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Committee Secretary
Standing Committee on Industry, Innovation,
Science and Resources
PO Box 6021
Parliament House
Canberra ACT 2600

6 February 2017

Dear Committee Secretary

INQUIRY INTO THE SOCIAL ISSUES RELATING TO LAND-BASED DRIVERLESS VEHICLES IN AUSTRALIA

As a group of University researchers interested in the social issues related to automated vehicles we are very happy to have an opportunity to make a submission to the Standing Committee's Inquiry into the Social Issues Relating to Land-Based Driverless Vehicles in Australia.

The following members of the academic staff at Queensland University of Technology (QUT) have contributed to the submission by QUT:

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Yours sincerely

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Professor Belinda Bennett

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QUEENSLAND UNIVERSITY OF TECHNOLOGY

SUBMISSION

INQUIRY INTO THE SOCIAL ISSUES RELATING TO LAND-BASED DRIVERLESS VEHICLES IN AUSTRALIA

FEBRUARY 2017

Background

QUT's real world research priorities focus on being a globally leading university that delivers solutions to the challenges of today and the future. This is achieved through high-impact research that spans discipline boundaries and is pursued in partnership with end users, leveraging our deep technological strengths and responding to the human capital needs of the local and global economies. Our research is differentiated through its engagement with real world challenges and its technological focus, coupled with our ability to work across disciplines and with end users. This represents an important advantage for QUT and positions us distinctively in Australian higher education.

Technologies of automation, big data and developments in material science are advancing disciplines, transforming professions and disrupting business models. QUT has built critical mass in these enabling technologies and is well positioned to differentiate its research and teaching through their early adoption and innovative application. QUT's research aims to provide solutions to real world problems. Our research questions need to be framed in the context of the innovation needs of the relevant sectors of the economy. Solutions often require that we work across disciplinary boundaries, and as technology now impacts on every sector of the economy these solutions inevitably benefit from deep technological capabilities. Home to the Australian Centre for Robotic Vision, the Centre for Accident Research and Road Safety-Queensland (CARRS-Q), and the Australian Centre for Health Law Research (ACHLR), QUT is well-positioned to lead research at the intersections of transformative technologies, transportation, and legal and social policy.

Introduction and Executive summary

The development and introduction of automated vehicles will undoubtedly transform transportation as we currently know it. However, the transformative impact of automated vehicles must be considered in a broader context that takes account of the complex social, economic, policy and regulatory issues they raise. In this submission our analysis of these broader aspects of automated vehicles addresses the following issues:

- Automated vehicles and improved road safety
- Access and equity for vulnerable members of the community and for those living in rural and remote areas
- Design of cities and transportation
- Research studies and trials of automated vehicles
- Ethics and automated decision-making
- Consumer preferences
- The need for regulatory clarity

We are supportive of continued engagement with the social issues raised by automated vehicles and suggest the establishment of a national body with members with diverse expertise to provide ongoing advice to Australian governments about these important issues.

Although we use the term 'automated vehicles' in our submission, we acknowledge that a number of different terms are used to describe increasing levels of automation in land-based vehicles including automated vehicles, autonomous vehicles and driverless cars. We also acknowledge the different levels of automation being developed for vehicles. In our submission, when referring to levels of automation we are referring to the levels specified in SAE International Standard J3016, which has levels ranging from 0 (no automation) to 5 (full automation).[1]

[1] For details of these levels see National Transport Commission, *Regulatory Options for Automated Vehicles: Discussion Paper* (May 2016), at 31. See also, H. Reese. 2016. Updated: Autonomous Driving Levels 0 to 5:

Automated vehicles and improved road safety

Reductions in traffic crashes and in associated injuries and fatalities will be amongst the major benefits of automated vehicles.[2] Proponents of automated vehicles suggest that since human error accounts for more than 90% of motor vehicle crashes, use of automated vehicles will reduce the number of crashes by a similar figure.[3] Improvements in vehicle safety have the potential to benefit younger, less experienced drivers, and elderly drivers, with drivers aged 17-25 years and those aged over 75 years having the highest rates of fatalities from road crashes.[4]

