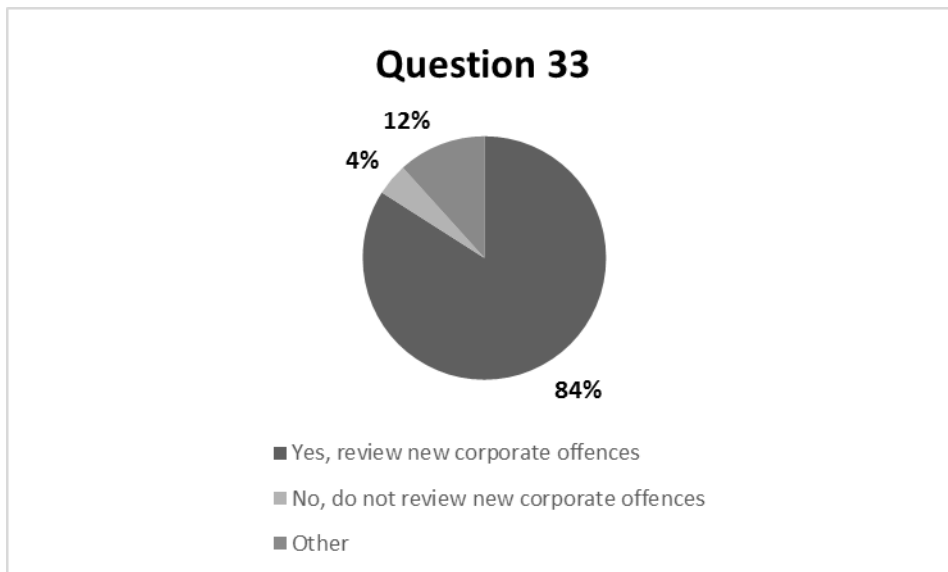
## **DEATH OR SERIOUS INJURY CAUSED BY DEVELOPER WRONGDOING**

### **Q33: We seek views on whether the Law Commissions should review the possibility of one or more new corporate offences, where wrongs by a developer of ADSs result in death or serious injury.**

7.152 The Consultation Paper raised possible wrongdoing by developers, such as: suppressing poor test results; installing a “defeat device” so that the software performed better in tests than in real life; or disabling safety critical features. Where these wrongs caused death, they may amount to corporate manslaughter. However, this offence does not apply to non-fatal injuries. It is also difficult to establish against large multi-national companies where senior managers may be insulated from decisions. We asked if we should review the law in this area.

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<sup>91</sup> See for example, responses from the Metropolitan Police Service; Transport for London; Living Streets Hackney; Road Danger Reduction Forum; and Heather Bradshaw-Martin.



7.153 The majority of consultees agreed. Out of 94 consultees who responded to this question, 79 (84%) agreed. Only 4 (4%) disagreed, while 11 said “other”.

#### The case for a review

7.154 Many of those who agreed pointed to the limitations of the law of corporate manslaughter, namely that it is difficult to use against large companies and does not apply to non-fatal but serious injuries.

7.155 It was thought that a new offence would promote safety and accountability:

*The potential for harm associated with automated vehicles means it is of utmost importance that developers of [ADSs] can be held fully accountable where their wrongs lead to death or serious injury. [Mills & Reeve LLP]*

*Steps should be taken to minimise any risks taken by developers which jeopardise user safety within an AV and to punish those who are demonstrated to have knowingly done so. [Forum of Complex Injury Solicitors (FOCIS)]*

*Transport for London is committed to delivering Vision Zero and safety is of paramount importance. [Transport for London (TfL)]*

7.156 Gowling WLG (UK) LLP were concerned about “a radical legal asymmetry – between individual drivers who are always subject to criminal liability, and corporations which are subject only to civil sanction”. They suggested that “the existence of at least a backstop potential for criminal liability on the part of ADSEs will assist in avoiding the suggestion that the system is unfair by design”.

7.157 Burges Salmon LLP said that it is important to review how the Health and Safety at Work Act 1974 and the concomitant regulations would apply to AVs. They wrote extensively on this issue.

7.158 Dr Chris Tennant, of the London School of Economics, said that ADSEs should be held responsible for creating “foreseeable opportunities for human error”: even when human error is a contributory factor it should not be treated as the only factor.

## Problems with new corporate offences

7.159 Several respondents agreed in principle but saw difficulties with any new offence. The first problem is that systems which rely on machine learning may not be explainable. As Zurich Insurance (UK) said:

*Given the particular difficulties around 'black box' concepts and software 'explainability', we anticipate it will often be extremely challenging to establish a causative link between [ADS] failure, and the management or organisation of corporate activities.*

7.160 Arcadis added that a "single corporate causation" will be difficult to establish because so many different companies are involved in producing an automated vehicle.

7.161 Many respondents stressed the need to distinguish between wrongdoing and simple failure. Direct Line Group (DLG) pointed to

*a clear distinction between wilful neglect of duties or active misrepresentation..., which should give rise to an offence..., and incidents which are simply the result of the technology failing or being unable to negotiate a particularly complex situation.*

7.162 Similarly, Andrew Catlin said that any new offence should only apply to deliberate omission or negligence.

*Rapid development will ultimately save a lot of lives. A highly punitive framework around deaths or injuries arising from mistakes in system development is likely to slow down development considerably, which will result in many more casualties overall.*

7.163 DLG added: "Having too onerous corporate responsibilities could lead to the level of risk being reduced to such an extent that AVs will simply not be functional".

7.164 Transport Systems Catapult said that wrongs are often subjective; "developers could always spend more... to achieve a higher level of safety". They were concerned that if professionals in the AV industry are at higher risk of being fined or imprisoned relative to other industries, then it will be difficult to attract the best talent, which in turn will be detrimental to safety.

7.165 Both CAVT and Transport Systems Catapult did not think that automated vehicles presented any unusual risk to life compared to other products. The CPS thought that the law of corporate liability should be reformed across the board, not solely for AVs.

## Disagree

7.166 Developers tended to oppose any review of new criminal offences. The SMMT argued that the existing law is adequate (including corporate manslaughter and the General Product Safety Regulations 2005).

7.167 FiveAI thought it wrong to single out the automated vehicle industry:

*In our view there are no particular characteristics of [ADSs] compared to other products (both those with partly autonomous decision making and those without, but where the consequences of an error are more severe) that would seem to justify different regulation. There is also a risk that singling out the industry in this way would*

*both put up barriers to its development and also promulgate the incorrect view that [ADSs] operate differently to other products / are quasi-human.*

7.168 BMW Group UK said that a new offence “may hinder the development of autonomous driving systems in the UK as developers look to deploy in other more developer-friendly jurisdictions”.

## **THE WAY FORWARD**

7.169 Our 2020 consultation will need to include detailed proposals to reform criminal liability in the light of automated driving. The consultation has shown support for the following:

- (1) amendments to Regulation 107 of the Road Vehicles (Construction and Use) Regulations 1986, to ensure that it does not impede automated driving;
- (2) clarification that a user-in-charge is not a driver but does need to be qualified and fit to drive. A user-in-charge may also bear some of the other responsibilities associated with vehicle “users”, such as those relating to insurance, roadworthiness, reporting accidents and ensuring children wear seatbelts;
- (3) a new system of regulatory sanctions where an ADS fails to meet road rules. The range of sanctions will need to be sufficiently flexible to respond to patterns of problems. They might include notifications, improvement notices, fines, and suspension or withdrawal of ADS approval.

7.170 A substantial majority of consultees (84%) thought that the Law Commissions should review the possibility of one or more new corporate offences, where wrongs by a developer of ADSs result in death or serious injury.

7.171 We agree that this project should include a review of the law in this area. This should look beyond manslaughter and culpable homicide offences to include the Health and Safety at Work Act 1974 and General Product Safety Regulations 2005. However, we note the concerns of developers and manufacturers about stifling innovation and have not yet reached any view about the outcome.

7.172 We also raised the possibility of a new aggravated offence, where a breach of section 22A of the Road Traffic Act 1988 leads to death or serious injury. We think this is best seen as part of a package to deter unauthorised interference with vehicles and roads, as discussed at the end of Chapter 8.

## Chapter 8: Interfering with automated vehicles

### OVERVIEW

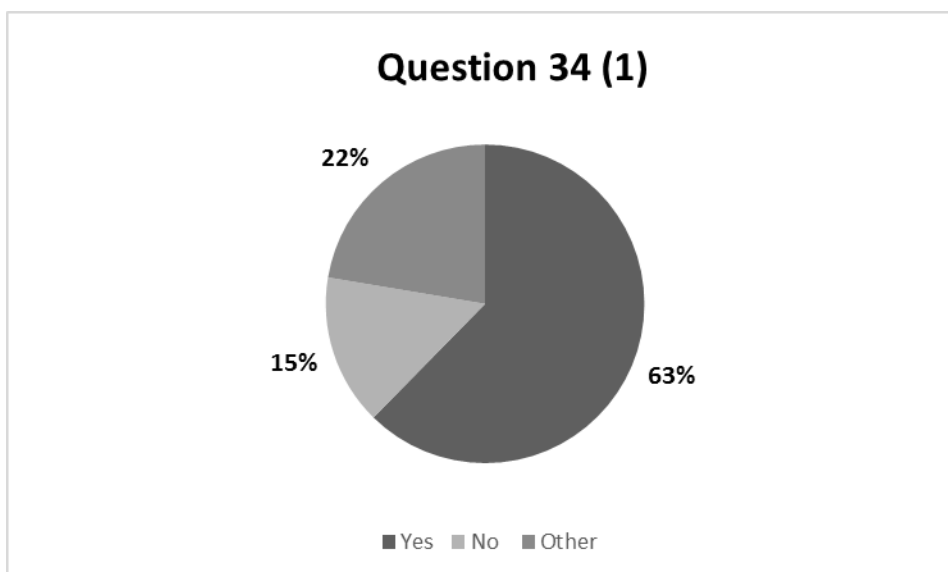
- 8.1 Many concerns have been raised that automated vehicles will encourage new forms of mischief. These include: running into the road to see if automated vehicles will stop; spraying paint over the sensors; deliberately obscuring road signs or white lines; and hacking into software to cause a crash.
- 8.2 The Consultation Paper concluded that most of these behaviours are already criminal offences. However, we asked if any new offences are required. We also asked whether there were any advantages to enacting new laws for behaviours which are already criminal, to *clarify* that interfering with automated vehicles is unacceptable.
- 8.3 Fewer than half of respondents to the Consultation Paper engaged with these questions, but most of those who did so asked either for specific new offences or for greater clarity that existing offences apply to automated vehicles. They thought this would make the law clearer, have a deterrent effect and help increase public trust in automated vehicles. By contrast, those arguing against new offences wished to prevent the expansion of criminal offences.
- 8.4 One concern was that people would step out in front of automated vehicles, impeding their progress. However, enacting further criminal offences in this area is controversial, especially if they criminalise pedestrians crossing the road.
- 8.5 The review identified three specific gaps or uncertainties in the current law:
- (1) *Tampering*: It is an offence to tamper with brakes or “other mechanisms”. We asked if it is necessary to clarify that “other mechanism” includes sensors. Most of those answering thought it was necessary. Several consultees thought that the offence should be extended even further, to include interference with any part of the system.
  - (2) *Taking a conveyance*: In England and Wales, it is an offence to take a conveyance without authority, but only if it can carry people and can be controlled by someone inside the vehicle. This contrasts with the law in Scotland, where the equivalent offence applies to any motor vehicle. We asked if it should be a crime to take any motor vehicle without authority. Less than 50% of consultees responded, but of those who did, the great majority argued for an extension. This was because vehicles are increasingly being designed to be operated from outside the vehicle. Respondents also saw value in creating consistent laws across the UK.
  - (3) *Interfering with vehicles and signs*: In England and Wales, it is an offence to interfere with vehicles or traffic signs in a way which is obviously dangerous. We asked if this offence should be extended to Scotland. Although under half of respondents engaged with this question, most who did so agreed that the offence should apply to Scotland.

## ARE NEW CRIMINAL OFFENCES NEEDED?

**Q34 - We seek views on whether the criminal law is adequate to deter interference with automated vehicles. In particular:**

**(1) Are any new criminal offences required to cover interference with automated vehicles?**

**(2) Even if behaviours are already criminal, are there any advantages to re-enacting the law, so as to clearly label offences of interfering with automated vehicles?**



8.6 Only around half of consultees to the Consultation Paper engaged with Question 34(1): 85 out of 178 (48%). Of those who did engage, 53 (63%) saw a need for new offences; 13 said there was no need; and 19 answered 'other'.

8.7 Even fewer engaged with Question 34(2): only 71 (40%). Of these 48 (68%) said there were advantages in re-enacting the law, 17 (24%) said there were no advantages, while 16 replied 'other'.

### The case for new criminal offences

8.8 Those in favour of new criminal offences expressed concern about the many ways to harm an automated vehicle, including remote jamming or interfering with software amendments. For example, Transport for London noted that "one area for new criminal offences which might need consideration is 'over-the-air' software updates and potential interferences with this".

8.9 Nominet mentioned the possibilities for spoofing<sup>92</sup> the system, stating that interference offences should cover cases:

*where data received by the vehicle has been maliciously altered upstream in the supporting infrastructure. For instance, this may be to 'spoof' the system that is to pick*

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<sup>92</sup> Spoofing is where an automated vehicle is maliciously tricked.

*up passengers from location X instead of Y. Numbers of vehicles may be given the same command and thus causing grid lock in a city.*

- 8.10 Some respondents argued that obstructing road signs or interfering with connected roadside technology could be as serious as interfering with the car itself Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA):

*Should damaging the sensor on, or communications from, a traffic light be treated in the same way as damaging these on a vehicle? – the consequences are arguably the same.*

- 8.11 BMW Group UK made a list of legislation that it thought should be brought up to date to deal with the risk of “a hacker disabling or interfering with an autonomous driving system”.<sup>93</sup>

#### **A new pedestrian offence?**

- 8.12 There was concern about people stepping out in front of cars. Andrew Catlin from the Driving Skills Agency, responding in a personal capacity, suggested a new pedestrian offence, equivalent to ‘careless and inconsiderate driving’.

*Automated vehicles will be able to respond very quickly and effectively to someone stepping out in front of them, so as to protect life. This response could, however, result in great discomfort to passengers in the vehicle, or damage to goods or property. One could imagine children (or adults for that matter) amusing themselves by stepping out in front of vehicles, safe in the knowledge that it will be forced to complete an emergency stop without hitting them.*

- 8.13 FiveAI also asked for it to be an offence to ‘bully’ or ‘game’ automated vehicles.

- 8.14 This, however, is a controversial area. Sustrans, for example, said that there must be “no creep towards preventing people from crossing roads where they wish”.<sup>94</sup> The Chartered Institution of Highways and Transportation (CIHT) described the concern that pedestrians will risk death “because they ‘know’ vehicles will stop” as “somewhat exaggerated”:

*Our recent advice on Creating Better Streets emphasised that all streets are shared streets, to a greater or lesser extent, and we should not de-emphasise the rights that pedestrians, cyclists and other users have to road space.*

#### **The case for clarity that offences cover automated vehicles**

- 8.15 Some respondents who were against the introduction of new laws were nonetheless in favour of amending existing laws to make specific reference to automated vehicles. They thought this would make the law clearer, have a deterrent effect, and help increase public trust in automated vehicles. Brake, for example, described this as “a good idea,

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<sup>93</sup> BMW Group UK listed the Computer Misuse Act 1980, Serious Crime Act 2015, Police and Justice Act 2006, Terrorism Act 2006, Extradition Act 2003, Interception of Communications Act 2000 and the Regulation of Investigatory Powers Act 2016.

<sup>94</sup> For further discussion of this issue, see paragraphs 2.6 and 9.114.

to enable public understanding”. The law firm Mills & Reeve LLP thought that the Computer Misuse Act 1990 should be amended to include explicit reference to vehicles.

