PARLIAMENT OF NEW SOUTH WALES

Joint Standing Committee on Road Safety (Staysafe)

REPORT 2/56 – SEPTEMBER 2016

DRIVERLESS VEHICLES AND ROAD SAFETY IN NSW

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New South Wales Parliamentary Library cataloguing-in-publication data:

New South Wales. Parliament. Joint Standing Committee on Road Safety (Staysafe).

Inquiry into driverless vehicles and road safety / Joint Standing Committee on Road Safety (Staysafe), Parliament of New South Wales. [Sydney, N.S.W.] : the Committee, 2016. – 106 pages ; 30 cm. (Report ; no. 2/56).

Chair: Greg Aplin, MP.

"September 2016"

ISBN 9781921012365

1. Automobiles—Automatic control—New South Wales.
2. Autonomous vehicles—New South Wales.
3. Traffic safety—New South Wales.
4. Traffic accidents—New South Wales—Prevention.

I. Title
II. Aplin, Greg.
III. Series: New South Wales. Parliament. Joint Standing Committee on Road Safety. Report ; no. 2/56

388.3 (DDC22)

The motto of the coat of arms for the state of New South Wales is "Orta recens quam pura nites". It is written in Latin and means "newly risen, how brightly you shine".

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Terms of Reference

That the Joint Standing Committee on Road Safety (Staysafe) inquire into and report on driverless vehicle technology in New South Wales with particular reference to:

(a) The capacity of driverless vehicle technology to deliver improved road safety outcomes including a lower road toll, and fewer accidents and injuries to drivers, pedestrians and other road users.
(b) The extent to which current road safety policies and regulations in NSW anticipate the introduction of driverless vehicle technology, including driverless heavy vehicles, and any regulatory and policy changes which will be required.
(c) The preparedness of NSW road safety regulators to meet the challenges extended by driverless vehicle technology.
(d) The experience of other jurisdictions in Australia and overseas in adopting and adapting to driverless vehicle technology.
(e) Other related matters.

Chair's Foreword

I am very pleased to present this report on driverless vehicles and road safety in New South Wales.

Driverless or automated vehicle technology is just one of many areas where human endeavour and ingenuity is transforming our world with breathtaking speed.

When we began our inquiry we might have expected to learn about embryonic trials and anticipated changes to which we could respond in good time. Instead, we learned that automated vehicles are already available and technological advances are occurring almost daily.

The most important issue before us was to understand how to maximise the road safety benefits of automated technology and to minimise the risks, with the aim of enjoying the benefits as soon as possible. With the technology already being trialled and deployed in many places in Australia and overseas, an attractive option might have been to take a New South Wales-first approach. The evidence from regulators, researchers and manufacturers, however, persuaded us that acting in isolation could result in fragmented and incompatible regulation. A patchwork approach will set us back in the future, especially given the comparatively small Australian market and its dependence on imported technology.

We have recommended that the best way forward is to work with the other jurisdictions to produce an agreed national framework. By acting together we can ensure the best technologies are rolled out in a coordinated way, manufacturers can operate in Australia with certainty, and the community can be confident that the benefits are real and timely, and the risks well managed. A national framework will ensure a consistent approach to complex issues like managing transition and a mixed fleet, and identifying the costs of providing and maintaining new infrastructure.

While we agree that the road safety benefits of automated technology will be significant, we understand the concerns of vulnerable road users: pedestrians, cyclists and motorcyclists. It is important that the technology meets high performance standards and the community are educated about the potentially unfamiliar driving characteristics of automated vehicles. Delaying transition, however, will delay the road safety benefits without any guarantee that the technology will be improved in the longer run. We believe it is a far better strategy to engage with the technology and enjoy the safety and other benefits as it develops, rather than be overly cautious.

In addition to road safety, automated vehicle technology promises a range of economic and social benefits which will fundamentally change our lives. Some of these benefits will become clearer as the technology develops, but they include improved mobility for many people whose access to vehicles is currently restricted, more efficient freight and public transport, more effective road use, and reduced health costs as accident rates decline.

There will be costs and uncertainties, however, in areas like liability and insurance, data security, and paying for the infrastructure to support vehicle connectivity, especially in rural and regional areas. By engaging with the technology now and supporting its trialling and

deployment, these costs can be identified, explained, budgeted for, and allocated, with community endorsement.

We are happy to report that the NSW Government is well prepared for the roll out of automated technology and committed to the development of the national framework we recommend. The NSW Smart Innovation Centre and Cooperative Intelligent Transport Initiative are state-of-the-art responses to technological change, placing New South Wales at the forefront of innovation.

We are also happy to report that the National Transport Commission is engaging effectively with New South Wales and the other states and territories. The Commission is currently examining the regulatory barriers to automated vehicle technology and is primed to deliver its final recommendations in November this year. We look forward to the Commission's report and trust that our report is both timely and influential in supporting the Commission's work.

I thank my fellow Committee members for their cooperation in making our examination of driverless vehicles and road safety both fruitful and interesting. I particularly thank my colleague and Deputy Chair, Scot MacDonald MLC for his assistance during the 56th Parliament. I also thank the Committee staff for their support and expertise.

Greg Aplin MP
Chair

List of Recommendations and Findings

The Committee believes that improved road safety outcomes can be best achieved through a national regulatory framework which will maximise the benefits and minimise the risks of automated vehicle technology. Therefore, the Committee recommends that a national regulatory framework for the development and deployment of automated vehicles be developed by the National Transport Commission, in consultation with NSW and other states, and implemented by an agreed date with the following components:

a) A robust national trialling and testing regime, including collaboration between regulators and manufacturers, and consultation with users;

b) The establishment of agreed benchmarks for setting safety and performance standards for both automated vehicles and users, and other road users, including vulnerable road users;

c) Incorporation of the benefits of international standardisation and/or an international framework;

d) A determination of the liabilities attaching to the manufacture, sale, and use of the technology, to be legislated if necessary;

e) An examination of the security of the data systems which underpin the technology, including the development of protocols to facilitate data sharing and address privacy issues;

f) A comprehensive public education campaign about the deployment of the technology, targeting amongst others, drivers of both automated and non-automated vehicles, cyclists, motorcyclists, and pedestrians;

g) The public identification of automated vehicles to make them visually distinctive to other road users, particularly during the trial and testing phase;

h) A program to determine the impacts of automated vehicle technology on the provision and maintenance of road infrastructure, including consideration of both current arrangements, and any new arrangements required to support vehicle connectivity; and

i) Transition protocols for managing safe road use by a mixed fleet.

The Committee recommends that pending the introduction of a national framework, the NSW Government should publish a clear statement outlining the terms and conditions for conducting trials of automated vehicles on NSW roads, or adopt a code of practice, based on the current regulatory and policy settings, for governing the deployment of the technology in NSW.

The Committee recommends that the NSW Government take measures to identify the economic and social impacts of the deployment of automated vehicles including:

a) The future investment in, and form of public transport, public transport infrastructure integration, and any measures to protect current and future investment in public transport;

b) The impacts on road congestion;

c) The compatibility of automated vehicle technology with road access pricing;

d) Mobility for the disabled and the elderly, and for people who are not eligible to be licensed drivers;

e) The price charged to individuals for automated vehicle technology;

f) The impact on commerce and industry, including on employment in transport industries;

g) The costs and benefits of providing and maintaining the existing and future infrastructure required to support the technology, including how these costs should be raised, from whom and by whom;

h) The impact on driver training, skills development and retention, and driver behaviour; and

i) A review to identify any other legislative impacts.

The Committee finds that the NSW Government is satisfactorily monitoring the development and deployment of automated vehicle technology.

The Committee finds that a national framework for regulating the deployment of automated vehicle technology is essential to maximise the benefits and minimise the risks deriving from the technology, and particularly the road safety benefits and risks.

The Committee finds that individual state-based regulation of the deployment of automated vehicle technology will not ensure that the benefits of the technology are maximised and the risks are minimised. The Committee finds, however, that any state-specific trials to test particular technologies, vehicles, and road conditions should proceed until such time as a national framework is introduced.

The Committee finds that the National Transport Commission is engaging in a practical and consultative way with NSW and other jurisdictions to achieve a national framework for regulating the deployment of automated vehicle technology.

The Committee finds that, given the rapid development of automated vehicle technology, and noting that the deployment of Level 3 automated vehicles on Australian roads is proceeding, setting timeframes for deploying and transitioning to higher levels of automation is not practicable. The transition to automated vehicles should be regulated under a comprehensive nationally- consistent framework which supports performance-based regulation aimed at maximising the performance of the technology, achieving the best safety outcomes as early as possible, and securing community support.

Glossary

ABS	Anti-lock braking system
ACT	Australian Capital Territory
ADR	Australian Design Rules
ADVI	Australian Driverless Vehicle Initiative
APP	Australian Privacy Principles
ARRB Group	Provider of research, consulting and information services and products to the road and transport industry
Austroads	Association of Australasian road transport and traffic agencies
AV	Automated vehicle
CAV	Connected automated vehicle
Cetran	Centre of Excellence for Testing and Research of Autonomous Vehicles
CITI	Cooperative Intelligent Transport Initiative
C-ITS	Co-operative Intelligent Transport Systems
CO2	Carbon Dioxide
CRC	Co-operative Research Centre
CRS	Centre for Road Safety
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTP Insurance	Compulsory Third Party Insurance
DIRD	Department of Infrastructure and Regional Development
EDR	Event Data Recorder

EWD	Electronic Work Diary
EU	European Union
GDP	Gross Domestic Product
GNSS	Global Navigation Satellite System
HVNL	Heavy Vehicle National Law
IAP	Intelligent Access Program
IPP	Information Privacy Principles
IPWEA	Institute of Public Works Engineering Australasia
ITS	Intelligent Transport Systems
NHTSA	National Highway Traffic Safety Administration
NRMA	National Roads and Motorists' Association
NTC	National Transport Commission
OAIC	Office of the Australian Information Commissioner
OECD	Organisation for Economic Co-operation and Development
PKI	Public Key Infrastructure
PIA	Privacy Impact Assessment
RAC	Royal Automobile Club
RFID	Radio Frequency Identification
RMS	Roads and Maritime Services
SAE	Society of Automotive Engineers
SCMS	Security Credential Management System

SIC	Smart Innovation Centre
SIRA	State Insurance Regulatory Authority
TCA	Transport Certification Australia
TfNSW	Transport for New South Wales
TISOC	Transport and Infrastructure Senior Officials Committee
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle

Chapter One – The Committee's recommendations

SUMMARY

This chapter lists the three recommendations which the Committee makes regarding the development and introduction of automated vehicle technology in New South Wales.

The Committee recommends that a national regulatory framework is required for the successful introduction of the technology. In the Committee's view a national framework is the best way to maximise the benefits of the technology and minimise the risks, and particularly the road safety benefits and risks. A national framework will eliminate any state-based approaches which might fragment the regulation of the technology, and will ensure that Australia's stake in a global market is protected and enhanced.