While improved road safety will undoubtedly bring benefits for human health through reductions in road injuries and fatalities, these improvements may bring new challenges for the health system. Automated vehicles have the potential to reduce physical activity for example, by taking away some of the disincentives to driving and removing the need to walk from a parking spot to a destination. A reduction in road fatalities associated with the use of automated vehicles may also reduce the number of organs available for donation.[5] Reductions in road crashes and fatalities through mandatory seat-belts and other road safety measures over the past couple of decades have contributed to a decline in the role of road fatalities in contributing to donor organs.[6] Furthermore, Australia has traditionally had a low rate of organ donation relative to comparable countries. The organ donation rate in Australia (18.3 donors per million population), is much lower than other comparable countries, including the United Kingdom (20.2 donors per million population), Belgium (32.4 donors per million population) and Spain (39.7 donors per million population).[7] In planning for the introduction of automated vehicles it will be important to also plan for their potential impact on areas other than transportation, such as the potential for the safety benefits of automated vehicles to create new challenges by reducing the availability of organs for donation.

Access and Equity

The growing use of automated vehicles provides both opportunities and challenges for social access and equity. On the opportunity side is the potential for automated vehicles to provide increased mobility to people with disabilities, the elderly, and for people who are currently unable to drive for medical reasons,[8] although the realization of these benefits assumes a very high level of autonomy

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Understanding the Differences: http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/

[2] S. Pettigrew. 2016. Why Public Health Should Embrace the Autonomous Car. *Australian and New Zealand Journal of Public Health* doi: 10.1111/1753-6405.12588; DJ Fagnant and K Kockelman. 2015. Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. *Transportation Research Part A* 77: 167-181.

[3] See, for example, KPMG and Centre for Automotive Research. 2012. *Self-driving cars: The next revolution* (KPMG and the Center for Automotive Research), at 7.

[4] Bureau of Infrastructure, Transport and Regional Economics (BITRE). 2016. *Road Trauma Australia: 2015 Statistical Summary* (Canberra: BITRE), at 26.

[5] E. Griffith. 2014. If Driverless Cars Save Lives, Where Will We Get Organs? *Fortune*. 15 August 2014. http://fortune.com/2014/08/15/if-driverless-cars-save-lives-where-will-we-get-organs/; S. Pettigrew. 2016. Why Public Health Should Embrace the Autonomous Car. *Australian and New Zealand Journal of Public Health* doi: 10.1111/1753-6405.12588.

[6] For discussion see Legal and Social Issues References Committee, Legislative Council, Parliament of Victoria. 2012. *Inquiry into Organ Donation in Victoria – Report*, at 27-28 discussing Australian reports on data and trends.

[7] Australian and New Zealand Organ Donation Registry. 2016. *ANZOD Registry Report 2016*, at 2-2. Figures are for 2015.

[8] DJ Fagnant and K Kockelman. 2015. Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. *Transportation Research Part A* 77: 167-181, at 171; S. Pettigrew. 2016. Why Public

that does not require human intervention.[9] However, in order to achieve these benefits it will be important to ensure that automated transportation options are affordable and accessible.

Australia is a signatory to the Convention on the Rights of Persons with Disabilities (CRPD).[10] The Convention establishes obligations on the part of States Parties to the CRPD to 'ensure and promote the full realization of all human rights and fundamental freedoms for all persons with disabilities without discrimination of any kind on the basis of disability' (Article 4(1)). Amongst the rights protected by the CRPD are the rights of persons with disabilities to personal mobility. The obligations of States Parties to the CRPD include: to 'take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas' (Article 9(1)), and 'facilitating the personal mobility of persons with disabilities in the manner and time of their choice, and at affordable cost' (Article 20(a)).

In Australia, access and equity issues will be also a significant problem for rural and remote communities. Not only is the road infrastructure unlikely to be ready for passenger vehicles in remote environments but the acceptance, affordability, and maintenance of such technology in remote areas may be difficult to implement. Planning for the introduction of automated vehicles and incentives to encourage their use as part of strategies to reduce road congestion should be inclusive of the needs of persons with disabilities, the elderly, and those living in rural and remote areas.

