Are we ready to 'handover' to driverless technology?

VENTURER Insurance and Legal Report 2017/18

Contents

About VENTURER

VENTURER brings together public sector, private sector and academic experts to understand the blockers and enablers to wide scale adoption of Connected and Autonomous Vehicles (CAV).[1]

The VENTURER trials are intended to develop understanding of the insurance and legal implications of increased vehicle autonomy. The project is now in its third and final year and takes place in the Bristol and South Gloucestershire region.

VENTURER is made up of organisations from various sectors:

University of Bristol · Bristol City Council · AXA · First · UWE Bristol, University of the West of England · Atkins, Member of the SNC-Lavalin Group · Fusion Processing · South Gloucestershire Council · Williams · BAE Systems, Inspired Work · brl, Bristol Robotics Laboratory · Burges Salmon

[1] VENTURER: A New and exciting autonomous vehicle project, http://www.venturer-cars.com/

Foreword

This report is our second as part of the VENTURER project and draws on the excellent work done by our academic partners as well as the emerging legal and insurance environment.

In the 2017 Autumn Budget the Chancellor of the Exchequer confidently stated that automated vehicles (AV) will be on the UK's roads by 2021. This should excite everyone who believes in the positive societal impact that these vehicles could have, saving lives and offering mobility solutions to those who are currently unable to drive.

We need to ensure, however, that we are as clear as we can be about how we define the terminologies surrounding this technology. People must understand what the vehicles are capable of and, very importantly, what the law allows us to do (or not do) when travelling in them.

For example, the Automated and Electric Vehicles Bill that is currently making its way through Parliament states that the Secretary of State will create a list of vehicles that will be deemed to be "automated". As it stands, we anticipate that this definition is likely to fall within SAE Level 4 (the most widely used definition of the various stages of autonomy).[2]

Whilst some motor manufacturers have stated their intention to go straight to this higher level of automation, many cars will be coming to market in the coming months and years which will be Level 3 and capable of allowing the driver to hand over control to the vehicle, but only in certain circumstances. Should the driver wish to regain control or should the vehicle identify a reason for handing back control, this will take place as part of the dynamic driving task i.e. whilst the car is still moving. It's important to realise, therefore, that we are discussing in this context high-level driver assist features. With these, fundamentally, the driver remains responsible for the vehicle in the eyes of the law and potentially liable from an insurance perspective in the event of an accident.

This is what makes the findings of VENTURER's Trial 1 results so fascinating. Those trials have a real-world application now as the handover element will be an increasingly common feature on many vehicles in the near future. How we, as drivers, react in those circumstances and how motor manufacturers incorporate the technology in the first place to take account of that behaviour are both very important. Once we get to Level 4 we have true autonomy and insurance protection for the 'driver' as well as their passengers, but this work and these reports have relevance and importance not just when we reach that end state, but at every stage of the exciting journey as things progress.

David Williams,
Technical Director,
AXA

Chris Jackson,
Head of Transport Sector,
Burges Salmon LLP

[2] SAE International, Automated Driving - http://www.sae.org/misc/pdfs/automated_driving.pdf

Chapter 1

Introduction and summary – Legal and insurance implications of Trial 1 findings

The VENTURER consortium has reported separately the results of Trial 1, in which it investigated the handover of control from an autonomous driving system to a human driver.[3] This report considers the legal and insurance aspects of handover in the context of the VENTURER Trial 1 results and Government proposals for insurance of autonomous (or 'automated') vehicles.[4] Government has signalled its willingness to extend the current regime of driver insurance to incidents arising as a result of system failures whilst a vehicle is in autonomous mode. This is intended to avoid the procedural issues, delay and complexity which would result from affected third party motorists otherwise being faced with the prospect of claiming against original equipment manufacturers (OEMs) for accidents caused by product failure. We are supportive of Government's proposals for legislative reform to facilitate an insurance regime for autonomous vehicles.

From a legal and insurance perspective, the Trial 1 results confirm that the allocation of liability that accompanies the transfer of control between system and human driver needs to be considered carefully. Increased attention needs to be paid to the consequences of automation for fault-based systems of negligence. Proper regard must be had to the difficulties for human drivers in responding where an automated system passes them control of a vehicle and the circumstances in which they will be considered liable for events around the handover period.

The regulatory background defining requirements for handover of control will also need to reflect human factors. OEMs, insurers and consumers will all benefit from clear standards informed by rigorous experimental and empirically-obtained data around how human drivers interact with automated driving systems for the purposes of passing control between an autonomous driving system and a human driver. The standards introduced need to reflect the capabilities it is reasonable for us to expect of human drivers, and respect the limitations of human performance by designing in safety. This in turn will inform expectations of drivers as issues around allocation of liability between insurers, drivers and OEMs are resolved by the courts on an emerging case by case basis.

For these reasons handover is a live issue. The results of VENTURER Trial 1 and other similar trials should be considered for relevance to the development of a suitable handover protocol as part of the Government's drive to enable the introduction of AV technology to UK roads, understanding that the immediate application will apply to SAE Level 3 vehicles and form part of Advanced Driving Assist Systems (ADAS). Standards need to afford drivers sufficient certainty as to what is expected of them to support uptake of the technology and underpin the development of autonomous driving systems which are safe by design.

It is also clear that all the work being done in the UK must be seen in an international context, with the UN Economic Commission for Europe (UNECE) actively looking at whether the handover process should be entrenched in the system at the manufacturing stage.

[3] VENTURER – Trial 1 Findings are available at http://www.venturer-cars.com/. This report is one of a series produced by the VENTURER partners and is the follow-up to the first AXA Insurance Report produced in July 2016 (also available at http://www.venturer-cars.com/).

[4] "Automated" vehicles being the term used in the Vehicle Transport and Aviation Bill, previously introduced as the Modern Transport Bill and now intended to be introduced to Parliament as the Automated and Electric Vehicles Bill.

Chapter 2

Background – Policy and legislative developments

Overview

The House of Lords, Science and Technology Select Committee published a report on 'Connected and Autonomous Vehicles: The future?' on 15 March 2017 outlining the potential uses and benefits of connected and autonomous vehicles:

> **The possible applications of connected and autonomous vehicles (CAVs) are far-reaching, straddling a variety of different sectors. The examples provided in our evidence included–but were not limited to–aerial, marine, public roads, private and public transport (including metro and rail), space, military, warehousing, ambulance services, precision agriculture, inspection and monitoring of resources, working in dangerous and hazardous environments (such as nuclear facilities) and the delivery of humanitarian supplies.[5]**

Government has recognised the potential benefits and taken a proactive approach to CAVs and has made it a policy priority to position the UK a global leader in this area.

This activity has included:

- Providing funding for in excess of twenty driverless car projects;
- Publication of the DfT code of practice for testing driverless cars and 'The Pathway to Driverless Cars: Summary report and action plan';
- Establishing the Centre for Connected and Automated Vehicles (CCAV); and
- Introducing legislative proposals to modernise relevant insurance legislation, through the Automated and Electric Vehicles Bill (which replaces the Vehicle Technology and Aviation Bill which was dropped as a result of the General Election 2017).[6]

Industrial Strategy and CAV initiatives

As part of the Government's long-term strategy in this area, it announced a new 'Connected and Autonomous Vehicle Hub' or 'CAV Hub' at Loughborough's Olympic Park Campus, which will act as a co-ordination centre for the development of autonomous vehicles in the UK, as well as looking at the wider framework to support CAVs, such as data management, cyber-security and insurance.

This was followed on 7 September 2017 when the Government launched MERIDIAN, aimed at creating a cluster of excellence along the M40 corridor between Coventry and London and accelerating the development of CAV technology, growing intellectual capital and attracting overseas investment.