The Committee recommends that pending the introduction of a national framework, the conditions under which automated vehicle technology can be trialled and tested on NSW roads should be published by the NSW Government. In the Committee's view, the current and planned activity by manufacturers and others to trial the technology demands that a clear statement outlining the conditions under which any trials will take place be made to ensure the public can be confident that trials are well managed, the safety of road users is assured, and all stakeholders are operating on a level playing field. Any statement or code of practice is an interim measure pending the introduction of a national framework.

The Committee recommends that the NSW Government examines the range of additional issues related to automated vehicle technology which have been presented in evidence to the inquiry.

A COMPREHENSIVE NATIONAL REGULATORY FRAMEWORK TO GOVERN ALL ASPECTS OF DEVELOPMENT AND DEPLOYMENT

RECOMMENDATION 1

The Committee believes that improved road safety outcomes can be best achieved through a national regulatory framework which will maximise the benefits and minimise the risks of automated vehicle technology. Therefore, the Committee recommends that a national regulatory framework for the development and deployment of automated vehicles be developed by the National Transport Commission, in consultation with NSW and other states, and implemented by an agreed date with the following components:

a) A robust national trialling and testing regime, including collaboration between regulators and manufacturers, and consultation with users;

b) The establishment of agreed benchmarks for setting safety and performance standards for both automated vehicles and users, and other road users, including vulnerable road users;

c) Incorporation of the benefits of international standardisation and/or an international framework;

d) A determination of the liabilities attaching to the manufacture, sale, and use of the technology, to be legislated if necessary;

e) An examination of the security of the data systems which underpin the technology, including the development of protocols to facilitate data sharing and address privacy issues;

f) A comprehensive public education campaign about the deployment of the technology, targeting amongst others, drivers of both automated and non-automated vehicles, cyclists, motorcyclists, and pedestrians;

g) The public identification of automated vehicles to make them visually distinctive to other road users, particularly during the trial and testing phase;

h) A program to determine the impacts of automated vehicle technology on the provision and maintenance of road infrastructure, including consideration of both current arrangements, and any new arrangements required to support vehicle connectivity; and

i) Transition protocols for managing safe road use by a mixed fleet.

1.1 The Committee believes that the development and deployment of automated vehicle (AV) technology in New South Wales must occur within a comprehensive national regulatory framework.

1.2 In the Committee's view, a comprehensive national regulatory framework will maximise the road safety benefits and minimise the risks from the introduction of AV technology, and indeed maximise the benefits and minimise the risks which the technology has outside the field of road safety.

1.3 The alternative to a comprehensive national regulatory framework is separate state regulatory frameworks. The Committee heard evidence of the development and deployment of AV technology in other jurisdictions, both interstate and overseas. This evidence shows that the development and deployment of the technology is rapid. Indeed, it is the speed at which the technology is being rolled out that is one of the chief reasons for the Committee to be so committed to the value of a comprehensive national regulatory framework.

1.4 The major risk posed by a regulatory framework based around each separate state is fragmentation. Just as state-based railway gauges in the 19th century held back interstate travel and trade, and national economic development, state-based regulatory frameworks have the potential to foster incompatible technological and regulatory development. An outcome which saw the application of some technologies limited to certain states would not be in the best interests of manufacturers, vehicle and road users, or the wider community. Australia is only a middle-sized player internationally, so it is important to ensure we can present a strong and united face if we are to influence technological developments where we need to in our national interests. State-based approaches will diminish this possibility.

1.5 This is not to deny the virtues of competition between the states or states pursuing technological trials which play to their local strengths and needs. In the Committee's view the states can continue to encourage and oversee trials successfully under a national framework focused on consistent regulation and shared national goals.

1.6 The Committee does not see evidence in Australia of the pitfalls which the lack of a national framework could give rise to. But this lack of evidence does not mean these pitfalls will not arise. By acting now we can ensure that we can avoid any potential risks by working together.

1.7 Perhaps the single most important thing we can do is to be prepared. The Committee received evidence that semi-autonomous vehicles are already on our roads. We are already entering the transition phase where we will be managing a mixed fleet. Vehicle manufacturers are already responding to market demands for AV technology by deploying vehicles within the existing licensing and safety regulations. As levels of automation increase, the capacity of our current regulations to govern vehicles with greater autonomy will be tested. The national regulatory framework we recommend will ensure we can move forward without regulatory confusion, duplication, inconsistency and gaps.

1.8 We have identified nine components which a national regulatory framework should contain. These nine components are distilled from the various submissions we received for regulating AVs, including the NSW Government's twelve key issues to be considered in relation to a regulatory framework for automated technology, listed in Chapter Three. The evidence for the value of these nine components is discussed throughout this report. In summary:

1 A national trialling regime is required to ensure all trials are designed and conducted to achieve agreed national goals;

2 Nationally agreed safety and performance standards for autonomous vehicles will ensure the best outcomes for all road users, including vulnerable road users;

3 A national framework will ensure that the highest international standards are the basis of our regulations;

4 Standards for personal and manufacturer liability can be determined and implemented;

5 The security of data systems can be determined, the benefits of shared data can be explored, and privacy can be ensured;

6 The public can be comprehensively educated about the new technology;

7 Autonomous vehicles can be publicly identified;

8 The impacts of the technology on infrastructure provision and maintenance can be costed and planned for; and

9 Transition protocols required for managing the mixed fleet can be developed.

1.9 Finally, the Committee recommends that an agreed national framework be introduced on an agreed date. The Committee cannot determine this date which will be identified by the responsible national authority working in partnership with the state agencies.

INTERIM ARRANGEMENTS PENDING THE INTRODUCTION OF A NATIONAL FRAMEWORK

RECOMMENDATION 2

The Committee recommends that pending the introduction of a national framework, the NSW Government should publish a clear statement outlining the terms and conditions for conducting trials of automated vehicles on NSW roads, or adopt a code of practice, based on the current regulatory and policy settings, for governing the deployment of the technology in NSW.

1.10 The Committee believes that pending the introduction of a national framework, it is important for all stakeholders and especially the public, to have access to a clear statement from the NSW Government outlining its approach to trialling and deploying AV technology.

1.11 While such a statement or code of practice may be valid for only a short period if a national framework can be agreed and implemented quickly, the value of such a statement will be in its clarifying what is happening and may happen in the road environment.

1.12 While manufacturers and regulators will benefit from a clear statement, the most benefit will probably accrue for community road users and particularly vulnerable road users. The Committee heard evidence from vulnerable road users of fears that AV technology may present safety risks in areas like pedestrian, bicycle and

motorcycle detection, and crash prevention. Whether or not these fears are well founded, the community has a right to understand the circumstances in which they might confront AV technology on the road and so be prepared rather than surprised.

1.13 A statement or code of practice need not be technically complicated. Useful examples of codes of practice are available from the United Kingdom, New Zealand and Victoria. A New South Wales code of practice could be derived from these examples, or could be drafted with all or some of the following components:

(a) Testing an automated vehicle must occur in compliance with NSW road rules.

(b) An automated vehicle must be under the control of a licensed driver at all times.

(c) An automated vehicle must be manufactured to Australian vehicle standards.

(d) Prior to on-road testing, an automated vehicle must be track tested and the test results supplied to the NSW Government.

(e) Testing must be approved by the NSW Government prior to commencement.

(f) A test vehicle must be clearly and publicly identified.

(g) The NSW Government must be satisfied that satisfactory public liability and professional indemnity insurance is held by the tester.

(h) The NSW Government must be satisfied that a safety management plan is in place to protect the participants and the public.

(i) A safety management plan might include:

- A description of the technologies being tested.
- A description of testing already undertaken and test performance.
- A testing plan, testing schedule and testing methodologies.
- Safety management accountabilities, lines of responsibility, and fail-safes.
- Risk and hazard identification, and planned management actions and treatments.
- Completed and planned staff safety training and drills.
- An incident register, and exception reporting methodologies.

MEASURES TO IDENTIFY ECONOMIC AND SOCIAL IMPACTS

RECOMMENDATION 3

The Committee recommends that the NSW Government take measures to identify the economic and social impacts of the deployment of automated vehicles including:

a) The future investment in, and form of public transport, public transport infrastructure integration, and any measures to protect current and future investment in public transport;

b) The impacts on road congestion;

c) The compatibility of automated vehicle technology with road access pricing;

d) Mobility for the disabled and the elderly, and for people who are not eligible to be licensed drivers;

e) The price charged to individuals for automated vehicle technology;

f) The impact on commerce and industry, including on employment in transport industries;

g) The costs and benefits of providing and maintaining the existing and future infrastructure required to support the technology, including how these costs should be raised, from whom and by whom;

h) The impact on driver training, skills development and retention, and driver behaviour; and

i) A review to identify any other legislative impacts.

1.14 The terms of reference for the Staysafe Committee and for this particular inquiry are limited to inquiring into and reporting on road safety issues.

1.15 The inquiry's terms of reference encompass improved road safety outcomes, road safety policies and regulations, and the preparedness of road safety regulators, extending to the experience of other jurisdictions and other related matters.

1.16 Unsurprisingly, the road safety focus of the inquiry did not limit stakeholders in presenting evidence concerning the benefits and risks of AV technology in areas beyond road safety. These areas include the economic and social impacts of the technology including impacts on public transport and road congestion, costs and benefits for individuals and industry, improved mobility especially for people who currently do not or cannot hold drivers licences, and costs and benefits for infrastructure provision.

1.17 The Committee intends that this report and the evidence we have received and published present a valuable source of information on the subject of AV technology. In addition to the road safety aspects, the value of the non-road safety-related material should not be under-estimated and the Committee recommends that the NSW Government examine this material as well.

Chapter Two – Automated vehicle technology

SUMMARY

This chapter examines the definition of automated vehicles, the different levels of automation and their potential impact on road safety. It describes the status of enabling legislation and trialling of automated vehicles in several Australian and overseas jurisdictions. The current situation in New South Wales is discussed in Chapter Three.

This chapter also contains a discussion of the potential safety benefits and challenges posed by autonomous vehicles.

A more detailed discussion of issues arising from the development of AV technology, including communication and consumer information; driver licensing, training and behaviour; liability; data generation, usage and protection; and economic and social issues, is contained in Chapter Four.

WHAT ARE AUTOMATED VEHICLES?

2.1 Driverless vehicles may also be referred to as self-driving, autonomous driven cars,[1] connected and automated vehicles, or autonomous vehicles. While on commencement of the inquiry the Committee referred to 'driverless' vehicles, the term 'automated vehicle' or AV will be used throughout the report to maintain consistency with the National Transport Commission (NTC) and accommodate the differing levels of vehicle automation. The NTC states:

> … there is also a lack of clarity in the terminology related to 'driverless cars'. The NTC describes this technology as 'more automated vehicles' recognising that automation exists on a spectrum from driver assistance through to fully driverless vehicles.[2]

2.2 As cars have evolved, technology has assisted drivers in functions normally applied by the driver. Most vehicles driven on Australian roads today contain some automated technology to assist with driving: including cruise control and adaptive cruise control; self-stopping indicators; air bags; automatic windscreen wipers; alerts to notify when a seatbelt is not in use, a door is not fully closed or low petrol levels; blue tooth; automatic headlights; forward collision warning; lane centring; and a lane departure warning system.

