GOV.UK

Centre for Connected and Autonomous Vehicles

Consultation outcome

Self-driving vehicles: new safety ambition – summary of responses and government response

Updated 9 May 2024

Contents

This publication is available at https://www.gov.uk/government/consultations/self-driving-vehicles-new-safety-ambition/outcome/self-driving-vehicles-new-safety-ambition-summary-of-responses-and-government-response

Executive summary

This document summarises the responses to the Department for Transport (DfT) consultation on the proposed safety ambition for self-driving vehicles as published in Connected and automated mobility 2025: realising the benefits of self-driving vehicles (CAM 2025) (https://www.gov.uk/government/publications/connected-and-automated-mobility-2025-realising-the-benefits-of-self-driving-vehicles).

The safety ambition is part of a comprehensive legislative and safety framework for self-driving vehicles set out in CAM 2025 and introduced as part of the Automated Vehicles Bill in the House of Lords on 8 November 2023.

The Bill will enable the safe deployment of self-driving vehicles. It will deliver one of the most comprehensive legal frameworks of its kind anywhere in the world for self-driving vehicles, with safety at its core, and cement the UK's position as a global leader in this high tech, and high growth industry. The Bill will also release the huge growth potential of this sector, which will allow us by 2035 to create a UK market of up to £42 billion and create 38,000 skilled jobs.

This new legal and safety framework is based on a 4-year project by the Law Commission of England and Wales and the Scottish Law Commission (the Law Commissions). This review included consultation on several options for a safety threshold for self-driving vehicles. The Law Commissions concluded that an acceptable level of safety is determined by the public's acceptance of risk and that it is essentially a political question, best taken by ministers.

As seen in Reported road casualties Great Britain, annual report: 2022 (https://www.gov.uk/government/statistics/reported-road-casualties-great-britain-annual-report-2022), we have some of the safest roads in the world and the fourth safest in Europe.

In 2022, 1,711 people were killed on our roads. This is equivalent to over 4 people a day, 33 people a week or 143 people a month losing their lives. This, and the 28,000 people who are seriously injured every year, is unacceptable.

Self-driving vehicles have the potential to make transport safer, more convenient and more accessible, improving the lives of millions of people. Driver assistance technologies in vehicles are already improving safety on our roads. The European New Car Assessment Programme (Euro NCAP) and the Australasian New Car Assessment Program (ANCAP) assessed that vehicles fitted with low-speed advanced emergency braking (AEB) had a 38% reduction in real-world rear-end crashes compared to a sample of equivalent vehicles with no AEB (https://www.euroncap.com/en/press-media/press-releases/study-confirms-high-effectiveness-of-low-speed-autonomous-emergency-braking-aeb/). Because human error is a significant factor in many road collisions, self-driving technologies have the potential to further improve safety.

The Institute for Engineering and Technology (IET) claims that for every 10,000 errors made by drivers, a self-driving vehicle will commit just one (https://www.theiet.org/media/3449/autonomous.pdf). This is supported by evidence showing that in 2020, 88% of all recorded collisions on roads in Great Britain involved human error as a contributory factor (https://www.data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data).

The safety ambition aims to provide a clear focus for government and industry as self-driving vehicles are developed and deployed and to provide an understandable aim to support public acceptance. It must balance innovation, safety and public acceptability, and will set the tone for the development of the detail of the safety framework. For example, developing technical approval requirements for vehicles prior to deployment, and in-use operational requirements to ensure continued safety.

The following safety ambition was proposed:

> “ Government believes that self-driving vehicles should be held to the same high standard of behaviour as that expected of human drivers. Current law expects human drivers to be competent and careful. Self-driving vehicles should, therefore, be expected to achieve an equivalent level of safety to a competent and careful human driver. This is safer than the average human driver.”

The consultation asked for final views on the proposal.

The responses to the consultation were analysed to identify key themes and to assess whether respondents were in support of the proposal. A majority of respondents (56%) were assessed as supporting the ambition, 5% were assessed as neutral and 39% were assessed as not supportive. Of those who were assessed as not supportive, none expressed the view that the ambition was too stringent, some interpreted the ambition to be less stringent than the government’s interpretation and others sought a more stringent approach.

A common ask across both those who supported the ambition and those who did not was for further clarity on what a level of safety equivalent to a competent and careful human driver means in practice, and a common theme was the need for detailed regulation to ensure self-driving vehicle safety.

The Automated Vehicles Bill requires the government to publish a statutory ‘statement of safety principles’ for use in assessing self-driving vehicles. These must be framed with a view to securing that authorised self-driving vehicles achieve a level of safety equivalent, or higher than, that of careful and competent human drivers. These principles will be developed with stakeholders and will provide more detail explaining what is meant by this term as well as providing guidance to industry on how they should embed this standard. These principles will, in turn, be used to shape the technical assessments supporting

the legal and safety framework for self-driving vehicles. All statutory guidance and secondary legislation will be subject to consultation.