8.16 When the Chartered Institute of Legal Executives surveyed their members, over three-quarters agreed that it would be advantageous to re-enact laws so that they clearly related to automated vehicles. Members’ comments included: “Existing legislation would be no more than continually trying to make a square fit into a triangle” and “New case specific legislation should be introduced so there are no question marks over liability”.

8.17 The Senators of the College of Justice in Scotland said that it was “important that the citizen should know what is criminal and what is not”:

*Relying on existing criminal offences in this area drafted and designed for driver controlled vehicles would risk public ignorance and could result in unnecessary and protracted legal arguments in court on statutory interpretation.*

8.18 Similarly, the Faculty of Advocates in Scotland submitted:

*Whilst we are generally of the view that criminal legislation should not be expanded where existing laws can cover the conduct in question, we accept that automated vehicles may be very heavily reliant for their safety on ancillary systems, such as sensors, software and communication systems and that such systems may be fitted in the vehicles themselves or as part of the road and traffic infrastructure. For that reason, we can see there is a good argument for re-enacting the law to deal with unauthorised interference with vehicles or infrastructure.*

8.19 Several law firms also saw some benefit in this:

*Given the novelty of automated vehicles and need to reinforce public messaging around safety, there is a case for being absolutely clear on prohibition and criminal liability. Explicitly referencing interference with automated vehicles and automated driving systems [(ADSs)] in relevant legislation might be part of the solution. [Burgess Salmon LLP]*

*Even where the behaviours are already criminal, there is an advantage in re-enacting the law to link these specifically to automated vehicles so that potential offenders are deterred from carrying out these behaviours relating to interference. [Kennedys Law LLP]*

8.20 FiveAI also agreed with new offences but commented that it “could have an associated disbenefit of drawing wider public attention to the types of malicious acts that could be performed”.

### **The case against new criminal offences**

8.21 Others said that new offences were unnecessary and should be avoided to prevent the expansion of criminal statutes.

8.22 Heather G Bradshaw-Martin from Humanity in Motion said, “there is no reason to treat this technology as exceptional”. The RAC Foundation was concerned that “the statute book is already overcrowded and prey to overlapping obligations”. Similarly, the Law



Society of Scotland commented that “the replication of criminal offences in general is not something that seems to us advisable”. The Metropolitan Police Service thought that the suggestion “appears to introduce unnecessary duplication”.

- 8.23 The Crown Prosecution Service was broadly satisfied with the current law, but thought that specific cross-jurisdictional legislation may be needed:

*There are jurisdictional problems that arise with ‘hacking’ offences... – a person in China for example could hack into the main system or the specific software of a business or vehicle owned and operated in the UK.*

- 8.24 Richard Hinde was in favour of creating new offences, but warned that reform must be conducted carefully:

*Badly-worded legislation could prohibit anybody (or anybody outside a tightly-defined group) repairing a vehicle. This could create a monopoly, undermining mechanics. Also, what will happen to “white hat” hackers who “interfere” with automated vehicles to establish safety/security issues?*

## **TAMPERING WITH BRAKES OR “OTHER MECHANISMS”**

**Q35: Under section 25 of the Road Traffic Act 1988, it is an offence to tamper with a vehicle’s brakes “or other mechanisms” without lawful authority or reasonable cause. Is it necessary to clarify that “other mechanism” includes sensors?**

- 8.25 Many consultees wanted to expand the definition of “other mechanism” in section 25 of the Road Traffic Act 1988. Out of 107 consultees who addressed this question, 70 (65%) thought that further clarification was necessary, 18 (17%) said that it was not, and 19 answered ‘other’.

### **The case for clarifying that tampering covers sensors**

- 8.26 Some consultees thought that it was far from clear that the phrase “other mechanism” included sensors. Richard Morris from Innovate UK, responding in a personal capacity, wrote:

*In normal usage, a mechanism is a mechanical apparatus in which movement is involved to achieve an objective. A solid state electronic system might not be considered to be a mechanism.*

- 8.27 The Senators of the College of Justice were similarly concerned that the term “mechanism” might be construed narrowly:

*‘Other mechanism’ could be read as being related to brakes (read ejusdem generis) and therefore on this interpretative approach sensors would not be covered as they are not brakes or a form of brakes. In these circumstances to avoid doubt (and endless arguments) the section should be amended to make it explicit that it is a crime to tamper with sensors.*

- 8.28 Others were more confident that the term would be construed broadly, but nevertheless thought that it would be helpful to clarify this point. As Highways England put it:

*We agree that... sensors would be considered part of the mechanism, though the issue is not entirely certain. Our view is that it would be sensible to clarify that the term “mechanism” includes sensors.*

### **A need to extend the offence beyond sensors?**

- 8.29 Several consultees wanted to do more than simply include sensors. They thought that the offence should extend to tampering with data or any part of the system.

*Thought should be given to whether the phrase ‘other mechanism’ captures all other equipment utilised in an AV, potentially including tampering with data held within the system. [International Underwriting Association (IUA)]*

*The definition will need to be broad enough to include any infrastructure, present or future associated with the operation of a [Connected and Automated Vehicle]. We could perhaps also observe that some of this infrastructure will be increasingly remote from the road (e.g. 5G networks, beacons, etc.) and accordingly may extend the scope of the Road Traffic Act beyond what is currently intended. [Arcadis]*

*An automated vehicle relies on a range of systems to function properly.... [including] data coming from various sources such as via V2X<sup>95</sup> (e.g. traffic congestion or traffic light data), or via the vehicle’s own data network (e.g. [Controller Area Network] Bus).<sup>96</sup> Interfering with these for example by spoofing a transmission from a traffic light, or injecting signals on the vehicle’s data network, should all be included. [Eric Chan, CAVPoint, responding in a personal capacity]*

- 8.30 Consultees suggested that rather than attempt to list types of equipment or mechanisms, it would be better to adopt a broad approach:

*Would it be better to replace “mechanism” with a much broader term, such as “functioning system”? [Intelligent Transport Systems (ITS) UK]*

*A more expansive term than “other mechanisms” or an explicit reference to safety critical systems may be beneficial. [Mills & Reeve LLP]*

### **TAKING A CONVEYANCE WITHOUT AUTHORITY**

**Q36: In England and Wales, section 12 of the Theft Act 1968 covers “joyriding” or taking a conveyance without authority, but does not apply to vehicles which cannot carry a person. This contrasts with the law in Scotland, where the offence of taking and driving away without consent applies to any motor vehicle. Should section 12 of the Theft Act 1968 be extended to any motor vehicle, even those without driving seats?**

- 8.31 Currently, in England and Wales, the offence of taking a conveyance without authority does not cover vehicles which cannot carry a person. And even if the vehicle can carry a person, it would be exempted if it could only be controlled by a person outside the vehicle. We gave an example in which a group of people pick up an automated pizza

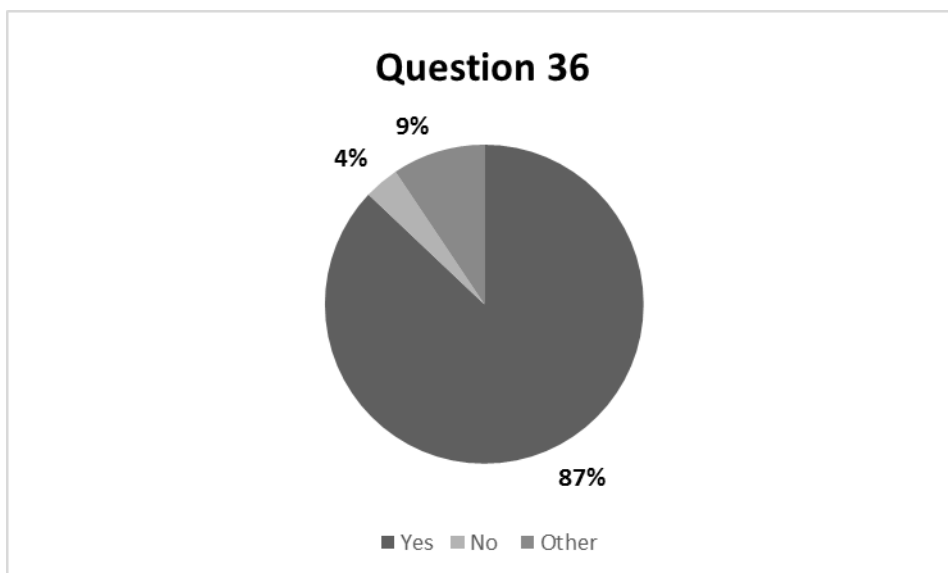
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<sup>95</sup> V2X refers to communication between the vehicle and other objects.

<sup>96</sup> A Controller Area Network Bus (CAN Bus) is an internal communications network that connects components inside a vehicle.

delivery vehicle and put it in a ludicrous place, such as the top of a bus shelter. Under the current law this would not appear to be a criminal offence.<sup>97</sup>

- 8.32 Slightly under half of respondents (48%) engaged with this question. However, of the 85 consultees who did engage, the great majority argued for an extension: 74 (87%) said yes, only 3 said no and 8 answered 'other'.



### The case for extending section 12

- 8.33 Those who agreed with the proposed amendment argued that vehicles are increasingly being designed to be controlled from outside the vehicle. As noted by Edward Christian Macfarlane from Abbott Risk Consulting, responding in a personal capacity:

*The risk is associated with movement of the vehicles, no matter if there is not a driving seat.*

- 8.34 Some respondents also saw value in making the law consistent across the UK. As DAC Beachcroft LLP said:

*We appreciate that the legal system in Scotland is distinct from that in England and Wales, but we believe that a consistent approach across all parts of the UK would be beneficial. This is especially true as vehicles can be driven between the jurisdictions, and a difference could cause confusion or challenges to the law.*

- 8.35 Richard Morris suggested that the law should also be extended to “intelligent trailers” that may have motors for acceleration assistance, braking and stability control or a low powered drive system for parking off-road.

### Those who disagreed

- 8.36 The three respondents who disagreed were not strongly opposed to the change but were not convinced that it was necessary. Centaur Consulting, for example, said

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<sup>97</sup> Consultation Paper, para 8.35.

*The relevant issues may already be covered (or to be covered) under other provisions, such as theft, computer misuse, or (new/revised) user-in-charge offences... Again, though, if this is felt to be simplest approach for clarity, probably a good idea.*

**Should the offence apply more widely?**

8.37 A few respondents wondered whether the extension should only apply to road vehicles, or whether it should extend to those on private land or even drones:

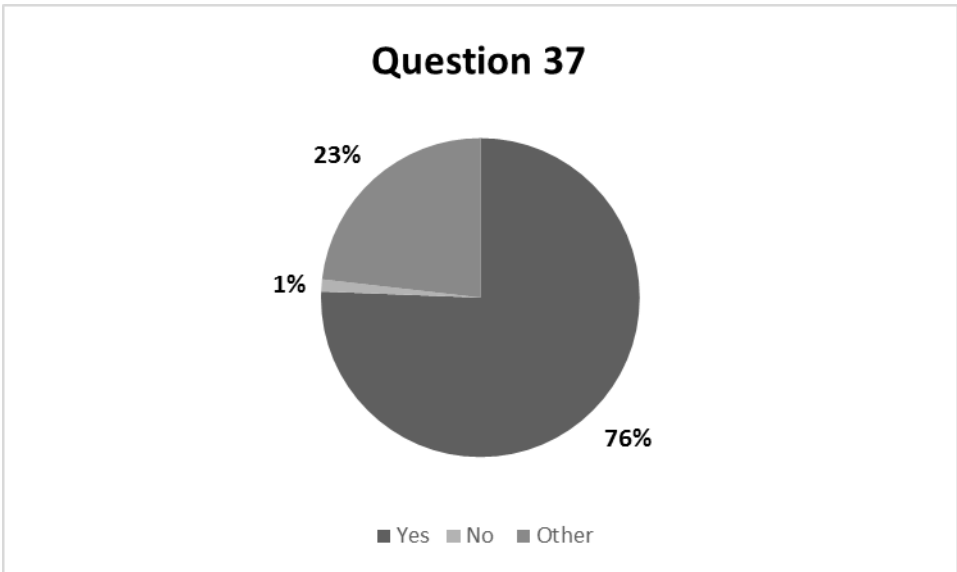
*It's also worth considering how this compares to fully automated 'vehicles' operating on private land, e.g. robots operating within a warehouse (which are already in existence) – should these also come under the new law, or should they be treated the same as any other equipment stolen from an industrial environment? Perhaps the key test is whether the item could be used for 'joyriding'. [Transport Systems Catapult]*

*This raises the question of whether this offence should apply only in the case of automated road vehicles or whether it should be captured by an equivalent offence that covers automated vehicles more generally to include drones, for example. [Mills & Reeve LLP]*

**EXTENDING SECTION 22A OF THE ROAD TRAFFIC ACT 1988 TO SCOTLAND**

**Q37: In England and Wales, section 22A(1) of the Road Traffic Act 1988 covers a broad range of interference with vehicles or traffic signs in a way which is obviously dangerous. In Scotland, section 100 of the Roads (Scotland) Act 1984 covers depositing anything on a road, or inscribing or affixing something on a traffic sign. However, it does not cover interfering with other vehicles or moving traffic signs, even if this would raise safety concerns. Should section 22A of the Road Traffic Act 1988 be extended to Scotland?**

8.38 Although relatively few respondents engaged with this question, most who did so agreed. Of the 82 respondents, 62 (76%) said yes, only 1 said no and 19 said other.



## The case for change

- 8.39 Those who agreed with the proposition saw it as a necessary step towards increasing the safety of Scottish roads once automated vehicles are introduced. The Faculty of Advocates wrote:

*Arguably, the offence of culpable and reckless conduct already deals with such behaviour; however, given the reliance of automated vehicles on ancillary systems and infrastructure, interference with such systems should be clearly unlawful.*

- 8.40 Some saw harmonisation between legislation on both sides of the border as beneficial in itself. ITS UK said:

*Interference with the AV could occur in Scotland, but the effects of that interference could be seen in England or Wales. There could be timed digital interference, and this highlights the need for the laws to be updated in parallel.*

## Other issues concerned with signage

- 8.41 Some respondents used this opportunity to make other comments about how automated vehicles would interact with traffic signs (or, as ITS UK put it “traffic signals and communication systems”; they said that “signs are 19<sup>th</sup> century”).

- 8.42 The CIHT pointed out that moving signs was not necessarily malicious, but could cause problems if automated vehicles relied on them:

*We are aware of numerous incidents where those performing road works do not use best practice and obstruct footways and cycle paths with traffic signage. This can result in pedestrians and cyclists moving signs to make access easier and we feel that they shouldn't be unduly punished for doing so. If autonomous vehicles are relying on these signs to be alerted to changes in road conditions (e.g. warnings for unsurfaced roads) then there is a liability chain which must be made clear.*

- 8.43 The Transport Planning Society asked how automated vehicles will cope with signs which are obstructed innocently:

*Obstructing sight of a road sign (e.g. by a tall vehicle parked in front of it, or merely travelling in front of an ADS vehicle) could have adverse consequences for an ADS. This cannot be a criminal offence but some thought may have to be given as to how to mitigate the consequences.*

- 8.44 Similarly, Richard Sarginson said that road signs could also be obscured by unpruned foliage, while Rosalind Readhead noted that even changing the frontage of a shop could potentially confuse an automated vehicle.

## THE WAY FORWARD

- 8.45 Most conceivable forms of interference with automated vehicles are already criminal offences. Generally, the law in this area appears “good enough for now” and we do not see reform as a priority. We appreciate consultees’ concerns that the law should be clear and have a strong deterrent effect. However, to legislate in the absence of

experience of specific problems could make the law less clear, especially if the new law did not cover the behaviour in question.

