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Law Commissions' consultation on Automated Vehicles: A Preliminary Consultation Paper

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The National Physical Laboratory (NPL) is the UK's National Metrology Institute and is at the heart of both the National Measurement System and UK's leadership in the international system of measurement that underpins UK and international trade.

Chapter 3: Human factors

Consultation Question 1: Do you agree that:

(1) All vehicles which "drive themselves" within the meaning of the Automated and Electric Vehicles Act 2018 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?

Other:

NPL is currently supporting the UK's Connected Autonomous Vehicle (CAV) testing infrastructure. We believe it is essential that there is an independent assessment of whether an Automated Driving System (ADS) is fit for purpose; and able to perform its driving functions safely.

In the supporting documents, it is indicated that a user-in-charge must be inside the vehicle continually monitoring the performance and observing for potentially dangerous situations. The definition of taking over control is key. E.g. it's extremely difficult to envisage that a user-in-charge could assess a dynamic situation and act in time to avert a crisis. It is more likely to be acceptable for the user-in-charge to press the emergency stop button and have the vehicle bring itself to a rest. However this would require a degree of standardisation around emergency stop functionality across all vehicle types.

In the preliminary stages of deployment, the user-in-charge model would seem to be a sensible precaution and instil confidence in the public. This would need to be accompanied by an effort to quickly move to a stage where the technology can function safely in a fully autonomous mode.

(3) If the user-in-charge takes control to mitigate a risk of accident caused by the automated driving system, the vehicle should still be considered to be driving itself if the user-in-charge fails to prevent the accident.

Other:

There is a strong case for the development of standards on data quality, storage and sharing in order to determine cause of any incident. Regulations or testing requirements for automated vehicles will need to be updated in light of standards developed. NPL notes that there are many scenarios that could be envisaged where user intervention would be too little or too late to avoid an accident.

Consultation Question 2: We seek views on whether the label “user-in-charge” conveys its intended meaning.

The use of the words ‘user’ and “in charge” conveys the sense of responsibility and an indication that the vehicle is not driving itself. There is further clarification required as to whether the user-in-charge has to be in the vehicle or whether they can be a remote operator? Or even a corporate body: E.g. in the case of a fleet of automated taxi’s, or delivery vehicles.

Consultation Question 3: 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.

Other:

An acceptable level of testing and assurance for autonomous vehicles should be a precursor to deployment. Whether it is necessary for a user in charge to assume criminal liability for certain actions should not be a substitute for this.

Consultation Question 4: We seek views on how automated driving systems can operate safely and effectively in the absence of a user-in-charge.

The growing testbed ecosystem in the UK presents a significant opportunity to develop and deploy a standardised testing and assurance regime which would demonstrate autonomous vehicles (i.e. which drive themselves) as fit for purpose and which includes achieving the designated standard for minimal risk condition. It is sensible that in the early phases of public/commercial deployment of autonomous vehicles, such deployments should be limited to specific use cases and locations in order to minimise any risks. It is also recommended that a standard around data quality, storage and sharing is developed and applied in order to monitor and identify potential risks, such as arising from near misses or unexplained decisions.

Consultation Question 5: Do you agree that powers should be made available to approve automated vehicles as able to operate without a user-in-charge?

Agree:

Please also see the response to question 4. The availability of new technologies will require a framework to demonstrate fitness for purpose, to be able to operate without users in charge.

Consultation Question 6: Under what circumstances should a driver be permitted to undertake secondary activities when an automated driving system is engaged?

NPL’s observations are based on the current SAE definitions: secondary activities should only be permissible in Level 4 (it is assumed there is no driver for Level 5) where the vehicle is within its designated automated operating mode for level 4 and has confirmed this to the user/occupants. If someone is acting as a ‘user-in-charge’, they should not be undertaking secondary activities. An additional question which needs to be resolved is ensuring standardisation of any driver notification system, in terms of criteria and features; without this, some drivers might be disadvantaged in their ability to respond.