Design of cities and transportation

Developments in transportation have shaped the design of cities. The introduction of trains and trams in Australian cities in the mid-late 1800s, allowed people to travel longer distances, thus allowing the expansion of cities from the small-scale city where people walked or used horses and carriages.[11] The widespread use of motor vehicles in the period following World War II contributed to urban sprawl with highways, freeways and low density suburbs.[12]

Automated vehicles could either lead to increased urban congestion or could help to reduce it.[13] Thus, with the development of automated vehicles come important policy choices about the design of urban environments and the use of incentives for forms of transportation that help to reduce congestion.[14] In particular, although the use of automated vehicles could increase mobility for some members of the community who are currently unable to drive, this increased mobility could increase demand for transportation[15] leading to increased congestion.[16] Furthermore, since automated

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Health Should Embrace the Autonomous Car. *Australian and New Zealand Journal of Public Health* doi: 10.1111/1753-6405.12588.

[9] For discussion of levels of autonomy see H. Reese. 2016. Updated: Autonomous Driving Levels 0 to 5: Understanding the Differences: http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/; M. Milford. 2016. Driverless Cars Need to Hit the Road Come Rain, Wind or Shine. *The Conversation.* https://theconversation.com/driverless-cars-need-to-hit-the-road-come-rain-wind-or-shine-60436.

[10] United Nations, Convention on the Rights of Persons with Disabilities. A/RES/61/106 (2006).

[11] KPMG, *No U-Turn: How Autonomous Vehicles will Reshape our Cities* (2016).

[12] KPMG, *No U-Turn: How Autonomous Vehicles will Reshape our Cities* (2016).

[13] KPMG, *Connectivity or Congestion: Two Visions for an Autonomous Future* (2016).

[14] S. Fox, 'Planning for Density in a Driverless World.' Electronic copy available at: http://ssrn.com/abstract=2735148.

[15] CD Harper, CT Hendrickson, S Mangones, C Samaras. 2016. Estimating Potential Increases in Travel With Autonomous Vehicles for the Non-Driving, Elderly and People with Travel-Restrictive Medical Conditions. *Transportation Research Part C* 72: 1-9; S. Fox. Planning for Density in a Driverless World, at 19. Electronic copy available at: http://ssrn.com/abstract=2735148; DJ Fagnant and K Kockelman. 2015. Preparing a Nation for

vehicles could make commuting times less of a deterrent to urban sprawl, the combination of automated systems and private transportation could actually lead to greater urban sprawl and greater road congestion in the absence of appropriate planning and management strategies.[17]

Based on current trends the advent of automated cars will probably incorporate a combination of three complementary technologies: internet-based car sharing (shared vehicles - SVs), automated navigation (automated vehicles - AVs) and all electric propulsion (electric vehicles - EVs). In this form we project that the uptake of shared electric automated vehicles (SEAVs) will be rapid. This is based on firstly already changing habits and preferences. The advent of peak car in Australia and in other similar developed economies indicates that, particularly in inner city environments, people are beginning to use privately owned car less – for the first time since the invention of the internal combustion engine.[18]

This decline is particularly marked in high density urban areas where accommodation of privately owned vehicles is increasingly problematic. Research is indicating that SEAVs as a shared on-demand resource (e.g. accessed by telephone apps as for Uber) will provide a far lower cost, far more convenient form of transport than can be provided by privately owned vehicles.[19] Moreover SEAVs will offer passengers freedom for individualised tasks which offer considerably greater enjoyment and utility than from driving. Thus while public acceptance will need to be driven by a substantial cultural shift in drivers' attitudes we believe that targeted information on the reliability, modality, and socio-economic advantages will lead to rapid acceptance.

There are compelling advantages for local and state governments in the adoption of SEAVs. They lie in radical reductions in congestion, pollution and motor vehicles crashes. Such benefits clearly have important secondary implications in terms of reducing demand on medical and associated facilities, and the need for fewer resources devoted to traffic management. Urban design and housing may also change as garages will not be needed to same extent if the use of shared vehicles becomes widespread.

Over the longer term there are equally if not greater savings to be derived in terms of reduced transport infrastructure. However such savings will depend critically on how governments integrate automated vehicles into the transport system as a whole. The critical challenge for governments is therefore to manage the uptake of SEAVs so as maximise their potential to effect an historic and long overdue rebalancing of the role of privately-owned cars in increasingly congested urban settings. Managing transport modal usage in such a radically changed environment is therefore

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Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. *Transportation Research Part A* 77: 167-181, at 170-171.