Levels of automation

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

http://www.sae.org/misc/pdfs/automated_driving.pdf Note: Copyright © 2014 SAE International. The summary table may be freely copied and distributed provided SAE International and J3016 are acknowledged as the source and must be reproduced AS-IS.

[1] Submission 10, Volvo Car Australia, p1.

[2] Submission 6, National Transport Commission, p8.

2.3 The levels of automation in vehicles are currently ranked via a numbering system. While there are a few different systems used, such as those created and used by the US National Highway Traffic Safety Administration (NHTSA)[3] this report will refer to the Society of Automotive Engineers (SAE) *International Standard J3016*, as outlined in the table above. In summary, the levels are:

Level 0
A human driver is fully responsible for all areas of control of the vehicle including steering, acceleration and brakes.
Level 1
A driver is in control and responsible for operating the vehicle, with an automatic function to assist with steering or speed, such as cruise control.
Level 2
The driver is still responsible for driving the vehicle assisted by two automated functions such as lane centring technology and cruise control which controls the vehicle in increasing or decreasing speed.
Level 3
The car is able to self-drive, with a driver available to take over when required.
Level 4
The vehicle is able to self-drive with the human driver taking a passive role. While no human intervention is expected, the vehicle is able to over-ride human error if required.
Level 5
The car is fully independent and self-driving. There is no steering wheel and no active role for a human driver.

2.4 The semi-automated vehicles presently available in NSW are at level 3. These include the *Volvo CX90* which has options for driving without needing to steer and sensors allowing the vehicle to stop, and the *Tesla Model S*, with the following features:

> Autopilot allows Model S to steer within a lane, change lanes with the simple tap of a turn signal, and manage speed by using active, traffic-aware cruise control. Digital control of motors, brakes, and steering helps avoid collisions from the front and sides, as well as preventing the car from wandering off the road. Model S can also scan for a parking space, alert you when one is available, and parallel park on command. Autopilot features are progressively enabled over time with software updates.[4]

2.5 Google is presently testing level 5 cars in the USA. These cars do not have steering wheels or the option for a driver to take control of the vehicle.[5]

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[3] Submission 11, Dr Gary Ellem, p1, *U.S. Department of Transportation Releases Policy on Automated Vehicle Development* , 30 May 2013. http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development viewed September 2016.

[4] https://www.tesla.com/en_AU/models viewed September 2016.

[5] A First Drive. Google Self Driving Project. Published 27 May 2014. https://www.youtube.com/watch?v=CqSDWoAhvLU viewed September 2016.

AUTOMATED VEHICLES IN AUSTRALIA

South Australia

2.6 The first AV test on a public road in the Southern Hemisphere was conducted in Adelaide by Volvo in November 2015. The test was in a controlled environment using a *Volvo XC90 SUV* model with autonomous features that were programmed for the trial. The demonstration took place on Adelaide's Southern Expressway.

2.7 During that month, the International Driverless Cars Conference was held in South Australia and opened by the Premier of South Australia, the Hon Jay Wetherill MP.[6]

2.8 In March 2016, South Australia became the first state or territory in Australia to pass laws allowing on-road trials of AVs.[7] The Minister for Transport and Infrastructure announced that companies wanting to trial automated car technology on public roads in South Australia are required to submit their trial plans and have adequate insurances to protect the public.[8]

Western Australia

Automated buses

2.9 In February 2016 the Western Australian government announced driverless and fully electric shuttle bus trials would take place during 2016.[9] The trials will commence at the RAC's (Royal Automobile Club) Driving Centre for testing prior to going on Perth roads. The shuttle bus was developed by French company NAVYA SAS who specialise in intelligent transport systems. The RAC advise:

> The shuttle bus is fitted with multi-sensor technology providing 3D perception that allows it to map the environment, detect obstacles on the road and interpret traffic signs. The shuttle bus is the result of 10 years research and expertise which allows it to achieve the highest level of autonomy possible making it an entirely autonomous, or driverless, series vehicle.[10]

2.10 The shuttle bus differs from cars as it will travel over short distances which are considered too long to walk but too short by car. The bus can accommodate up to 15 passengers with an average speed of 25 kilometres per hour, although it can reach a maximum speed of 45 kilometres per hour.

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[6] International Driverless Cars Conference. Government of South Australia. http://dpti.sa.gov.au/driverlesscars viewed September 2016.

[7] SA becomes first Australian jurisdiction to allow on-road driverless car trials. South Australian Premiers Press Release. 31 March 2016. http://www.premier.sa.gov.au/index.php/stephen-mullighan-news-releases/337-sa-becomes-first-australian-jurisdiction-to-allow-on-road-driverless-car-trials viewed September 2016.

[8] SA becomes first Australian jurisdiction to allow on-road driverless car trials. Government of South Australia. 31 March 2016. http://dpti.sa.gov.au/news/?a=255933 viewed September 2016.

[9] WA trials driverless vehicles from NAVYA SAS. GovNewsFebruary 2016. http://www.govnews.com.au/wa-trials-driverless-vehicles-from-navya-sas/ viewed September 2016.

[10] Driverless, fully electric shuttle a reality in RAC's new staged trial. RAC. 9 February 2016 https://rac.com.au/about-rac/media/media-releases/february-2016/driverless-fully-electric-shuttle-a-reality-in-racs-new-staged-trial viewed September 2016.

Automated trucks

2.11 Driverless trucks are currently being used by mining company Rio Tinto at the Yandicoogina and Nammuldi mining sites in the Pilbara region.

2.12 In January 2015 Rio Tinto claimed their 54 trucks had driven 3.9 million kilometres[11] and as of October 2015 were reported to have a total of 69 vehicles, comprising a fifth of its Pilbara fleet. The driverless trucks are controlled by staff based 1,200 kilometres away, at the operations centre in Perth.

2.13 Fully automated trucks offer the safety benefit of addressing worker fatigue. In October 2015, former Rio Tinto Iron Ore Chief Executive Andrew Harding said:

> Automation has gone further and faster than we'd ever have imagined. Not only is it reducing costs and raising efficiency, it's also improved our health, safety and environmental performance.[12]

Victoria

2.14 The Victorian Government's regulator of roads and vehicles, VicRoads, advises that automated vehicles can be tested on Victorian roads without special approvals providing they meet three criteria:

1. the vehicle complies with Australian Design Rules (ADRs) and Victorian standards for registration
2. the vehicle is currently registered
3. there is a human driver in the driver's seat monitoring the system and environment, able to override the automated function at any time.[13]

2.15 VicRoads must approve the testing of fully automated or driverless vehicles on public roads.

2.16 The Victorian Government has published a Code of Practice for testing AVs on Victorian roads. The code is based on the United Kingdom's Department for Transport 'The Pathway to Driverless Cars: A code of practice for testing' with amendments to meet local conditions. VicRoads states:

> The use of this Code is an interim position, which will develop as national and international guidelines evolve. We support the development of nationally agreed guidelines to ensure consistency across jurisdictions.[14]

[11] Rio Tinto. Autonomous Haulage System. Website. Viewed 30 August 2016. https://riotintogroundbreakers.com/46-autonomous-haulage-system/ viewed September 2016.

[12] Rio Tinto talks up autonomous trucks, innovation cred. IT News. 13 January 2015. http://www.itnews.com.au/news/rio-tinto-talks-up-autonomous-trucks-innovation-cred-399341 viewed September 2016.

[13] Testing of automated vehicles. VicRoads. https://www.vicroads.vic.gov.au/safety-and-road-rules/vehicle-safety/automated-and-connected-vehicles/testing-of-automated-vehicles viewed September 2016.

[14] Testing of automated vehicles. VicRoads https://www.vicroads.vic.gov.au/safety-and-road-rules/vehicle-safety/automated-and-connected-vehicles/testing-of-automated-vehicles viewed September 2016.

AUTOMATED VEHICLES OUTSIDE AUSTRALIA

New Zealand

2.17 The New Zealand Government is encouraging trialling of semi and fully automated vehicles and other intelligent transport system (ITS) technologies on New Zealand roads. The New Zealand Ministry of Transport has published extensive information governing the testing of automated vehicles on New Zealand roads. New Zealand does not designate or quarantine any specific roads for testing so potentially, the entire road network is available.

2.18 New Zealand transport legislation does not contain any specific requirements for the testing of AVs. Testing must occur under conditions which comply with existing legislation including holding appropriate insurance and the submission of a safety management plan. A test vehicle operator may or may not be in the vehicle under test.[15]

Singapore

2.19 In August 2016 the Centre of Excellence for Testing and Research of Autonomous Vehicles (Cetran) was launched in Singapore for the testing and research of AVs. Cetran aims to have its test circuit ready in late 2017 which will allow AVs to be trialled on simulated roads prior to testing on public roads.[16]

Europe

2.20 There is currently no European Union-based regulatory framework for the testing of AV technology.[17] [18]

2.21 The European Commission established the High Level Group on Automotive Industry 'GEAR 2030' in October 2015.[19] One of the Group's roles is to consider a roadmap for the smooth rollout of AVs.

2.22 Several European countries are currently trialling or preparing to trial AVs, some of which activities are described below.

Sweden

2.23 In 2017, 100 self-driving cars will be driven on public roads in and around the city of Gothenburg. The project, known as 'Drive Me' is a joint initiative between Volvo Car Group, the Swedish Transport Administration, the Swedish Transport Agency, Lindholmen Science Park and the City of Gothenburg. The City of Gothenburg advises:

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[15] http://www.transport.govt.nz/ourwork/technology/specific-transport-technologies/road-vehicle/autonomous-vehicles/testing-autonomous-vehicles-in-nz/ viewed September 2016.

[16] New centre for testing and research on driverless vehicles. 2 August 2016. The Straits Times. http://www.straitstimes.com/singapore/new-centre-for-testing-and-research-on-driverless-vehicles viewed September 2016.

[17] http://www.cms-lawnow.com/ealerts/2015/09/eu-gears-up-for-connected-vehicle-regulation-but-longer-road-ahead-for-autonomous-vehicles viewed September 2016.

[18] http://etsc.eu/wp-content/uploads/2016_automated_driving_briefing_final.pdf viewed September 2016.

[19] Policy and strategy. European Commission. https://ec.europa.eu/growth/sectors/automotive/policy-strategy_en viewed September 2016.