Other themes raised by respondents, and set out here, include the importance of considering vulnerable road users (VRUs) and other road users when developing self-driving vehicle safety measures. Several respondents also highlighted the importance of education and training for road users to ensure self-driving vehicle safety. Respondents also provided detailed comments on more technical issues such as cybersecurity, infrastructure and safety data. These comments and views are being taken into account in detailed policy development.

On the basis of the consultation responses, and after review of the more detailed themes raised by respondents, the safety ambition for self-driving vehicles will be retained as an equivalent level of safety to that of competent and careful human drivers. This is reflected in clause 2 of the Automated Vehicles Bill.

Introduction

Self-driving vehicle safety ambition consultation

This paper is the government response to the consultation on a proposed safety ambition for self-driving vehicles. This consultation was set out as part of Connected and automated mobility 2025: realising the benefits of self-driving vehicles in the UK (CAM 2025) (https://www.gov.uk/government/publications/connected-and-automated-mobility-2025-realising-the-benefits-of-self-driving-vehicles), published in August 2022.

The following ambition was proposed:

> “ Government believes that self-driving vehicles should be held to the same high standard of behaviour as that expected of human drivers. Current law expects human drivers to be competent and careful. Self-driving vehicles should, therefore, be expected to achieve an equivalent level of safety to a competent and careful human driver. This is safer than the average human driver.”

Government asked for views on the proposal that self-driving vehicles should be expected to achieve an equivalent level of safety to that of a competent and careful human driver. This paper outlines the responses to that consultation and sets out the government’s response.

Background

In 2018, government asked the Law Commission of England and Wales and the Scottish Law Commission (the Law Commissions) to conduct a review of legislation to prepare for the safe introduction of self-driving vehicles on GB roads. This world-leading review concluded in January 2022 with the publication of a report with 75 recommendations to government (https://lawcom.gov.uk/project/automated-vehicles/) which, taken together, set out a new regulatory framework for self-driving vehicles.

The review involved extensive consultation across the self-driving vehicle landscape, including manufacturers, insurers, academics, and civil society. The Law Commissions' recommendations were supported by 3 rounds of consultation between November 2018 and December 2020, involving 404 written responses and 350 meetings with interested parties.

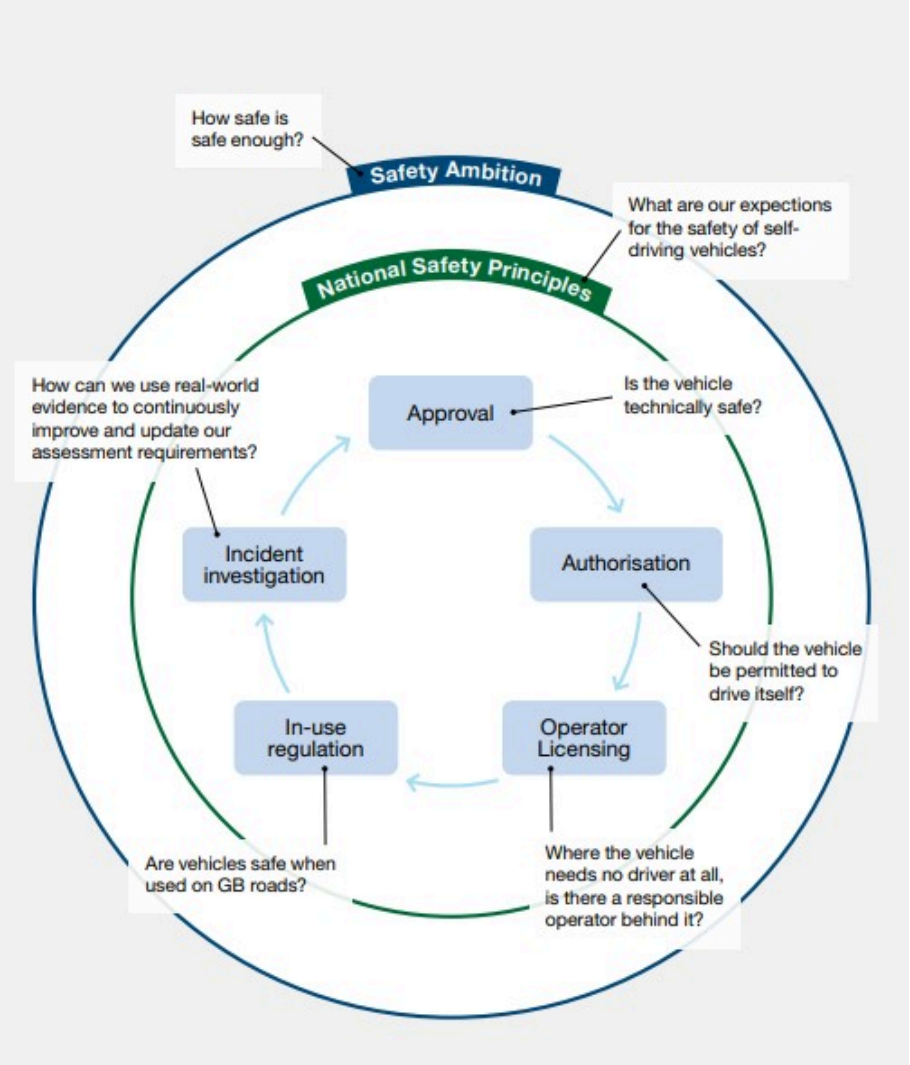
The evidence is clear that realising the potential of self-driving vehicles is only possible if DfT also transforms the way to ensure safety. Government's plans for a comprehensive legislative and safety framework for self-driving vehicle were set out in the CAM 2025 paper and, more recently, the Automated Vehicles Bill.