[16] KPMG, *Connectivity or Congestion: Two Visions for an Autonomous Future* (2016); S. Fox. Planning for Density in a Driverless World, at 16-20. Electronic copy available at: http://ssrn.com/abstract=2735148; DJ Fagnant and K Kockelman. 2015. Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. *Transportation Research Part A* 77: 167-181 at 170-171.

[17] KPMG, *Connectivity or Congestion: Two Visions for an Autonomous Future* (2016); S. Fox. Planning for Density in a Driverless World, at 16-17. Electronic copy available at: http://ssrn.com/abstract=2735148; DJ Fagnant and K Kockelman. 2015. Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations. *Transportation Research Part A* 77: 167-181, at 171.

[18] DC Cosgrove. 2011. Long-term Patterns of Australian Public Transport Use. *Australasian Transport Research Forum 2011 Proceedings*, 28 - 30 September 2011, Adelaide, Australia.

[19] Morgan Stanley. 2015. Autonomous Cars: The Future Is Now. Morgan Stanley www.morganstanley.com/articles/autonomous-cars-the-future-is-now; A. Ozimek. 2014. The Massive Economic Benefits of Self-Driving Cars. *Forbes Business* http://www.forbes.com/sites/modeledbehavior/2014/11/08/the-massive-economic-benefits-of-self-driving-cars/#6f83aefa68d9

essential. Specifically, it is argued that urban planners have two key tasks in creating an appropriate regulatory framework for SEAVs.

- Firstly the right incentives and information will be needed to persuade people to adopt low cost, low pollution, low space utilising SEAVs in exchange for privately-owned vehicles.
- Secondly equally robust incentives will be needed to ensure that the attractions of SEAVs do not lead to displacement of public transport.

Thus if Governments are able to achieve an appropriate new modal usage mix which radically reduces the numbers of vehicles, then the socio-economic benefits of SEAVs can be fully realised. Such a transformation of the transport system does not, however, come without considerable structural change. The automotive sales and repairs industries are a substantial part of any modern economy. Thus while, Australia no longer has a manufacturing future in the manufacturing of automobiles, car sales, spare parts, service and repair industries will shrink in concert with the automotive sharing economy. Such important structural change will clearly need sensitive management given it will not be without dislocative effects. However it is argued that the social and economic benefits of SEAVs will far outweigh these costs. Thus the potential for beneficial transformation of urban environments through reduced automotive populations – particularly as densities in inner city areas are being increased substantially – are as exceptional as they are exciting. The economic benefits in terms of road infrastructure and traffic management savings; road trauma reductions; and reduced pollution and green-house gas emissions are similarly of a size to justify structural change within the automotive industry.

Research studies and trials of automated vehicles

It is universally accepted that any research involving human should have at its core the ethical consideration of participants' social and physical wellbeing. There is a risk that the enthusiasm for innovative research in automated vehicle may fail to speak to these concerns. Research participants enrolled in a study, or incidental participants, may be adversely impacted if a research team focusses exclusively on outcomes motivated exclusively by other factors i.e. economics, business improvement, etc. That is, although the benefits of automated vehicle research may speak to the pressing need for innovation, if the human impact of automated vehicles is neglected or ignored in the design and methods of research studies, the social and health and wellbeing matters may become invisible. This potentially challenges the social acceptability of automated vehicles in a world where disruptive technology leads the most significant change this century in multiple domains of an individual's life. Research design that includes human factors will better inform how technology influences social values and acceptability and give a more contextually relevant insight into related issues such as policy, legislation and funding etc.

Ethics and automated decision-making

While it has been speculated that automated vehicles will be safer than manually operated vehicles, it is highly likely that crashes will continue to occur. In the context of highly automated vehicles (level 4), however, it may be difficult to determine who is at fault (e.g., vehicle manufacturers, drivers, or individuals outside the vehicle). Fully-automated vehicles (level 5) are designed to take the safest route and avoid crashes. However, and as previously stated by Goodall,[20] if a crash is unavoidable the vehicle must decide the safest way to crash by using the information which has already been pre-programmed into the vehicle. This issue is one that has attracted considerable

[20] N. Goodall. 2014. Ethical Decision Making During Automated Vehicle Crashes. *Transportation Research Record: Journal of the Transportation Research Board (TRB),* 2424: 58-65.

attention[21] and builds on the original trolley car dilemma.[22] In the United States, the National Highway Traffic Safety Administration has stated in relation to highly autonomous vehicles (HAVs):

> Algorithms for resolving these conflict situations should be developed transparently using input from Federal and State regulators, drivers, passengers and vulnerable road users, and taking into account the consequences of an HAV's actions on others.[23]

We support the adoption of a similar approach in Australia.