Cementing all the above, the Government published its Industrial Strategy White Paper[7] in November 2017 which committed the UK to becoming a world leader in the way people, goods and services move. In the paper the Government stated its intention to see fully self-driving cars, without a human operator, on UK roads by 2021. It will therefore make 'world-leading changes' to the regulatory framework, including updating the code of practice for testing automated vehicles to allow developers to apply to test their vehicles nationwide without a human safety operator and carrying out a project with the Law Commission to set out proposals for a long-term regulatory framework for self-driving vehicles.

[5] House of Lords Science and Technology Select Committee, Connected and Autonomous Vehicles: The future? (15 March 2017), p.11 https://www.publications.parliament.uk/pa/ld201617/ldselect/ldsctech/115/115.pdf

[6] HMT, The Queen's Speech 2017, The Automated and Electric Vehicles Bill, p. 27.

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/662508/industrial-strategy-white-paper.pdf

Insurance framework and legislative developments

Automated and Electric Vehicles Bill

The Automated and Electric Vehicles Bill, originally announced in the Queen's Speech following the election, was published in October 2017. The Bill replaces the previous Vehicle Technology and Aviation Bill, which failed to complete its legislative passage through Parliament due to the General Election on 8 June 2017. The substantive clauses are nearly identical to those put forward in the previous iteration of the Bill.

The Bill aims to support innovation in self-driving technology in the UK and to ensure that the UK remains a world leader in new industries. It contains two parts:
Part 1, which sets out the broad parameters of how automated vehicles involved in accidents will be treated for insurance purposes; and Part 2, which covers electric vehicles and charging.

Civil Liability and insurance model

Under current legislation, the insurers of the driver who is at fault pay out to third parties who have suffered damage. The question then arises as to where liability should sit where a driver relies on an automated system and is not therefore directly in control of the vehicle.

The Government chose to address this in Part 1 of the Automated and Electric Vehicles Bill by defining a framework for how CAVs involved in accidents will be treated for insurance purposes. This proposes to extend the requirement on the insurer to pay out to affected third parties where the system, rather than the driver, is at fault.

The purpose of this is to obviate the need for an affected third party to seek redress from an OEM, maintainer or other third party who might have some degree of responsibility for the defective performance of the automated driving system, where liability is ultimately with the manufacturer of the vehicle, the company that programmed the algorithm operating the vehicle in autonomous mode or a person who in some other way is responsible for the system's failure.

> **We expect automated cars to appear from the 2020s. They present an enormous opportunity for the UK: securing high quality jobs and investment; creating new mobility solutions that can transform lives; and, as I said earlier, improving road safety. In 2016, human error was responsible for a very significant proportion of all reported accidents. Automated cars will radically change that. To support consumers and businesses involved in automated vehicle accidents, they will need an insurance framework that is fit for purpose. Currently, they may not be covered for collisions that result from vehicle failure, because in the UK only the driver is insured. Victims might have to take vehicle makers to court, which would be time-consuming and expensive, undermining the quick and easy access to compensation that is a cornerstone of our insurance system. Not tackling this problem risks jeopardising consumer protection and undermining the automotive industry's competitiveness.[8]**
>
> – Rt Hon John Hayes MP, Minister of State for Transport Legislation

[8] Second reading of the Automated and Electric Vehicles Bill (23 October 2017) https://hansard.parliament.uk/commons/2017-10-23/debates/BDAB60DC-D67C-44CF-B0CB-9FBE8DAE3F30/AutomatedAndElectricVehiclesBill

Chapter 2

This represents the minimum step possible to accommodate automated vehicles within the existing insurance framework, which speaks to the consequences of fault through reliance on the insurance policy of the driver. For insurance purposes, the system will effectively 'become' the driver under these proposals (to the extent the behaviour of the system triggers a claim), with the insurer then separately being entitled to pursue the OEM or other third party responsible for the system's failure to recover any compensation which the insurer has paid to affected third parties.

Additionally, in a situation where there is a product failure when the vehicle is in an autonomous function, the driver may be the victim of a personal injury that he or she did not cause. Under existing legislation, a driver's insurance only needs to cover third parties and not the driver themselves. After extensive consultation, the Government has decided to widen insurance cover so that this includes damage to the driver where the automated vehicle is driving itself. The intention behind the legislation is to emphasise that if there is an insurance 'event' (accident) the compensation route for the individual remains within the motor insurance settlement framework, rather than through a product liability framework against a manufacturer.[9]

The question of liability becomes more complex when we consider the handover point between autonomous and manual driving phases. Determining at what point fault lies either with the driver (driver error) or with the system (product/ maintainer error), will be critical in determining where liability and financial responsibility, and potentially criminal liability, ultimately rests. This issue has also been raised during the ongoing passage of the Automated and Electric Vehicles Bill. We look at this in chapter 5 of this report.

Summary

Part 1 of the Bill (clauses 1–7) addresses the insurance issues that will arise when responsibility for a vehicle is shared between the driver and the system itself. The application of 'intelligence' to cars is gathering pace and there is a strong push by manufacturers to develop automated vehicles, which will drive themselves. Currently it is a requirement that all (human) drivers have to have insurance when they drive in order to provide compensation for third parties for personal injury or property damage due to a driving related incident. Such principles need to be extended to cover automated vehicles. The Government believes that answering the insurance questions sooner rather than later will encourage manufacturers to develop transport technology in the United Kingdom with the confidence that they can exploit market opportunities.[10]

[9] The House of Commons Library, Automated and Electric vehicles Bill 2017-19 (20 October 2017) p.3

[10] Ibid, p.9

Chapter 3

VENTURER Trial 1 results

As we outlined in the first VENTURER insurance report,[11] switching control between a human driver and an autonomous driving system raises difficult questions around the allocation of liability. The proper allocation of responsibility and liability between the system and the driver requires a clear understanding of the handover process, when and how control switches to the driver and vice versa.

VENTURER Trial 1 involved simulator and road experiments at Bristol Robotics Laboratory on the University of the West of England campus. The experiments tested drivers' ability to retake control following a period of automated driving and measured takeover time (the time it took participants to put their hands back on the controls) and the handover period (the total time to achieve a level of control consistent withbaseline indicators).

Previous studies have shown that drivers experience a delay in regaining effective control following handover of control from the system.[12] Trial 1 was conceived to test the effect of more frequent handover on driver performance, the initial literature review undertaken by the VENTURER team having identified that studies to date had focused on driver performance following long periods of disengagement from the driving task. The trials also sought to cover a wider and slower range of speeds and to involve less experienced drivers than in previous studies. Using a road vehicle alongside a simulator with the scenario parameters set to replicate the road vehicle, combined with a simulator environment which represented the real-world test circuit, and a within-subjects design for the road and simulator conditions, amounted to a novel experimental design for CAV research.

The results of Trial 1 indicated better performance in frequent handover scenarios than might have been expected by reference to earlier studies. However, delays in regaining control of various lengths were observed at different speeds, with other effects on baseline driving being observed. These included slower driving by participants following handover and a marked delay in achieving baseline performance when retaking control at speeds ranging from 20-50mph.

Full details of the Trial 1 results and a separate summary document can be found viewed online.[13]

[11] VENTURER, AXA Annual Report 2016.(https://www.axa.co.uk/uploadedFiles/Content/Newsroom_v2/Media_Resources/Reports_and_Publications/Downloads/Driverless_Cars/VENTURER%20-%20AXA%20Annual%20Report%202016%20FINAL.pdf)

[12] Morgan, P., Alford, C. and Parkhurst, G. (2016) Handover issues in autonomous driving: A literature review. Project Report. University of the West of England, Bristol, UK. Available from: http://eprints.uwe.ac.uk/29167

[13] http://www.venturer-cars.com/.