With the Automated Vehicles Bill providing the right regulation, the right investment, and the right support for our home-grown innovators; the UK could capture as much as £42 billion of the market by 2035.

This is a hugely competitive sector internationally. We have the opportunity to put the UK on the front foot. Providing the certainty and confidence that the private sector needs to unlock research, innovation and investment in this exciting new technology and while realising the safety benefits self-driving vehicles can bring.

A summary of the proposed safety framework is set out below.

The self-driving vehicle safety framework



The self-driving vehicle safety framework will be guided by a high-level safety ambition for self-driving vehicles, which will be expanded upon in the ‘statement of safety principles’ (previously known as the National Safety Principles) as introduced in the Automated Vehicles Bill. Driving systems will be assessed against safety requirements, most often through approval to either national or international technical standards.

Vehicles with self-driving systems will be assessed at authorisation to determine whether they should be permitted to drive themselves in at least some circumstances or situations. This will include identifying the organisation responsible for the vehicle when it is driving itself.

Where the vehicle requires no driver at all, the government intends to identify a responsible operator who must be licensed to oversee the vehicle’s operation. Government intends to monitor the continuing safety of a self-driving vehicle through in-use regulation, and issue sanctions to the responsible organisation(s) if standards fall below those set out in the statement of safety principles or in wider regulation.

If a specific incident of concern occurs, or a significant negative trend is identified, a road safety investigatory capability for self-driving vehicles may also investigate and identify improvements, which will be fed back into the

safety framework. The framework, as a whole, creates a safety feedback loop that provides for continuous learning throughout the life of a self-driving vehicle.

What constitutes an acceptable level of safety

Safety is the first priority for the development and introduction of self-driving vehicles. Wider benefits will not be realised if the technologies are not safe. It is, therefore, essential that self-driving vehicles meet a publicly acceptable level of safety.

The question of what an appropriate level of safety is has attracted significant debate and was addressed by the Law Commissions in their review. Having consulted on several options, the Law Commissions concluded that an acceptable level of safety is determined by the public's acceptability of risk and that it is, essentially, a political question, best taken by ministers. The Law Commissions also concluded that there is no single or easy test for whether a vehicle is safe enough to meet public acceptability.

Self-driving vehicles could make transport safer, more convenient and more accessible, improving the lives of millions of people. With 88% of collisions currently involving human error, the potential for automated vehicles to reduce costs, injuries and fatalities is enormous. Wider social benefits could include better connectivity for rural communities, reducing isolation for people with disabilities and older people, helping deliver essential goods and improving access to education, work and leisure.

Government is keen to realise the potential safety benefits of self-driving vehicles as soon as possible to prevent needless injuries and deaths. To achieve this, the safety requirements must not be set at a level that stifles innovation or sacrifices near-term safety improvements. Equally, requirements should be high enough to avoid the safety benefits being very low or non-existent. The proposed ambition aims to strike the right balance between safety and innovation, supporting innovation to realise the safety and societal benefits that self-driving vehicles can bring while maintaining public trust in, and hence the acceptability of, the technology.

The ambition is designed to set the aim for the whole safety framework for self-driving vehicles and will be expanded on in the Statement of Safety Principles set out in the Bill. Historic road safety ambitions and standards have changed over time and adapted as new technologies have developed. Setting the principles out in statutory guidance enables them to be changed over time in response to technological development or public opinion. Further detail on how the ambition will be applied in practice is being developed and will be consulted on in secondary legislation.

Consultation responses

The safety ambition consultation ran for 8 weeks, from 19 August 2022 to 14 October 2022, and received a total of 74 responses, of which 69 were included in the analysis (5 responses were removed as these were either duplicates or blank).

The consultation asked for views on the government's proposed safety ambition for self-driving vehicles. This document summarises the responses, which have been anonymised or omitted where permission for publication was not provided.

The identification of particular suggestions does not mean that the government will necessarily take them forward. Similarly, the absence of a suggestion from this report does not mean it will not be considered. Government continues to gather evidence, engage with stakeholders and further develop policy in this emerging area.

Methodology for analysis of responses

The consultation question was open-ended, seeking views on government's proposal. A thematic analysis of responses was undertaken and focused on identifying the key themes raised in the responses. Our analysis also considered whether or not responses were broadly supportive of the proposal, based on the views and comments expressed in the responses.