8.46 On the other hand, consultees supported the three relatively minor changes discussed in the Consultation Paper. In our 2020 paper, we intend to make proposals to extend the following offences:

- (1) tampering with brakes or “other mechanisms” under section 25 of the Road Traffic Act 1988, to include tampering with any part of the vehicle’s system;
- (2) taking a conveyance without authority under section 12 of the Theft Act 1968, to cover all motor vehicles;
- (3) unlawful interference with vehicles and traffic signs under section 22A of the Road Traffic Act 1988, so that it extends to Scotland.

8.47 In Chapter 7 we discussed whether there should be a new aggravated offence, where breach of section 22A causes death or serious injury. Most consultees (71%) thought that such an aggravated offence would be a helpful deterrent and would express society’s disapproval. We think that there is a good case for this relatively limited change and we will include it in the 2020 consultation.

## Chapter 9: Adapting road rules

### OVERVIEW

- 9.1 Driving rules have been developed to be interpreted and applied by human drivers. In Chapter 9 of the Consultation Paper we considered the challenges of taking these “analogue” legal rules and developing them into a more precise “digital highway code” to govern the actions of highly automated vehicles. We asked how regulators and developers can best collaborate in this area.
- 9.2 We then raised three “sample questions” about whether automated vehicles should ever mount the pavement, exceed the speed limit or “edge through” pedestrians. Our aim was to use these examples to address broader questions about when automated vehicles should be allowed (or required) to depart from road rules.
- 9.3 All three issues proved controversial:
  - (1) *Mounting the pavement*: A small majority (56%) thought that this would be acceptable to allow emergency vehicles to pass, while 52% thought it would be acceptable to avoid an accident. However, many arguments were put that mounting the pavement at speed should never be permitted.
  - (2) *Exceeding speed limits*: Here views were split. While RAC members and other motorists generally supported exceeding the speed limit within accepted tolerances in some circumstances, many safety groups put a strong view that speeding was never acceptable.
  - (3) *Edging through pedestrians*: A majority of respondents thought it would never be acceptable to edge through pedestrians in a way that introduced any chance of injury. However, a few respondents thought that without some small but credible threat it would be difficult for automated vehicles to make progress.
- 9.4 There are concerns that automated decision-making may be biased against particular groups. We therefore asked if there should be audits of training data to reduce this risk. A majority of consultees (60%) said yes. However, many developers queried whether such audits were feasible: one described machine learning as inherently inscrutable. It was suggested that scrutiny should focus on outputs, not inputs.
- 9.5 We asked if developers should publish their ethics policies. A majority (61%) said they should. However, many respondents criticised the premise that developers should have ethics policies. There was also concern that such publications would become exercises in public relations, providing little information to readers.
- 9.6 Finally, we asked if any other issues should be considered in the course of this review. Although we received over 100 responses to this question, most have been considered elsewhere. We discuss three remaining issues: highway authority powers; whether automated vehicles should be labelled as such; and ensuring an open market in maintenance and repairs.

## COLLABORATION TO PRODUCE A DIGITAL HIGHWAY CODE

### **Q38: We seek views on how regulators can best collaborate with developers to create road rules which are sufficiently determinate to be formulated in digital code.**

9.7 Some 93 respondents engaged with this question. Of these, 41 argued for greater collaboration, and only 4 argued against. The rest discussed a digital highway code, without focusing on the procedure for achieving it.

#### **Arguments in favour of collaboration**

9.8 Several consultees stressed the need for an inclusive process. As Driverless Futures said, “it is vital that the process of defining and inscribing new road rules is an inclusive one”.

9.9 Dean Hatton of the National Police Chiefs Council (NPCC) Roads Policing,<sup>98</sup> responding in a personal capacity, said that the process should start soon:

*The sooner collaboration begins the sooner solutions will be found, but nothing should override the need for public protection. The pace of the developing technology cannot be allowed to outstrip the pace of developing the ‘rules’.*

9.10 Uber suggested a structured public dialogue, which could include:

*a review by regulators of existing road rules that they believe to be barriers, public meetings where input is sought from the industry, opportunities for formal public comment, and similar efforts. Likewise, regulators will need to find a way to communicate with the general public such that any potential rule modifications are not viewed as a degradation in safety.*

9.11 Mobileye pointed out that one could not simply ask for maximum safety as the safest vehicle “never leaves the garage”. There were therefore difficult cultural decisions about how to achieve “a balance of safety and usefulness”:

*Industry, Government and consumers must come together then to decide what does safe driving mean for a machine, and how can we measure conformity with that definition.*

9.12 Visteon noted that “the highway code is lacking in many areas”, including how to deal with emergency vehicles. Therefore:

*We need clear standards of behaviour, which are not open to interpretation, associated with road rules, signage etc.*

9.13 Gowling WLG (UK) LLP commented that, although “the Law Commissions themselves are unlikely to be able to address the detail”, we should “consider the legal and institutional structures” to allow the issues to be addressed. They thought that a new regulatory body needs to be created as “a priority action”.

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<sup>98</sup> The response was provided in a personal capacity, and does not represent the collective NPCC view.



9.14 Addison Lee Group suggested that there should be mandatory co-operation:

*Regulators and developers should be mandated to work together under a code of conduct that is connected to the body that will implement/govern the CAV standards.*

9.15 DAC Beachcroft LLP said that an example of good collaborative effort is that of the new cyber security standard published by the British Standards Institute:

*Funded by the Department for Transport, this was the result of work between academics and experts from leading businesses in the automotive industry.*

#### Arguments against co-operation

9.16 A few respondents felt that the issue should be left to developers:

*It is up to the manufacturers to be able to demonstrate compliance with real world rules... [I]t is not appropriate that the cost of developing a digital rule book is placed as a burden on the state. [Professor John Parkin, University of the West of England]*

*It should be up to developers to prove that their systems can comply with the existing established and long tested rules of the road. The suggestion that regulators should collaborate with developers to change regulation raises instant questions about regulatory capture. [Jacob Hardy]*

9.17 Heather G Bradshaw-Martin, who worked as a software developer, thought that software developers should first work to codify the current rules for automated vehicles before any changes are made to the law.

#### The difficulty of creating a “digital highway code”

9.18 There was concern that a digital highway code would be difficult, if not impossible, to create. As Peter Brown, an individual, put it:

*It is difficult enough to produce a highway code for human drivers; producing a code to cover all eventualities for machine driving would be I think a practical impossibility.*

9.19 Others echoed this concern:

*Many of the laws and outcomes of court cases in UK seem to be based on subjective 'what is reasonable' basis, so I don't understand how this can correlate to a binary "this is right, that is wrong" rule for autonomous cars. [Martin Scott]*

*The challenge will be in replacing current judgement by determinate rules. That will be challenging, not least because judgement is variable from one driver to the next, and from one circumstance to the next. We are not sure that it is worth doing. [Transport Planning Society]*

9.20 The Society of Motor Manufacturers and Traders (SMMT) noted that the process of creating a digital code would likely be incremental, take a considerable amount of time and involve a wide range of stakeholders. It expressed concern that developing such a code might delay progress and could

*benefit new entrants or latecomers more than incumbents who have invested huge amounts over the years to develop a refined machine understanding and interpretation of road rules.*

### Overcoming the difficulties

- 9.21 Those who argued in favour of a digital highway code stressed that it should be about outcomes and principles rather than the detail of how automated vehicles are coded. FiveAI put forward its view of a digital highway code in the following terms:

*A key principle that should underpin any such code is the separation between what should be achieved and how that could be achieved. So, for instance, a digital code could stipulate that ‘there should never be more than some specified amount of risk of harming a pedestrian’ without getting into the details of how risk could be calculated or enforced in decision making. This is key to ensuring that the regulation does not preclude innovative solutions not yet envisioned.*

- 9.22 Mobileye highlight the need to “collaboratively define a universally acceptable set of safety assurance principles for automated vehicle systems”. It drew attention to its work on Responsibility Sensitive Safety (RSS), which “formalizes what it means to be a safe driver into transparent mathematical equations”:

*Rules like, always maintain a safe following distance, or be cautious when in areas where pedestrians could be occluded, make up a set of behavioural characteristics defined by RSS that have universal applicability to any driving scenario.<sup>99</sup>*

- 9.23 Transport for West Midlands (TfWM) believes that developing a digital highway code is essential and noted that, together with partners, it will be piloting some early versions of this with the Meridian CAV testbeds.

- 9.24 The joint response of Parking and Traffic Regulations Outside London (PATROL) joint committee and the Traffic Penalty Tribunal (TPT) noted that:

*geospatial mapping already enables ‘road rules data’ to be incorporated into ‘digital Traffic Regulation Orders’, but the process and drafting of the future must provide the flexibility for regular updates to take account of new development and infrastructure.*

- 9.25 Transport Systems Catapult wrote that a digital code could be a beneficial starting point, although it would not be the whole answer to programming automated vehicles:

*... [E]ven simple rules can be extremely complicated to formulate deterministically. With the infinite combinations of parameters in the natural driving world (road geometry, other road users, weather etc.), a deterministic unambiguous digital code is unlikely to be achievable.*

*However, a machine-readable set of the highway code doesn’t necessarily require translation into a full set of deterministic rules. There is still value in translating the highway code into formal syntax and using that to define the main highway code principles. This machine-readable version of the highway code could be used by the*

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<sup>99</sup> See <https://www.mobileye.com/responsibility-sensitive-safety/>.

*[Automated Driving System (ADS)] as one layer of its decision-making process (in the same way as human drivers use the code).*

#### Issues a digital code should address: passing vulnerable road users

- 9.26 Several consultees thought there was a need to prescribe minimum safe passing distances. Driverless Futures, for example, raised Rule 163 of the Highway Code, which requires motor vehicles to give space to vulnerable road users.

*Such a distance will need to be quantified in an automated system, albeit with variable parameters according to circumstance. The process of determining the parameters will not be value-free nor objective, and needs to involve a wide consultation and likely further empirical evidence.*

- 9.27 London Living Streets, Cycling UK and the London Cycling Campaign also asked for codified rules on how much space a motor vehicle should leave when overtaking pedestrians, cyclists and horse riders. The British Horse Society stressed that automated vehicles should take account of horses' unpredictable behaviour.

#### Issues a digital code should address: mitigating adverse weather conditions

- 9.28 The Met Office used the example of maintaining safe distances in fog:

*For example, if there is an area of low visibility on the road (such as thick fog) which impedes the sensor performance of an autonomous vehicle, the mitigation would be to change driving pattern to increase vehicle spacing. This decision could be taken by the vehicle or by infrastructure/traffic management systems. This means that road rules will need to be clear as to what conditions necessitate what mitigation and what actions need to be taken by which systems so that these can be designed in accordingly.*

- 9.29 The Met Office asked for "sufficient cross organisational collaboration to ensure that a holistic approach is taken".

#### Parity between automated vehicles and human drivers

- 9.30 Several respondents argued that both human drivers and automated vehicles should be subject to the same rules. As the Association of British Insurers (ABI) and Thatcham Research wrote in their joint response:

*The priority for insurers on this issue is that road rules can be applied equally to human drivers and [ADSs]. There should be no separate Highway Code or obligations depending on the driving mode as this could lead to confusion among road users and be detrimental to road safety.*

- 9.31 Other consultees echoed this point:

*It is important to ensure that a single set of road rules apply to ALL vehicles to prevent confusion or differential handling. [The Floow]*

*The Highway Code should apply to both conventional vehicles and automated vehicles. [Transport for London (TfL)]*

*Acts and consequences which would be illegal if done by a human should remain illegal if the equivalent is done by an automated vehicle. (Obviously with appropriate modification of definition, e.g. 'taking hands of the steering wheel' would not be illegal for an autonomous vehicle, but 'losing transmission to the steering wheel' would).*  
[Professor Phil Goodwin]

- 9.32 The SMMT highlighted possible conflicts between “ADS compliance with road rules and human drivers’ social norms that don’t necessarily comply”:

*Developers, vehicle manufacturers and regulators should conduct ongoing dialogue about how road rules are being interpreted and conflicts that emerge.... These should progress to finding some common ground to mitigate any safety risks that such conflicts may entail.*

### Arguments against parity

- 9.33 A minority of respondents thought that technical developments meant that automated vehicles should abide by different rules. For example, Andrew Catlin wrote:

*Autonomous vehicles require a new approach to road rules. These should not seek to make autonomous vehicles comply to the road rules for humans, but be focussed around intelligent safe behaviour based on factual information available, allowing for intelligent connection between vehicles and accurate information of planned paths...*

*This will include platooning, not stopping for junctions with cars crossing each other precisely without contact, responding smoothly in a unified way to other road users and obstacles etc.*

- 9.34 Mills & Reeve LLP highlighted how ADSs’ enhanced perceptive abilities (using multiple sensors to detect road users beyond visual range) and scope for connectivity (with other vehicles and with infrastructure) offer opportunities to dispense with traditional approaches to road rules altogether by avoiding dangers in the first place. Further:

*It is our firm view that automated vehicles should be seen as an emerging alternative transport system using the same regulated space; to suggest that automated vehicles should emulate human driving is like suggesting that the automobile should have been designed to act like a horse when the horseless carriage was first introduced at the turn of the 20<sup>th</sup> century.*

### Comparative and cross-sectoral examples

- 9.35 KPMG LLP suggested we can learn from other jurisdictions, including the Singapore Standards Council report, which has a section on codifying road rules for automated vehicles.<sup>100</sup>

- 9.36 Oxbotica noted that “the aerospace industry is a good analogy for many aspects of the future autonomous vehicle industry”.

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<sup>100</sup> Singapore Standards Council report, Technical Reference 68, February 2019.

9.37 FiveAI suggested that air traffic control provides a useful example of where regulators have helped developers follow the rules by making them as close to formal specifications as possible.<sup>101</sup>

## SHOULD AUTOMATED VEHICLES MOUNT THE PAVEMENT?

**Q39: We seek views on whether a highly automated vehicle should be programmed so as to allow it to mount the pavement if necessary:**

- (1) To avoid collisions;**
- (2) To allow emergency vehicles to pass;**
- (3) To enable traffic flow;**
- (4) In any other circumstances?**

9.38 Some 124 respondents engaged with this question. A majority thought that vehicles should mount the pavement, at least in some circumstances. However, many respondents expressed concerns about pedestrian safety.

9.39 Even those who agreed tended to take a cautious approach. For example, South East of Scotland Transport Partnership (SEStran) said:

*the automated vehicle should only be allowed to do so when mounting the pavement is safe and does not create a risk of injury to other road users, such as cyclists, and pedestrians.*

9.40 Similarly, TfL stressed that automated vehicles should not “endanger other road users or members of the public”:

*For example, in mounting the pavement, it is vital that AVs are sophisticated enough to identify vulnerable road users such as physically impaired or visually impaired users who may not be as quick to respond to a vehicle.*

### Automated vehicles should have the same options available to them as human drivers

9.41 Most respondents who agreed that automated vehicles should mount the pavement argued that they should have the same options as a human driver. As The Floop put it:

*We would support that autonomous vehicles should have the same full capability to operate under the same restrictions and operating freedom as human drivers do when under ADAS control. Therefore, we would argue it should be possible to mount the pavement in rare situations.*

9.42 Many others expressed a similar view:

*The general principles that apply to human drivers should also apply to AVs. In certain situations most human drivers would mount a pavement in order to negotiate a*

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<sup>101</sup> See, for example Jean-Baptiste Jeannin et al, "Formal verification of ACAS X, an industrial airborne collision avoidance system" (2015) *Proceedings of the 12th International Conference on Embedded Software*, IEEE Press.