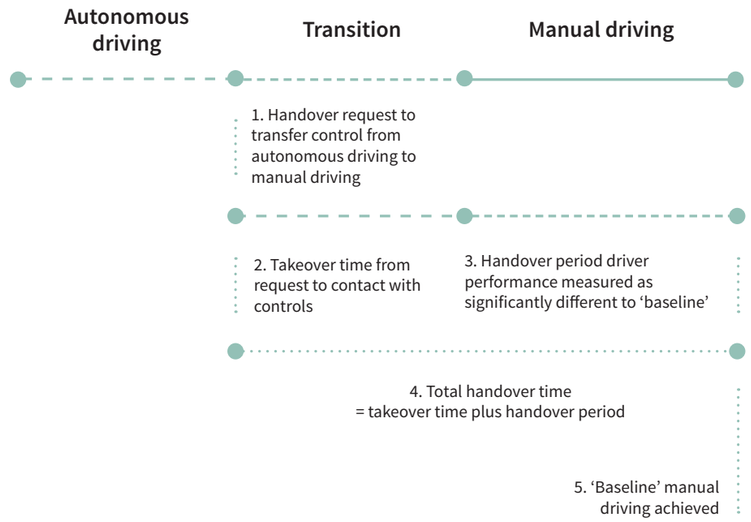
VENTURER Trial 1 – key results

The following conclusions drawn by the investigators are of particular relevance from the perspective of allocation of liability around the handover event:

> **The findings from the driving simulator study, supported by similar experimental conditions used in the road study, suggest that designers of AV technology with handover functionality need to proceed with caution. The experiments highlight the need to consider human performance under multiple driving conditions and scenarios in order to plot accurate takeover and handover time safety curves.[14]**

The results of Trial 1 confirmed the difficulties for human drivers executing the handover task. This highlights the need for a rigorous evidence base informing the development of appropriate standards around handover.

Handover process



[14] VENTURER - Trial 1 Summary, page 3 http://www.venturer-cars.com/

Chapter 3

Safety

For a safety-critical system, the average response time is limited as a valid measure: the system also needs to be able to account for the slowest expected responder. Indeed, this would be a failsafe in the case of an upper acceptable limit to takeover. It is reasonably likely that the extremes of driver behaviour and performance during handover have not been measured in Trial 1 given the modest sample size.

In the development of standards and assessment of liability, due regard will be needed as to how a wide range of individuals perform. As a minimum, these findings emphasise the need for a managed process which respects slower responders: it may be the case that a lower bound criterion based on a statistical analysis needs to be set to capture the majority of responses without trying to mitigate for all. It also underlines the need for a process around handover, and does not support a liability model which expects a human driver to take responsibility immediately when previously disengaged from the driving task.

> **An additional finding from the road trial that was not evident from the simulator trial was the time lag between accepting responsibility for control and beginning to take control.**
>
> **This represents a risk of a different nature, during which the autonomous system has ceded control, the human has signalled acceptance, but in practice he or she has not exerted control and could not be regarded as being in control. It would therefore be important that future handover design relies not on the human signal for the passage of control, but evidence of active input into the human-machine interface by the human driver.[15]**

Noting that the UK has not ratified the Vienna Convention, international standardisation is strongly desirable where possible and ultimate driver responsibility for control reflects the traditional liability model. A requirement for evidence of active input (and any assessment of the quality of input) raises interesting liability considerations. Query for instance how a requirement for the system to validate that the input of the human driver is of sufficient quality sits with the requirement for human override assumed by the Vienna Convention, or the potential difficulty of determining liability consequences if a human driver were to override the system when it indicated it considered the human was not performing well enough.

This may be an area for regulators to assess in the creation of regulations or guidance around autonomous driving – e.g. where a vehicle is in autonomous mode, the current law would mean that drivers should be obliged to remain engaged to retain a degree of 'feel' for the vehicle and awareness of its surroundings, even if not actively controlling the vehicle (i.e. when driving using ADAS in a Level 3 vehicle). At level 4, it may be very difficult to require a human to retain this degree of 'feel', and as such regulators may wish to consider how best to minimise unnecessary handovers. Designers and regulators will also wish to have regard to the limited human capability to manage the transition between controlled and uncontrolled environments.

[15] VENTURER – Trial 1 Summary, page 3 http://www.venturer-cars.com/

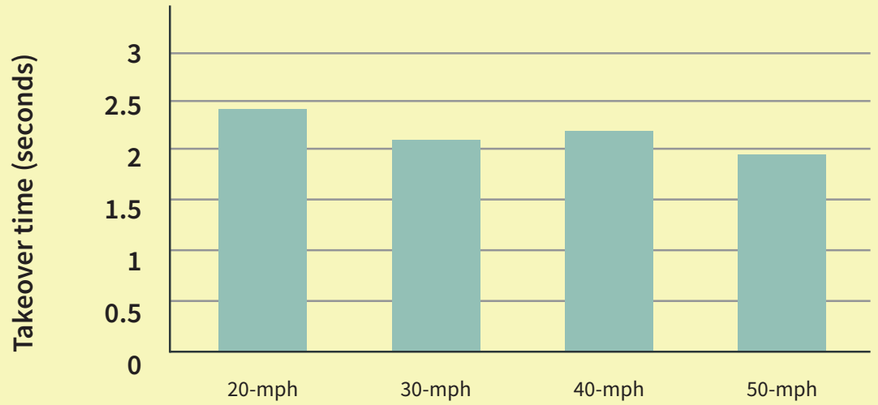
Traffic Management

> **It is important that driver assistance features such as 'lane keeping' are retained and functioning within vehicles, particularly during handover. Rather than handover being from autonomous system to human driver, in practice it might be from autonomous system to human driver supported by driver assistance.**
>
> **Some commentators see high-speed, limited access roads as the most natural first niche for AVs. Where handover is concerned, however, the findings suggest that lower speeds, similar to those in urban areas, are moderately safer. It may be that AV systems should follow procedures to slow the vehicle to a lower, safer speed, such as 40.[16]**

Some commentators see high-speed, limited access roads as the most natural first niche for AVs. Where handover is concerned, however, the findings suggest that lower speeds, similar to those in urban areas, are moderately safer. It may be that AV systems should follow procedures to slow the vehicle to a lower, safer speed, such as 40mph.[16]

These findings underline the need to design safety into the handover procedure. Acknowledging and accommodating driver shortcomings will be necessary to reduce the scope for human error. This type of systems approach draws on the lessons learned in the development of modern safety culture and acknowledges that individuals may not perform well in safety critical situations. To the extent possible, designing a system in which safety is not dependent on an individual's split second decision-making capability is likely to result in safer journeys.

More broadly, the VENTURER Trial 1 results and the team's analysis indicate that further technical investigation will be needed before it is possible to define an appropriate use case and supporting liability model.



[16] Ibid.

Chapter 4

Handover: outlining potential issues

The 'handover problem' arises more as a feature of the development of autonomous vehicles, which are 'high-level driver assist' but not 'highly or fully' autonomous: where drivers do not need to engage with a range of tasks in the driving process when the autonomous mode is selected, but do need to be able to take control when necessary. Manufacturers have identified this of central importance in the development of autonomous vehicles, with Mercedes-Benz commenting that this is the most difficult stage of the transition to autonomous vehicles[17] and Ford intending to bypass this stage completely and move directly to level four automation.[18]

The VENTURER Trial 1 demonstrates that handover continues to present difficulties in the context of more frequent transfers of control between vehicle and driver. Both industry and the Government will need to work to find effective solutions to some of the issues raised below, in order to encourage sufficient public confidence in the technology and therefore support wider uptake.