> The aim is to study the benefits to society of self-driving cars such as road safety and lower CO2 emissions... Self-driving cars are viewed by the Swedish Government and by Volvo Cars as an important solution in achieving the vision of zero fatalities in traffic.[20]

2.24 The objective of the car trial is explained by Erik Coelingh, Technical Specialist at Volvo Car Group:

> Our aim is for the car to be able to handle all possible traffic scenarios by itself, including leaving the traffic flow and finding a safe 'harbour' if the driver for any reason is unable to regain control.[21]

Greece

2.25 The European Union (EU) has funded research for the testing of automated road transport systems with self-driving buses across Europe. A trial of a self-driving bus was conducted in Trikala, Greece over a five month period, commencing in October 2015. Four buses (with two reserves) ran between Tuesday and Sunday for twelve hours a day. They were programed to follow a schedule along pre-determined 2.5 kilometre routes.[22]

2.26 The buses travelled in a dedicated lane, but were otherwise trialled in real traffic conditions, sharing the road with cars, cyclists and pedestrians.[23]

2.27 Each bus contained an electric engine powered by batteries, and carried up to 12 passengers at speeds of up to 20 kilometres an hour. Sensors were used to detect any obstacles before taking decisive action to avoid collision.[24] At the completion of the trial it was reported that the buses had conducted 1,400 journeys over approximately 3,500 kilometres and carried 11,302 passengers.[25]

2.28 Greece was the first EU country to legislate to enable AVs.[26] The Trikala trial took place under a 2014 Greek law which allowed the use of AVs in a demonstration context and did not require driver to be in vehicle.[27]

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[20] DriveME self-driving cars for sustainable mobility. City of Gothenburg. http://international.goteborg.se/smart-cities-and-sustainable-solutions/driveme-self-driving-cars-sustainable-mobility viewed September 2016.

[21] Drive Me - self-driving cars at Lindholmen. 28 April 2014. Lindholmen Science Park. http://www.lindholmen.se/en/news/drive-me-self-driving-cars-lindholmen viewed September 2016.

[22] Tiny automated bus experiment begins in Greece. 3 October 2015. euronews. http://www.euronews.com/2015/10/03/tiny-automated-bus-experiment-begins-in-greece viewed September 2016.

[23] Interview with Dimitris Papastergiou. CityMobil2 Newsletter No 7 , February 2016 http://www.citymobil2.eu/en/upload/public-docs/CityMobil2%20newsletter%207.pdf viewed September 2016.

[24] Tiny automated bus experiment begins in Greece. 3 October 2015. euronews. http://www.euronews.com/2015/10/03/tiny-automated-bus-experiment-begins-in-greece viewed September 2016

[25] Trikala town's driverless bus completes pilot phase. Apokorona News. 2 March 2016. http://apokoronasnews.gr/trikala-towns-driverless-bus-completes-pilot-phase/ viewed September 2016.

[26] Trikala. October 2015. CityMobil2. http://www.citymobil2.eu/en/city-activities/large-scale-demonstration/trikala/ viewed September 2016.

[27] Interview with Dimitris Papastergiou. CityMobil2 Newsletter No 7, February 2016. http://www.citymobil2.eu/en/upload/public-docs/CityMobil2%20newsletter%207.pdf viewed September 2016.

Netherlands

2.29 Truck platooning trials were commenced on motorways in the Netherlands in February 2015. The tests are designed to demonstrate linked driving in which the trucks drive within a fixed distance from each other, linked to achieve simultaneous braking. The Dutch Government has proposed that automated trucks can be deployed within five years and will provide benefits which include reduced road space requirements, and improved safety and environmental impacts.[28]

Germany

2.30 The German Government adopted its 'Strategy for Automated and Connected Driving' in September 2015. [29] The strategy states:

> In the future, German road traffic law must permit the deployment of automated and connected driving systems to the full extent. The Road Traffic Act must stipulate that vehicles with such systems may use the roads.
>
> ….
>
> The Federal Government will review the regulatory framework governing automated and connected driving and, where necessary, adapt it to the latest developments. Consideration should be given to whether traffic law should reflect the fact that, in certain situations, it is no longer the driver but the system that performs the driving task.[30]

2.31 The strategy notes the need for changes to driver training and legislation:

> Automated and connected driving will provide drivers with new functions that are currently not subjects taught in driver training. New requirements, such as handing over and resuming control of the vehicle, will be incorporated into the framework plan for driver instructor training at driving instructor training centres, the Learner Driver Training Regulations and Driver Licensing Regulations.[31]

2.32 In January 2015, the German Transport Minister announced that a section of the A9 autobahn between Munich and Berlin would be fitted with technology to allow testing of AVs.[32] Deemed the 'Digital Motorway Test Bed', the announcement described the proposal as:

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[28] Experiments on autonomous and automated driving: an overview 2015. Public Affairs ANWB. April 2015. http://www.anwb.nl/bestanden/content/assets/anwb/pdf/over-anwb/persdienst/rapport_inventarisatie_zelfrijdende_auto.pdf viewed September 2016.

[29] Strategy for Automated and Connected Driving. Die Bundesregierung. September 2015. http://www.bmvi.de/SharedDocs/EN/Publikationen/strategy-for-automated-and-connected-driving.pdf?__blob=publicationFile viewed September 2016.

[30] Strategy for Automated and Connected Driving. Die Bundesregierung. September 2015. P 16-17. http://www.bmvi.de/SharedDocs/EN/Publikationen/strategy-for-automated-and-connected-driving.pdf?__blob=publicationFile viewed September 2016.

[31] Strategy for Automated and Connected Driving. Die Bundesregierung. September 2015. P 17. http://www.bmvi.de/SharedDocs/EN/Publikationen/strategy-for-automated-and-connected-driving.pdf?__blob=publicationFile viewed September 2016.

[32] Self-driving cars to hit German Autobahn. The Local. 26 January 2015. http://www.thelocal.de/20150126/self-driving-cars-to-hit-german-autobahn viewed September 2016.

> …a technology neutral offer to industry and the research community and can be used by all stakeholders from the automotive industry, the digital technology sector (including the cyber security sector) and academia who are interested in testing their innovations.
>
> On the 'Digital Motorway Test Bed', the Federal Government is promoting trial operations of highly automated to fully automated vehicles. In addition, the focus is on connected driving using car-to-car and car-to-infrastructure communications with sophisticated sensor technology, high-precision digital maps and real-time communications with the latest transmission standards.[33]

United Kingdom

2.33 The UK government pledged its support for AVs as part of its 'National Infrastructure Plan 2013':

> To ensure that UK industry and the wider public benefit from the development of driverless cars, the government announces in the National Infrastructure Plan that it will conduct a review, reporting at the end of 2014, to ensure that the legislative and regulatory framework demonstrates to the world's car companies that the UK is the right place to develop and test driverless cars. It will also create a £10 million prize for a town or city to develop as a testing ground for driverless cars.[34]

2.34 Following the offer, in December 2014, four cities were awarded funding to test AVs on their roads; Greenwich (London), Bristol, Coventry and Milton Keynes. The trials will include shuttle buses, self-driving cars on the road and self-driving pods in pedestrian areas.[35] Testing is due to commence in 2016 / 2017.

2.35 The UK Department for Transport has published a Code of Practice outlining the framework for safely undertaking the trials which states:

> In current legislation a person who holds a full category B (car) driving licence without restrictions is authorised to drive any car. Existing legislation makes no reference to highly or fully automated vehicles. From a driver licencing perspective we have not identified any legal barriers that would prevent the testing of highly automated vehicles on public roads providing the test driver holds an appropriate category of licence. We do not consider that there is a need to introduce regulatory changes in relation to driver licencing or testing to allow for the testing of highly automated vehicles on public roads.[36]

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[33] Strategy for Automated and Connected Driving. Die Bundesregierung. September 2015. http://www.bmvi.de/SharedDocs/EN/Publikationen/strategy-for-automated-and-connected-driving.pdf?__blob=publicationFile viewed September 2016.

[34] National Infrastructure Plan 2013. HM Treasury, December 2013, p65. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263159/national_infrastructure_plan_2013.pdf viewed September 2016.

[35] Experiments on autonomous and automated driving: an overview 2015. Public Affairs ANWB, April 2015, p8. http://www.anwb.nl/bestanden/content/assets/anwb/pdf/over-anwb/persdienst/rapport_inventarisatie_zelfrijdende_auto.pdf viewed September 2016.

[36] The Pathway to Driverless Cars: A detailed review of regulations for automated vehicle technologies, [UK] Department for Transport, February 2015, p35. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401565/pathway-driverless-cars-main.pdf viewed September 2016.

United States of America

2.36 In 2013 the USA National Highway Safety Traffic Administration (NHSTA) released a policy to give guidance to states wishing to permit testing of emerging technologies.[37] The NHSTA updated the policy in 2016 to include federal funding to accelerate the development and adoption of the technology.[38]

2.37 The USA pursues a state-based approach to testing and licensing AVs on roads. Amongst the various states which are investigating the technology, Nevada was the first state to authorise the operation of AVs in 2011. By 2015 sixteen states had introduced legislation to enable testing. Fourteen states had considered, but elected not to enact enabling legislation up to 2015.[39]

2.38 The status of various US states' AV legislation can be found on the National Conference of State Legislatures' website : http://www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx

California

2.39 California illustrates the approach and achievements of an advanced jurisdiction in the USA. State legislation enacted in 2012 provides for the adoption of safety standards and performance requirements to ensure safe operation of AVs on public roads. The California Department of Motor Vehicles has published definitions and testing regulations governing AVs,[40] and as of August 2016, had issued Autonomous Vehicle Testing Permits to fifteen corporations,[41] including the highly publicised Google Self Driving Car Project[42].

2.40 The Department also publishes AV accident reports and AV disengagement reports. These latter reports document disengagements of AV technology during testing and are required to be submitted to the Department by manufacturers annually. [43]

Virginia

2.41 A notable US example of testing AV technology is the Virginia Automated Corridors project.

2.42 Like the German Digital Motorway Test Bed, the Virginia project is designed to attract manufacturers to Virginia by creating an AV test site. The site will include 70 miles of interstate and arterial roads and two off-road test-tracks.

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37 http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development viewed September 2016.

38 Autonomous / Self-Driving Vehicles Legislation , 1 July 2016.National Conference of State Legislatures. http://www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx viewed September 2016.

39 Autonomous / Self-Driving Vehicles Legislation , 1 July 2016.National Conference of State Legislatures. http://www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx viewed September 2016.

40 https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/bkgd viewed September 2016.

41 https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing viewed September 2016.

42 https://www.google.com/selfdrivingcar/ viewed September 2016.

43 https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/disengagement_report viewed September 2016.

2.43 The automated corridors will offer:

- Access to dedicated high-occupancy interstate toll lanes
- High definition mapping capabilities, real time traffic and incidents, and intelligent routing
- Pavement markings maintained for completeness and retro-reflectivity
- Accurate localisation via global navigation satellite systems
- Connected-vehicle capabilities enabled by dedicated communications technology
- High speed complex test-track access.

2.44 The Virginia Government has offered to forego bonds for on-road testing, and to arrange licensing and insurance.[44]

Pennsylvania

2.45 Pennsylvania has not enacted legislation to enable the deployment of AVs. However, the online transportation platform Uber has established its research base, the Advanced Technologies Centre, in Pittsburgh as a hub for testing AVs, and has commenced a trial of driverless taxis in that city. In September 2016, Uber deployed four AVs in Pittsburgh with plans for another twelve. Uber claims these vehicles are fully automated although a driver is present in each vehicle at all times.[45] While the City of Pittsburgh is fully supportive of the trial,[46] whether or not the vehicles comply with state regulations is unclear. Pennsylvania state authorities have vigorously prosecuted Uber and other ride-sharing companies in the past for non-compliance with taxi regulations.[47]

POTENTIAL SAFETY BENEFITS OF AUTOMATED VEHICLES

2.46 Automated driving can reduce or remove the risk of fatalities and injuries caused by vehicles on NSW roads. Up to 90 per cent of vehicle crashes are caused by human factors such as behaviour and error.[48] These include fatigue, speed, driver distraction, impairment due to the use of alcohol and drugs, health issues, inexperience and risk taking.