Part of the disquiet around automated vehicles is an emotional reaction to the inability to understand their decision-making or predict their behaviour. Ignorance of the perceptual and decision-making systems of automated vehicles risks them being judged as negligent or reckless agents or even a public menace. For example, what issues arise for acceptance in terms of regulation and consequences for socially unacceptable behaviour (e.g. driving too quickly in a car park and frightening humans, even if the vehicle is rated as safe moving at those speeds)? We are still at an early stage of developing our understandings of public perceptions of and interactions with automated vehicles. Consumer engagement in the development of programming decisions about vehicle responses in a crash or emergency will be an important aspect of ensuring consumer confidence in this new technology.

Consumer preferences

The paucity of scientific literature on social issues related to automated cars is inconsistent with the vast amount of public and policy interest.[24] There are a growing number of peer-reviewed studies where the member of the public is asked about their acceptance and willingness to use automated cars.[25] Although the questionnaires used in these studies are based on well-established psychology theories, these studies remain highly subjective. The major drawback of such studies is that participants viewed and responded to vignettes or scenarios involving automated vehicles, or descriptions of automated vehicles. Thus, these participants have never experience a real driving an automated car (level 3-4). It could be speculated that individuals still perceive driverless cars as

[21] See for example, J Gogoll and JF Müller. 2016. Autonomous Cars: In Favour of a Mandatory Ethics Setting, *Science and Engineering Ethics*: DOI 10.1007/s11948-016-9806-x; JD Greene. 2016. Our Driverless Dilemma: When Should Your Car Be Willing to Kill You? *Science* 352(6293): 1514-1515; P Lin. 2016. Why Ethics Matters for Autonomous Cars. In M Maurer, JC Gerdes, B Lenz and H Winner (eds). 2016. *Autonomous Driving: Technical, Legal and Social Aspects* (Springer), 69-85; JC Gerdes and SM Thornton. 2016. Implementable Ethics for Autonomous Vehicles. In M Maurer, JC Gerdes, B Lenz and H Winner (eds). 2016. *Autonomous Driving: Technical, Legal and Social Aspects* (Springer), 87-102.

[22] JJ Thomson. 1985. The Trolley Problem. *Yale Law Journal* 94(6): 1395-1415.

[23] National Highway Traffic Safety Administration. 2016. *Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety* (September 2016), at 26-27.

[24] See for example, RT Baker & J Wagner. 2013. Policy Pathways to Vehicle Automation: Industry Perspectives on the Role of Public Policy in Autonomous Vehicle Development. *2013 International Conference on Connected Vehicles and Expo (ICCVE)*, Las Vegas, Nevada; J Wagner, T Baker, G Goodin, & J Maddox. 2014. *Automated Vehicles: Policy Implications Scoping Study*. Retrieved from https://pdfs.semanticscholar.org/9f9b/de49b1a487651d3d9276492b0099b7c0cd88.pdf.

[25] See for example, C Hohenberger, M Spörrle, & IM Welpe. (in press). Not Fearless, but Self-enhanced: The Effects of Anxiety and Willingness to Use Automated Cars Depend on Individual Levels of Self-enhancement. *Technology Forecasting & Social Change*; MA Nees. 2016. Acceptance of Self-driving Cars: An Examination of Idealized versus Realistic Portrayals with a Self-driving Car Acceptance Scale. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, September 2016, Washington, D.C.; FMF Verberne, J Ham, & CJH Midden. 2012. Trust in Smart Systems: Sharing Driving Goals and Giving Information to Increase Trustworthiness and Acceptability of Smart Systems in Cars. *Human Factors and Automation in Vehicles,* 54(5): 799-810.

"science fiction". They cannot form an accurate (non-biased) assessment of the true potential of such a disruptive technology without actually driving it.