Liability in the handover phase

As discussed in Chapter 2, Government's approach to the development of insurance regulation (as set out in the Automated and Electric Vehicles Bill) assumes that insurers would pursue rights of recovery if negligence could be proven in respect of some other party or the vehicle manufacturer. However, the handover period currently represents an area of uncertainty as to where to apportion liability.

The issue is that negligence as a concept is defined objectively by comparing the actions of the driver involved in an accident with that of a reasonable driver. The basis of the doctrine therefore requires a baseline of what a reasonable driver is (objectively) required and not required to do. That is well known and long-established in conventional driving. No equivalent baseline currently exists for a new situation – that of handover. These trials and the further work which will follow on from them will need to inform that baseline.

This report focuses on the civil liability and insurance position – which in turn determines when compensation is payable. Civil liability is a compensatory concept. Clearly however the law will in due course need to look at what behaviours and actions are to be defined as constituting fault for the purposes of criminal law. The criminal law is not about compensation but about sanction by the state against individuals and organisations for conduct falling below the level specified as required. That issue will be looked at in our third and final report.

[17] Wheels Mag, 'Mercedes-Benz autonomous tech hits handover speed hump' (July 2016) https://www.wheelsmag.com.au/news/1607/mercedes-benz-autonomous tech-hits-handover-speed-hump.

[18] BBC news, "Ford's self-driving car 'coming in 2021'' (August 2016) http://www.bbc.co.uk/news/technology-37103159.

Chapter 4

Time lag in handover and regaining baseline control

Assuming that an autonomous vehicle was involved in an incident causing damage to another road user while in fully autonomous mode due to a malfunction of the vehicle's technology, insurers would (if having to pay out to an affected third party under the Government's proposed new legislation) then be able to pursue rights of recovery from the vehicle manufacturer (or other person responsible for the vehicle or system failure).

Contrast this with the position where a driver is engaged in the driving task and responsible for the vehicle where, if an incident arises due to a mistake of the driver, he or she (and his/her insurers) will be liable.

The VENTURER Trial 1 experiments found time lags in drivers retaking control following handover from the automated system (e.g., of just under three seconds at a speed of 20mph), together with other delays in returning to baseline driving performance, particularly at higher speeds. This time lag in completion of an effective handover process presents a complication in respect of the basic liability model: where in the handover period should the human driver's responsibility end and the insurers' right of recovery against the OEM start?

It would appear unreasonable to expect people to be able to disengage from the driving task only to have to resume control of the vehicle immediately. On the other hand, it would also appear impracticable, from the perspective of developing good driving habits as well as encouraging effective manufacturer and supply chain engagement in designing systems which seek an optimum balance between safety and performance, to expect OEMs (or other potentially liable third parties, such as software providers or system maintainers) to create a handover system that took an undue length of time once the vehicle had indicated the intention of handing back control to the driver. A balance between the two will need to be struck so as not to discourage either the development or the take-up of the technology. This then raises the question of how to judge a reasonable length of time for handover, and the extent to which the handover process should be standardised.

Government has signalled its intention to designate certain vehicles, or categories of vehicles, as 'automated' vehicles. Assessing whether a vehicle is "automated" (i.e. capable of driving in autonomous mode and benefiting from the insurance arrangements described in the Automated and Electric Vehicles Bill) will require definition by reference to some form of minimum standards.

We recommend that as part of the process of defining standards for automated vehicles consideration is given to how an effective handover protocol may look, the process through which control is handed over to the driver (including probably an element of active monitoring and feedback) and the time periods for a driver to be able to retake control.

This may include establishing different conditions and procedures for handover at SAE Level 3 and SAE Level 4. SAE Level 3 hands off operation should only have a realistic expectation of handing over to a driver in normal operation mode under a suitably established and acceptable handover protocol. SAE Level 4 should arguably only request dynamic driving task handover when not safety critical and a suitable and acceptable handover protocol is in place to ensure that handover, if accepted, is not only safe and effective but potentially also optimal (i.e. it could be the same as the Level 3 normal operation handover protocol or even more generous to give drivers even more notice and time to assume control in full command and a state of readiness to drive progressively).

Notwithstanding the development of standards, defining the boundaries between driver and system liability will rely on case by case development of the law – it will be for the courts to determine where the limits of human control end and where the liability of OEMs begins (in much the same way as the courts establish whether a driver is at fault now). In assessing where these boundaries lie, we would expect the courts to pay close regard to the difficulties of handover, including as demonstrated by the results of VENTURER Trial 1.

Chapter 4

Unpredictable handover

VENTURER Trial 1 tested the handover period when the driver knew he or she might be alerted to take control in certain situations, described as 'predicted handover'. The trial did not test 'unpredictable', unplanned handover situations where a vehicle might suddenly have a technical fault or other issues. In the case of an unpredictable handover, the process can be expected to occur in the context of a crisis.

Given that there is a time lag in regaining effective control in a predicted handover, it can be expected that there will also be a time lag in an unpredicted handover, and possibly one of a greater length. This raises questions for both manufacturers and insurers. Firstly, where the handover is unpredicted as a result of issues with the design of the system or how the system performs, would insurers seek rights of recovery against manufacturers? Secondly, in the event that the driver is not able to take back control or the handover is not executed properly, does responsibility lie with the driver for this failure – or with the manufacturer as a result of the failure of the system causing the unpredicted handover? Thirdly, assuming the driver is able to regain control, what is a 'reasonable' length of time for handover in such a scenario and again, should this be standardised? Finally, consideration will need to be given to liability issues in the event that handover is completed successfully but the driver is then unable to manage the stricken vehicle.

Further trials on an unpredicted handover may provide data on the time lag for regaining effective control in an unpredicted handover to assist with this final question. However, given the difficulty of takeover on a planned basis, it must follow that unplanned takeover is yet more problematical from the human driver's perspective and less suitable as a basis for fixing the driver with responsibility for an incident.

This links again to the need going forward (assuming that negligence will remain a part of the legal attribution of civil liability) to establish a new baseline for negligence.

Conclusion

The Government, manufacturers, insurers and drivers will want to ensure that the allocation of responsibility between driver and system during the handover phase is fair and proportionate to reflect the capabilities of users. Any other approach risks stifling the appeal of the technology and unfairly penalising drivers. Separately, a review of the relevant road traffic law and guidance for drivers will be required (e.g. as to the extent to which clarification is required around when a driver (or an OEM) may be criminally liable for mis-managing handover.)

More broadly, as has been observed in similar contexts, where a system is designed not to require the input of a human being (or to require limited input), if that input is required it is not likely to be of high quality.[19] Accommodating the increased difficulties of handover may require development of a more nuanced understanding of safety systems and processes, including an appreciation of what it means to be a skilled driver in an increasingly automated world, in order for the allocation of liability to remain fair and manufacturers incentivised to deliver safe systems.

In the following sections of this chapter we look at other outcomes of Trial 1 which reinforce the need to view handover in the context of system design.

Safety implications of the handover period

Distance travelled during handover

The findings from the STISIM simulator, supported for some experimental conditions by the on-road Wildcat, suggest that the designers of highly autonomous vehicle technology will need to consider human performance under multiple driving conditions and scenarios in order to plot accurate takeover and handover time safety curves.

In particular, the differences in faster response to take control shown between 30, 40 and 50mph do not compensate for the greater distance travelled at higher speeds. At 50mph, a vehicle will be travelling at 22.5 metres per second, so given the average time of two seconds for takeover, it will have travelled a distance equivalent to 45 metres, or half a full football field, two lengths of a typical swimming pool or a row of nine parked cars before the driver actually begins to manipulate the vehicle controls.[20] Moreover, basing these estimations on average takeover times is limited, as any system would also need to account for the slowest expected takeover time to ensure it is safe. Due to the limited sample size in VENTURER Trial 1, it is reasonably likely that the extremes of human takeover and handover performance have not been captured in the data.