*particular situation, such as the three examples listed above. AVs should be permitted to do the same where necessary within their design domain. [Direct Line Group]*

*It seems sensible to establish under which circumstances it is acceptable for vehicles to mount the pavement and apply the same rules consistently regardless of who is in control of the vehicle. [the ABI and Thatcham Research]*

*Notwithstanding current legislation and rules on mounting the pavement, it is clear that there are occasions in which vehicles are permitted or expected to be able to mount the pavement. In principle, it would not be desirable to prevent an automated vehicle from doing anything which an ordinary vehicle under the control of a human driver can and may be expected or required to do. [Burgess Salmon LLP]*

9.43 Burgess Salmon LLP noted that road traffic legislation often uses the term "reasonable cause" to provide exceptions: "however, these simple words mask in practice very complicated decision-making processes".

9.44 The RAC Foundation thought that any debate about when it is legitimate to depart from the strict rules of the road should also apply to human drivers. They pointed out that the public accepts that there is a "hierarchy of rules (e.g. you drive onto the empty footway to avoid the child who has jumped in the road, you pull into a bus or cycle only lane to allow an ambulance to pass etc)":

*We need a bigger conversation about the way our motoring regulations engage with this "least worst option" hierarchy, which is prompted by the arrival of autonomy, but is not exclusive to it.*

#### Automated vehicles should never mount the pavement

9.45 A minority of respondents argued against allowing automated vehicles to mount the pavement, especially at speed. Brake wrote:

*Never. Pavements are for people, roads are for traffic. No sudden manoeuvres onto pavements should ever be allowable, and no safety assurance would allow it due to the variables involved. Such allowance would be utterly counter to a Vision Zero or Healthy Streets approach and potentially damage the vehicle.*

9.46 Others expressed similar views:

*No, this should not be permitted under any circumstance. AVs should be going slow enough so as not to require any of these manoeuvres. [Living Streets Hackney]*

*No, they should not under any circumstances. Such action would significantly negatively impact on vulnerable road users, especially pedestrians including children and the elderly. [Cycling Scotland]*

9.47 In response to a poll conducted by Disability Equality Scotland, 80% of respondents (28 respondents) thought that automated vehicles should never mount the pavement. One respondent to the poll asked:

*Will these vehicles be able to assess the pavement area ... i.e. children, elderly and disabled people, can they get out of the way if near the kerb in time? The space*

*available to do so? How can the cameras that control these vehicles be able to assess the pavement quickly and safely enough i.e. deaf and blind people might not be aware of the fact that there are emergency vehicles in the area.*

#### Specific situation – emergency vehicles

- 9.48 A majority of consultees (70 out of 124, 56%) expressly stated that automated vehicles should be permitted to mount the pavement to allow emergency vehicles to pass. As Stewarts Law put it, without this possibility, automated vehicles are unlikely to be able to share roads easily with emergency vehicles.
- 9.49 Several argued that this should be done only at low speeds. For example, Brake agreed “with the caveat that slow-speed, safe operation should be demonstrated in the safety assurance scheme”. The Confederation of Passenger Transport UK (CPT) thought that automated vehicles should never mount the pavement at speeds “greater than say 5kmh in any circumstances”.
- 9.50 The Society of Motor Manufacturers and Traders (SMMT) agreed that, for early generation automated vehicles, mounting the pavement for an emergency vehicle should be permitted as a last resort. However:

*This should become unnecessary when Emergency Vehicle Warning, a V2V C-ITS<sup>102</sup> service, enables the necessary action to be taken long before an emergency vehicle approaches.*

#### Specific situation – avoiding collisions

- 9.51 Slightly fewer consultees (64 out of 124, 52%) expressly stated that vehicles should be allowed to mount the pavement to avoid a collision.
- 9.52 Those who thought automated vehicles should mount the pavement generally argued that automated vehicles should have the same range of options as human drivers.
- We believe that cars should be able to mount pavements to avoid injury – as a person driving a car would. [Forum for Complex Injury Solicitors (FOCIS)]*
- 9.53 However, many respondents stressed the need for caution. For example, Transport for West Midlands (TfWM) accepted that it might be necessary to “mitigate immediate and severe risk to life and injury”, but only in a “clear and legally defined set of circumstances”:

*This should be based on assurances that AV decision making is fast enough to deal with changing conditions, and such assertions should be rigorously tested and potentially treated as a mandated and formally reportable situation which can be investigated (similarly to Health & Safety incidents and near misses) by a formal independent third party.*

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<sup>102</sup> Vehicle-to-vehicle co-operative intelligent transportation systems: this refers to technology which allows vehicles to communicate with each other.

- 9.54 Several consultees provided detailed arguments against swerving onto the pavement to avoid a collision. Transport Systems Catapult wrote:

*This should not be allowed. Based on prior research, it can be expected that, in urban areas with 30mph speed limits, it would be extremely rare for swerving to be the best course of action, and this may well be true for 40mph zones as well....*

*Mounting the pavement at speed is also problematic in that the field of view of sensors may be insufficient. Pedestrians could emerge from buildings or gardens. There is also the issue of bumping up the kerb, for which it might be difficult to control the vehicle. Therefore, prohibiting this behaviour would provide reassurance to the public that they can walk on the pavement without fear of an AV swerving into them.*

- 9.55 Similarly, Peter Brown said that:

*Mounting the kerb is much more likely to cause an accident than prevent it. Impact with the kerb is likely to burst one or more tyres, resulting in a loss of control by the automated vehicle.*

- 9.56 The Chartered Institution of Highways and Transportation (CIHT) commented that

*best practice is often to brake firmly and effectively and the vast majority of road users will not need to swerve on to a pavement to avoid collisions in their driving lifetimes.*

- 9.57 The Parliamentary Advisory Council for Transport Safety (PACTS) also argued that swerving to avoid collisions should not be permitted:<sup>103</sup>

*It might put pedestrians in danger and, unlike vehicle occupants, pedestrians have no collision protection.*

*In addition, pavements (footways) often contain street furniture (lamp posts, for example) that could cause injury to the vehicle occupants. We believe it is unlikely that an AV would be able to weigh up the safety situation on the highway and footway sufficiently quickly or accurately enough to make a safe decision.*

#### Specific situation – enabling traffic flow

- 9.58 Only a minority of respondents (46 out of 124, 37%) thought that automated vehicles should be allowed to mount the pavement to enable traffic flow.

- 9.59 Those who argued in favour mentioned the need to avoid congestion:

*I think this is key as the inability for them to do this could result in traffic chaos and create transport problems. [Amey]*

*Unless the Highway Code is changed to allow both drivers of conventional vehicles and automated vehicles alike to mount the pavement in these circumstances, there is a risk that automated vehicles will prevent traffic flow and cause gridlock. [DAC Beachcroft LLP]*

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<sup>103</sup> See also Ian Barclay's response.



9.60 The Office of the Scottish Road Works Commissioner (OSRWC) observed that:

*not all 'pavements' (footways) will be higher or lower than the associated carriageway, and in that circumstance, being prevented from entering a footway area entirely could block traffic.*

9.61 Even those agreeing often expressed caution:

*Yes, eventually, though this is not as essential as the above and should only be considered when the technology has advanced further than that required for collision avoidance and allowing emergency vehicles to pass. [Esure]*

9.62 Those arguing against thought that one should not trade safety for convenience:

*Absolutely not. The convenience of vehicle users should never introduce any unnecessary danger, threat (worry that vehicles could hop onto the pavement in their own interests at any time) or inconvenience (obstructing pedestrians). [Sam Wakeling]*

*Enabling traffic flow falls outside of the scope of maintaining public safety and this goes for most other circumstances for vehicles mounting the pavement. [Wayve Technologies]*

#### The role of the user-in-charge

9.63 Several respondents suggested that the issue would not arise if there were a user-in-charge in the vehicle; instead the user-in-charge should take over to allow an emergency vehicle to pass or to enable traffic flow. Those making this point included the Automobile Association (AA), the Crown Prosecution Service (CPS), PACTS, the Magistrates Association and CIHT.

9.64 The Transport Planning Society thought that “only a user-in-charge can weigh up the pros and cons, and make a reasonable decision”.

9.65 The Metropolitan Police Service (MPS) wrote:

*a vehicle should always be programmed to obey all relevant law. Any deviation is then a matter solely for the user-in-charge.*

#### Other situations

9.66 Several consultees raised the need to cross a pavement to reach a driveway or other enclosed space:

*CAVs will need to be able to cross pavements to enter some side roads where continuous footways are in place and to access some driveways. [Jonathan Flower, of the Centre for Transport and Society (CTS), personal response]*

9.67 Similarly, the Freight Transport Association (FTA) mentioned the need to access areas “encapsulated by kerbs i.e. shops, churches, etc”.

9.68 Several respondents (including the FTA and Centaur Consulting) mentioned the need to park on roadside verges or grassy spaces. Centaur Consulting noted that it may also

be necessary to drive over a field, for example to park for a festival, or when traffic is re-routed.

- 9.69 Finally, the British Horse Society thought that automated vehicles might have to pull off the road to allow a horse or horse and carriage to pass.

#### Identifying a “pavement”

- 9.70 Several respondents queried what we meant by “pavement”, and whether it was the correct term to use. Sustrans said that the term was often indistinct. Adrian Payne queried whether it would be possible to identify in the countryside and in small villages and hamlets. Neckermann Strategic Advisors thought that bicycle lanes and scooter lanes should also be considered in this context.

## VEHICLES PROGRAMMED NEVER TO MOUNT THE PAVEMENT

### **Q40: We seek views on whether it would be acceptable for a highly automated vehicle to be programmed never to mount the pavement.**

- 9.71 Some 119 respondents engaged with this question. Views tended to be polarised along the lines discussed earlier.

#### Views against a prohibition

- 9.72 Those who saw mounting the pavement as in the interests of safety thought it would be wrong for a developer to prevent an automated vehicle from pursuing this option. These quotations provide a flavour of the arguments against a prohibition:

*[It may] create a more hazardous environment, for example if emergency vehicles cannot pass.* [National Physical Laboratory (NPL)]

*It is a crude and simplistic approach which does not consider safety from a holistic viewpoint and would not be justifiable.* [Richard Morris]

*This would be immoral if the result was human harm which could have been avoided.* [Jacob Hardy]

*Highly automated vehicles should be programmed to be able to make judgement calls in unusual situations - like human drivers can.* [TfL]

#### Views in favour of a prohibition

- 9.73 Conversely, those who thought mounting the pavement would introduce safety risks argued in favour of a prohibition:

*People should be able to walk, cycle and scooter knowing that their space for active travel is protected from invasion by vehicles at any time.* [Brake]

*... [N]ot only acceptable but a requirement.* [Living Streets Hackney]

*...[T]he overriding imperative must always be safety. No new category of vehicle should endanger those who use the pavement* [If you look and If Vehicles]

- 9.74 Transport Systems Catapult thought that while vehicles had a user-in-charge, the user could deal with the scenarios we had outlined.<sup>104</sup> And by the time users-in-charge were no longer required “there should be solutions available to prevent most of these scenarios”.

#### Giving discretion to developers

- 9.75 Two developers argued that developers should be given discretion on this issue. In other words, it should be acceptable to programme some vehicles never to mount the pavement, without precluding the possibility in others. FiveAI wrote that:

*It should be acceptable and possible to use or deploy a highly automated vehicle which has been programmed never to mount the pavement. Indeed, in some circumstances this may be desirable, such as in areas where pedestrians and vehicles are largely segregated with pedestrians confined to pavements or other walkways. However..., this should also not preclude the possibility of using or deploying an automated vehicle which has not been programmed [in this way].*

- 9.76 Volvo Car Corporation also thought that the answer would depend on the automated vehicle’s operational design domain:

*the starting point would be that if a pavement is in the ODD [operational design domain], then the car should be able to resolve the conflict situations that could arise if the vehicle mounted it. If the vehicle is not able to resolve the conflict situation, then the pavement should not be in the [operational design domain].*

## EXCEEDING SPEED LIMITS WITHIN ACCEPTED TOLERANCES

### **Q41: We seek views on whether there are any circumstances in which an ADS should be permitted to exceed the speed limit within current accepted tolerances.**

- 9.77 Some 123 respondents engaged with this question. Views were split down the middle. Around 60 respondents thought that automated vehicles should never speed, with academics and safety groups putting robust arguments for this point of view.
- 9.78 However, a similar number of respondents thought it may be necessary for an automated vehicle to speed in some situations. As we discuss below, when the RAC polled its members on the question, there were substantial majorities in favour of allowing speeding in some circumstances. The issue of speed limits divides society, making it difficult to reach a consensus on this issue.

#### The RAC poll findings

- 9.79 The RAC reported the results in its consultation response:

*The RAC Opinion Panel conducted research into this area in January 2019 on a range of scenarios where an automated vehicle would be permitted to exceed a speed limit within the speed tolerance threshold as outlined in police guidance. Our findings from 2,201 respondents showed:*

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<sup>104</sup> Kevin Chapman also thought the user-in-charge was best placed to intervene.

- *Two-thirds (68%) of motorists support the idea of allowing autonomous vehicles to exceed the speed limit if it helped maintain traffic flow. Only a third (32%) opposed this.*
- *More than two-thirds (75%) of motorists support the idea of allowing autonomous vehicles to exceed the speed limit to prevent overly sharp braking when reaching a lower speed limit. Only a quarter (25%) opposed this.*
- *A large majority (85%) of motorists support the idea of allowing autonomous vehicles to exceed the speed limit if it was done in the interests of safety (e.g. overtaking a vehicle quickly to avoid a collision). Only 15% opposed this.*

### **No, there are no circumstances that require speeding**

9.80 The argument against allowing automated vehicles to exceed speed limits was put comprehensively by PACTS in the following terms:

*An [ADS] should not be permitted to exceed the speed limit, “within current accepted tolerances”, except to allow for minor, short term variations in gradient etc.*

*We believe there are strong safety, ethical, legal and liability grounds for this position, including the following reasons:*

- *Speed limits have been established in law for good reasons, including safety, traffic flow and environment.*
- *It would inequitable, controversial and, in our view, entirely wrong to permit AVs to do something that is against the law for human drivers.*
- *One of the most commonly cited reasons to justify ADS being permitted to exceed the speed limit is the potential need to ‘overtake a vehicle as quickly as possible to avoid collision’ or to ‘speed out of danger’. We do not accept this premise. The ADS should be programmed to avoid such situations...*
- *There has been some suggestion that ADS might be permitted to exceed the speed limit in accordance with current police speed enforcement guidelines (formerly “ACPO” guidelines), i.e. by 10% + 2mph. This would be wrong and a misunderstanding of the purpose of the police guidelines which are based on the accuracy limitations of enforcement technology and a policy of focusing on more serious speeding offences.*
- *It is hard to see how, in the event of a collision, the AV manufacturer would not be liable if the vehicle had been deliberately programmed to break the law. The speed limit is stipulated by law; it is not overridden by guidelines.*

9.81 These themes were developed in other responses. First, it was said that excessive speed always increases risk for other road users. Professor John Parkin wrote:

*This is the case no matter the form of control (human driver or automated vehicle). The reason is linked quite simply with physics: a) the faster the speed, the less*

*perception (detection) and reaction (computing time) to determine a course of action, and b) the greater the kinetic energy if a collision were to ensue.*

9.82 Similarly, Transport Systems Catapult pointed out that in the event of an accident:

*contacting a pedestrian at 35mph would be significantly more serious than 30mph, and the 30mph limit was set partly with consideration of accident survivability. It is also important to consider that increased speeds would also reduce the available reaction time for other road users attempting to avoid the AV, making the vehicle difficult to interact with safely.*

9.83 Professor Phil Goodwin dismissed the “folk myth” that “exceeding the speed limit while overtaking can be a contribution to safety”. Jean-Francois Paris similarly felt that this scenario was based on “flawed logic”.