We have set out the overarching themes raised in the consultation responses and, where possible, provided comments and/or highlighted relevant current work and future plans.

Overview of respondents

Responses to the consultation were received via email, online survey and post. Of the 69 analysed responses, 38 were from organisations and 31 were from individuals. Responses were received from a range of organisation types, with the highest proportion coming from research, consultancy and professional organisations (10 responses), legal organisations (7 responses) and safety and road user groups (5 responses). See figure 1 for a full breakdown.

Figure 1: type of organisations that responded

As depicted in figure 2, a total of 37 reported their main location as England, 2 as Scotland, and 23 as the UK. Responses were also received from the US, the Netherlands and Germany.

Figure 2: reported respondent locations

Assessment of attitude towards proposed safety ambition

Figure 3: assessment of support for proposed safety ambition

As shown in figure 3, of the 66 relevant responses (3 did not contain enough information to allow assessment) about the statement published in CAM 2025 saying that government's proposed safety ambition that self-driving vehicles would be expected to achieve an equivalent level of safety to that of a competent and careful human driver:

- 56% were assessed as positive
- 39% were assessed as negative
- 5% were assessed as neutral

When looking at those responses from organisations or bodies representing multiple stakeholders (as opposed to individuals), 73% were assessed as being positive about the proposed safety ambition.

On the basis of this analysis, including the findings from the thematic analysis reported on below, the safety ambition for self-driving vehicles will be retained as an equivalent level of safety to that of competent and careful human drivers.

Key themes

Safety ambition

The vast majority of responses addressed the safety ambition directly. A high proportion of respondents expressed the view that self-driving vehicles should be as safe as a careful and competent driver or must be safer than human drivers. Some respondents added additional caveats to their support. For

example, specifying that the comparator for self-driving vehicles should be an average human driver in charge of a modern vehicle fitted with advanced driver assistance systems (ADAS), or that self-driving vehicles should be as safe as possible.

Several respondents sought a higher level of ambition, eliminating all deaths and serious injuries while, conversely, other respondents highlighted that setting higher safety standards could restrict technology development. Some respondents expressed concern about the ability of self-driving technology to meet the standard of a competent and careful driver. Others expressed concern that self-driving vehicles that are equivalent to a careful and competent human driver would not reduce the number of collisions.

A respondent also highlighted the risk of reputational damage if a low safety standard were set.

CAM 2025 highlighted that balancing safety, innovation and public expectations is challenging, and must be considered carefully in the context of technologies that are still under development and about which public understanding is still being built.

It is government's view that a competent and careful driver is safer than the average human driver – which includes, for example, drivers who are fatigued, distracted or under the influence of drink or drugs. The standard of a competent and careful driver will, therefore, capitalise on the huge safety potential of self-driving vehicles, ensuring improved safety on our roads and thereby supporting public trust and acceptability.

A higher level of ambition at this point could stifle the introduction of the technology and sacrifice safety improvements. A lower level of ambition would not deliver a publicly acceptable level of safety and risk undermining the introduction and uptake of the technology. This ambition is, therefore, deemed to be the appropriate level to deliver safety benefits from self-driving vehicles as soon as possible, but it has the potential to be revised in future as technologies advance still further.

A small number of respondents specifically raised concerns about their perceived differences between criminal and civil thresholds, with one stating that the criminal standard of careful and competent is 'materially lower' than the civil standard for the safety of consumer products.

Self-driving vehicles must achieve a certain level of both product safety and driving performance. The proposed safety ambition uses an outcome-based approach and sets the minimum rather than maximum level of safety for driving performance. Product safety legislation will also still have a place, as part of our type approval and authorisation processes, with products tested to relevant safety standards.

As set out in CAM 2025, the purpose of the safety ambition for self-driving vehicles is to provide a clear focus for government and industry as self-driving vehicles are developed and deployed and to provide an understandable aim to support public acceptability. It is one part of a wider framework and will complement the detailed, clear and verifiable technical requirements for pre-deployment approval and in-use operation.

These technical requirements are being developed as part of the CAVPASS programme (https://www.gov.uk/guidance/connected-and-automated-vehicles-process-for-assuring-safety-and-security-cavpass) in discussions with stakeholders. We intend to consult on these and on proposed secondary approval and authorisation regulations for self-driving vehicles in due course.

Other internationally recognised standards such as ISO standards may also be used to ensure an appropriate level of safety during product development.

However, not every aspect of a system or every scenario that system might encounter can be tested by government. For those aspects not subject to detailed testing, the safety ambition provides a safety backstop. Those organisations in charge of the self-driving feature will be held accountable against the ambition in every scenario. It should be integrated into an organisation's safety culture as a level their self-driving vehicles should never fall below. If vehicles do fall below this ambition, they may be subject to sanctions.

A number of respondents highlighted the difficulty of benchmarking a self-driving vehicle standard in comparison to human behaviour.