To solve this problem and ensure that highly autonomous vehicles are safe, the system may need to incorporate speed dependent phased handover periods, or require the vehicle speed to be automatically reduced to a manageable safe speed before handover is attempted. [21]

[19] The American Society of Safety Engineers, "Automation vs Human Intervention, What is the Best Fit for the Best Performance" http://www.asse.org/practicespecialties/management/automation_human_intervention/.

[20] VENTURER – Trial 1 Findings http://www.venturer-cars.com/.

[21] Ibid.

While most behaviours measured in the STISIM simulator experiment showed greater caution following takeover, the findings relating to steering input at all speeds suggested a reduced level of control. In particular, the positioning within the lane at the highest speed condition (50mph) is cause for concern.

Given that, following rollout of the technology, a scenario could arise where large numbers of vehicles on multilane roads could be transitioning from autonomous to human control at approximately the same time within the same space, these behaviours could be problematic. Looking at the most extreme scenario, there is the potential for two human drivers to drift lanes during this period, endangering each other and potentially causing a collision.

To mitigate this risk, it may be possible to employ driver assistance features, such as active lane keeping, while in human driven mode. This would mean that rather than viewing the handover period as a move from autonomous system to human driver, in practice it might be from autonomous system to supported human driver, or in other words a move between levels of automation.[22]

Driver distraction

One of the cited socio-economic benefits of autonomous vehicles is that people will regain time otherwise lost to driving and will be able to engage in other more productive activities such as sleeping, reading, watching films/TV or replying to emails while the car is driving autonomously. It is clear that this benefit is only realistic when fully autonomous vehicles that are capable of coping with any circumstance they encounter are achieved, as any handover period in a highly autonomous vehicle would not be safe if the driver was otherwise engaged and therefore the time lapse for takeover is slower.

However, it is within the realm of possibility that a driver's attention could wane when a car is in autonomous mode even if they are aware that car may hand over control to them. Evidence provided to the House of Lords Science and Technology Committee inquiry into autonomous vehicles is relevant in this context. As Professor Neville Stanton explained, "even the most observant human driver's attention will begin to wane. Their mind will wander."[23] A driver may well fall asleep by accident or get distracted by engaging in conversations with other passengers – these are problems that can occur with a manual vehicle so are arguably more likely with a Level 3 vehicle where less concentration is required when the car is in autonomous mode.

As Professor Sarah Sharples, Associate Faculty Pro-Vice-Chancellor for Research and Knowledge Exchange and Professor of Human Factors at the University of Nottingham, notes, "it is therefore important to understand the implications of increased autonomy on the capability of humans to maintain vigilance and attention in order to be able to respond to an emergency situation. It may also be necessary for the rollout of highly autonomous vehicles to be accompanied with the advice – or even law – that in some or all circumstances the driver must maintain attention to the driver situation and that other activities should be minimised or avoided." [24]

[22] Ibid.

[23] House of Lords Science and Technology Committee inquiry into autonomous vehicles: written evidence (AUV0029) from Professor Neville Stanton, Chair in Human Factors Engineering, University of Southampton (October 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/written/41762.html.

[24] House of Lords Science and Technology Committee inquiry into autonomous vehicles: oral evidence session, question 56 (November 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/oral/43733.html.

Driver competence

As well as risks with driver concentration, there are also potential negative implications of highly autonomous vehicles for drivers' competence. Drivers could become complacent and over-reliant on technology as they get used to driving in autonomous mode, creating the problem of 'de-skilling', particularly in terms of a reduction in 'situational awareness'.[25] Given that a driver may need to take back control of the vehicle, even with a fully autonomous vehicle, this could be problematic.

This could be addressed by strategies to ensure sufficient driver exposure to maintain skills. When giving evidence to the Lords Science and Technology Committee, Professor Natasha Merat from the Institute for Transport Studies at the University of Leeds suggested that there should be a system of driver licencing for autonomous vehicles, as well as a need for driver training, including for those drivers who already have licences for conventional vehicles. [26] Professor Sharples added that there is a need to maintain the understanding that people have "an appropriate level of competence through a driving test", and that there is a need to consider whether any such driving test includes an understanding of how an autonomous vehicle will behave rather than just focusing on control of the vehicle.[27]

[25] Morgan, P., Alford, C. and Parkhurst, G. (2016) Handover issues in autonomous driving: A literature review. Project Report. University of the West of England, Bristol, UK http://eprints.uwe.ac.uk/2916.

[26] House of Lords Science and Technology Committee inquiry into autonomous vehicles: oral evidence session, question 60 (November 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/oral/43733.html.

[27] Ibid.

Chapter 4

Safety of other road users

The risk of complacency also extends to other road-users who will interact with autonomous vehicles, such as pedestrians, cyclists and other drivers. An understanding of how autonomous vehicles will affect the behaviour of these other road-users will be important in developing both the technology and the policy for the rollout of these vehicles.

In particular, it is important to understand how human behaviour may change as a result of the interaction with autonomous vehicles. The Government previously commissioned a scoping study to understand the main social and behavioural questions relating to autonomous vehicles, which identified nearly 400 open questions and concluded that behavioural aspects have been under-researched.[28]

Professor Merat believes one of the reasons for the lack of research on pedestrians' understanding of autonomous vehicles is that it is a very complicated topic: cultural and regional differences in pedestrian and cyclists' behaviour are complex for human drivers to understand, let alone the sensors and cameras of an autonomous vehicle.[29] Professor Sharples has also pointed out that risks to autonomous vehicle users' safety may arise as a consequence of other road users adapting their behaviour in response to autonomous vehicles being on the road.[30] In the reverse, other road users may need to adapt their behaviour and expectations to accommodate the conduct of various types of automated vehicle: for example it could be the case that pedestrians would become complacent and assume that autonomous vehicles would avoid them, thereby crossing roads at any point.

The Greenwich Automated Transport Environment (GATEway) project has carried out a trial with a TRL driving simulator, comprising two driving tasks: crossing a 'give way' junction and overtaking a slow-moving vehicle on an urban dual carriageway, in order to understand more about how human drivers might respond to the presence of automated vehicles, particularly if human drivers know autonomous vehicles are designed to be risk averse and compliant with traffic rules.[31] The study provides some evidence that, as autonomous vehicles become more prevalent, some human drivers may adapt their driving behaviour. At junctions, human drivers may pull out into smaller gaps between vehicles when there are more autonomous vehicles in the traffic, but when overtaking, participants typically chose to wait until the approaching vehicle had passed in all instances, regardless of whether the vehicle was an autonomous vehicle or a human driven vehicle. Comments from drivers who did not adapt their behaviour towards autonomous vehicles suggest they may be motivated to do so in certain circumstances, such as when they are in a hurry.[32]

Further research is needed in this area to gain a fuller understanding of the impact of the technology on the behaviour of other road users.

[28] House of Lords Science and Technology Committee inquiry into autonomous vehicles: written supplementary evidence (AUV0095) from the Government – Department for Transport (DfT) and the Department for Business, Energy and Industrial Strategy (BEIS) (December 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/written/44865.html.

[29] House of Lords Science and Technology Committee inquiry into autonomous vehicles: supplementary written evidence (AUV0092) from Professor Natasha Merat, Institute for Transport Studies, University of Leeds (November 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/written/43683.html.

[30] House of Lords Science and Technology Committee inquiry into autonomous vehicles: written evidence (AUV0049) from Professor Sarah Sharples and colleagues, University of Nottingham (October 2016) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/autonomous-vehicles/written/41871.html.

[31] GATEway (Greenwich Automated Transport Environment) research project led by TRL, launched in February 2015 https://gateway-project.org.uk/ppr807//.