2.47 Improvements to road safety are expected from reducing or removing human control over road vehicles. By replacing human control with automated technology, driver error and risk taking behaviour are removed. Although public education and advertising campaigns have assisted in reducing the road toll[49] there continue to be road fatalities. The latest report from Transport for NSW

[44] https://governor.virginia.gov/newsroom/newsarticle?articleId=8526 viewed September 2016.
[45] http://www.nytimes.com/2016/09/15/technology/our-reporter-goes-for-a-spin-in-a-self-driving-uber-car.html?_r=0 viewed September 2016.
[46] http://pittsburghpa.gov/mayor/release?id=6496 viewed September 2016.
[47] http://www.reuters.com/article/us-uber-tech-pennsylvania-idUSKCN1175ZQ viewed September 2016.
[48] Submission 17, NSW Government, p26.
[49] Submission 8, Law Futures Centre and Urban Research Program, Griffith University, p4.

Road Safety shows the road toll for NSW up to and including 21 August 2016 as 390 for the 12 month period.[50]

2.48 Dr Kieran Tranter, Associate Professor, Law Futures Centre and Urban Research Program, Griffith University supported the view that replacing the driver, as the main cause of accidents, with technology would greatly improve road safety:

> Engineers have clearly pointed out that the only place where we can make improvements for safer roads and less road trauma is to increasingly augment and replace the driver. That is the weak point in the system. The level of passive safety we can build into roads and vehicles has pretty well been reached. So autonomous vehicles at one level is the next step.[51]

2.49 Improvements to road safety resulting from AV technology are already evident. The NSW government submission noted:

> Vehicle safety automation features have already been delivering significant road safety to NSW road users over time. Anti-lock braking and stability (traction) control are now standard features in cars sold in Australia…. As additional safety technology features continue to be adopted and incorporated into vehicle production, even greater safety benefits will be realised.[52]

2.50 Mr Bernard Carlon, from the Centre for Road Safety described to the Committee the development of technologies which have impacted on vehicle safety over the last 20 years, including airbags, electronic stability control and anti-lock braking systems (ABS). The combining of these with newer technologies as they become more widely available in the market is allowing vehicles to gain greater autonomy and promising even greater impacts.

> Some of those technologies, such as adaptive cruise control, are already in New South Wales. More than 52,000 vehicles are fitted as standard with that technology and around 154,000 with it offered as optional. In the last 10 years that has grown from 619 vehicles up to 21,000 vehicles in 2015 that were plated with that technology already standard in the vehicle.[53]

2.51 Mr Carlon told the Committee that international studies have shown that these technologies have reduced the total number of crashes by around 6 per cent, and up to 49 per cent for rear end crashes.[54] He also described the benefits of lane-assist technology which helps maintain vehicle control, especially where driver fatigue is an issue. Lane-assist systems are fitted to 54,000 registered vehicles in NSW, up from zero ten years ago:

[50] NSW Road Toll Statistics. Transport for NSW. Accessed 21 August 2016. http://roadsafety.transport.nsw.gov.au/downloads/dynamic/nsw-road-toll-daily.pdf viewed September 2016.
[51] Dr Kieran Tranter, Law Futures Centre and Urban Research Program, Griffith University, transcript of evidence, 20 June 2016, p13.
[52] Submission 17, NSW Government, p12.
[53] Mr Bernard Carlon, Executive Director, Centre for Road Safety, transcript of evidence, 17 June 2016, p3.
[54] Mr Carlon, transcript of evidence, 17 June 2016, p3.

> In the modelling for those crashes which are near side crashes and lane movement crashes, associated with both fatalities and serious injuries, we know that lane assist systems reduce them significantly.[55]

2.52 The advances in braking technology have made major impacts on crash reduction. Mr Carlon said:

> We currently have 36,000 vehicles in New South Wales fitted with the technology of autonomous braking systems and 108,000 where it was offered as optional. We know that change in the fleet over time as well. In 2005 again that technology was not available in the fleet in New South Wales. Studies indicate that between a reduction of 35-41 per cent in rear end crashes. Our own data shows that 11 per cent of our serious injury crashes in urban areas where people are admitted to hospital are attributed to rear end crashes.[56]

2.53 Mr Carlon told the Committee that these figures demonstrated the road safety benefits already being derived from the introduction of individual technologies. He said that the eventual agglomeration of these technologies will allow greater and even full autonomy of vehicles, culminating in driverless vehicles.[57]

2.54 The decrease in rates of death and serious injury from vehicle crashes will also impact and benefit the community due to reduced health costs to the public health system. [58]

POTENTIAL SAFETY CHALLENGES OF AUTOMATED VEHICLES

2.55 While the majority of vehicle crashes can be attributed to the driver, there are other factors presenting road safety risks. These hazards include a third party such as pedestrians or wildlife appearing suddenly, defects in vehicle manufacturing, faulty service from a provider, and issues with road and technology infrastructure such as signage or traffic lights.[59] These risks are likely to continue with the introduction of AVs.

2.56 Additionally, there are potential risks that relate specifically to AVs. These hazards include the failure of technology such as sensors and software, the potential for hacking of data, the level of ability for AVs to detect vulnerable road users, wildlife and roadside barriers.[60] There are also safety challenges with the human passenger being unable to respond or intervene when required due to alcohol or drug impairment, health conditions or sleeping.[61]

Managing transition to a mixed fleet

2.57 While AV technology is assumed to be programed to be compliant with the legal road rules, concerns were raised by various stakeholders on the level of safety

[55] Mr Carlon, transcript of evidence, 17 June 2016, p3.

[56] Mr Carlon, transcript of evidence, 17 June 2016, p3.

[57] Mr Carlon, transcript of evidence, 17 June 2016, p3.

[58] Ms Michele Huey, Group General Manager Strategy, Transurban, transcript of evidence, 17 June 2016, p33.

[59] NTC Regulatory barriers to more automated road and rail vehicles Issues paper, p40. http://www.ntc.gov.au/Media/Reports/(66E42530-B078-4B69-A5E3-53C22759F26E).pdf viewed September 2016.

[60] Submission 8, Law Futures Centre and Urban Research Program, Griffith University, pp9-13.

[61] Submission 1, Professor Toby Walsh, UNSW and Data 61, p1.

offered compared to a human driver being able to make a decision based on reading the environment. This is particularly seen as an issue with mixed fleet on the road.

2.58 In its submission, the NSW Government discussed the need to consider the safety implications of a mixed fleet. It reported studies showing that AVs have a higher crash rate than conventional vehicles, although qualified these by noting the distance accumulated by AV is relatively low and AV driving conditions are limited. It also noted the research which shows that the AV was not at fault in any of the reported crashes.[62]

2.59 Mr Ray Rice, Bicycle NSW told the Committee:

> The mixed fleet period where there are different vehicles on the road is incredibly important. We will see a new style of crashes between driverless vehicles and human controlled vehicles. Driverless vehicles just do not behave the same as human controlled vehicles do. I think we have seen that with the Google vehicle. Even though the crashes that have occurred there have been the fault of humans, they have occurred because in a lot of circumstances the vehicles are not behaving as human controlled vehicles do. The same thing applies in the mixed fleet vehicle period as far as vulnerable road users goes.[63]

2.60 Other stakeholders also addressed the mixed fleet issue by referring to the Californian trials where the AV reportedly drove too cautiously.[64] The Motorcycle Council of NSW wrote in their submission:

> A major fault with driverless vehicle technology is the fact that you are introducing programmed behaviour (the vehicle software) into a scenario where learnt behaviour is not fully compliant with the rules. A simple program that does not take into account cultural differences in various locations will never be able to maintain a safe driving environment until the rest of the road users change their behaviour. This has proven to be the case with driverless vehicles in California that have had an increased crash rate due to other vehicles rear ending the driverless car which follows the rules to the letter.[65]

2.61 Professor Walsh, Professor of Artificial Intelligence and Research Group Leader, University of NSW and Data61 suggested that reports of the Californian Google trial had not told the whole story with regard to reliability and reporting of around a dozen accidents involving the test vehicles. He told the Committee:

> [Google] have claimed that in only one of the accidents was the vehicle at fault when it pulled out in front of a bus. In that case it would obviously be responsible. But almost all of the other accidents involved rear-ending where, for example, the vehicle stopped suddenly at a red light. I suspect that if you were to study the situation you would find that a normal driver would have gone through the yellow light and not stopped so quickly. In that regard they may have been partially responsible. If the motorist in the car behind had been aware that they were

[62] Submission 17, NSW Government, p17.

[63] Mr Ray Rice, CEO Bicycle NSW, transcript of evidence, 20 June 2016, p38.

[64] Submission 8, Law Futures Centre and Urban Research Program, Griffith University, pp9-13; Submission 1, Professor Toby Walsh, UNSW and Data 61, p1.

[65] Submission 4, Motorcycle Council of NSW, p3.

> following a Google car they would know that it could stop abruptly and that it would follow the rules to the letter. In that case they might be able to brake and avoid the accident. We should always err on the side of caution.[66]

Safety of other road users

Vehicle identification

2.62 Professor Walsh also proposed that AVs need to be easily identified to other road users, just as learner drivers are identified. He was concerned that drivers be aware of AVs because of their different driving characteristics and the need for other drivers to adapt.[67]

2.63 Mr Mark Brady from the Law Futures Centre and Urban Research Program, Griffith University addressed the Committee on the question of the behaviour of AVs and how it might differ from vehicles driven by humans:

> …the behaviour of an autonomous vehicle, which follows the road rules that we currently have to the letter, could be quite erratic relative to normal human-driven vehicles. We might potentially go through a yellow light and think, 'Okay, it is safe to do so'. Whereas the autonomous vehicle might be programmed to stop immediately. [68]

2.64 Mr Brady suggested that a public identification system for AVs, such as easily visible number plates, would be a warning to other road users that the vehicle might stop suddenly, and allow them to drive defensively.[69]

2.65 The Committee pursued the question of how automated and human behaviour might differ when they asked Mr Robert McDonald, Director, IAG Research Centre for his view on clear identification of AVs. Mr McDonald supported the need for identification:

> …autonomous cars will have a level of logic that is quite different from human thinking. It would be good if people could know that a vehicle may behave differently to how a person may behave.[70]

2.66 The Committee also asked for Mr Chris Siorokos, General Manager, Advocacy and Media, NRMA about the need for vehicle identification. He told the Committee:

> …in a trial phase, if you were to trial autonomous vehicles, then it would absolutely make sense to have them clearly marked so that people knew what they were and knew that they may need to behave differently around them. I suspect over time, as I said as technology becomes more and more ubiquitous and commonplace, any kind of special markings would not be needed.[71]

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[66] Professor Toby Walsh, UNSW and Data 61, transcript of evidence, 20 June 2016, p11.