The issue of measuring self-driving vehicle safety in comparison to human behaviour is recognised by industry and government as a challenge. The availability and suitability of data, as well as identifying appropriate measures for an emerging technology, are topics that are under consideration.

A large proportion of respondents highlighted a desire for greater clarity on the definition of a competent and careful human driver and how it applies to a self-driving vehicle. Several provided suggestions for where this could already be provided and/or how it could be developed. For example, reviewing decided cases of dangerous driving and careless driving under the Road Traffic Act 1988 provides examples of actions likely to be considered inconsiderate (such as overtaking which could not have been carried out safely) – and could, therefore, be inferred as not meeting the standard of a competent and careful driver.

The Highway Code (https://www.gov.uk/browse/driving/highway-code-road-safety) was also mentioned as relevant statutory guidance and several respondents highlighted that self-driving vehicles could improve road safety by strict adherence to it.

Government recognises the desire for further guidance and information. CAM 2025 made it clear that self-driving vehicles will be expected to comply with road traffic law and relevant rules in The Highway Code. This may not mean they should replicate the actions that a competent and careful human driver would take in every circumstance because, for example, their agreed operating conditions may be limited.

Further information on how the safety ambition will be met will be set out in the statement of safety principles, as introduced in the Automated Vehicles Bill. These will be developed with stakeholders and will be consulted on in due course.

Safety regulation

A large number of respondents referred to the regulation of self-driving vehicles, covering a wide range of topics relating to safety regulation.

Of those respondents referring to regulation, the most commonly raised issue was a desire for safety standards to be aligned with European and International regulations. This was generally expressed by organisations rather than by individual respondents.

The government continues to engage in the work of the United Nations Economic Commission for Europe (UNECE), together with other countries across the world, to share knowledge and understanding in the area of self-driving vehicles and to drive forward the development of future harmonised regulatory frameworks.

Another commonly raised issue was the need for government transparency in relation to self-driving vehicle safety regulation and the wider safety framework. Suggestions included publication of the safety framework, as well as self-driving vehicle incident statistics. Respondents also suggested increased industry transparency about vehicle capabilities, safety data, fail safes, and monitoring, for the public to make informed decisions. Several respondents expressed the opinion that minimum safety standards for self-driving vehicles would increase overall confidence in them. This desire for greater transparency about vehicle capabilities (https://www.gov.uk/government/publications/self-driving-vehicles-public-perceptions-and-effective-communication) was something the general public also wanted to help build acceptability of the technology and trust in both the vehicles and the processes to assure their continuing safety.

A proportion of responses covered wider statistics and data requirements in relation to safety regulation with several stating that data is needed to prove safety, potentially before deployment, and to demonstrate liability in road collisions. There was a recognition of the difficulty in determining careful and competent statistically.

The issue of transparency and trust in regulation is important and government published clear proposals for a new self-driving vehicle safety framework in CAM 2025, based on the 4-year review by the Law Commissions. The proposals require legislative change and all new regulations will be subject to public consultation. The timeframe for this legislative change was raised by several respondents. Government has committed to legislate with the introduction of the Automated Vehicles Bill into the House of Lords in November 2023.

Data is an important and complex issue in relation to the regulation of self-driving safety. Data reporting and publication requirements are being considered in relation to each element of the safety framework:

- approval
- authorisation
- in-use regulation
- incident investigation

Access to data will be an important part of the safety assurance of self-driving vehicles, and the Automated Vehicles Bill makes provision for information to be shared for the purposes of safety regulation. In support of this, the government is working across departments and in conjunction with stakeholders, including manufacturers, telecom operators and enforcement agencies, to map out data uses, availability and requirements. This work will also consider the use of personal data across the industry. The Bill does not seek to replace or change existing legislation on personal data protection.

Some respondents considered safety regulation in a significant degree of detail including, for example, expressing views on how regulations might apply to different deployments. Some respondents emphasised that while the operational design domain (ODD) should be tightly controlled, different regulations could be applied to different ODDs. The need to ensure consistency and integration of related regulatory regimes, for example, cyber, connectivity and self-driving regulation, was also raised.

Government’s work on the detailed technical requirements for self-driving vehicles recognises that the relevance of certain technical assessments may vary with the ODD. For example, scenario testing of self-driving behaviour at roundabouts would not be relevant for a motorway-only ODD. Proposed technical requirements will also include consideration of integration with other road users and may be adapted over time if new road user types emerge. However, the overall safety standard for self-driving vehicle deployments (equivalent to a competent and careful human driver) will remain the same no matter what the deployment context.

A small minority of respondents referred to the potential for automated driving systems (ADS) to be biased based on the data sets a self-driving vehicle is trained on. Twelve percent of respondents mentioned one or more protected

characteristics in their responses. Government has committed to including a principle on equality and fairness in the Statement of Safety Principles. This could, for example, include a declaration that overall safety benefits should not come at the expense of any particular group of road users. Further detail could then specify that training datasets must be representative of different sectors of society.