[32] Published GATEway Project Report PPR807, 'Driver responses to encountering automated vehicles in an urban environment' (February 2017) https://gateway-project.org.uk/wp-content/uploads/2017/02/Driver-responses-to-encountering-automated-vehicles-in-an-urban-environment-1.pdf.

[33] VENTURER – Trial 1 Findings http://www.venturer-cars.com/.

[34] BBC News, MPs debate £1,200 cap on insurance costs for young drivers (March 2017) http://www.bbc.co.uk/news/business-39327089.

[35](Cohen's f = .25 – .4) with power of .8 (determined using G*Power 3.1.7 software: Faul et al., 2007). Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioural, and biomedical sciences. Behaviour Research Methods, 39, 175-191.

Traffic implications

Another often-cited benefit of autonomous vehicles is the reduction in congestion and improvement in traffic flows, through the transmission of traffic information such as the location of road closures or incidents. However, from the perspective of traffic management, the findings around delayed response and cautious driving behaviour following takeover could be important.

Current free flow traffic conditions typically show average speeds that are at or moderately above the speed limit. If the cautious driving behaviour and reduced speed found in VENTURER Trial 1 is replicated across drivers in general in the real world, and if they persisted with greater experience of autonomous vehicles, then this could cause a build-up of traffic and therefore have a reverse effect on road networks.[33]

Further investigation into whether the observed cautious behaviour would, in practice, be eroded by the competitive pressure of other drivers in the context of widespread roll-out of the technology in a real-world environment, or whether caution would depress traffic speeds, is needed. Investigation by highway engineers on the effect of cautious driving following handover on traffic flow would also be valuable to gain a fuller understanding of the potential extent of any problem.

Impact on underwriting

Data on driver performance during handover will enable underwriters to assess the risk class and category of a driver based on their behaviour. This judgment enables a decision to be made on a driver's insurance cover and the premium he or she should pay.

It is therefore important to examine behaviour and performance when handover is required multiple times throughout a driving scenario, as well as considering the performance of drivers with a range of age and driving experience. This is particularly the case given the current policy debate around high car insurance premiums for younger drivers, [34] and the potential benefits autonomous vehicles can bring to groups whose driving might be restricted through lack of experience and limited or declining skills.

Previous studies into the handover period have generally used middle-aged participants who are highly experienced drivers, and in some cases experienced and trained for simulator studies. However, VENTURER Trial 1 determined the age range of participants with a view to including younger, less experienced drivers as well as older and more experienced drivers.

Participant sample Trial 1 experiments

Experiment	UWE STISIM Simulator	Wildcat Road Vehicle
Number of participants	31	27
Sample size	Powered to detect a medium-large effect size. [35]	Medium to large effect size.
Age range	18-69 years of age. Mean = 41.0, Standard Deviation = 13.9, 3 > 60-years of age hence a mean age > 40 years of age	20-60 years of age Mean = 39.6, Standard Deviation = 12.5, 6 participants ≥ 50-years
Gender	16 male 15 female	17 male 10 female

Chapter 4

While age has not been considered as an independent variable in the data analysis, if it is the case that younger people are able to react faster to a handover request and therefore have a quicker takeover time, then arguably they could see a reduction in their insurance premiums. Typically, younger drivers face higher insurance premiums because they are typically regarded as carrying a higher risk, due to their age as well as factors such as their driving experience and claims history.[36] However, if in the context of autonomous vehicles, younger people were found to bring less risk to the insurance pool due to faster handover times, this could bring a benefit to them as a group in the form of reduced premiums.

The effect of autonomous vehicles on insurance premiums across the board will also need to be considered. Given that one of the key benefits of autonomous vehicles is the increase in safety (90% of all motor accidents are caused by human error), those driving autonomous vehicles can expect to see a reduction in their premiums: Telegraph Money has reported that annual premiums could be reduced by £265 on average by 2020.[37] Looking further to the future as the technology is more widely taken up, if as expected vehicle crashes decline when vehicles are in automated driving mode, it is possible that those still driving manual cars will be priced out of the market for insurance. Insurers, manufacturers and the Government will have to work together to provide a solution to this problem. One option could be to help those who can't access driverless technology, for example by introducing a scheme to encourage people to 'cash in' their old, non-autonomous cars to help them afford an autonomous vehicle, known as a scrappage scheme.

> **Lots of work has been done on this by insurance companies and by market consultants, and they predict substantial reductions in the total premium pot. There will probably be a slight increase initially because you will have more expensive gadgets strapped around the periphery of vehicles, but once we see a higher proportion of these vehicles on the road, consultants predict a 50%-plus reduction in the total motor premium market. From our perspective, we are planning in that regard. The good thing is that it will not happen overnight, and therefore as we see motor premiums reduce we can move our staff and our capital on to other lines of business.[38]**
>
> – David Williams, Technical Director, AXA

[36] House of Commons Transport Select Committee and Petitions Committee one-off oral evidence session on cost of car insurance for young people: question 38 (February 2017) http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/petitions-committee/the-cost-of-car-insurance-for-young-people/oral/48201.pdf.

[37] The Telegraph, 'Driverless cars will shave £265 off insurance premiums in five years' (May 2015) http://www.telegraph.co.uk/finance/personalfinance/insurance/motorinsurance/11623218/Driverless-cars-will-shave-265-off-insurance-premiums-in-five-years.html.

[38] Automated and Electric Vehicles Bill Committee oral evidence session (October 2017) https://hansard.parliament.uk/commons/2017-10-31/debates/b1d00f88-a22b-4291-937d-8f6a47d335d7/AutomatedAndElectricVehiclesBill(FirstSitting)

Chapter 5

Perspectives on insurance and civil liability

Context

In April 2016, the transport ministers of all 28 EU Member States signed the Declaration of Amsterdam, a document that lays down agreements on the steps necessary for the development of autonomous vehicle technology in the European Union. The Declaration notes that, as well as technological progress on the actual vehicles, there is a wide range of further 'challenges and uncertainties' which will need to be resolved as the technology evolves, which includes the issue of liability.[39]

Public opinion surveys have shown that many consumers remain wary of the idea of driverless vehicles on our roads. Analysis undertaken for the then Department for Business, Innovation and Skills of public attitudes to automated vehicles found that this cautious attitude appears to be fuelled by a lack of clarity about how the technology would work in practice. Four principle areas of uncertainty were revealed by the analysis, one of which was around legal issues. Key questions raised by the public in this regard include 'Who's responsible when it goes wrong?', 'Will the programmer be liable?' and 'How will insurance work?'.[40] These questions go to the heart of the issue of liability, which is one of the most important aspects of the regulatory framework the UK Government is seeking to create to facilitate the development of autonomous vehicles.

Public acceptance of the development of autonomous driving technology requires human factors to be taken into account in designing AV systems and the associated legal and insurance processes. These need to work within the international context, with the UK playing a leading role. Standards and legal and insurance requirements have to be fair to both manufacturers and consumers to encourage take-up and stimulate development of effective, practical technology.

The current model of civil liability in motor claims

The Road Traffic Act 1930 introduced compulsory third-party insurance for every motorist driving on UK roads. This requirement remains in place to this day, as implemented by the Road Traffic Act 1988.

Third party insurance – the legal minimum – covers motorists who have an accident causing damage or injury to any other person, vehicle, animal or property.[41]

This system is designed to ensure that victims are compensated fairly and quickly, regardless of who is at fault in the collision. When victims are damaged or injured by uninsured or untraced drivers, the Motor Insurers' Bureau acts as insurer of last resort.[42]

The model of liability is relatively simple: in the event of an accident, the insurer of the at-fault driver pays out on insurance claims by third parties who suffer damage. The advent of semi- and fully autonomous vehicles muddies these waters, as it is no longer a straightforward matter of at-fault drivers – in the event of a collision when the car is in autonomous mode, it may be the vehicle itself which is at fault and this begs the question of whether liability therefore lies with the vehicle manufacturer.