Assuming that automated vehicle software can be perfected, it may eventually be the case that all vehicles on the road will be level 5 and that there will be few if any collisions between vehicles. However, riding in a level 5 vehicle may require a surrender of control by humans that some may find difficult for a range of personal, social and/or psychological reasons.[26] For that reason, whatever the pace of technical development of vehicles in terms of the levels of automation, acceptance of automated vehicles may for many require surrender of control by degrees. Accordingly, until such time that all vehicles on the road are level 5, there will likely be an interim period in which roads will be shared by a combination of automated vehicles of level 3 and/or level 4 and human controlled vehicles, thus making for a complex regulatory environment.

Need for regulatory clarity

The introduction of automated vehicles onto Australian public roads will raise a range of complex regulatory issues. Clarity about these regulatory issues is vitally important for governments, key industries such as insurers, and for the general public. An absence of regulatory clarity could impede the development and adoption of automated vehicles.[27]

A full analysis of the regulatory issues arising from the introduction of automated vehicles is beyond the scope of this submission. However, for the general public[28] they can broadly be divided into four main areas: (i) driver licensing requirements; (ii) road rules and traffic offences; (iii) liability and insurance; and (iv) data collection and privacy. We note the current work of the National Transport Commission on the development of regulatory options for automated vehicles[29] and we support the development of a nationally coordinated approach to these important issues.

Driver licensing requirements

The introduction of automated vehicles raises the question of whether current driver licensing requirements are adequate. Current licensing requirements contemplate such matters as theoretical knowledge of road rules, operational knowledge (eg how to brake, signal, park the vehicle etc) and some degree of tactical knowledge (eg when it is appropriate to change lanes, turn etc[30]). As an optional extra some drivers seek to acquire more advanced tactical knowledge and skills through defensive driving training to help them to respond appropriately to potentially dangerous situations.

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[26] J Zmud, I Sener and J Wagner. 2016. *Consumer Acceptance and Travel Behaviour Impacts of Automated Vehicles Final Report* (Texas A&M Transportation Institute).

[27] JS Brodsky. 2016. Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit the Brakes on Self-Driving Cars. *Berkeley Technology Law Journal* 31: 851-877; M Schellekens. 2015. Self-Driving Cars and the Chilling Effect of Liability Law. *Computer Law & Security Review* 31: 506-517.

[28] We recognise that additional regulatory issues may arise for governments, including for example, the regulatory requirements that need to be met before autonomous vehicles are permitted to be used on public roads. For discussion of these issues see, National Transport Commission, *Regulatory Reforms for Automated Road Vehicles: Policy Paper* (November 2016); National Transport Commission, *National Guidelines for Automated Vehicle Trials: Discussion Paper* (November 2016). See also, N Kalra and SM Paddock. 2016. Driving to Safety: How Many Miles of Driving Would it Take to Demonstrate Autonomous Vehicle Reliability? *Transportation Research Part A* 94: 182-193.

[29] National Transport Commission, *Regulatory Reforms for Automated Road Vehicles: Policy Paper* (November 2016); National Transport Commission, *National Guidelines for Automated Vehicle Trials: Discussion Paper* (November 2016).

[30] Which may differ in differ jurisdictions, such as 'hook turns' in Victoria – a manoeuvre requiring specialist operational and tactical knowledge not required in other jurisdictions.

This kind of driving licence may not be a sufficient qualification to address the risks associated with operation of a level 3 vehicle. Two forms of risk may potentially arise in relation to level 3 vehicles:

- where the human occupant fails to disengage the automated system where disengagement was reasonable and appropriate;[31] and
- where the human occupant disengages the automated system where the disengagement was not appropriate.

An ensuing crash in either case may be judged to have resulted from a failure of occupant's duty of care, which may require taking reasonable steps to disengage an automated system only where appropriate. Liability in such cases naturally has implications for insurers.

Acquiring the capacity to know when it is appropriate to disengage the automated system is therefore likely to be an important part of operation of an automated vehicle. It may be a challenge for many drivers, but may be accentuated in some cases such as drivers who are inexperienced in 'reading the road', those who are slow or indecisive in decision-making, and those who tend to act impulsively.

Promoting safe operation of a level 3 vehicle may therefore require implementation of a different licensing scheme from that which currently exists. Such a new scheme will likely require operators of such a vehicle to:

- have knowledge of the road rules, since these may inform a decision whether to disengage the system;
- have less need for some forms of operational knowledge, such as how to brake, signal or park since many of these functions will be assumed by the automated system, but require different forms of operational knowledge such as that which may be required to disengage the system; and
- have a greater focus on tactical knowledge, not only in relation to basics such as when it is appropriate to change lanes or turn, since these may also inform any decision whether to disengage the system, but also importantly more advanced knowledge such as the appropriate response to potentially dangerous situations.