[67] Submission 1, Professor Toby Walsh, UNSW and Data 61, pp1-2.

[68] Mr Mark Brady, Law Futures Centre and Urban Research Program, Griffith University, transcript of evidence, 20 June 2016, p15.

[69] Mr Brady, transcript of evidence, 20 June 2016, p15.

[70] Mr Robert McDonald, Director IAG Research Centre, transcript of evidence, 17 June 2016, p 59.

[71] Mr Chris Siorokos, General Manager Advocacy and Media NRMA, transcript of evidence, 20 June 2016, p5.

Communication between road users

2.67 The issue of non-verbal or expressive communication between AVs and other road users was raised by various stakeholders. The Motorcycle Council of NSW expressed concern at the lack of facial communication between drivers and other road users such as eye contact, in their submission:

> Eye contact with a driver can no longer occur, which would lead to diminishing courtesy between drivers. Courtesy extended by one driver to another is commonly through eye contact and small gestures, providing direct wordless communication that reduces stress and likelihood for errors of judgement…[72]

2.68 The National Transport Commission (NTC) also raised the issue of communication between road users:

> …human drivers are often able to read pedestrian body language and safely gauge whether or not a person is about to step out onto the road. Some pedestrians also rely on making eye contact with drivers before crossing the road.[73]

Intoxication and taking over vehicle control

2.69 While the ability for cars to self-drive can be argued as addressing the problem of driving under the influence of alcohol or drugs, Mr Ian Faulks raised the question of whether intoxicated people could intervene and operate an AV:

> Even if it is an autonomous vehicle, the alcohol-impaired person is still the driver. After all, actions need to be taken to start the vehicle, enter instructions regarding destination and route, and engage the self-driving function. These actions constitute driving, and if you're drunk, that's drink driving…[74]

Loss of driving skills

2.70 The move to AVs has the potential for drivers to lose their skills. Many stakeholders told the Committee that this loss is likely as the level of automation rises and drivers become over-reliant on technological assistance. Mr Chris Siorokos of the NRMA, said:

> What you need to do is to repeat activities over and over and over again so that you become accustomed to them. If you drive in an autonomous vehicle or a semi-autonomous vehicle and then go into a vehicle that does not have those features, there are risks that you may neglect to do something simply because you are not used to doing it anymore.[75]

2.71 Without regular practice, driving skills may decrease over time, presenting a risk if the driver needs to take control of the vehicle. Mr John Roydhouse, Chief Executive Officer, Institute of Public Works Engineering Australasia, NSW Division (IPWEA NSW) told the Committee that drivers of AVs will still be required to be able to drive. He offered the Committee the example of grader drivers when their machines were upgraded from steering wheel to joystick controls:

[72] Submission 4, Motorcycle Council of NSW, p7.

[73] Submission 6, National Transport Commission, p 54.

[74] Submission 9, Mr Ian Faulks, attachment 'self-driving cars will not help the drinking driver'.

[75] Mr Siorokos, transcript of evidence, 20 June 2016, p7.

> There was resistance, and there had to be a re-education process for operators. That is their living; they do it every day. Everything was fine until something went wrong and there was a gut reaction to grab the steering wheel but there was no longer a steering wheel to grab to turn the grader off the road.[76]

2.72 Professor Michael Regan, Chief Scientist, Human Factors, ARRB Group Ltd, Australian Driverless Vehicle Initiative (ADVI) queried whether even total vehicle automation would eliminate the need for or the wish of people to drive, and hence the need for people to maintain driving skills:

> People talk about level 5 vehicles as if they are inevitable and that at level 5 no-one will have to do any driving. …I know from speaking to other vehicle manufacturers that they are not ready to give people vehicles which they hop into as passengers if people still demand to be able to drive. We need to be thinking that level 5 vehicles in the future may very well be vehicles that allow people still to drive.[77]

2.73 Concern that younger drivers may never gain adequate driving skills was raised with the Committee by Professor Walsh:

> ... it is also a concern that younger users will never have those skills because they will never have the road hours to develop them in the first place. That is a very real concern. Hopefully at some point the technology will be so good that we will never have to depend on having those skills.[78]

[76] Mr John Roydhouse, CEO Institute of Public Works Engineering Australasia NSW Division, transcript of evidence, 20 June 2016, p32.

[77] Professor Michael Regan, Chief Scientist Human Factors ARRB Group Ltd, transcript of evidence, 17 June 2016, p27.

[78] Professor Walsh, transcript of evidence, 20 June 2016, p11.

Chapter Three – Preparedness of the NSW Government

SUMMARY

In this chapter the Committee examines the preparedness of the NSW Government to identify regulatory and other issues posed by the advent of AV technology.

The Committee examines both the regulatory environment and the AV testing environment, in NSW with a view to assessing governmental readiness and engagement.

The Committee also examines the NSW Government's participation in and contribution to national activity aimed at addressing regulatory barriers to AV technology.

The Committee finds that the NSW Government is satisfactorily engaged with these issues, and that a national framework for regulating AV technology is essential if the benefits of the technology are to be maximised and the risks minimised.

The Committee also finds that individual state-based regulation will not maximise benefits and minimise risks, but that a national framework is not a barrier to trials of any particular technology taking place in any state.

The Committee finds that the transition to higher levels of automation will be best regulated through outcomes or performance-based standards, and that the public identification of AVs will have road safety benefits.

THE COMMITTEE'S FINDINGS

FINDING 1

The Committee finds that the NSW Government is satisfactorily monitoring the development and deployment of automated vehicle technology.

FINDING 2

The Committee finds that a national framework for regulating the deployment of automated vehicle technology is essential to maximise the benefits and minimise the risks deriving from the technology, and particularly the road safety benefits and risks.

FINDING 3

The Committee finds that individual state-based regulation of the deployment of automated vehicle technology will not ensure that the benefits of the technology are maximised and the risks are minimised. The Committee finds, however, that any state-specific trials to test particular technologies, vehicles, and road conditions should proceed until such time as a national framework is introduced.

FINDING 4

The Committee finds that the National Transport Commission is engaging in a practical and consultative way with NSW and other jurisdictions to achieve a national framework for regulating the deployment of automated vehicle technology.

FINDING 5

The Committee finds that, given the rapid development of automated vehicle technology, and noting that the deployment of Level 3 automated vehicles on Australian roads is proceeding, setting timeframes for deploying and transitioning to higher levels of automation is not practicable. The transition to automated vehicles should be regulated under a comprehensive nationally-consistent framework which supports performance-based regulation aimed at maximising the performance of the technology, achieving the best safety outcomes as early as possible, and securing community support.

FINDING 6

The Committee finds that the public identification of automated vehicles, whether by signage or plates, will benefit other road users and contribute to road safety, at least during the transition phase.

3.1 In Chapter One the Committee recommended that a national regulatory framework be developed to govern the development and roll-out of AV technology. The Committee is strongly persuaded that a national framework is the only practical way to maximise the benefits and minimise the risks of the technology, and also to ensure that Australia is best placed in a global market, to contribute to the development of the technology.

3.2 In the evidence quoted below, the Committee makes its case that the NSW Government is satisfactorily monitoring the development and deployment of the technology, in terms of the regulatory changes required as well as supporting innovation and working with industry.

3.3 Further, the evidence below demonstrates that New South Wales is working collaboratively with the national and other state jurisdictions in Australia, notably under the auspices of the National Transport Commission, and is committed to developing and being part of the national framework which the Committee recommends.

3.4 As discussed in Chapter Two, the United States experience of pursuing a fragmented state-based approach has potential pitfalls, especially for concerns such as incompatible connectivity infrastructure and inconsistent regulation. While states like California and Virginia are at the forefront of technology development and trialling, other states have fallen behind. In Australia's smaller market such a fragmented approach could have much greater impacts than in the US, especially given our reliance on imported technology.

3.5 A national framework does not diminish any state's ability to identify particular technology partners and encourage particular trials, as the Committee reports in Chapter Two regarding the South Australian and Western Australian trials, and as the Committee reports in Chapter Three regarding the NSW Cooperative Intelligent Transport Initiative.

3.6 The issues raised by the need to manage transition to a mixed fleet, discussed in Chapter Two, and the speed with which AV technology is developing, suggest that setting transitioning timeframes are neither wise nor practicable. Rather, the Committee finds that the NSW approach of taking a thorough and considered approach to regulatory changes and a collaborative and consistent national framework will support performance-based regulation and achieve community support. A particular outcome of this approach will be enjoying the road safety benefits of the new technology as it evolves.

3.7 Finally, in making its recommendations in Chapter One, the Committee was concerned to avoid focusing too closely on technical matters while emphasising that a comprehensive national regulatory framework would maximise the benefits of AV technology and minimise the risks. On the question of the benefits of vehicle identification, at least during the transition phase, the Committee finds that some form of public identification of AVs will benefit road users and contribute to road safety. We are persuaded by the evidence reported briefly in Chapter Two and in more detail in Chapter Four that vehicle identification will alert other road users to adjust their driving behaviour in the presence of AVs which may behave differently to human-controlled vehicles.

THE REGULATORY ENVIRONMENT IN NSW

3.8 The NSW Government described the current regulatory environment in NSW in its submission to the Committee.

Twelve key issues

3.9 The NSW Government listed twelve key issues to be considered in relation to a regulatory framework for automated technology:

1. the future definition and use of the term 'driver' in road transport legislation;
2. whether different rules and conditions should apply to vehicles (and their use) based on their level of automation;
3. the extent to which occupants of autonomous vehicles require training, experience, minimum fitness standards or knowledge of road transport law before 'using' an autonomous vehicle in NSW;
4. the extent to which occupants of autonomous vehicles are responsible for unsafe or illegal 'behaviour' of the vehicle, and what level of responsibility occupants are obliged to intervene to prevent road crashes;
5. the ongoing application of 'human factor' laws in the autonomous vehicle context, such as drink and drug driving laws, including the appropriate way of dealing with driver behavioural issues when human intervention is required to take control of an automated vehicle;
6. the ongoing need for existing safety programs that attempt to address dangerous behaviours, particularly those that include use of technology as a key safety control (for example, the mandatory alcohol interlock program for repeat and high range drink drivers);
7. developing an appropriate enforcement framework that recognises different levels of 'driver control' in different vehicles and traffic situations;
8. ensuring that vehicle design rules and vehicle standards appropriately balance priorities of not stifling innovation and ensuring safety of all road users;
9. assessing whether any additional items are required to ensure that vehicle modifications are adequately dealt with in the context of autonomous vehicles;
10. identifying the extent to which IT security and related issues (such as hacking) should be addressed in road transport legislation;
11. the extent to which rules may be required to ensure road safety in circumstances where autonomous vehicles (or supporting infrastructure) experience system failure or malfunction; and
12. identifying appropriate mechanisms to ensure that 'autonomous vehicles' are operating within current local laws at all times (including vehicles that may be 'visiting' from another jurisdiction).[79]

3.10 The submission also noted that NSW Police had raised issues for legal consideration in relation to prosecutions in AV technology. [80]

[79] Submission 17, NSW Government, pp44-45.
[80] Submission 17, NSW Government, pp45-46.