Consultation Question 7: Conditionally automated driving systems require a human driver to act as a fall-back when the automated driving system is engaged. If such systems are authorised at an international level:

(1) should the fall-back be permitted to undertake other activities?

No:

As in Question 6 above. Additionally, it is recommended that the fall back has "driver related tasks" to ensure they are paying attention. E.g. push a button, respond to prompt, etc. If they fail to acknowledge the vehicle must be able to come to a standstill safely.

[Chapter 4: Regulating vehicle standards pre-placement](#)

Consultation Question 8: Do you agree that:

(1) a new safety assurance scheme should be established to authorise automated driving systems which are installed:

(a) as modifications to registered vehicles; or

(b) in vehicles manufactured in limited numbers (a "small series")?

Other:

NPL has been providing advice to the Centre for Connected Autonomous Vehicles and Meridian Mobility to support industry discussions on how to test and assure an autonomous vehicle's reliability. There are acknowledged issues around liability and where approval should sit. There is a case to be made that all vehicles considered to operate an automated driving system (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. There is a need to understand clearly - and using common evaluation methodologies - the manner in which these sensors perform outside their operating envelope and the uncertainty associated with this. This is important to supporting any definition of an operating envelope of an autonomous vehicle; it is also necessary for reliable simulation modelling and testing, which is considered an essential component of any autonomous vehicle testing programme.

(2) unauthorised automated driving systems should be prohibited?

Agree:

Please see our answer to question 8 part 1. This also raises the questions of what body does the authorising and what is required to standardise any testing and data inputs to support the decisions of that authorising body. (e.g. a safety framework)

(3) 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?

Other:

As per question 8 part 1, NPL observes 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.

Consultation Question 9: Do you agree that every automated driving system (ADS) should be backed by an entity (ADSE) which takes responsibility for the safety of the system?

Other:

NPL’s expertise does not extend to matters of legal responsibility. However, an ADSE is likely to be the most appropriate entity to put forward an autonomous vehicle for authorisation and assuming ongoing responsibility and liability for performance of the whole vehicle system not just the ADS.

Consultation Question 10: We seek views on how far should a new safety assurance system be based on accrediting the developers’ own systems, and how far should it involve third party testing.

Accreditation indicates the need for a standardised framework, in particular around what constitutes ‘safe’ otherwise it is hard for manufacturers or other stakeholders to know whether the autonomous vehicles are fit for purpose.

It is likely the best approach will involve a combination of self-certification by developers; and an audit of processes by third parties and independent validation in-silico, as well as physical test drives.

Any assurance system should include:

- Type testing components and sub-systems in all conceivable scenarios
- Guiding safety principles / requirements for developers
- Requirement that developers will follow a recognised safety case process to develop whole systems and integration. In addition, testing (physical and in-situ) and validation regime to demonstrate safe operation pre-service covering a variety of scenarios and operational hours
- The above should be audited by some accredited body
- Simulation and physical testing by a third party of limited edge-case scenarios (note – need to avoid only designing to pass the test)

The development of common evaluation methodologies, including the use of scenarios and simulation environments, where the edge cases and failure modes of autonomous vehicles may be identified, is an important component of assuring the public, transport authorities, insurers and manufacturers that the vehicles in question are fit to drive on the roads.

Consultation Question 11: We seek views on how the safety assurance scheme could best work with local agencies to ensure that it is sensitive to local conditions.

We refer to the point about scenarios in question 10 above.

Chapter 5: Regulating safety on the roads

Consultation Question 12: If there is to be a new safety assurance scheme to authorise automated driving systems before they are allowed onto the roads, should the agency also have responsibilities for safety of these systems following deployment?

Other:

Any new safety assurance scheme should continue to have some form of oversight or guidance role if not outright responsibility for safety of the systems in question once they are deployed. This would ensure a higher degree of continuity and consistency between pre-deployment assurance and post deployment compliance and enforcement.

If so, should the organisation have responsibilities for:

- (1) regulating consumer and marketing materials?
- (2) market surveillance?
- (3) roadworthiness tests?

Please explain your answer:

We seek views on whether the agency's responsibilities in these three areas should extend to advanced driver assistance systems.