Specific topics that were brought up by a small minority include reference to the ability of a user-in-charge (UiC) to perform secondary tasks while an ADS is engaged. There were responses both in support of UiCs being granted this ability and against it unless proven safe.

Government is undertaking primary research to explore what non-driving related tasks could be performed, if any, when the self-driving mode is engaged in a UiC vehicle while ensuring that drivers are able to resume safe control of the driving tasks when required. When referring to safe control, this means both the physical ability to respond to the transition demand within the required timeframes and that they have sufficient levels of situational awareness to resume the driving task safely.

Driver education and additional licencing requirements were referenced in several responses.

In 2021, government established a group of representatives – known as AV-DRiVE – to steer and support driver education on self-driving vehicles. These representatives are from:

- motor and related industries
- advertising sector
- law enforcement
- road safety organisations
- government departments

The group has initially focused on automated lane keeping system (ALKS) and other UiC self-driving vehicle technologies, publishing an educational toolkit for those communicating with the public. In the longer term, AV-DRiVE will expand to cover other self-driving vehicles as they become commercially available.

The potential for additional licensing requirements is an issue that is under active consideration as part of work looking at the safe use of self-driving vehicles. Any future proposals for changes will be subject to consultation.

Safety of other road users

Many respondents expressed the view that self-driving vehicles must be able to identify a wide variety of vulnerable road users (VRUs), other roads users and unpredictable behaviour in order to operate safely. Some respondents highlighted specific concerns about safety around motorcycles, and one expressed the view that regulation is required to ensure the safety of VRUs. Another commented that self-driving vehicles shift the overall risk distribution towards VRUs.

The statement of safety principles, required under the Automated Vehicles Bill, must be framed with a view to securing that road safety in Great Britain will be better as a result of the use of authorised self-driving vehicles on roads. The term road safety covers all road users. This is the case in existing road safety legislation, where offences such as dangerous driving are concerned with the safety of all road users.

Government is also committed to including a principle on equality and fairness in the statement of safety principles. Under the public sector equality duty (https://www.gov.uk/government/publications/public-sector-equality-duty), the government must have due regard to eliminating discrimination and advancing equality of opportunity when creating new policies.

As set out in CAM 2025, government intends to require any organisation seeking authorisation of its vehicle as self-driving to submit an assessment of fair outcomes, including considerations of data bias, which must include how it will avoid its vehicles unfairly discriminating against certain people as well as VRUs, and its considerations of the importance of accessibility for people with different disabilities. Further information on authorisation is provided in the Automated Vehicles Bill and further detail will be consulted on as part of the development of secondary legislation arising from this. In addition, self-driving vehicles will be expected to comply with road traffic law and relevant rules in The Highway Code, including those regarding the hierarchy of road users.

Public perception

Many respondents expressed the view that self-driving vehicles will not be accepted unless they show an increase in safety. Respondents highlighted that public trust is essential for implementation but accepted that this will take time. It was suggested that a rapid introduction of self-driving vehicles could negatively affect public perceptions of self-driving vehicles and another respondent noted that perceptions of road safety hazards can be a barrier to active travel.

Government recognises the importance of public trust and has funded programmes of research to understand and address public concerns towards self-driving vehicles, and public expectations for their introduction. This research has shown that the public expects self-driving vehicles and services to

be accessible, safe, easy to use, comfortable and reliable. In relation to safety, the research shows that the public expects there to be regulation, legislation and the necessary oversight put in place prior to the introduction of self-driving vehicles. These processes should cover the whole lifecycle of self-driving vehicles, from development and testing prior to being allowed on UK roads and throughout their use.

As part of a groundbreaking research project conducted throughout 2022, it was shown that exposure to and learning about self-driving vehicles helps to improve awareness (https://www.gov.uk/government/publications/self-driving-vehicles-public-perceptions-and-effective-communication), understanding and perceptions as well as address concerns, especially for women and older adults, groups that traditionally have greater levels of concerns.

At the end of the research, the majority of participants indicated that taking part had made them feel:

- less worried about using self-driving vehicles (71%)
- safer being in or around a self-driving vehicle (60%)
- more confident about self-driving vehicles' ability to handle unexpected situations (50%)

Government priorities

The majority of responses relating to government priorities came from organisations as opposed to individuals. Of these, a number referenced a need for government to work with industry to create the safety framework, with an equal number requesting confirmation of the government's legislative timeline.

Particular stakeholder groups (individuals, for example) also expressed a concern that, in their view, government prioritises growth over safety. In contrast, some respondents raised concerns that if the UK did not lead on self-driving vehicle standards 'this would impact on the competitiveness and attractiveness of the UK as a location of choice'.

Manufacturers called for the safety ambition and other aspects of the regulatory framework to align with new international conventions that are likely to be developed. One respondent highlighted that if there were a significant divergence, it would be likely to 'create unnecessary administrative burdens for organisations as they seek to navigate differing regimes'.