[39] The Netherlands EU Presidency 2016, 'Declaration of Amsterdam: Cooperation in the field of connected and automated driving' (April 2016) https://english.eu2016.nl/documents/publications/2016/04/14/declaration-of-amsterdam.

[40] Department for Business, Innovation and Skills and Sciencewise, 'Public attitudes to automated vehicles' (December 2014) http://www.sciencewise-erc.org.uk/cms/assets/Uploads/Automated-vehicles-what-the-public-thinksNov-15.pdf.

[41] https://www.gov.uk/vehicle-insurance/overview.

Government position on civil liability

Government set out to address the issue of liability as part of a consultation launched in July 2016.[43] The consultation paper noted that, in a world in which all vehicles were fully automated and had no input from human drivers, it would be a simple matter of locating liability with the manufacturer (product liability) and leaving them to handle any claims. Such a world – if indeed it ever arrives – remains some time away. The more imminent reality lies in a 'transitional world of mixed fleets, made up of both conventional and autonomous vehicles' which is 'more complex and difficult…to handle' with regard to liability.[44]

In its original consultation, Government defined its objectives as being to ensure that the use of vehicles continues to be covered by insurance, and that claims continue to be handled quickly. To achieve these goals, the consultation proposed a set of changes to apply to those buying automated vehicles. Significantly, as originally envisaged, these changes would have extended the compulsory insurance requirements for automated vehicles so that owners of such vehicles would have to have an insurance policy, which covered the manufacturers' and any other entities' product liability.[45]

The consultation did not, however, propose any fundamental changes in the rules on liability in road traffic accidents, with Government expressing the view that a fault-based approach combined with existing product liability law, rather than moving to a new strict liability regime, would be the best way forward.[46]

Government responded to the consultation in January 2017 and noted that, while a 'significant majority' of respondents agreed that the insurance framework needs to be altered to cater for the onset of autonomous vehicles, the original proposals put forward by Government would not be the best way to do so.[47] This reflected feedback from a number of respondents who identified potential problems with a model, which would rely on the co-existence of product liability with the compulsory motor insurance framework. Among the restrictions that were highlighted by respondents were that product liability insurance is optional, product liability claims can only be made in the first 10 years of a product's lifespan and product liability insurance does not cover damage caused by the product itself.[48]

Given this variety of issues identified with the product liability model, Government is instead legislating to amend the Road Traffic Act 1988 provisions on compulsory motor insurance to take account of autonomous vehicles and establish a 'single insurer' model, where an single insurer covers both the driver's use of the vehicle and the AV technology. This ensures that the driver is covered both when they are driving and when they are a 'passenger' when the vehicle is in automated driving mode.[49]

This is the model that Government previously introduced in the Vehicle Technology and Aviation Bill before Parliament was dissolved for an early General Election in June 2017, and has been re-introduced in the Automated and Electric Vehicles Bill, currently making its way through Parliament.[50]

[42] Centre for Connected & Autonomous Vehicles, 'Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies' (July 2016) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/536365/driverless-cars-proposals-for-adas-and_avts.pdf.

[43] Ibid. [44] Ibid. [45] Ibid. [46] Ibid.

[47] Centre for Connected & Autonomous Vehicles, 'Pathway to driverless cars: Consultation on proposals to support Advanced Driver Assistance Systems and Automated Vehicles – Government Response' (January 2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/581577/pathway-to-driverless-cars-consultation-response.pdf.

[48] Ibid.

[49] Automated and Electric Vehicles Bill https://publications.parliament.uk/pa/bills/cbill/2017-2019/0112/18112.pdf

[50] Ibid.

Chapter 5

> **We have consulted widely and, having worked closely with parliamentary colleagues, the automotive industry and the insurance sector, the Government is creating a new compulsory insurance framework that covers motorists when they are driving and when they have legitimately handed control to the vehicle. We will ensure that consumers can buy insurance in the same way they do now, and that they will continue to have quick and fair access to compensation. Insurers will pay out to victims and, where they can, recover costs from the liable party using common and product law.[51]**
>
> **– Rt Hon John Hayes MP, Minister of State for Transport**
> **Legislation, House of Commons, 23 October 2017**

There are only two caveats to the liability model which the UK Government has laid out. These are if the motorist has either made alterations to software in breach of the insurance policy or failed to install required safety critical updates to the operating system software. [52] In terms of the latter, the importance of such updates should not be downplayed; it is unreasonable to equate a software update on an automated vehicle with one on a smart phone, for example, because the safety implications for drivers and other road users are paramount. In all other circumstances, the insurer's statutory liability will be unconditional. Significantly, this means that the insurer of the vehicle will be liable, even if the collision is as a result of the vehicle having been hacked.[53]

This position has been welcomed by the insurance industry. The Association of British Insurers (ABI) welcomed the legislation, commented that the planned approach would 'keep the process as straightforward as possible for consumers'.[54]

The insurance industry also welcomes the Government's recognition that, in cases where the manufacturer is found to be liable, although the insurer will pay out in the first instance, they will be able to recover against the manufacturer under existing common law and product liability laws.[55]

[51] Automated and Electric Vehicles Bill, Second Reading Debate, House of Commons (23 October 2017) https://hansard.parliament.uk/commons/2017-10-23/debates/BDAB60DC-D67C-44CF-B0CB-9FBE8DAE3F30/AutomatedAndElectricVehiclesBill

[52] Automated and Electric Vehicles Bill, Clause 4

[53] Centre for Connected & Autonomous Vehicles, 'Pathway to driverless cars: Consultation on proposals to support Advanced Driver Assistance Systems and Automated Vehicles – Government Response' (January 2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/581577/pathway-to-driverless-cars-consultation-response.pdf.

[54] Association of British Insurers, Automated and Electric Vehicles Bill is the way forward (October 2017) https://www.abi.org.uk/news/news-articles/2017/10/automated-and-electric-vehicles-bill-is-the-way-ahead-says-the-abi/

[55] Centre for Connected & Autonomous Vehicles, 'Pathway to driverless cars: Consultation on proposals to support Advanced Driver Assistance Systems and Automated Vehicles – Government Response' (January 2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/581577/pathway-to-driverless-cars-consultation-response.pdf.

> **The Bill makes it clear that if an accident has been caused by an autonomous vehicle compensation will be payable by the insurer. The whole point of the Bill is to give the general public the confidence that if a third party is injured, they do not have to worry about whether an insurer is going to claim that the software was defective. If they are injured by an automated vehicle, there will be virtually a strict liability on the insurer and we will deal with that claim.**
>
> **- David Williams, Technical Director, AXA**

However, within the automotive industry there are mixed views on the Government's approach, with the Society of Motor Manufacturers and Traders (SMMT) agreeing with the 'spirit and rationale' of the proposal and saying that a majority of its members conditionally supported extending compulsory motor insurance to cover product liability for Level 4 or 5 vehicles, but noting several members disagree and argue that recourse through existing product liability laws is deemed sufficient.

While there is not total harmony in the views of insurers and manufacturers, and cases will undoubtedly continue to go to court to determine where liability lies, the Government nevertheless anticipates that manufacturers and insurers will quickly develop processes to avoid protracted disputes, further noting that it would not be in the commercial best interests of manufacturers to be obstructive as insurers would ultimately have the option to cease offering cover for troublesome manufacturers vehicles.[56] There is a degree of mutual self-interest here for manufacturers, insurers and motorists.