Vehicle control and the definition of 'driver'

3.11 First amongst the government's key issues is the question of vehicle control.

3.12 The *Road Transport Act 2013* defines 'drive' as to 'be in control of the steering, movement or propulsion of a vehicle…' and 'driver' as 'any person driving a vehicle, and includes any person riding a vehicle'.[81]

3.13 While the definition of driver does not specifically state 'human', the definition of 'person' in the *Interpretation Act 1987* may be sufficiently broad to allow for a corporation to test an automated vehicle without a human driver in the vehicle.[82]

3.14 Ms Clare Gardiner-Barnes, representing Transport for NSW, described the definition of a driver as the critical question for all jurisdictions considering how to move from human-controlled vehicles to technology-controlled ones:

> Right now, in New South Wales, the legislation requires that a human driver is in control of the vehicle. However, there are provisions within the current legislative framework, to seek exemptions. So there are possibilities within the current legislative framework for new technologies—driverless-type vehicles—to be trialled within New South Wales.[83]

THE TESTING ENVIRONMENT IN NSW

The Smart Innovation Centre

3.15 A major initiative of the NSW Government to prepare for AVs and testing was the establishment of the Smart Innovation Centre (SIC) in April 2016.[84] In its submission, the Government advised that the Centre will:

> …provide collaborative support, facilities and expertise to promote research and innovation and position NSW as a leader in accelerating deployment of emerging transport technologies.[85]

3.16 Transport for NSW emphasised the role of the SIC in the government's plans for testing AV technology. It advised that the NSW Government has called for expressions of interest for industry partners to work with the Centre, with a particular focus on crash laboratory technologies and crash analysis. The SIC will extend its core business with a view to establishing mechanisms to test the safety and roadworthiness of new and emerging technologies. [86]

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[81] *Road Transport Act 2013*, part 1.2 Interpretation, p4. http://www.legislation.nsw.gov.au/inforce/72c01500-07a9-48f8-a954-a8b0fce13648/2013-18.pdf, viewed September 2016.

[82] *Interpretation Act 1987*, part 2, section 8, gender and number, 15 September 2015. http://www.legislation.nsw.gov.au/#/view/act/1987/15/part2/sec8 viewed September 2016.

[83] Ms Clare Gardiner-Barnes, Deputy Secretary Freight, Strategy and Planning, Transport for NSW, transcript of evidence, 17 June 2016, p4.

[84] http://www.transport.nsw.gov.au/media-releases/future-transport-nsw-government-launches-transport-and-roads-technology-hub viewed September 2016.

[85] Submission 17, NSW Government, p50.

[86] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, pp3-4.

The Cooperative Intelligent Transport Initiative

3.17 In its submission to the inquiry, the NSW Government described the work of the NSW Centre for Road Safety and a current project which is reviewing heavy vehicle use of technology for road safety. The Cooperative Intelligent Transport Initiative (CITI) project is:

> …the only large-scale deployment of cooperative intelligent transport system dedicated to heavy vehicles in the world. The project allows heavy vehicle drivers to receive safety messages about upcoming hazards and potential crashes. The messages come via technology attached to other vehicles, as well as structures such as traffic signals. Drivers received messages warning of intersection collisions, forward collision danger, heavy braking ahead, traffic signal phase and speed limits.[87]

3.18 The testing facility for the project is based in the Illawarra Region, south of Sydney. In stage one of the project, which was completed in November 2015, 58 heavy vehicles, two light vehicles and a motorcycle were fitted with the safety messaging technology, as well as three sets of traffic signals and a solar powered trailer which provides speed zone alerts to trucks.

3.19 The NSW Government submission advised that the CITI project had already collected more than 500 million safety messages. This data is being used to better understand how the messaging technology works under Australian conditions and assist in quantifying the safety, efficiency and environmental benefits of connected vehicles. According to the submission, the project, and especially its collaborative basis involving government agencies and researchers, will provide a strong base for future research into the development of AV technology.[88]

A legal framework for on-road testing in NSW

3.20 In its May 2016 discussion paper the National Transport Commission (NTC) noted that on-road trials are necessary to ensure that automated systems can operate safely and efficiently in Australian conditions, and for building public understanding and confidence. The NTC highlighted that different trial standards, processes and requirements might inhibit a nationally consistent approach. It advocated that governments support the development of a code of practice, endorse national guidelines, and agree to consistent legislation in order to ensure comprehensive, nationally-consistent and efficient on-road trials.[89]

3.21 In its submission, the NSW Government described its rationale for establishing a legal framework to permit on-road trials of AVs. The Government proposed a pragmatic approach to removing legislative impediments to safe testing, allowing NSW to be positioned at the forefront of emerging transport and vehicle technologies.

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[87] Submission 17, NSW Government, pp50-51.

[88] Submission 17, NSW Government, pp50-51.

[89] https://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

> The introduction of specific legislation to facilitate trials will increase market certainty that trials can be legally conducted in NSW, and will ensure that trials are undertaken consistently and with appropriate conditions to ensure the safety of motor vehicle occupants, other road users and broader public safety.[90]

3.22 The Government also described a number of potential regulatory barriers to conducting a trial outside of the scope of road transport law, including consumer protection, liability, insurance and common law issues, which it was also examining through the proposed legislative framework.

> For example, the importation of vehicles to Australia is governed by Commonwealth legislation and vehicle import approval from the Commonwealth will be required to import vehicles that do not comply with National Standards in order to participate in any proposed trial or demonstration in NSW.
>
> Appropriate public liability or other insurance arrangements may be also required for vehicles participating in trials or demonstrations, if CTP insurance requirements do not apply or are not considered suitable.[91]

3.23 The Government acknowledged that the use of the highest levels of AV technology (Levels 4 and 5) would require changes to road transport regulations in order to clarify their legality and ensure the most supportive legal environment to encourage innovation.[92]

NSW AND A NATIONALLY CONSISTENT APPROACH

3.24 The NSW Government acknowledged that increasing vehicle automation is best managed by a nationally consistent approach.[93]

3.25 It advised the Committee of its work with the Australian Driverless Vehicle Initiative, Austroads, and the National Transport Commission on projects which aimed to develop a nationally consistent approach to regulating the deployment of AV technology.[94]

Australian Driverless Vehicle Initiative

3.26 The Australian Driverless Vehicle Initiative (ADVI) is a partnership of more than 50 Australian and international organisations which aims to:

> …explore the impacts and requirements of automated and connected vehicle technology in a truly Australian context, and make recommendations on ways to safely and successfully introduce them.[95]

3.27 The Government emphasised the need for national consistency regarding infrastructure and signage. It expressed the view that higher levels of automation will be achieved sooner if linked to and supported by connected infrastructure.

[90] Submission 17, NSW Government, pp53-54
[91] Submission 17, NSW Government, pp53-54.
[92] Submission 17, NSW Government, p44.
[93] Submission 17, NSW Government, p9.
[94] Submission 17, NSW Government, p55.
[95] Submission 17, NSW Government, pp51-52.

> The Policy Framework for Intelligent Transport Systems in Australia provides guidance designed to ensure that the technology used in each jurisdiction is compatible and is developed around a set of agreed policy principles.[96]

3.28 The Government stressed the importance of uniformity of road infrastructure and signage across different jurisdictions to enable highly automated vehicles to navigate effectively. It noted that local governments maintain a large proportion of road infrastructure and signage in NSW and the potential for variations in signage and road quality despite current efforts to achieve consistent standards.

> In responding to the uptake of automated vehicle technology, NSW Government agencies would need to take account of this, as well as the potential need to assist local government in bringing their road networks up to a uniform standard in addition to ensuring that State managed roads are up to the standards required.[97]

Austroads

3.29 The Government submission described the participation of NSW agencies in four strategic research projects commissioned by Austroads, the peak organisation of Australasian road transport and traffic agencies,[98] which aim to identify and assess key issues which need to be addressed for connected and AVs to operate safely. These projects are:

- assessing the safety benefits of connected and automated vehicles
- identifying the impacts of automated vehicles on registration and licensing, and compulsory third party insurance arrangements
- assessing key road operator actions to support automated vehicles
- establishing a Cooperative ITS operational framework.

3.30 The Government advised that it expected the first three of these projects to be completed by the end of 2016.[99]

National Transport Commission

3.31 The National Transport Commission (NTC) is an independent statutory body whose role is to develop and submit recommendations for improving the productivity, safety and environmental performance of Australia's transport systems.[100]

3.32 The NTC is currently reviewing regulatory barriers to the safe introduction of more AVs in Australia with the aim of delivering a policy paper with final recommendations to the Transport and Infrastructure Council in November

[96] Submission 17, NSW Government, p 19.
[97] Submission 17, NSW Government, p19.
[98] http://www.austroads.com.au/about-austroads viewed September 2016.
[99] Submission 17, NSW Government, p56.
[100] Submission 6, National Transport Commission, p3.

2016.[101] In an issues paper released earlier in 2016, the NTC identified the key regulatory barriers to AVs as:

- National consistency
- Liability
- Vehicle regulation
- Security and data privacy.[102]

3.33 The Committee discusses these issues and the work of the NTC in more detail in Chapter Four of this report.

3.34 In its submission, the NSW Government described the New South Wales contribution to the NTC review by reference to the review's components:

- a nationally agreed classification system for automated vehicles including agreed automation functions;
- the role of government in regulating automated vehicles including registration systems, accident compensation funds and enforcement guidelines;
- road traffic law including the Australian Road Rules that assume the presence of a human driver able to exercise human judgement;
- policy challenges associated with the regulation of the driver including driver training and licensing;
- the regulatory challenges of human factors i.e. the transition when humans must take back control of the vehicle; and
- the need to test the safe operation of automated vehicles including validation of international test results through on-road trials in Australia. [103]

3.35 At its public hearing held on 17 June 2016, the Committee asked the NSW Government representatives to respond to concerns that current state-based approaches to assessing the impacts of AV technology could lead to a fragmented regulatory response to the detriment of a nationally-consistent approach. Ms Clare Gardiner-Barnes acknowledged that the risks of inconsistent state-based responses are being managed through a number of key mechanisms including:

> …the National Transport Commission. That is providing some good policy overarching guidance to all jurisdictions and is keen to see a national approach to how we introduce any further regulatory environment into this space. We also have the Transport and Infrastructure Senior Officials Committee [TISOC], which is the executive committee for all chief executives that are heads of transport agencies across Australia and New Zealand. They come together three times a year. As well, there is the Ministerial Transport and Infrastructure Council. This item has been on the agenda for those meetings. We also have Austroads, which all jurisdictions

[101] Submission 6, National Transport Commission, p4.
[102] Submission 6, National Transport Commission, p5.
[103] Submission 17, NSW Government, p55.