Accordingly, as part of any regulatory framework for automated vehicles consideration should be given to whether operators of level 3 vehicles should be required to undergo a program of training in relation to disengagement, both in terms of the means of this disengaging and the circumstances in which disengagement is appropriate, as a precondition for licensing.

In the United States, the National Highway Traffic Safety Administration has considered the role of consumer education for highly automated vehicles (HAVs), stating:

> Consumer education should cover topics such as an HAV system's intent, operational parameters, capabilities and limitations, engagement/disengagement methods, HMI, emergency fall back scenarios, operational boundary responsibilities, and potential mechanisms that could change function behavior in service.
>
> As part of their education and training programs, HAV manufacturers, dealers, and distributers should consider including an on-road or on-track hands-on experience

[31] Disengagement may be appropriate where, for example, there is failure of the technology such as an incorrect behaviour prediction of other traffic participants, hardware or software discrepancies, failure to respond to emergency vehicles or failure to respond to change road conditions (eg temporary changes in speed limits due to roadworks): cf Google Self-Driving Car Testing Report on Disengagement of Autonomous Mode (December 2015), at 10.

demonstrating HAV operations and HMI functions prior to release to the consumer. Other innovative approaches (e.g., virtual reality) should be considered, tested, and employed as well. These programs should be continually evaluated for their effectiveness and updated on a routine basis, incorporating feedback from dealers, customers, and other data sources.[32]

Road rules and traffic offences

Automated vehicles will require review and possibly amendment of a range of road rules and traffic-related offences.[33] We note the work of the National Transport Commission to review Australian road rules and their application to automated vehicles and acknowledge the importance of a nationally consistent approach to regulatory reform in this area.

Automated vehicles obeying the law will also present a problem for governments which use speeding tickets and parking violations as key parts of government revenue. This revenue is used to fund a wide array of public services and infrastructure including supporting libraries, building parks and public transport. New revenue systems—such as new taxes—will need to be put in place to replace offence-based revenues. Research is needed to examine what sorts of revenue streams might be acceptable to the public in lieu of traffic offence revenue.

Liability and insurance

Automated vehicles are likely to bring about significant changes for the insurance industry as a result of a dramatic decline in crashes, although the costs of each crash could increase depending on the costs of vehicle components for automated vehicles.[34]

Governments, insurers and the public will all need clarity around liability-related issues and insurance if the adoption of automated vehicles is to become widespread. For example, uncertainty over whether the human driver/occupant of the vehicle is responsible in the event of a crash or whether the manufacturer is liable if the vehicle was in automated mode at the time of the crash will create confusion for consumers.[35] This confusion is likely to be exacerbated if there is also confusion over whether the data recorded by the vehicle can be readily accessed by consumers and/or insurance companies in the event of a crash.

Data collection and privacy

Automated vehicles generate a great deal of data. In the case of road vehicles this includes information concerning the condition of components of the vehicle (such as the brakes and tyres), the performance of the vehicle (including its speed and braking performance), its proximity in relation to other vehicles and its location. Information concerning the condition and performance of the vehicle as well as its proximity to other vehicles assist an automated vehicle to operate safely, avoid crashes and efficiently negotiate traffic. From a regulatory point of view, however, relevant questions will therefore include who should own such data, what use the data may be put to, and who may have access to that data.

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[32] National Highway Traffic Safety Administration. 2016. *Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety* (September 2016), at 24.

[33] K Tranter. 2016. The Challenges of Autonomous Motor Vehicles for Queensland Road and Criminal Laws, *QUT Law Review* 16(2):59-81; National Transport Commission. 2016. *Regulatory Reforms for Automated Vehicles: Policy Paper*.

[34] KPMG. 2015. *Automobile Insurance in the Era of Autonomous Vehicles: Survey Results*.

[35] JK Gurney. 2013. Sue My Car Not Me: Liability and Accidents Involving Autonomous Vehicles. *Journal of Law, Technology & Policy* 247-277.