Yes, extend to advanced driver assistance systems

Advanced driver assistance systems and autonomous vehicles will be using similar technologies but with different degrees of integration. Many 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.

Consultation Question 13: Is there a need to provide drivers with additional training on advanced driver assistance systems?

Other:

This is likely to depend on the types and complexity of advanced driver assistance systems and whether these systems behave in the same fashion across all manufacturer's models.

If so, can this be met on a voluntary basis, through incentives offered by insurers?

Other:

See answer to question 13 part 1.

Consultation Question 14: We seek views on how accidents involving driving automation should be investigated.

NPL has discussed this area with various stakeholders including the police. It has been observed that due to the need for accurate and consistent data, there will likely need to be new regulations around standard approaches for data quality, sharing, access, and ontologies. Indications are that (UTC) traceable time stamping, such as provided by NPL, and geolocation metadata such as provided by Ordnance Survey, will become more important in matching different data sets: for example, from all vehicles involved in an incident as well as ground truth derived from local sensors. It is also recommended 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.

We seek views on whether an Accident Investigation Branch should investigate high profile accidents involving automated vehicles? Alternatively, should specialist expertise be provided to police forces.

NPL's recommendation is to ensure consistency in how specialist expertise is involved. One challenge will be determining at the incident site whether automated / autonomous systems were in use and therefore whether specialist expertise is required.

Consultation Question 15:

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

Agree:

It is strongly recommended that an independent body has oversight for monitoring this. Firstly, to ensure the industry and individual developers are held accountable. But also to ensure that a balanced picture of, hopefully, improving safety record can be demonstrated to continue to ensure public acceptance (e.g. one fatality will hit the headlines but 100 crashes avoided will never be reported).

In this context it is therefore valuable to monitor and record near misses - if a definition can be arrived at for near misses. This would also require that the vehicle is able to define and record a near miss; or it is observed by local sensor infrastructure or another vehicle.

Comparison with human drivers may not be sufficient in itself. It will also be important to understand accident type since the driving behaviours of humans driving automated vehicles as the user-in-charge may lead to different accident scenarios which do not draw strict comparison with human driver accidents.

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

Yes, monitor advanced driver assistance system accident rates

We refer to the answer to question 15 part 1. Near misses should also be considered, in particular as such vehicles will be operating in environments with cars driven solely by humans. There could be a further challenge as monitoring will require substantial accurate and reliable data from the vehicle since the monitoring will need to identify whether the advanced driver assistance system or the driver was in control at the time of the incident.

Consultation Question 16:

(1) What are the challenges of comparing the accident rates of automated driving systems with that of human drivers?

The comparison with human drivers may not be sufficient in itself. It may also be important to understand accident type since the driving behaviours of humans driving autonomous vehicles, may be sufficiently different to humans in standard vehicles to result in different accident scenarios which cannot draw strict comparisons.

Additionally, it is anticipated that the public have little appreciation of the current high-level of accidents/fatalities. In addition, they will have “higher” expectations of advanced systems, this is perception rather than a numerical argument.

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

NPL is not able to answer that question as it does not have access to existing sources of data referred to.

Chapter 7: Criminal liability

Consultation Question 20: 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 automated driving system.

Yes, amend regulation 107 in this way.

The legal aspects of this question topic are not in NPL’s sphere of expertise and this answer does not seek to offer legal opinion.

The purpose of some highly autonomous vehicles is not to require a driver, nor be designed for a human to be able to drive the vehicle. Therefore regulation 107 would seem to be incompatible with such vehicles being deployed on roads. With regards vehicles which are designed to also be driven by a human (i.e. advanced driver assist or user-in-charge scenarios), regulation 107 could still legitimately apply.

Consultation Question 24: 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?

Agree:

The legal aspects of this question topic are not in NPL’s sphere of expertise and this answer does not seek to offer legal opinion. There could be a challenge as demonstrating who/what was in charge of the vehicle at the time of the incident. This may require substantial accurate and reliable data from the vehicle since investigators need to identify whether ADAS / ADS or driver was in control at the time of the incident. On this basis, it is recommended that the AI should be required to be self-reporting and “hand-over” a minimum data set.