DfT's priorities include:

- growing and levelling up the economy

- improving transport for the user, which includes ensuring the transport network is safe

For self-driving vehicles, these priorities are inextricably linked and are being considered hand-in-hand. Already £476 million in direct industry investment including an estimated 1,465 jobs have been generated in the UK CAM sector between 2018 and 2022, with the industry projected to be worth £42 billion by 2035 creating 38,000 jobs. With the introduction of the Automated Vehicles Bill into the fourth session, the government set forth the clear intention to prioritise this growing sector allowing safety benefits to be realised for all road users.

Without self-driving vehicles being safe and seen to be safe, demand for these vehicles will not occur. At the same time, overly restrictive safety regulations could hamper the industry and lose potential safety benefits. Conversely, confidence in safety will support the growth of the connected and automated mobility industry, while a strong industry could support a range of potential deployments to deliver safety and other societal benefits.

Other safety concerns

Both individuals and companies saw the consultation as an opportunity to share wider views on connected and automated vehicles, including on infrastructure requirements. These responses included comments on:

- use of biometric data
- short-range beacons to assist in location detection
- smart motorways
- latency issues for remotely-driven vehicles

These responses have been passed to relevant policy teams. For remote driving, government welcomes the Law Commission's remote driving report (https://lawcom.gov.uk/project/remote-driving/) and is considering the conclusions.

A further safety concern raised by respondents was the cybersecurity of self-driving vehicles. DfT works closely with the National Cyber Security Centre, other government departments and the transport sector to understand cyber vulnerabilities and ensure an effective regulatory regime is in place.

DfT chairs the UNECE group that developed 2 new international regulations on cybersecurity and software updates and has an active cybersecurity programme. In addition, the CAVPASS programme has a cyber workstream that is investing in research and developing assurance processes to ensure self-driving vehicles are cyber-resilient. All research will be published where possible.

Some respondents highlighted that the full potential safety benefits of self-driving vehicles may not be realised by those operating in initial, more limited, ODDs. Although it will be for manufacturers to determine which technologies they bring forward, the introduction of self-driving vehicles is expected to be gradual and initial deployments may be on those roads that statically show fewer incidents (https://www.rospa.com/road-safety/advice-and-information/roads/motorway-driving). This does not mean that there are no safety benefits to be gained, but an understanding that the full impact of these vehicles may take time.

A respondent expressed the opinion that a 10-second transition demand (as set out in the UNECE ALKs Regulation (https://unece.org/transport/documents/2021/03/standards/un-regulation-no-157-automated-lane-keeping-systems-alks)) is inadequate while another expressed concern that any transition demands a self-driving vehicle may make might not be accepted and wished to highlight the danger they perceived this could potentially pose.

Although the ALKS transition demand timing has been set in regulation, transition demand requirements for UiC self-driving vehicles will vary with the deployment context. In July 2022, DfT amended The Highway Code to clarify driver responsibilities in self-driving vehicles. The Highway Code makes it clear that drivers are expected to respond to a transition demand, so a failure to do so should only occur if the driver is incapacitated (suffering a stroke or a heart attack, for example).

One respondent said that the technology was progressing too fast and should be halted in development. CAM 2025 set out the government's vision for connected and automated mobility and the potential benefits that it could bring. It also outlined the steps the government is taking to realise these benefits and minimise any potential adverse effects.

Capability of self-driving vehicles

Many respondents highlighted that safety is the biggest potential benefit of self-driving vehicles and that improving road safety has the ability to facilitate greater mobility. In contrast, it was commented that self-driving vehicles may have difficulty with complex situations and making ethical decisions and/or that it is unrealistic to expect self-driving vehicles to avoid all incidents in the short term.

As part of the proposed self-driving vehicle safety framework, all self-driving vehicles will need to show that they can meet the safety requirements relevant to their expected deployment context. As with the human driving test, not every scenario will be tested. However, simulation will allow for testing of far more scenarios than can be tested with humans.

Like human beings, technology is not infallible and the proposals for the new safety framework include the ability to issue appropriate sanctions in the case of incidents. Limited fleet penetration and continued technological developments may also mean the full effect of these vehicles may not be realised for a while, but this does not mean that there are no safety benefits to be gained.

It was also highlighted in a response that human error may still influence self-driving vehicles, impacting their safety, for example, in the form of passenger interference. Measures to prevent those inside vehicles from taking action that inappropriately affects the self-driving system when in use will need to be part of the safety assessment for authorised self-driving vehicles or no-user-in-charge (NUiC) operators. In addition, the Automated Vehicles Bill includes provisions to prevent deliberate tampering with the vehicle equipment by the UiC.

Education and training

Many respondents expressed the view that drivers must be educated on what self-driving vehicles can do, and their responsibilities as a driver, UiC and/or passenger. A smaller proportion highlighted a need for educational material to be accessible. A respondent also reported that all road users, not just drivers, need education on how to operate around self-driving vehicles to avoid an increase in collisions. In addition, a respondent expressed the view that drivers will become less competent over time if self-driving vehicles perform most of the driving task.