For example, some manufacturers of automated agricultural equipment assert ownership to all data generated, not only in relation to the condition and performance of the equipment but also in relation to the crops and land being serviced by that equipment. While this 'big farm data' may lead to greater efficiencies and improved yields, it may also be shared with preferred suppliers such as vendors of fertiliser, without reference to the owner of the land concerned.[36] In like fashion, automated road vehicles will have the capacity to compile a vast amount of data concerning users – such as their daily routines, when they leave and return home, and the places they prefer to visit – and from those profiles offer better service to make users' lives easier.[37] However, this information may also be shared with third parties such as service suppliers who are in some way affiliated with the vehicle's manufacturer. As in the case of 'big farm data', whatever benefits may be produced by the compilation of information by automated road vehicles, they are accompanied by concerns regarding ownership, use and access to that data.

Apart from third party vendors, other parties may be interested in data produced by automated vehicles. These include:

(a) government authorities who may wish to access the information for the purposes of maximising traffic flow, monitoring road usage, and for future planning;
(b) government authorities who may wish to access the information for the purposes of law enforcement and crash investigations; and
(c) family members who may wish to access data concerning the location of the vehicle in order to monitor its use.

Regulators will therefore need to consider whether the existing data protection regime under the *Privacy Act 1988* (Cth) is sufficient to address the challenges to privacy posed by automated vehicles. Apart from the generation of data, automated vehicles may also be fitted with cameras to monitor events both outside and inside the vehicle. In both cases there may be a risk that those cameras may record private activities. The current ad hoc use of dashboard cameras means a wide range of roadside scenes are already being recorded. Automated vehicles will generate visual, radar and ultrasonic information to be regulated.

Australia currently has a fragmented landscape of surveillance devices laws: only five jurisdictions have statutes governing optical surveillance devices, and these are not in uniform terms.[38] Of these only the legislation in South Australia, Western Australia and the Northern Territory would apply to private activities filmed either inside or outside the vehicle. The definition of' private activities' in the Victorian statute excludes anything occurring outside of a 'building', and would therefore not apply to any activity filmed taking place inside or outside the vehicle.[39] The New South Wales statute only regulates the installation, use or maintenance of surveillance devices where that involves entry into, or interference with, a vehicle without the consent of the owner.[40] Such provisions will have no operation to automated vehicles that have cameras installed by their manufacturers. The legislation

[36] M Castle, B Lubben and J Luck. 2016. Factors Influencing Producer Propensity for Datasharing & Opinions Regarding Precision Agriculture and Big Farm Data. *Presentations, Working Papers, and Gray Literature: Agricultural Economics.* Paper 48, 2016. http://digitalcommons.unl.edu/ageconworkpap/48.
[37] A Lafrance. 2016. How Self-driving Cars Will Threaten Privacy. *The Atlantic* March 21, 2016 http://www.theatlantic.com/technology/archive/2016/03/self-driving-cars-and-the-looming-privacy-apocalypse/474600/.
[38] *Surveillance Devices Act 2007* (NSW); *Surveillance Devices Act 2016* (SA); *Surveillance Devices Act 1998* (WA); *Surveillance Devices Act 1999* (Vic); *Surveillance Devices Act* (NT).
[39] *Surveillance Devices Act 1999* (Vic), s 4.
[40] *Surveillance Devices Act 2007* (NSW), ss 8-9.

in three jurisdictions goes no further than regulating the use of listening devices.[41] These would have no application to cameras in automated vehicles.

Regulators therefore should address the inconsistencies and inadequacies in the current laws governing surveillance device legislation by the enactment of a regime that will be will extend to cameras installed in automated vehicles which may record private activities occurring both inside and outside the vehicle, and which applies uniformly throughout the country.

Conclusion

As outlined in this submission, the introduction of automated vehicles will bring with it a range of social, economic, ethical and regulatory issues. The breadth of these issues, coupled with the rapid pace at which automated vehicles are being developed, highlight the importance of developing policy approaches at the state, territory and national level that will support the realisation of the anticipated benefits of automated vehicles for the Australian community. We would encourage continued consideration of the social issues raised by the development of automated vehicles and to this end, we would support the establishment of a national body with members with diverse expertise (including from consumer and disability groups), to provide ongoing advice to Australian governments about the social issues arising from automated vehicles.

[41] *Listening Devices Act 1992* (ACT); *Invasion of Privacy Act 1971* (Qld); *Listening Devices Act 1991* (Tas).