9.84 Many respondents argued that speed limits were absolute: there is no such thing as “accepted tolerances”:

*There are no acceptable tolerances. Rather we have chosen as a society not to enforce our own rules. We know that speed kills and that generally vehicles are driven at speeds and in ways that are not fuel efficient or good for the environment or pollution. We can address some of these issues with CAVs. [Jonathan Flower, of the Centre for Transport and Society (CTS), personal response]*

*The speed limit is indeed a limit and not a target. [British Insurance Brokers' Association (BIBA)]*

*Tolerances relate to enforcement of the speed limit. They do not permit driving above the speed limit. [CPS]*

9.85 Professor Phil Goodwin said that tolerances allowed for the inaccuracies of old speedometers and short periods of human inattention - reasons which do not apply to automated vehicles.

9.86 Sustrans argued for full compliance and slower speeds:

*We would like to see total compliance with speed limits. Therefore, we would consider it unhelpful if [ADSs] permitted vehicles to exceed the speed limit. We would also like to see speed limits set below current levels in many settings (e.g. blanket 20mph in built-up areas).*

9.87 Finally, Transport Systems Catapult expressed concern about a race to the bottom:

*If any tolerance band is allowed, this will effectively become the new limit rather than a tolerance, as manufacturers compete to make their products attractive.*

### **Yes, automated vehicles may be able to speed within set tolerances**

9.88 No respondents thought that automated vehicles should be allowed to travel markedly faster than the speed limit, at least not for now, on unsegregated roads. However, around half of respondents suggested that the rule should not be absolute. Instead, ADSs should be permitted to exceed the speed limit within current accepted tolerances,

in some limited cases and in appropriate conditions. As the Automobile Association put it, whilst automated vehicles “may be permitted to exceed posted limits by 10% +2 they would be expected normally to drive to conditions”.

### Speeding in the interests of safety

- 9.89 Several respondents said it might be necessary for automated vehicles to speed in some circumstances to avoid collisions (including the Road Haulage Association (RHA), McLaren Applied Technologies, The Association of Local Bus Managers (ALBUM), Arcadis and James Geraghty). Amey gave an example:

*there will be some situations where a vehicle may need to speed up to avoid an unsafe situation (which was not of the vehicle's creation). For example, if the vehicle is overtaking a lorry (set at 56 mph) on a 2-lane motorway and the vehicle spots a broken-down lorry in the outside lane the vehicle may need to break the speed limit to speed up to get past the lorry before colliding with the broken lorry.*

- 9.90 Similarly, SEStran wrote that:

*SEStran believes that automated vehicles should be allowed to exceed the speed limit (within reason) if it is to protect road safety, for example to quickly overtake a vehicle to avoid collision. The automated vehicle should in principle be able to anticipate speed limit changes but some tolerance might be necessary to prevent overly sharp breaking which could compromise road and passenger safety.*

- 9.91 The Freight Transport Association (FTA) added that there may be times when it would be necessary to accelerate past traffic to exit a motorway safely.

- 9.92 The International Underwriting Association (IUA) also thought that “speeding up to overtake a vehicle when it is safe to do so rather than breaking sharply” would be acceptable. However, they cautioned:

*This issue will require further careful consideration and extensive testing and should not in any event involve an AV exceeding the stated speed limit at the request of a user.*

- 9.93 FiveAI thought that “rules on this issue should not be overly prescriptive. Instead, safety principles should determine what a vehicle might do in any specific scenario. FiveAI expected, however, that in most cases, vehicles would stay within the speed limit as “an increase in speed is liable to increase the overall level of risk”.

### The effect on traffic flow

- 9.94 One of the anticipated benefits of automated vehicles is that they would have a smoothing effect on other traffic. As Andrew Catlin put it:

*As numbers of autonomous vehicles increase they will have a smoothing effect on overall traffic. They will anticipate arriving at a lower speed limit zone and slow gradually as they get to them to avoid wasting energy by braking, instead of braking suddenly as human drivers do as they see a speed sign or camera.*

- 9.95 However, there was some concern that in the short term, the presence of a few vehicles travelling more slowly than others might have the opposite effect. Transport Canada noted:

*It is arguable that permitting manufacturers to allow for speeding above the threshold (e.g. 5-10km/h in excess of the limit) is reasonable in the interest of road safety, especially where AVs are operating in mixed traffic settings (with vehicles controlled by humans). Research has demonstrated that speed differential (differences in speed between two vehicles travelling in the same direction) can be a significant factor in speed related collisions.*

- 9.96 Similarly, Zurich Insurance (UK) commented:

*If automated vehicles cannot match the speeds of vehicles travelling at legally acceptable speeds, this may cause frustration amongst other road users and reduce road safety levels. To this end, we note the improved road safety levels on the A9 after HGVs were allowed to increase their speeds from 40mph to 50mph.*

### Speed limits in the long term

- 9.97 The ABI and Thatcham Research said that automated vehicles should not currently be able to speed, but in the future, they might be able to do so in specially designed areas:

*If automated-vehicles-only lanes were to be considered in the future, it may be appropriate to revise this in the future and explore separate speed limits for these design domains, provided that there is evidence that [ADSs] can safely travel faster under these circumstances.*

- 9.98 Other respondents made similar points:

*In the medium term, as autonomous/connected vehicles are able to communicate with each other and are able to "see ahead" for considerable distances, this would justify high speed lanes for autonomous vehicles, unrestricted as in German autobahns, to allow more rapid transit. [Andrew Catlin]*

*In the long term, it may be appropriate to reconsider speed limits where there are no vulnerable road users or manually driven vehicles around (e.g. a road designated solely for AVs, with no pedestrian access). [Transport Systems Catapult]*

- 9.99 Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA) pointed out that new technology provided opportunities for a more adaptable approach to speed limits:

*If you assume that in the future roads will become smart, then it will be possible to raise local speed limits in exceptional circumstances (e.g. to allow emergency vehicles to drive at speed).*

*The concept of phasing in speed limits and how variable speed limits could be used should be explored. If defined transition zones are recognised then in addition to improving ride quality the risk of (following) vehicles losing traction as they sharply brake to meet a new significantly lower speed limit will be reduced.*

## EDGING THROUGH PEDESTRIANS

**Q42: We seek views on whether it would ever be acceptable for a highly automated vehicle to be programmed to “edge through” pedestrians, so that a pedestrian who does not move faces some chance of being injured. If so, what could be done to ensure that this is done only in appropriate circumstances?**

9.100 Of the 125 respondents who engaged with this question, around 60 were strongly against the idea that automated vehicles should ever edge through the pedestrians. A minority (around 30) made arguments in favour of edging through pedestrians, although most said this should be limited to particular circumstances, or subject to particular safeguards.

### Arguments against edging through pedestrians

9.101 Many respondents found the proposition shocking. Bob Downie called it a “crazy question”. Martin Scott wrote: “I cannot believe you are even contemplating this”. David Hunter felt that this was akin to asking whether automated vehicles should be able to hit pedestrians. Steven Ratcliffe doubted whether “even the most talented programmer” could find a way of achieving this safely.

9.102 There was particular concern about the effect on people with disabilities.

*This will likely be particularly dangerous to disabled/vulnerable pedestrians. [Richard Hindes]*

*This would only be acceptable if the sensors were able to stop the vehicle before any contact to ensure people who are deaf, blind, deafblind or restricted in their ability to move out of the way were not touched by the vehicle. [DeafblindUK]*

*Edge through pedestrians this sounds dangerous i.e. could be someone who is blind what way does the car go! What about wheelchair users trying to self-propel when suddenly one of these cars is trying to push through? Think they should remain on the road in a safe position. [respondent to the poll by Disability Equality Scotland].*

9.103 There was a fear that it would place motor vehicles above people. Sustrans commented that the proposition was “unacceptable” and “underscores the dominance of car travel in transport policy that has been the UK paradigm for decades”. Others echoed this view:

*Cities are for people, and autonomous vehicles in use should be subservient to the needs of people. To allow an autonomous vehicle to edge through pedestrians implies they have equal, or potentially greater, rights than humans do. [Professor John Parkin]*

*Disabled, injured and drunk should all have more rights than a machine. [Michael Broadbent]*

### Arguments in favour

9.104 The strongest support for the proposition was voiced by Dr Charles Fox, who studies game theory in AV-pedestrian interactions. He argued that some small but credible threat was a necessary part of road user interaction:



*Game theory shows that a vehicle (human or autonomous driven) MUST be capable of carrying out a "credible threat" to either hit or otherwise inflict some other negative utility onto pedestrians and other vehicles, in order to make any progress at all. If a vehicle is programmed to be completely safe then other road users will learn of this and then take advantage of it to take priority over it in every interaction, and the vehicle will make no progress. Actually, carrying out the credible threat -- as in nuclear warfare -- would be an extremely rare occurrence, but there must be some small probability of doing so formally programmed into the system.*

9.105 Wayve Technologies saw this as an area for further development:

*This is likely to be a necessity for autonomous driving in most urban centres, due to existing patterns of human behaviour. We anticipate that this will be an ongoing area of technical development which will require significant public engagement with rigorous testing.*

9.106 Some respondents commented that, at present, pedestrians would expect some risk from stepping out in front of cars:

*We do not think it would be inappropriate for humans to expect the possibility of injury if they were to step in front of an autonomous vehicle in circumstances when they should not do so (much in the same way that a human would expect the risk of injury if they stepped in front of other forms of transport currently). [Mills & Reeve LLP]*

*While it does not automatically follow that there is a directly proportional relationship between how close a vehicle comes to a pedestrian and the probability of collision / injury to that pedestrian (i.e. it may be perfectly possible to edge through a crowd of pedestrians safely), we do not think it would be inappropriate for a pedestrian to expect some possibility of injury if they fail to move away from the vehicle and this applies equally to human driven vehicles. [FiveAI]*

9.107 Both Mills & Reeve LLP and FiveAI emphasised that these interactions would be at low speed.

9.108 The Freight Transport Association (FTA) drew a distinction between moving and stationary pedestrians. They thought "edging through" would be acceptable "where the pedestrians were moving and hence have the ability to move past the vehicle". However, "this would not be the case where the pedestrian/s are stationary".

9.109 Apollo Vehicle Safety drew a distinction between "edging forward to encourage pedestrians to give way" and "deliberately allowing an automated vehicle to make contact with a pedestrian" which was "unlikely to ever be acceptable".

#### How to make edging safer for pedestrians

9.110 Several consultees suggested that automated vehicles should give warnings or even spray water.

*[I]t could be fitted with an alarm or caution message stating that it needs to move forward so pedestrians know (like when a lorry is backing up). [Amey]*

*Alternative means of encouragement are likely to be lower risk/more acceptable - for the sake of provoking debate, making increasingly strident audible alerts or spraying water ahead of the vehicle! [Apollo Vehicle Safety]*

*Where a vehicle is operating without a user-in-charge, the vehicle should issue an audible warning and begin recording its actions before proceeding. [Weightmans LLP]*

9.111 The Association of Personal Injury Lawyers (APIL) commented that geo-sensing and traffic alert technology would allow automated vehicles to avoid areas with large volumes of pedestrians: “the car would be shown a different route to avoid that hazard”. Similarly, Weightmans LLP thought that V2X connectivity<sup>105</sup> should enable the vehicle to avoid demonstrations, football crowds or an injured person lying on the road. CPT suggested that it would be necessary to define environments and circumstances in which pedestrians and cyclists have priority.

9.112 Many respondents thought that an automated vehicle which needed to edge through pedestrians should hand back control to the user-in-charge. This view was put by, among others, the Automobile Association (AA), the CPS, IAM RoadSmart, Transport Systems Catapult, Buchanan Computing and the Institute of Highway Engineers (IHE) and Cycling UK.

#### [New jaywalking-type offences?](#)

9.113 Finally, several respondents suggested that the issue could be addressed by making it a criminal offence for pedestrians to obstruct automated vehicles:

*It may therefore be necessary to protect autonomous vehicles via laws to prevent humans obstructing their progress (equivalent to laws against ‘jaywalking’ in the US), with sensor data from the vehicle used to aid prosecution. [Transport Systems Catapult]*

*It may be that legislation needs to make it a criminal offence to impede the progress of an automated vehicle. [Addison Lee Group]*

*Perhaps pedestrians who deliberately obstruct traffic could face criminal sanctions – and autonomous vehicles are well placed to record the actions of such pedestrians. [Kennedys Law LLP]*

9.114 As we have seen however, Sustrans argued strongly against any new laws which prevented people from crossing roads where they wish.<sup>106</sup> ADEPT - Rights of Way Managers Working Group also highlighted that, particularly in rural locations, “jaywalking” laws could have the effect of severing the Public Rights of Way (PROW) network. They further noted that “the vast majority of rural carriageways do not have footways” and therefore pedestrians in these areas must be able to walk on the carriageway.

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<sup>105</sup> V2X connectivity refers to technology which allows the vehicle to communicate with other objects e.g. traffic lights.

<sup>106</sup> See paragraphs 2.6 and 8.14.

## AUDITING TRAINING DATA

### Q43: To reduce the risk of bias in the behaviours of ADSs, should there be audits of datasets used to train ADSs?

9.115 Some 115 respondents engaged with this question. A majority (69 consultees, amounting to 60%) said yes, compared to only six who said no. However, there was considerable concern about the difficulties of conducting the audits: many respondents who said yes qualified their answers while a further 40 respondents made comments about the difficulties without saying either yes or no.<sup>107</sup>

#### Arguments for auditing training data

9.116 The case for auditing was put strongly by Dr Charles Fox who said, “stereotyping from data will be a serious issue”. He drew on current research on how to predict the assertiveness of pedestrians. As well as body language, this might involve gender and age, with early indications that “elderly people may be more assertive, because they expect drivers to give way to them more than younger pedestrians”. He continued:

*There might be statistical correlations even between skin colour and behaviour. All of these demographic factors could be useful to program into AVs if they help to improve predictions of behaviour and reduce accidents from collisions, but there are obviously big ethical questions around how much, if any, of these stereotyped, prejudiced predictions should be used.*

9.117 The National Physical Laboratory (NPL) said that there “could also be limitations in just looking at training data to assess the nature of bias”. However, audits of training data should be part of a wider process:

*It is recommended that there should be a recognised and auditable process that the developers should follow. Training data sets should be included in that; and such an approach is to be considered as part of a wider package of measures to assess the safety of autonomous vehicles.*

#### The problem of bias

9.118 The ABI and Thatcham Research thought it was wrong to treat one class more favourably than another:

*Any discrimination based on protected characteristics is both unlawful and unacceptable. There may be merit in auditing datasets as part of overall validation/approval procedures to avoid biased behaviour.*

9.119 The University of York also addressed this point:

*It is worth giving serious thought to the recommendations of Germany's Ethics Commission on Automated and Connected Driving, to the effect that [ADSs] should be prohibited from basing decisions on "any distinction based on personal features*

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<sup>107</sup> See also UN Secretary-General's High-Level Panel on Digital Cooperation, *The Age of Digital Interdependence* (June 2019), Recommendation 3C: “Audits and certification schemes should monitor compliance of AI systems with engineering and ethical standards, which should be developed using multi-stakeholder and multilateral approaches.”

*(age, gender, physical or mental constitution)" (Principle 9). A version of this principle would appear to be a natural sequitur of the protections contained in the Equality Act 2010, but there is merit in expressly considering and articulating its implications for how [ADSs] can permissibly be programmed to make challenging decisions.*

9.120 In contrast, FiveAI argued that asymmetry between different groups was not a problem in itself, so long as the automated system provides everyone with a minimum level of safety:

*We suggest that the relevant and pertinent issues here are*

*(i) demonstrating that the [ADS] has been trained with a sufficient diversity of training data so as to be comprehensively representative of the operational design domain in which the vehicle will be used and*

*(ii) demonstrating that the [ADS] will then achieve at least a common minimum level of safety reflecting any judgement as to acceptable risk for all classes...*

9.121 Driverless Futures thought that attempts to “fix” inequality could lead to further injustice:

*The acknowledgement of bias in large datasets has led to attempts by programmers to fix their algorithms. But such approaches fail to recognise that discrimination may be a feature of a system, rather than a bug. Algorithms are often used to classify things into categories. Even if they do so without fault, people may legitimately object to a particular classification. This is a political issue that cannot be ‘fixed’.*

#### Covering all groups and scenarios

9.122 A more limited aim is to ensure that the ADS has been trained to recognise and respond to all road user groups, in a wide enough variety of circumstances. Sustrans, for example, emphasised that automated vehicles would need to be trained to recognise and respond to all types of bicycles. Similarly, the British Horse Society was concerned that automated vehicles must be able to identify horses.