Driver and user education is a requirement to enable public acceptability, safe use of, and interaction with self-driving vehicles. Consistent with responses to this consultation, members of the public wanted programmes of education and public engagement to be implemented prior to the introduction of self-driving vehicles. This is to enable greater awareness and understanding about the changes they would bring to the road environment and ensure they are able to use them and interact with them safely. These should include information about:

- the practicalities of the technology
- the processes put in place to ensure their safety (such as regulation and standards)
- any changes to existing processes (such as driving tests and MOTs)
- the implications on road user behaviour

As set out above, government has established the AV-DRiVE group to steer and support driver education on self-driving vehicles. The group has already developed an educational toolkit, published by the Society of Motor Manufacturers and Traders (SMMT) in November 2021, and will expand its

work to cover a broader range of self-driving vehicles as they become commercially available. Government will also be launching a new programme focused on implementing the recommendations from the Great Self-Driving Exploration (https://www.gov.uk/government/publications/self-driving-vehicles-public-perceptions-and-effective-communication) to deliver a more consistent programme of public engagement and education.

The concern that driver competence could be reduce if driver engagement in the driving task is reduced is one that is recognised by government and is under consideration by DfT and relevant motoring agencies.

Infrastructure

The most common topic cited in reference to infrastructure was in relation to the integration of self-driving vehicles with existing infrastructure. An equal number of respondents expressed the view that self-driving vehicles needed to integrate with existing infrastructure and that self-driving vehicles would require upgrades to current infrastructure. One respondent expressed the view that physical infrastructure will need to be in an improved state of repair for self-driving vehicles to operate safely, and another highlighted that the infrastructure was not yet ready for self-driving vehicles. A respondent expressed the view that self-driving vehicles can only be safe if the infrastructure is also regulated.

One respondent commented that agencies and local authorities need to understand their legal obligations regarding upgrading and maintaining highway infrastructure.

As set out in CAM 2025, it is government's view that self-driving vehicles must integrate into existing infrastructure in the first instance, but recognise that the full benefits of self-driving vehicles may not be realised until they are integrated into connected infrastructure, such as modified speed to adapt to traffic conditions ahead.

The Automated Vehicles Bill therefore includes provisions for the digitisation of Traffic Regulation Orders (TROs). This follows a consultation in 2022 in which 87% of respondents supported the proposal. TROs hold information that can facilitate a self-driving vehicle's understanding of the road and the legal parameters of the road network, for example, information on speed limits, parking bays, bus lanes and road works. However, the information is currently held by individual traffic regulation authorities on separate systems. Making the information available digitally, in a common format and on a published platform, can support the safe operation of self-driving vehicles.

Lack of evidentiary support

A small proportion of respondents reported that simulation technology is not advanced enough to prove self-driving vehicle safety.

Government is aware that simulation is already used as part of the verification and validation activities for complex systems in conventional vehicles. Any simulation toolchains used must be validated against physical testing, and simulation is not used as the sole way to verify the performance of a system. Even once a simulation toolchain or process has been validated, a proportion of the outputs of simulation would be further verified by performing the same scenario as a physical test. Any gaps in the fidelity of simulations (for example, not representing the world in photo-realistic details) would have to be filled with alternative evidence. Government is considering whether specific technical requirements should apply to the use of modelling and simulation toolchains.

Government continues to support advances in the simulation industry to further improve the use of simulation in the development and testing of self-driving vehicles. The 2018 CAV SIM competition provided £10.5 million of grant funding to 6 projects exploring how modelling and simulation can be used to support the verification and validation of automated driving. In 2022, government launched a further ‘supply chain’ competition to support the commercialisation of the CAM supply chain, including verification and validation, and advanced software solutions, including simulation. DfT announced the winners of the £18.5 million of funding on 5 September 2023, helping 43 British companies, across 13 projects to improve the safety and security of self-driving vehicles by filling specific technology gaps, improving performance and reliability.

Next steps

As detailed above, a large number of responses raised areas in which work is already being undertaken. DfT will use the evidence provided in these responses to inform detailed development of the future legal and safety framework for self-driving vehicles.

As highlighted in CAM 2025, primary legislation is required to provide new powers and create the new legal entities that form part of this framework. The Automated Vehicles Bill, introduced in the House of Lords as part of the fourth session sets out the legislative framework including the new legal entities required.

Following the finalisation of this primary legislation, government will launch a series of consultations on the associated secondary legislation and statutory

guidance, including on the proposed statement of safety principles for self-driving vehicles.

In the meantime, the Centre for Connected and Autonomous Vehicles (CCAV) is engaging stakeholders on the likely contents of the detail for secondary legislation and guidance, both through open forums and targeted engagement with specific groups. For example, with the expert advisory panel to the CAVPASS programme and with industry stakeholders.

To be ready for the use of the safety framework, the CCAV is also considering practical implementation of the framework in conjunction with the Vehicle Certification Agency (VCA), the Driver and Vehicle Licencing Agency (DVLA) and the Driver and Vehicles Standards Agency (DVSA).