Consultation Question 28: 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.

The legal aspects of this question topic are not in NPL's sphere of expertise and this answer does not seek to offer legal opinion. Route planning for autonomous vehicles could follow a standardised approach or protocol, which would likely include barriers to driving in prohibited places and preventing humans from interfering with this; it should still be illegal to over-ride and make a car go where it should not.

[Chapter 8: Interfering with automated vehicles](#)

Consultation Question 35: Under section 25 of the Road Traffic Act 1988, it is an offence to tamper with a vehicle's brakes "or other mechanism" without lawful authority or reasonable cause. Is it necessary to clarify that "other mechanism" includes sensors?

Yes:

Clarification of this would most likely be beneficial.

[Chapter 9: "Machine Factors" - Adapting road rules for artificial intelligence decision-making](#)

Consultation Question 39: 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;

This is a safety issue which should be treated like any other for autonomous vehicles. An acceptable level of testing and assurance for autonomous vehicles should be a precursor to deployment and that the scenarios which test the reliability and safety (to all passengers / third parties) of the system under test when mounting a pavement should be included.

NPL also observes that the presence of the user in charge may affect the conditions under which an autonomous vehicle could mount a pavement.

Consultation Question 40: We seek views on whether it would be acceptable for a highly automated vehicle to be programmed never to mount the pavement.

Please see answer to question 39. It is important to note that such a requirement may significantly inhibit the routes or environments in which autonomous vehicles can operate; it may also create a more hazardous environment, for example if emergency vehicles cannot pass.

Consultation Question 41: We seek views on whether there are any circumstances in which an automated driving system should be permitted to exceed the speed limit within current accepted tolerances.

Developing protocol for when it is appropriate for an automated driving system to exceed a speed limit could prove challenging. If other vehicles, especially autonomous ones, are not aware that a vehicle is exceeding the speed limit, this may heighten the risk of a crash. At the same time, if autonomous vehicles default to observing a speed limit, which results in the most efficient traffic flow, then one vehicle exceeding a speed limit may make that traffic flow less efficient.

Consultation Question 42: 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?

It would not be a recommended approach to place an autonomous vehicle in a situation where there was an increased risk of injuring a pedestrian. An exception could be considered for emergency vehicles trying to reach a person needing help.

Consultation Question 43: To reduce the risk of bias in the behaviours of automated driving systems, should there be audits of datasets used to train automated driving systems?

Other:

NPL observes that there are two parts to this question and therefore, the answer: firstly, how to reduce the risk of bias and whether auditing datasets is the way to do this; and secondly as an audit indicates some form of standardised approach, who is assessing the contents of the audit as fit for purpose?

There could be barriers to accessing datasets and if these are not in a common format, may be hard to compare. There could also be limitations in just looking at training data to assess the nature of bias in any particular automated vehicle, since this does not allow for any other analysis or testing of the ADS behaviour. 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.

Consultation Question 44: We seek views on whether there should be a requirement for developers to publish their ethics policies (including any value allocated to human lives)?

Other:

Please also see our answer to question 43.

The ethics policies of different operators/developers may be described in fundamentally different ways, making them hard to compare. Furthermore, there should be an onus on the operator / developer to demonstrate that any ethics policies are effectively implemented in the decision-making process of the vehicle. Decisions must be explainable. If the ethics are used to develop the systems, then they should be published.

NPL also observes that:

- 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.
- We would expect high-level principles to be defined by the certifying authorities and many of these ethical principles would be in there. This would include an acceptable (not minimum) set of requirements that any ADS must be able to adhere to.

Consultation Question 45: What other information should be made available?

Testbed UK presents a significant opportunity to gather data in a standard format, against common test scenarios, for all autonomous vehicles which are intended for deployment on UK roads.

It would be of value to understand all the edge cases and failure modes a system under test has encountered, although how this data is accessed and managed would need to be determined.

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