9.123 The University of York commented:

*There is likely to be a reasonably strong case for auditing or reviewing the representative character of the data sets used in training the system, but this would be most effective if it were to form part of the overall regulatory framework, rather than a separate, bias-specific requirement.*

9.124 In a similar vein, Chief Inspector Adrian Davies wrote that:

*Developers should be encouraged to consult widely as to what driving scenarios they have considered as part of the design [in order] to reassure and to increase confidence in the product.*

#### Difficulties with auditing of training

9.125 Several respondents highlighted that audits of training data provide only limited benefit. For example, Transport Systems Catapult pointed out that biases can be introduced in multiple ways: “insufficient data coverage, poor data collection methods, human bias

from labelling training data or from the chosen algorithmic structure or provided success criteria”.

*An audit of the datasets may offer some limited benefit in flagging obviously limited and skewed approaches but will only address the reasons for bias related to the training data. It is unclear how an audit would work in practice without also observing how the machine-learned ADS was making use of it.*

9.126 Similarly, Wayve Technologies said that the audit should be only “part of a comprehensive safety case covering the complete autonomous system”:

*An audit of datasets in isolation without understanding the system behaviour will present an incomplete view of the autonomy.*

9.127 Centaur Consulting thought that audits would be of limited value when systems “change their behaviour over time in response to additional stimuli”:

*This has led to some unfortunate behaviour in other (but less dangerous) contexts, such as chatbots being "trained" to be racist and insulting through their interaction with humans. A poorly engineered AV might, even if trained on "good" data, evolve towards highly aggressive behaviour in the real world.*

9.128 Several respondents argued that it would be more appropriate to test the outputs rather than inputs. Mills & Reeve LLP, for example, thought that unconscious bias may not be apparent in an audit of the training data:

*We expect the risk of bias would be more appropriately addressed through testing of the developed system... testing its performance across an appropriately representative sample, for example, rather than examining the data used to train the system.*

### Arguments against audits

9.129 Professor Bryan Reimer of MIT thought that it would be too complex to conduct such audits. Buchanan Computing and the Institute of Highway Engineers (IHE) agreed:

*There is unlikely to be an issue that could be identified by an audit. Any biases overlooked by the developers would probably be overlooked also by the auditors.*

9.130 The SMMT argued strongly against audits, as unconscious bias may not be apparent from such audits. Furthermore, they could undermine developers’ intellectual property:

*In general, the datasets used to train [ADSs] are likely to be highly proprietary, so any such audits would have to be carried out under the strictest confidentiality protections, which might in itself undermine general transparency objectives. Furthermore, the potential liability borne by the custodian of such proprietary datasets, should there be a compromise or leak of the data, is prohibitively astronomical for anyone to be willing to handle the datasets and assume the associated risks.*

9.131 SMMT thought that, instead, “assessment should be based on outcomes rather than inputs”.

9.132 Propelmee provided a detailed consideration of the issue, emphasising that artificial intelligence was used in several different layers for many different purposes. Much of the training data was ephemeral and not available for scrutiny:

*In the 'Driving Policy' Layer - for example when Reinforcement Learning may be used to 'teach a car how to drive'...;*

*a) the AI operated on the basis of data provided through a human being's manual corrections to the steering wheel as the car learnt to drive.*

*b) This data was ephemeral and now would not exist for scrutiny at all.*

9.133 Propelmee went on to describe training-based approaches as “inherently inscrutable”. For example: “the actual approaches and network structures themselves can introduce various anomalies on account of their structure, such as the depth of a Neural Network”. Therefore:

*Just looking at the training data set reveals very little if anything at all regarding an AI approach... It is our view that AI will remain a very complex theme for regulators in many fields not just in relation to autonomous vehicles.*

## **PUBLISHING ETHICS POLICIES**

### **Q44: We seek views on whether there should be a requirement for developers to publish their ethics policies (including any value allocated to human lives)?**

9.134 In all, 115 respondents answered this question. Most (71 consultees, amounting to 61%) were in favour of publication, with only 11 respondents answering “no” and 33 answering “other”. However, many respondents criticised the premise that ADSs would or should have ethics polices. Another significant theme was that a central authority should set ethics policies, not developers.

9.135 There was some concern that the publication of ethics policies might also become skewed towards gathering good publicity, rather than illuminating the true nature of the programming. On the other hand, disclosing the full complexity of the programming might breach confidentiality. Finally, it might be difficult to compare ethics policies if individual companies each took their own approach.

### **Arguments for publication**

9.136 The main reason given for publication was to increase trust.

*The public confidence in AVs will be damaged if there is a lack of transparency on this issue. [Stewarts Law LLP]*

*We believe that transparency of ethics policies of developers would be welcomed by our sector and the wider public to build trust in the systems. [BIBA]*

9.137 Trifords (trading as Auto Windscreens) were concerned that developers did not put the cost of human life too low, citing past cases “where a manufacturer placed the value of Human Life less than the cost of rectifying a problem”.

9.138 Dr Charles Fox commented that although classic “trolley problem” scenarios were artificial, game theory decision-making would be more common in the interactions between autonomous vehicles and other road users. He favoured the disclosure of ethics policies, noting:

*We have also had informal conversations with a car maker whose brand is associated with assertiveness and masculinity, who have shown some interest in how their vehicles might be programmed to behave in these game-theoretic interactions in line with their brand's character.*

9.139 Richard Morris of Innovate UK, responding in a personal capacity, saw ethics policies as a tool for accident investigators:

*...the [Automated Driving System Entity (ADSE)] should provide substantial documentation describing how it expects the system to behave in a range of relevant and ethically challenging scenarios. This should be sufficiently detailed for an accident investigator to be able to determine how the system should have behaved in a given accident scenario.... If the vehicle did behave in that way but the outcome was not “acceptable” then the ADSE should change its ethical approach. If the vehicle did not behave as expected, this suggests a fault in the system which should be further investigated. Hence, the ethics policy should be used as a tool to help accident investigation, rather than a justification for a moral choice, or worse, a vanity project.*

#### Criticisms of the idea of ethics policies

9.140 Several developers were unclear what value an ethics policy would add. Wayve Technologies said that “as a developer we cannot put a value on human life”.

*A formalised ethics policy will be derivative of national legislation and regulation determining what an autonomous vehicle can (or cannot) do in situations of questionable ethics (e.g., driving on pavements, nudging through pedestrians), plus our autonomous system's safety case.*

9.141 Similarly, the SMMT commented:

*The requirement for developers to publish their ethics policies may add little, if anything, to the advancement of automated driving technology. This is because any such ethics policy is likely to be at a very high level of abstraction, very challenging to document, and unlikely to be sufficiently determinate to provide an informative overview of the developer's approach.*

9.142 The Flook thought that the language of ethics was inappropriate for automated systems: “ascribing these human descriptors to emergent behaviour is in itself not helpful to its understanding or safe implementation”.

9.143 Others opposed the notion that automated vehicles should make trade-offs between different scenarios. Instead, they should stay out of “the crash zone”. As the ABI and Thatcham Research put it:

*We would oppose the introduction of any [ADS] that assigns different values to human lives. Automated vehicles should attempt to remain out of a crash zone at all times.*

9.144 Several others took this view:

*No, we do not believe ADSEs should be responsible for making ethical choices at all. They should be designed, and regulated, to avoid such 'ethical dilemmas' arising in the first place... AVs should not be authorised for public use until they can demonstrate a high level of reliability at avoiding collisions. [Cycling UK]*

*It would not be appropriate for an ADS to be capable of allocating different values to human lives. An ADS should simply seek to limit loss of life and serious injury in any circumstance that it encounters... [International Underwriting Association (IUA)]*

*Ethics policies and value allocated to human lives is hypothetical and should not be relevant to autonomous driving systems. If they are functioning correctly they should never arrive at a situation where there is a life and death decision required. [Andrew Catlin, Driving Skills Agency, personal response]*

9.145 The Faculty of Advocates pointed out that "there is no single right answer to the trolley problem". Therefore:

*... it is difficult to see what value there would be to knowing that, say, Ford cars would not mount the pavement to avoid a collision whereas Tesla cars would do so.*

#### Those who wanted a central authority to set ethics policies

9.146 Many respondents thought that ethics policies should be set by the Government, as they were too important to be determined by private companies. This view was held by those who answered "yes", as well as those who answered "no" or "other".

*Should the Government decide to allow autonomous vehicles, it should be up to the Government to specify the ethics policy.... This is too big for manufacturers to "wing it". [Bob Downie]*

*Ethical policy must be decided centrally by appointed expertise. It is not appropriate that vehicles can be purchased based on their ethical policies. [Euro Car Parts]*

*Ultimately, ethical considerations relating to the programming of [ADSs] should be a matter of public policy to ensure consistency and transparency of approach. Such standards should ideally be set at international level. [DAC Beachcroft LLP]*

9.147 Consultees expressed concern that ethics policies could be seen as brand management rather than genuinely helpful documents:

*Leaving ethics policies to manufacturers is dangerous territory, because this can become part of the marketing strategy and the 'brand DNA', with manufacturers competing to be the most attractive (e.g. cutting in more aggressively to save time, sacrificing other road users to protect the driver). [Transport Systems Catapult]*

*The statement would probably be primarily designed to persuade purchasers that they can drive with a clear conscience. [Transport Planning Society]*



9.148 The Faculty of Advocates queried whether purchasers should really be able to “specify the ethical system with which the car is programmed (for example, Benthamite ethics) alongside the paint colour and interior trim”.

9.149 FiveAI called on the Government to set the parameters:

*Any deliberate design decisions intended to promote the safety of one class of object over another (e.g. to prioritise the safety of people over animals) should be guided by a set of high level ethics principles which we suggest should be consistent across the industry and set and communicated by Government to reflect public values.*

9.150 In contrast, the National Franchised Dealers Association argued in favour of a free market approach, with consumers choosing vehicles partly on their ethical approach:

*We believe that under the provision of a competitive market, decisions regarding the ethics of ADS will continue to be improved and refined in response to market and reputation pressures.*

#### Would published ethics policies be understandable?

9.151 The Transport Safety Research Group raised questions about who would read published ethics policies. She saw the primary audience as the safety assurance body and, when required, the courts:

*If this was to be made publicly available, then it would have to be in a way that the general public could understand.*

9.152 The National Physical Laboratory (NPL) noted that the ethics policies of different operators/developers may be described in fundamentally different ways, making them hard to compare. Furthermore, they might not be accurate:

*Without sufficient testing to demonstrate that an autonomous vehicle’s sensors, perception system and decision-making system can readily interpret and respond to scenarios which match the requirements of any ethics policy, the value of such ethics policy is limited.*

9.153 FiveAI cautioned that published information “can and will be (in some cases, wilfully) misinterpreted by the media”:

*An analogy from elsewhere in the industry lies with the publication of disengagement reports, a requirement of the Department for Motor Vehicles in California. Where those reports are concerned, there is limited standardisation of reporting and testing environments, leaving developers room for interpretation as to how they report and gather their data. As a result, there is disagreement across the industry as to the value of such reporting, ranging from (at worst) those who consider it largely meaningless or even reckless from a public communications perspective, through to (at best) those who consider it imperfect but a valid proxy for comparing performance and driving behaviours of different developers’ systems.*

#### Q45: What other information should be made available?

9.154 Seventy-six respondents replied, making a wide variety of points. Three main themes emerged.

##### Maximum transparency

9.155 Several respondents argued for maximum transparency. For example, Matt Stephen said “everything”; Adrian Payne said that “all information” irrespective of intellectual property rights. Esure wanted “all testing and assessment outcomes” to be released to the general public, while the Motor Accident Solicitors Society asked for disclosure of “all monitoring, testing, development notes and policies”. M Mann suggested that all “algorithms and software” should “be published on open platforms”.

##### Collision data

9.156 Secondly, respondents asked for publication of the vehicle’s safety record. For example, the International Underwriting Association (IUA) asked for “statistics relating to the number of accidents caused or contributed to by the ADS”. Similarly, TfL wanted:

*records of accidents and also disengagements, to provide an accurate picture of the performance of the operating system. These records should provide sufficient detail to apportion blame/responsibility for the accidents and identify the responsible ADSE.*

9.157 Cycling UK also asked for this data to be published, but said it should not be a substitute to detailed investigation:

*... full transparency is required - particularly in early phases of the technology’s development - on numbers of disengagements and any other incidents. But the availability of data does not always correspond to good use of that data - the regulatory authority must have the resources behind it to conduct detailed, high quality investigations into both the developing technology, and any collisions that occur.*

9.158 Burges Salmon LLP felt that safety reporting had the potential to increase confidence:

*We note from the CCAV Code of Practice that CCAV encourages trialling organisations to share publishable forms of their safety case to engender greater public acceptance of the technology. A degree of safety reporting even once such vehicles reach the market could arguably continue to build public confidence and acceptance.*

##### Capabilities and limitations of the system

9.159 Thirdly, responses asked for information to educate the public on the capabilities and limitations of automated vehicles. For example, the Transport Planning Society wrote:

*The limitations of the system need to be made clear so that drivers are in no doubt about the degree of risk they will encounter in different situations. There should be clear guidelines on circumstances in which the system should not be used (e.g. poor visibility, absence of road markings, traffic signals not working).*

- 9.160 The International Underwriting Association (IUA) asked for both a “full and detailed disclosure of the capabilities of an ADS” together with “an extensive description of any update, including the improvements brought and whether the update is safety critical”.
- 9.161 The Transport Safety Research Group said there should be disclosure of “known performance limitations” (such as a vehicle not being able to “see” low level objects), “the safety record and results of crash testing” (e.g. EuroNCAP or equivalent relevant tests) and “conflicts of interest within the development phase”.

#### Information that should not be shared

- 9.162 A few respondents argued that additional information should not be shared. For example, BMW Group UK thought:

*No further information needs to be made available. Type approval should cover the necessary information. Internationally agreed safety guidelines should be established and communicated.*

- 9.163 Similarly, Trifords (trading as Auto Windscreens) were also concerned that manufacturers/developers should not be required to disclose intellectual property.

#### SHOULD THE REVIEW CONSIDER ANY OTHER ISSUES?

##### **Q46: Is there any other issue within our terms of reference which we should be considering in the course of this review?**

- 9.164 Around 100 consultees responded to this question. Here we explore three issues which arose in answers to question 46 and are not discussed elsewhere in this analysis. These are highway authority powers, labelling and maintenance (including software updates and repairs).

#### Highway authority powers

- 9.165 Around 10 respondents raised issues relating to highway authorities. TfL said that if autonomous vehicles become “a mass-market proposition”:

*consideration should be given to what changes in legislation would be required to enable Highway Authorities to introduce AV-only roads / lanes for example.*

- 9.166 Several respondents asked for a review of legislation in this area:

*There is legislation around roads operation and obligations on Local Highways and Highways England (e.g. Traffic Management Act, Road Traffic Act, Driver Information Act 1989) that needs to be reviewed. [Intelligent Transport Systems UK]*

*There are legal implications on roads authorities (e.g. Traffic Management Act, Transport Act, etc) that should be considered. [LAMBDA-V project]*

9.167 The Parking and Traffic Regulations Outside London (PATROL) joint committee and the Traffic Penalty Tribunal (TPT) discussed problems with the Road Traffic Regulation Act 1984 (RTRA) and procedure regulations (LATOR<sup>108</sup>):

*The RTRA has, for a long while, been out-of-date and the procedures in LATOR are cumbersome and require considerable expenditure on the part of the traffic authority. Neither are suitable legislation for responding to the challenges of regulating the use of the roads of the future.*

*PATROL's member authorities would welcome the initiative sparked by autonomous and connected vehicles to create new legislation, which would also give rise to invaluable efficiencies, as well as meeting the needs of all road users, whether in or out the vehicle.*

9.168 Centaur Consulting raised the issue of highway authority liability. They asked, "whether there are new aspects of negligence or inappropriate behaviour that could lead to a highways authority being deemed to have acted unlawfully".