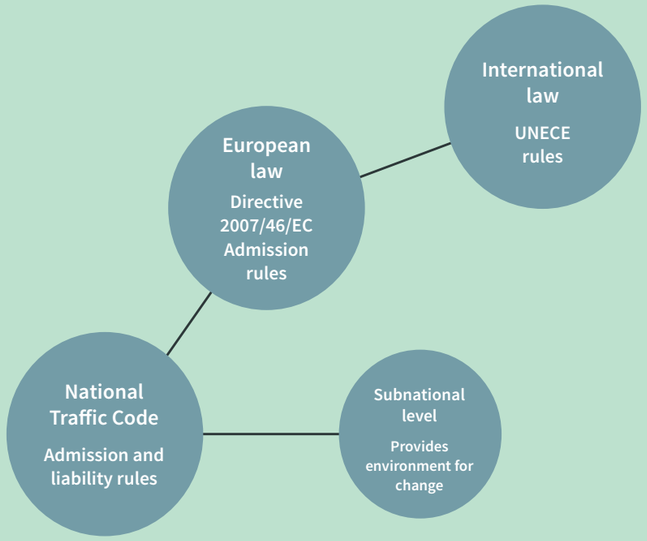
The arrangements put into place will also need to consider the position of the after sales market and the role of those able to access vehicle control systems. The position on notifications of upgrade and the ability to install or update software will be a key part in the factual and legal matrix going forward.

[56] Automated and Electric Vehicles Bill, Public Bill Committee (31 October 2017) https://hansard.parliament.uk/commons/2017-10-31/debates/b1d00f88-a22b-4291-937d-8f6a47d335d7/AutomatedAndElectricVehiclesBill(FirstSitting)

Chapter 5

International dimensions

The regulation of vehicles is governed by national law but is significantly influenced by European and international law.[57] The 1968 Vienna Convention on Road Traffic contains provisions regarding the liability of new technology and also states that 'every moving vehicle or combination of vehicles shall have a driver' and that 'every driver shall at all times, be able to control his vehicle'.[58] As such, the Convention has a direct bearing on the development of AVs in those countries that have ratified it, and an indirect bearing for those which are signatories to it. 74 countries have ratified the Convention, including all European nations except for the UK and Spain.[59]



Source: Policy Network[60]

The Convention had a new paragraph added in March 2014 to make allowance for a car driving itself so long as the vehicle's system 'can be overridden or switched off by the driver'. While this marks a step forward, the continued presence of the word 'driver' will still not allow fully autonomous cars to take to the road, as it explicitly states the driver has to remain in control while the autonomous system is operating. For this reason, Belgium and Sweden have pushed for additional amendments to the Vienna Convention. They would like to see further clarification of the differing levels of automated driving: distinguishing between the need for the driver to be able partially or completely to take over control from the vehicle for either a part or the whole of a journey.[61]

As a non-ratifying nation, the UK is not bound by the Convention, which contributes to the extent to which the UK has been able to press on with the development of autonomous vehicles on its own terms. Nevertheless, the international picture will remain crucial to the development of this emerging technology and the UK will be significantly affected by how regulations develop both in international forums and in other major nations. Additionally, international rules will also have an impact on autonomous vehicles that are taken abroad.

[57] Policy Network, 'Freeing the Road: Shaping the future for autonomous vehicles' (November 2016) http://www.policy-network.net/publications/6161/Freeing-the-Road.

[58] Economic Commission for Europe, Inland Transport Committee, 'Convention on Road Traffic' (1968) https://www.unece.org/fileadmin/DAM/trans/conventn/crt1968e.pdf.

[59] Policy Network, 'Freeing the Road: Shaping the future for autonomous vehicles' (November 2016) http://www.policy-network.net/publications/6161/Freeing-the-Road.

In September 2016 the UN Economic Commission for Europe (the body that produced and is responsible for updating the Vienna Convention) announced that experts on active safety and advanced driver assistance systems under the World Forum for Harmonisation of Vehicle Regulations had adopted technical provisions as a first step towards the introduction of self-steering systems. The group defined five categories of automation corresponding to the functionalities that the vehicle will be able to perform and adopted performance requirements for the first two levels of automation defined by SAE International. It is expected that further details will be published regarding higher levels of autonomy in due course.

The evolution of the UNECE international standards will have a significant influence on the domestic landscape as, where possible, the major nations will want to have harmonised rules concerning the regulation of CAVs. The UK is already ahead of the curve internationally and, on the issue of liability for instance, has already done much thinking on the most appropriate insurance framework, leading to the intended adoption of the 'single insurer' model.

We would strongly encourage the UNECE to follow the UK's lead in this regard and adopt a similar model to ensure consistency and enable motorists to continue to receive compensation in a simple and timely manner in the event of an incident.

Autonomous driving technology, safe systems and liability

In this report we have looked at the way in which the current proposals will accommodate automated technologies within the UK legal and insurance regime. We are supportive of the steps taken by the Government in this direction.

Effective take-up of the technology will also require development of an appropriate insurance and liability model which harnesses the abilities of engineers and designers to deliver the safer outcomes promised by the technology. In doing so, industry and regulators will wish to have regard to the human factors investigated by the VENTURER and other wave 1 Innovate UK funded projects.

Experience from other modes of transport will also be relevant. Take the serious derailment at Santiago de Compostela on 24 July 2013. [62] In this incident the train was changing between sections of track on which speed was automatically controlled and manually controlled. Humans have been shown on repeated occasions to have difficulties accommodating a switch between controlled and uncontrolled (or semi-controlled) environments. Automated technology design and the way in which fault is attributed need to recognise human limitations in order for the system to achieve its potential and remain fair.

[60] Florian Ranft, 'Autonomous cars: Could German efforts to race ahead be counterproductive?' (29 November 2016) http://www.policy-network.net/pno_detail.aspx?ID=6160&title=Autonomous+cars%3a+Could+German+efforts+to+race+ahead+be+counterproductive%3f.

[61] Policy Network, 'Freeing the Road: Shaping the future for autonomous vehicles' (November 2016) http://www.policy-network.net/publications/6161/Freeing-the-Road.

[62] BBC news, "Spain train crash: What happened" (25 July 2013) http://www.bbc.co.uk/news/world-europe-23449336.

Chapter 5

UK law continues to require a human in the loop with all the risk and liability consequences this entails. From the international perspective, note that for the time being the Vienna Convention still requires a human driver to be able to retake control, regardless of the capability of the system. To a degree this is a consequence of the current state of technological development. It means, however, a continued requirement for human involvement with the attendant risks and limitations around performance and brings to the forefront the question of where the boundary of human and system liability will lie.

Consider, for example, the situation in which a human driver decides to retake control. Will the consequences be different where the human does this because of concern over an apparently erratically performing system (even if data subsequently suggests that the system was performing adequately or judged the human driver was not performing the driving task well when he or she elected to retake control)? Unravelling these types of issues will be necessary to develop the clarity required as to what is expected of drivers as their task becomes increasingly (and not fully) automated.

The empirical approach of the courts in assessing where responsibility and civil liability should fall will continue to be important in demarcating these distinctions, with due regard to the complex interaction between system design, regulation and the individual. As a minimum, the law will need to continue to have regard to and refine its concept of what can reasonably be expected of the skilled and competent driver in the handover scenario.

In our third and final report we will look in further detail at the relevant arrangements including: the evolution of updated 'negligence benchmarking' during handover, legal aspects relating to the post sales market and evolution of the criminal liability position relating to driving and vehicle standards offences.

CAV technology offers the prospect of game changing improvements in safety and user experience. Government and industry should build on the foundations of the Automated and Electric Vehicles Bill to develop products which best exploit these opportunities. A common objective should be to arrive at standards and products which respect human fallibility and optimise manufacturers' ingenuity to optimise the most appropriate technology for modern roads. Managing the dynamic between human and machine to create safer systems will be a key area of focus for engineers and regulators, particularly around handover.

VENTURER Insurance and Legal Report 2017/18