### Labelling of AVs to distinguish from regular vehicles

9.169 One contentious issue not addressed in the Consultation Paper is whether automated vehicles should be clearly labelled, so that other road users realise that they are interacting with a robot. Driverless Futures summed up the issues:

*Some developers have claimed that, if vehicles are labelled, other road users may behave differently in their presence, stopping them from functioning properly.*

9.170 On the other hand, road users have a right to know what they are dealing with:

*A principle worth bearing in mind is Toby Walsh's so-called Turing Red Flag law ("An autonomous system should be designed so that it is unlikely to be mistaken for anything besides an autonomous system, and should identify itself at the start of any interaction with another agent.").<sup>109</sup> This point is also captured in one of the EPSRC's principles for robotics ("Robots are manufactured artefacts. They should not be designed in a deceptive way to exploit vulnerable users; instead their machine nature should be transparent.")<sup>110</sup>*

9.171 BMW Group UK also asked us to consider this issue. Visteon added that one should be able to identify whether the vehicle is in automated mode. The police, for example, might need to decide whether to stop a vehicle where the driver clearly has their hands off the steering wheel.

### Maintenance and repairs

9.172 Many consultees asked who would be responsible for failures to maintain vehicles. As the Senators of the College of Justice asked, "who is criminally or civilly liable for an

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<sup>108</sup> LATOR stands for Local Authorities' Traffic Orders (Procedure) (England and Wales) Regulations 1996.

<sup>109</sup> T Walsh, "Turing's red flag" (2015) arXiv preprint arXiv:1510.09033.

<sup>110</sup> <https://epsrc.ukri.org/research/ourportfolio/themes/engineering/activities/principlesofrobotics>.

accident if the ADS is inadequately maintained and that lack of maintenance leads to an accident?”<sup>111</sup> We intend to address this issue in our next Consultation Paper.

9.173 Oxbotica raised a “big question for the future”: whether manufacturers “are compelled to update all our machines forever”. This raises questions about how updates will be paid for, and how far manufacturers would be entitled to withdraw support for existing vehicles, potentially rendering them inoperable.

9.174 Euro Car Parts were concerned to ensure an open market in how automated vehicles are repaired and recalibrated. They suggested that an agency such as DVSA or British Standards Institute should commence discussions:

*on standards, processes and equipment for repairs and re-calibrations to autonomous vehicles and ADAS-assisted vehicles. Their terms of reference must include an imperative to ensure fair competition and effective market participation by SMEs so as to preserve adequate choice and cost-effective mobility for the consumer and vehicle owner.*

9.175 Similarly, the Garage Equipment Association (GEA) expressed concern that vehicle manufacturers would restrict the ability of independent operators to replace and recalibrate ADAS components.

9.176 By contrast, Aviva suggested “tamper proof systems to prevent non-accredited aftermarket repairs”. There is clearly a tension between ensuring a competitive aftermarket and allowing manufacturers to control repairs in the interests of safety.

9.177 The National Farmers Union Mutual Insurance Society (NFU Mutual) raised the need to protect those buying used automated vehicles. The British Vehicle Rental and Leasing Association and IAM RoadSmart also pointed out that buyers would need to know that an ADS is updated and “fit for its purpose”. They suggested an easily accessible summary of “all software updates and glitches that occurred”, through the life of the vehicle, “similar to a service history”.

## THE WAY FORWARD

### Adapting road rules for automated vehicles

9.178 The responses we received demonstrate the difficulties of adapting road rules to automated driving. This is not simply the technical challenge of replacing broad standards with determinate rules. It also raises policy issues of considerable public concern. As Driverless Futures put it, “the process of determining parameters will not be value-free nor objective, and needs to involve a wide consultation and likely further empirical evidence”.

9.179 The strong public concern about road rules is leading to a series of Government and regulatory initiatives. These include revisions to the Highway Code for vulnerable road

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<sup>111</sup> Others raising this issue included the ABI and Thatcham Research; Richard Hindes; DAC Beachcroft LLP, National Farmers Union Mutual Insurance Society.

users; the inquiry into pavement parking,<sup>112</sup> the Transport (Scotland) Bill 2019<sup>113</sup> and the Cats Bill currently before Parliament.<sup>114</sup>

9.180 These initiatives reveal a more general trend towards replacing standards with rules. In some cases, the new proposed rules set out quantitative measurements, for example in prescribing the minimum clearance for passing vulnerable road users. The introduction of automated driving is likely to increase this development. At this stage, we make the following suggestions.

### Promoting collaboration

9.181 We encourage Government to consider the feasibility of establishing a forum for collaboration on the application of road rules to self-driving vehicles.

9.182 It is important to manage expectations; a digital highway code that sets precise rules for every instance is not possible. It is impossible to predict all future scenarios in advance and an expectation that regulators should do this would place an impossible burden on them. In the same way, it is not desirable nor realistic to ask developers to deterministically prescribe the behaviour of ADSs in advance for every scenario.

9.183 However, it is possible to provide a more structured dialogue between developers and regulators, which allows developers to raise issues of concern. Regulators cannot provide rules, but they can set out broad principles for developers to follow. They can also ensure good information conduits with developers, so that systems can adapt to the many new initiatives in this area.

9.184 Areas where work could be usefully undertaken include:

- (1) Guidance on interpreting indeterminate terms in legislation and in the Highway Code.<sup>115</sup>
- (2) Identifying possible additions to the Highway Code to resolve conflicts between two automated vehicles (and which are currently resolved through non-standard communication between human drivers).

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<sup>112</sup> <https://www.parliament.uk/business/committees/committees-a-z/commons-select/transport-committee/news-parliament-2017/pavement-parking-launch-17-19/>

<sup>113</sup> Which will prohibit pavement parking and double parking in Scotland as well as some matters of bus regulation. See <https://www.parliament.scot/parliamentarybusiness/Bills/108683.aspx>. The British Parking Association noted that they are currently working alongside Guide Dogs UK, Living Streets and other organisations for the Government (DfT) to review and propose how a new law to end unsafe pavement parking would work.

<sup>114</sup> <https://services.parliament.uk/bills/2017-19/cats.html>. This would impose new duties on drivers to stop and report accidents which injure cats.

<sup>115</sup> Examples include Highway Code rules 144 to 158 that you must not drive dangerously, drive without due care and attention, drive without reasonable consideration of other road users, and Rules 204 to 225 relating to “road users requiring extra care”.

9.185 Several jurisdictions are now considering these issues, with useful precedents from Singapore<sup>116</sup> and the Netherlands.<sup>117</sup> A potential model could be to follow Singapore's approach by setting up a working group. This brings together a panel of developers and regulators, chaired by a respected independent expert. The aims of the group would be to promote

- (1) debate on how existing road rules apply to automated vehicles;
- (2) consistency between developers in how they interpret road rules;
- (3) public understanding of how conflicts in road rules are dealt with (e.g. circumstances where white lines may be crossed or mounting the pavement may occur).

9.186 The working group would report back to the public and a wide variety of interest groups to ensure appropriate input and representation of diverse societal interests.

9.187 The legal status of such a working group, its composition, processes for public engagement and status of its findings could be considered as part of the recommendations in our final report in 2021. Findings from this group would contribute to the safety assurance scheme for automated vehicles because compliance with road rules is a key aspect of promoting public safety.

### **Bias, transparency and ethics**

9.188 There was no consensus among consultees about the usefulness or feasibility of auditing training data of automated vehicles and publishing ethics policies. We note the considerable continuing research on ethics and new technologies.<sup>118</sup> We will draw on this work when we re-evaluate this issue in our third round of consultation in 2020.

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<sup>116</sup> See Singapore's Land Transport Authority work on the regulation of automated vehicles. On 31 January 2019 it published Technical Reference 68, Part I – Basic behaviour which describes road rules as subject to a hierarchy of importance, with safety as the primary objective and traffic flow as the secondary objective. It notes the need for "a shift in validation methods from ambiguous, subjective and qualitative references to definitive and quantitative measurements for the AV to follow". Its examples, such as crossing double white lines to overtake an illegally parked car, resonate with our questions about mounting the pavement.

<sup>117</sup> See <https://www.robbottuner.com/newsreader/driving-license-for-autonomous-vehicles.html>.

<sup>118</sup> See The Government's Data Ethics Framework (August 2018) and associated documents available at <https://www.gov.uk/government/publications/data-ethics-framework/data-ethics-framework>; the 'Driverless Futures' collaboration between University College London and UWE Bristol, funded by the UK Economic and Social Research Council <https://driverless-futures.com/>; University of York's Assuring Autonomy International Programme <https://www.york.ac.uk/assuring-autonomy/>.

## Abbreviations

**AA:** Automobile Association.

**ABI:** Association of British Insurers.

**ABS:** Anti-lock braking system.

**ADAS:** Advanced driver assistance system.

**ADEPT:** Association of Directors of Environment, Economy, Planning & Transport.

**ADS:** Automated driving system.

**ADSE:** Automated Driving System Entity.

**AEV Act:** Automated and Electric Vehicles Act 2018.

**ALBUM:** Association of Local Bus Managers.

**APIL:** Association of Personal Injury Lawyers.

**BIBA:** British Insurance Brokers' Association.

**BPA:** British Parking Association.

**BVRLA:** British Vehicle Rental and Leasing Association.

**CAV:** Connected and Autonomous Vehicle.

**CCAV:** Centre for Connected and Autonomous Vehicles.

**CIHT:** Chartered Institution of Highways and Transportation.

**CILEx:** Chartered Institute of Legal Executives.

**CPNI:** Centre for the Protection of National Infrastructure.

**CPT:** Confederation of Passenger Transport UK.

**CPS:** Crown Prosecution Service.

**DLG:** Direct Line Group.

**DPTAC:** Disabled Persons Transport Advisory Committee.

**DVSA:** Driver and Vehicle Standards Agency.

**FOCIS:** Forum of Complex Injury Solicitors.



**FOIL:** Forum of Insurance Lawyers.

**FTA:** Freight Transport Association.

**GEA:** Garage Equipment Association.

**IHE:** Institute of Highway Engineers.

**IUA:** International Underwriting Association of London.

**ITS:** Intelligent Transport Systems.

**MIB:** Motor Insurance Bureau.

**MPS:** Metropolitan Police Service.

**M&WBLAF:** Mid and West Berkshire Local Access Forum.

**MASS:** Motor Accident Solicitors Society.

**NPCC:** National Police Chiefs Council.

**NPL:** National Physical Laboratory.

**NFU Mutual:** National Farmers Union Mutual Insurance Society.

**NFDA:** National Franchised Dealers Association.

**ODD:** Operational Design Domain.

**OEM:** Original Equipment Manufacturer.

**OSRWC:** Office of the Scottish Road Works Commissioner.

**FACTS:** Parliamentary Advisory Council for Transport Safety.

**PATROL:** Parking and Traffic Regulations Outside London.

**RACE:** Remote Applications in Challenging Environments.

**RHA:** Road Haulage Association.

**SAE:** Society of Automotive Engineers International.

**SMMT:** Society of Motor Manufacturers and Traders.

**SEStran:** South East of Scotland Transport Partnership.

**SYSRP:** South Yorkshire Safer Roads Partnership.

**TfL:** Transport for London.

**TfWM:** Transport for West Midlands.

**TPT:** Traffic Penalty Tribunal.

**UK:** United Kingdom.

**UKAEA:** UK Atomic Energy Authority.

**UNECE:** United Nations Economic Commission for Europe.

**VCA:** Vehicle Certification Agency.

## Annex 1: Respondents

**The Association of British Insurers (ABI) and Thattham Research (joint response):** ABI is a trade association for insurers and providers of long-term savings.

Thattham Research is a not for profit research centre funded by insurers, with the aim of containing or reducing the cost of motor insurance claims whilst maintaining safety standards. It conducts research on vehicle safety, security and repair.

**Addison Lee Group:** A ground transport provider that offers private hire vehicle and courier services.

**Association of Directors of Environment, Economy, Planning & Transport (ADEPT) - Rights of Way Managers Working Group:** An association which represents directors from county, unitary and metropolitan authorities along with Local Enterprise Partnerships. They focus on issues such as roads, transport, environment, local economy and wellbeing. They represent members' interests by engaging central Government on policy and issues and supporting initiatives aimed at influencing Government policy.

The Rights of Way Managers Working Group is one of the working groups, within the ADEPT organisation. The response was provided by Paul Newark in his capacity as Chair of the Working Group and does not necessarily reflect the views of the wider ADEPT organisation.

**Ageas:** A multinational insurance company.

**AI:** A private individual.

**The Association of Local Bus Managers (ALBUM):** An association represents the remaining municipal and independent bus operators in the UK.

**Allen & Overy LLP:** An international law firm.

**Amey:** A UK based infrastructure support provider that works in the both the public and regulated sectors.

**Apollo Vehicle Safety:** A specialist engineering consultancy. Offering services related to forensic collision investigation, vehicle testing, data analytics and regulation and rating.

**Arcadis:** Arcadis is a global design, engineering and management consulting company.

**Association of Personal Injury Lawyers (APIL):** An organisation of legal professionals seeking to improve the services available to those who have suffered personal injury through no fault of their own.

**Automobile Association (AA):** A British motoring association which provides car insurance, driving lessons, breakdown cover, loans motoring advice, road maps and other automobile-associated services.

**Aviva:** A multinational insurance company.

**AXA UK:** The UK branch of the AXA, a multinational insurance company.

**AXA XL:** The “P&C” and specialty risk division of the multinational insurance company, AXA.

**Bar Council of England and Wales (the Bar Council):** An organisation that represents barristers in England and Wales.

**Barclay, Ian:** A private individual

**Bentley Motor Cars:** A UK manufacturer of luxury automobiles.

**Bevan, Nicholas:** A consultant solicitor with significant experience in the motor insurance field. Associated with Nota Bene Legal Consulting.

**Big Voice London - Model Law Commission:** A social mobility and youth empowerment charity, promoting access to the legal profession. The Model Law Commission is a project run by Big Voice which involves high school students mirroring the work of the Law Commission and producing a report.

**BMW Group UK:** The UK branch of the German multinational automobile and motorcycle manufacturer, BMW.

**Bradshaw-Martin, Heather G:** A private individual associated with Humanity in Motion.

**Brake:** An international charity that supports victims of road incidents and aims to prevent road deaths and injuries through its campaigns.

**Brayshaw, Lyn:** A private individual.

**British Horse Society:** A charity which conducts campaigns and initiatives to make a positive impact on the lives of horses and horse owners.

**British Insurance Brokers' Association (BIBA):** A general insurance intermediary organisation representing the interests of insurance brokers, intermediaries and their customers.

**British Parking Association (BPA):** An organisation that represents and promotes the traffic management profession throughout the UK and Europe. It has a membership that includes more than 750 organisations and individuals including local authorities, car park operators, retail parks, healthcare facilities, universities and railway stations.

**British Vehicle Rental and Leasing Association (BVRLA):** A trade body representing companies engaged in vehicle rental, leasing and fleet management.

**Broadbent, Michael:** Associated with the Milton Keynes Cycling Forum. Responding in a personal capacity.

**Brown, Peter:** Associated with the Barra Distillery. Responding in a personal capacity.

**BTO Solicitors LLP:** A Scottish law firm.

**Buchanan Computing and the Institute of Highway Engineers (IHE) (joint response):** Buchanan Computing is a company specialising in software for traffic engineering and highway management and in web mapping, cloud computing and training.

IHE is the professional institution for those practicing highway and traffic engineering. They also provide professional development and award qualifications.

The response is a joint response submitted by Simon Morgan of Buchanan Computing who is also a member of the IHE Traffic Signs Panel.

**Burges Salmon LLP:** An international law firm.

**Catlin, Andrew:** Associated with Driving Skills Agency. Responding in a personal capacity.

**CAVT:** An automotive technology research consultancy and micro-business. It provides services to a wide range of clients in the finance, automotive, petrochemicals, metals, media and communications sectors.

**Centaur Consulting:** A company offering business management consultancy services.

**Chan, Eric:** Associated with CAVPoint. Responding in a personal capacity.

**Chaplin, Alistair:** Associated with OneSails. Responding in a personal capacity.

**Chapman, Kevin:** A private individual.

**Chartered Institute of Legal Executives (CILEx):** The professional body for Chartered Legal Executives in England and Wales.

**Chartered Institution of Highways and Transportation (CIHT):** A charity that represents and qualifies professionals who plan, design, build, manage and operate transport and infrastructure.

**Confederation of Passenger Transport UK (CPT):** A trade association which represents firms, sole traders and partnerships who currently operate buses and coaches.

**Croker, Michael David:** A private individual.

**Crown Prosecution Service (CPS):** The principal public prosecuting agency which prosecutes criminal cases that have been investigated by the police and other investigative organisations in England and Wales.

**Cuervo, Florencio:** Associated with LEVE. Responding in a personal capacity.

**Cycling Scotland:** Cycling Scotland is the nation's cycling organisation. They attempt to work with others to create and deliver opportunities and an environment so anyone anywhere in Scotland can cycle easily and safely.

**Cycling UK:** A charitable membership organisation which supports cyclists and promotes bicycle use.

**DAC Beachcroft LLP:** An international law firm.

**Davies, Chief Inspector Adrian:** Associated with the Warwickshire and West Mercia Police. Responding in a personal capacity.

**DeafblindUK:** A charity which supports people with combined sight and hearing loss and enables them to live the lives they want.

**Direct Line Group (DLG):** An insurance company based in the UK.

**Disability Equality Scotland:** An organisation working to achieve full access and inclusion for every disabled person in Scotland.

**Disabled Persons Transport Advisory Committee (DPTAC):** Advises the Government on legislation, regulations and guidance and on the transport needs of disabled people, ensuring disabled people have the same access to transport as everyone else.

**Downie, Bob:** A private individual.

**Driverless Futures:** The Driverless Futures project is a social science research collaboration between University College London and UWE Bristol and is funded by the UK Economic and Social Research Council. They aim to work with people in the automated car industry and with public groups to examine issues related to automated vehicles.

**Economides, George:** Associated with the Oxfordshire County Council. Responding in a personal capacity.

**Enterprise Holdings:** Enterprise Holdings and its affiliates offer car rental, carsharing, truck rental, fleet management, retail car sales and other transportation services.

**Esure:** An internet and telephone based insurance company.

**Euro Car Parts:** A distributor of car parts and accessories with over 200 locations across the UK and Ireland.

**Faculty of Advocates:** An independent body of lawyers who have been admitted to practise as advocates before the courts of Scotland.

**FiveAI:** A company engaged in developing automated driving systems.

**Flower, Jonathan:** Associated with the Centre for Transport and Society (CTS) at the University of the West of England (UWE) Bristol. Responding in a personal capacity.

**Forum of Complex Injury Solicitors (FOCIS):** A UK-based forum of personal injury and medical negligence solicitors.

**Forum of Insurance Lawyers (FOIL):** A representative organisation for the defendant insurance lawyer community.

**Freight Transport Association (FTA):** A trade association of freight transporters who move goods by road, rail, sea and air.

**Garage Equipment Association (GEA):** An association which accredits garage equipment engineers, creates industry standards for equipment engineering and acts as an arbitrator for the industry.

**Geraghty, James:** A private individual.

**Glassbrook, Alex:** A barrister at Temple Garden Chambers, specialising in the law around automated vehicles. Responding in a personal capacity.

**GoBike:** A cycle campaign group based in Glasgow.

**Goodwin, Professor Phil:** Emeritus Professor of Transport Policy at University College London (UCL) and at the University of the West of England (UWE). Responding in a personal capacity.

**Gowling WLG (UK) LLP:** The UK member of Gowling WLG, an international law firm.

**Hardy, Jacob:** A private individual.

**Hatton, Dean:** Executive Business Manager, National Police Chiefs Council (NPCC) Roads Policing. Responding in a personal capacity.

**Highways England:** The Government-owned company charged with operating, maintaining and improving England's motorways and major A roads.

**Hindes, Richard:** A private individual.

**Hudleston, Robert:** Associated with HAUC(UK) training and accreditation. Responding in a personal capacity.

**Humanising Autonomy:** A technology company that creates human-centred tools that define how autonomous systems interact with people.

**Hunter, David:** A self-employed consultant at Not for Profit Planning, Edinburgh. Responding in a personal capacity.

**IAM RoadSmart:** A road safety charity whose objective is to improve car driving and motorcycle riding standards and to enhance road safety.

**If you look and If Vehicles:** If you look at it this way is a company which helps other companies develop their relationships with Government. If vehicles is a manufacturer of "micro-vehicles". The response was submitted by their chief executive, Bill Clare.

**Institute and Faculty of Actuaries:** The professional body which represents and regulates actuaries in the UK.

**International Underwriting Association of London (IUA):** An association that represents international and wholesale insurance and reinsurance companies operating in or through London.

**Intelligent Transport Systems UK (ITS UK):** A not-for-profit association which aims to promote intelligent transport systems. It provides a forum for all organisations concerned with such transport systems.

**Jacobs:** A design, engineering, construction and technical services firm.

**Kennedys Law LLP:** An international law firm.

**KPMG LLP:** An international professional service firm that provides audit, tax and advisory services.

**Kyd, Sally Professor:** Professor of Law at the University of Leicester. Responding in a personal capacity.

**LAMBDA-V project:** A project aimed at collecting data on informal rules of the road to help train automated vehicles. Their response was submitted by Andrew Graham of White Willow Consulting on behalf of the LAMBDA-V project.

**Law Society of Scotland:** The professional body for Scottish solicitors.

**Living Streets Hackney:** A local residents group that aims to improve Hackney's streets and public space for uses including walking, socialising, resting, playing and exercising.

**London Cycling Campaign:** A membership based charity that aims to give a voice to everyone who cycles, or wants to cycle, in Greater London.

**London Living Streets:** A group which seeks to make London one of the world's best cities for walking. They campaign for better walking conditions, safer streets and improvement of the city's public spaces.

**Macfarlane, Edward Christian:** Associated with Abbott Risk Consulting (ARC). Responding in a personal capacity.

**Magistrates Association:** A registered charity and member based association for magistrates in England and Wales. It seeks to provide a voice for Magistrates, promote the magistracy and provide further training for the role.

**Mann, M:** A private individual.

**McLaren Applied Technologies:** A company that develops technologies for the motorsport, automotive, public transport and health industries.

**Meridian Mobility UK:** A Government-backed and industry led brand for the development of CAV technology in the UK. It is now known as Zenzic.

**Met Office:** The UK's national weather service

**Metropolitan Police Service (MPS):** The territorial police force responsible for law enforcement in the Metropolitan Police District, which consists of the 32 London boroughs.

**Metz, Professor David:** Associated with University College London (UCL). Responding in a personal capacity.



**Mid and West Berkshire Local Access Forum (M&WBLAF):** A local access forum for Mid and West Berkshire. This statutory body advises decision making organisations, like local authorities, about making improvements to public access for outdoor recreation as well as sustainable travel.

**Miller, Peter:** A private individual.

**Mills & Reeve LLP:** An international law firm.

**Mobileye:** A company that develops advanced driver-assistance systems.

**Morris, Richard:** Associated with Innovate UK. Responding in a personal capacity.

**Motor Accident Solicitors Society (MASS):** A national association of motor accident solicitors who represent victims of road traffic accidents.

**National Farmers Union Mutual Insurance Society (NFU Mutual):** A UK registered mutual insurance composite.

**National Federation of the Blind UK:** A national membership organisation of blind and partially sighted people working and campaigning on behalf of other in the UK with similar difficulties.

**National Franchised Dealers Association (NFDA):** An association which represents franchised car and commercial vehicle dealers in the UK.

**National Physical Laboratory (NPL):** The national measurement standards laboratory for the UK.

**Neckermann Strategic Advisors:** A consultancy firm specialising in automated vehicles and future mobility.

**Nominet:** The company that runs the .UK domain name registry. They also provide expertise in relation to running and protecting critical internet infrastructure and cybersecurity.

**The Office of the Scottish Road Works Commissioner (OSRWC):** Monitors the performance of utility companies and road authorities in Scotland and promotes good practise.

**OmniCAV:** A project to create high-fidelity simulations for AV testing.

**Ordnance Survey:** The national mapping agency of the UK.

**Osmon, Emeritus Professor Peter:** Associated with the Campaign for Better Transport (London). Responding in a personal capacity.

**Oxbotica:** An Oxford-based autonomous vehicle software company.

**The Parliamentary Advisory Council for transport Safety (PACTS):** A registered charity that supports the All-party Group for transport safety. It advises Members of the House of Commons and the House of Lords on air, rail and road safety issues.

**Paris, Jean-Francois:** A private individual.

**Parkin, Professor John:** Associated with the University of the West of England (UWE), Bristol. Responding in a personal capacity.

**Paths for All:** A Scottish charity that promotes everyday walking.

**Parking and Traffic Regulations Outside London (PATROL) joint committee and the Traffic Penalty Tribunal (TPT):** A committee comprised of over 300 local authorities in England (outside London) and Wales. It has a statutory duty to make provision for the independent adjudication of parking and traffic penalties issued under the Traffic Management Act 2004. This adjudication is carried out via the Traffic Penalty Tribunal (TPT).

**Payne, Adrian:** A private individual.

**Phillips, Ben:** A private individual.

**Pinsent Masons LLP:** An international law firm.

**Police Scotland:** The national police service of Scotland.

**Propelmee:** A company that builds globally scalable self driving technology.

**RAC:** A UK automotive services company.

**RAC Foundation:** A transport policy and research organisation which explores the economic, mobility, safety and environmental issues relating to roads and their users.

**Remote Applications in Challenging Environments (RACE) of the UK Atomic Energy Authority (UKAEA):** A facility that conducts research and development and commercial activities in the field of robotics and autonomous systems, as part of the UKAEA

**Raemy, Olivier:** Lawyer, Federal Department of the Environment, Transport, Energy and Communications (DETEC), Switzerland. Responding in a personal capacity.

**Rainbird, John:** A private individual.

**Ratcliffe, Steve:** A private individual.

**Readhead, Rosalind:** A private individual associated with Ban Private Cars in London.

**Reimer, Professor Bryan:** Associated with the Massachusetts Institute of Technology (MIT) Centre for Transportation and Logistics AgeLab. Responding in a personal capacity.

**Road Danger Reduction Forum:** A forum run by local authority professionals associated with; transport planning, the promotion of cycling and walking, urban design, and safety education training. Its members seek to reduce road danger for all road users by identifying and controlling the principal courses of threat. They also seek to promote cycling, walking, and better public transport.

**Road Haulage Association (RHA):** A trade association dedicated to the interests of the road haulage industry.

**Ronald, Brian:** A private individual.

**Salmon, David:** A private individual.

**Sarginson, Richard:** A private individual.

**Scott, Martin:** A private individual.

**Senators of the College of Justice:** The group of judges who sit in the Court of Session and the High Court of Justiciary in Scotland.

**Shah, Anoop:** A private individual.

**Sheffield University Law Students:** A group of law students from Sheffield University.

**Society of Motor Manufacturers and Traders (SMMT):** A trade association which promotes the interests of the UK automotive industry.

**South East of Scotland Transport Partnership (SEStran):** The statutory Regional Transport Partnership for the South East of Scotland. It encompasses eight local authorities: City of Edinburgh, Clackmannanshire, East Lothian, Falkirk, Fife, Midlothian, Scottish Borders and West Lothian.

**South Yorkshire Safer Roads Partnership (SYSRP):** A group of local authorities, emergency services and public sector organisations from across South Yorkshire. They aim to reduce the number of people killed or seriously injured in collisions on South Yorkshire roads via road safety education, enforcement of road traffic laws and safer road infrastructure.

**Squire Patton Boggs LLP:** An international law firm.

**Stagecoach Group:** A transport group based in Scotland that operates buses, trains, trams and express coaches in the UK.

**Stephan:** A private individual.

**Stephen, Matt:** A private individual.

**Stewarts Law LLP:** A law firm based in the UK.

**Sustrans:** A UK based sustainable transport charity. It aims to make it easier for people to walk and cycle.

**Taylor, Sascha:** Private individual.

**techUK:** A UK based trade association of more than 900 technology related companies.

**Tennant, Dr Chris:** Associated with the London School of Economics and Political Science (LSE). Responding in a personal capacity.

**The Floow:** A telematics provider that works with insurance companies, automotive manufacturers and fleet operators.

**Thompsons Solicitors LLP:** A personal injury law firm based in the UK.

**Transport Canada:** A department within the Government of Canada, responsible for transportation policies and programs.

**Transport for London (TfL):** The integrated transport authority responsible for the day-to-day operation of London's public transport network and London's main roads.

**Transport for West Midlands (TfWM):** Part of the West Midlands Combined Authority which has been set up to: co-ordinate investment, improve the region's transport infrastructure, and create a fully integrated, safe and secure network.

**Transport Planning Society:** The professional body for transport planners.

**Transport Safety Research Group:** A research group within the Design School of Loughborough University. The response was submitted by Rachel Talbot on behalf of the group, it does not represent Loughborough University as a whole.

**Transport Systems Catapult:** Founded in 2013 as part of the wider Catapult programme; a Government-supported network of elite technology and innovation centres. It has now been combined with Future Cities Catapult to form Connected Places Catapult.

**Society of Motor Manufacturers and Traders (SMMT):** A trade association which promotes the interests of the UK automotive industry.

**Trifords (trading as Auto Windscreens):** An automotive glass repair and replacement company. They also perform calibration services.

**TRL:** Established as the UK's transport research laboratory. It is now a fully independent private company offering a transport consultancy and research service to the public and private sector

**Uber:** A multinational transportation network company. They offer services such as peer-to-peer ridesharing, ride hailing and food delivery.

**University of Lincoln:** This response from the University of Lincoln was submitted by Dr Charles Fox, an academic and senior lecturer at the University's school of Computer Science. His research looks at agricultural robotics, autonomous vehicles, pattern recognition and data.

**University of York:** Submitted by Professor Arvind Thiruvallore Thattai in his capacity as the University of York's research lead for the theme of Risk, Evidence, and Decision-making. The response itself is the product of a multi-disciplinary workshop focused on the consultation, with input from Computer Science (Automated Systems), Law, Management, Philosophy, and Sociology (Science and Technology Studies).

**Vernon, Lesley:** Associated with JRM Group. Responding in a personal capacity.

**Visteon:** A global automotive electronics supplier.

**Volvo Car Corporation:** A Swedish automobile company.

**Wakeling, Sam:** A private individual.

**Watson, Brian:** Associated with Trumpet911. Responding in a personal capacity.

**Wayve Technologies:** A company that develops AI systems for “self-driving” cars.

**Weightmans LLP:** A UK law firm.

**XPI Simulation:** A company that designs and manufactures a range of simulator systems for driver training and research applications.

**Zurich Insurance (UK):** The UK branch of Zurich, an international insurance company.