> contribute to through funding arrangements, which decides on priority research projects.[104]

3.36 Ms Gardiner-Barnes stressed that a key area for all jurisdictions was prioritising safety research investment. She told the Committee this would:

> …..build confidence, through all layers of government, that we are doing our best to collaborate, develop standards for the future and cooperate in how we manage this. The last thing we want is for different jurisdictions to be doing their own thing. There are professional communities at all layers of government coming together on this issue, along with universities and industry, because we can all see the benefits, and that collaboration will be the key.[105]

REGULATING FOR TRANSITION

3.37 Having examined the regulatory environment in New South Wales, the preparedness of the NSW Government to respond to AV technology, and the value of a national framework for regulating AV technology, the Committee considered whether there were any advantages in different regulatory approaches. This consideration focussed on whether a prescriptive approach, or a performance or outcome-based approach might be preferred.

3.38 The Committee heard evidence which suggested that a transition to the new technology should not occur until the technology was proven. In its submission the Motorcycle Council of NSW raised concerns that the availability of AV technology might be outstripping the readiness of regulators to test it and ensure the safety of all road users. The Council quoted the NTC issues paper of February 2016:

> Automated vehicles could potentially save many lives but through system failure they could cause the loss of a small number of others; a net gain for society but an extremely difficult problem from a community perspective.[106]

3.39 The Council concluded that the 'small number of others' is likely to be vulnerable road users, in particular motorcyclists.[107]

3.40 The Committee asked witnesses to comment on whether there was merit in delaying the introduction of AVs until this question could be resolved. Dr Kieran Tranter of Griffith University saw this as akin to seeking to ban the introduction of other technologies already available in a global market.

> I think we have to see ourselves as part of a global economy, and these are global consumer goods. These things are going to be introduced.[108]

[104] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, pp5-6

[105] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, pp5-6.

[106] National Transport Commission Issues Paper February 2016 quoted in Submission 4, Motorcycle Council of NSW, p3.

[107] Submission 4, Motorcycle Council of NSW, p3.

[108] Dr Tranter, transcript of evidence, 20 June 2016, pp15-16.

3.41 As the Committee has reported elsewhere in this report, AVs with Level 3 autonomy are already available in Australia. The transition is underway. We are already managing a mixed fleet.

3.42 In this regard Dr Gary Ellem told the Committee that it is important not to think that the risk increases with the level of autonomy:

> There is an inbuilt perception that it is harder to build a good autonomous vehicle that is completely driverless than one that is halfway between and that somehow the risks would be less if we allowed a little autonomy and not total autonomy. That fundamentally misunderstands human behaviour. My largest worries are to do with the lower levels of autonomy, mainly because the vehicle itself is not ready to accept the full task but the human is fairly happy to hand over control.[109]

3.43 The Committee does not dismiss the concerns of vulnerable road users. The Committee is satisfied, however, that the preparedness of the NSW Government and the collaboration towards producing a national framework for regulating AV technology will lead to performance-based or outcomes-based regulations designed to maximise the performance of the technology and satisfy community concerns that this has been done. Mr Bernard Carlon, Transport for NSW told the Committee that the take-up of the AV technologies already been introduced to vehicles has been market driven.

> Whether it has a lane assist system or an adaptive cruise control really is driven in the market by the future benefits that might be derived from having those technologies in your vehicle now. So we would not want to put in place anything that discourages the adoption of those or the testing and bringing to the market of those technologies that get proven as having a safety benefit in reducing the trauma on our roads. From our point of view and from a road safety perspective, the sooner we are able to get more of the fleet with these technologies that can protect drivers, passengers and other road users, the better.[110]

3.44 As Ms Gardiner-Barnes, Transport for NSW told the Committee:

> I think it would be a mistake not to continue to engage in new technologies and test them as they emerge.[111]

3.45 The Committee believes, on balance, that given the speed with which AV technology is developing in a global market, setting transitioning timeframes is neither wise nor practicable. The Committee considers that engaging with the technology as it emerges within a collaborative and consistent national framework will support performance-based regulation aimed at achieving the best safety outcomes and community support.

[109] Dr Gary Ellem, transcript of evidence, 17 June 2016, p51.

[110] Mr Carlon, transcript of evidence, 17 June 2016, p12.

[111] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p12.

Chapter Four – Detailed examination of policy challenges and non-road safety issues

SUMMARY

This chapter details a number of issues raised during the course of the inquiry not dealt with in the previous chapters or which merit more detailed examination.

Some of these issues relate to the broader social and economic impacts of AV technology and go beyond the specific terms of reference of this inquiry and the Staysafe Committee. A number of these issues, however, impact on efforts to implement AV technology and to improve road safety.

Several of these issues have been discussed briefly in earlier chapters, so in this chapter are discussed in greater detail. All the issues discussed in this chapter raise questions for governments and the community about the extent of regulatory and policy development required as AV technology becomes more widespread within the NSW vehicle fleet.

This chapter relies on evidence presented to the Committee in submissions and supplementary answers, and by witnesses appearing at the Committee's public hearings, and is augmented by research. In particular, publications of the National Transport Commission have been relied on to provide in-depth analysis.

THE COMMITTEE'S FINDINGS

FINDING 7

The Committee finds that many of the economic and social impacts of the deployment of autonomous vehicles cannot be determined without more information and experience.

FINDING 8

The Committee finds that the impact of the deployment of the technology on current infrastructure provision and maintenance arrangements, including funding arrangements, is not well understood.

FINDING 9

The Committee finds that the deployment of autonomous vehicle technology in rural and regional areas will present particular challenges which will need to be identified and addressed within a national framework.

4.1 The Committee received a great deal of evidence concerning non-road safety impacts of AV technology. The Parliament's resolution establishing the Staysafe Committee, and the terms of reference of this inquiry are limited to road safety matters. Given the volume and import of the non-road safety issues raised by stakeholders, it would be remiss of the Committee not to acknowledge and analyse them, and bring them to the attention of the NSW Government in this report.

4.2 Some of the evidence the Committee heard about the impacts of AV technology was conflicting. Will it reduce or increase road congestion? Will AVs require special training to operate or less training than drivers are required to receive now? Will AV technology improve mobility or will the cost of purchasing or accessing an AV be prohibitive? These impacts can be speculated upon, but cannot be determined without more information and experience.

4.3 Similarly, as Level 3 AVs evolve and vehicle connectivity increases, new roadside infrastructure will be required. Who will fund and maintain this infrastructure, especially in rural and regional areas, is not well understood.

COMMUNICATION AND CONSUMER INFORMATION

Communicating with other road users

4.4 Communications between road users and the transmission of data giving information about the traffic environment will become crucial as the mixed fleet emerges. Vehicles with different levels of automation and human involvement will interact on the same road network using the same infrastructure.[112]

4.5 Partly AVs, including those with electronic stability control and autonomous braking systems, already exist in the NSW fleet and are in operation on NSW roads. These types of vehicles can use on-board sensors, cameras, global positioning systems and telecommunications that gather and analyse information

[112] Submission 17, NSW Government, p35.

using complex computer algorithms to enable appropriate responses in safety critical situations without driver input.[113]

4.6 Vehicle connectivity is an important aspect of optimising the benefits from the deployment of AVs. Effective and reliable connected infrastructure is needed to support AV technology in a wide range of conditions and locations if the technology is to be demonstrably safe enough to be fully accepted by users.[114]

4.7 There are significant technical and other challenges to be overcome before fully AVs begin operating as a normal part of the NSW fleet.[115] As discussed in Chapter Three, the NSW Government is already actively engaged in research regarding AV technology and C-ITS. This includes the Cooperative Intelligent Transport Initiative (CITI) project which allows heavy vehicle drivers to receive safety messages about upcoming hazards and potential crashes.[116]

4.8 In addition, Transport for NSW is partnering with the Australian Driverless Vehicle Initiative (ADVI) to explore the impact and requirements of AV and CAV technology in a truly Australian context, and make recommendations on ways to safely and successfully introduce them.[117] At present, it is difficult to take full advantage of the safety benefits promised by AV technology and C-ITS, while technological standards for vehicle-to-infrastructure communication are still being settled.[118] Such matters have yet to be resolved at the national level.[119]

Pedestrians, cyclists and motorcyclists

4.9 Improving the capacity of vehicles to monitor and respond intelligently to the road and traffic environment offers the potential to significantly boost the safety of vulnerable road users, including pedestrians, cyclists and motorcyclists. As the OECD nations continue to reduce fatalities, the proportion of the vulnerable road user groups that are subject to fatalities has been increasing. Accordingly, there has been a refreshed investment in attempting to design better technologies for the recognition of pedestrians, cyclists and motorists.[120]

4.10 The number of vehicles using information systems, such as the blind spot monitor, to detect vulnerable road users is growing. In 2015, 30,000 vehicles had blind spot monitors in New South Wales.[121] The blind spot monitor is a vehicle-based sensor device that detects other vehicles located to the driver's side and rear, giving warnings which can be visual, audible, vibrating or tactile.[122] However, there are limitations to the technology in that not all blind spot monitors have the same detection capabilities or operating conditions.[123]

[113] Submission 17, NSW Government, p31.
[114] Submission 17, NSW Government, p36.
[115] Submission 17, NSW Government, p19.
[116] Submission 17, NSW Government, p9.
[117] Submission 17, NSW Government, p9.
[118] Submission 17, NSW Government, p19.
[119] Submission 17, NSW Government, p19.
[120] Mr Carlon, transcript of evidence, 20 June 2016, p11.
[121] Mr Carlon, transcript of evidence, 20 June 2016, p11.
[122] Submission 5, Bicycle NSW, p1.
[123] Submission 4, Motorcycle Council of NSW, p4.

Reliability of the performance of blind spot monitors is predicted to increase with the uptake of the systems.[124]

4.11 Pedestrian detection systems are an available technology which could improve the protection of vulnerable road users. These use technological communication (e.g. the pedestrian's mobile phone) to detect the location of pedestrians beyond the driver's line of sight and warn the driver of their presence and location.[125] Systems using a smartphone app or another form of communications technology such as Radio Frequency Identification (RFID) might be an alternative or complementary option to protect vulnerable road users, if fitted to their vehicle or fixed onto the shoes.[126] Overseas experience indicates that putting transponders on bicycles and attaching a receiver to trucks enables truck drivers to better detect cyclists in their vicinity. If this became a standard practice, cycling injuries and fatalities could be reduced.[127]

4.12 One perceived drawback with these approaches is that the government would be faced with the task of ensuring vulnerable road users are equipped with devices when in a road environment.[128] Another is the potential financial cost to vulnerable road users.[129] On the other hand, price points for relevant sensor systems are predicted to fall as new technologies and the volume of production increases.[130]

4.13 Organisations representing vulnerable road users question whether the technology is ready for widespread deployment and assert that manufacturers must be held fully responsible for protecting vulnerable road users from injury.[131] The impact of connectivity on the safety of vulnerable road users is currently being investigated by the association of Australasian road transport and traffic agencies, Austroads, as part of its project, 'Safety Benefits of Cooperative ITS and Automated Vehicles'.[132]

4.14 Failure to explore and appropriately mitigate the safety implications that the transition to AVs presents may negatively impact on community acceptance of the new technology.[133] As well as the need for further rigorous testing to determine safety standards, vulnerable road user advocates have stressed that improving driver education for all road users should be a priority. This would help

[124] Mr Carlon, transcript of evidence, 20 June 2016, p11.
[125] Submission 17, NSW Government, pp33-34.
[126] Submission 7, Amy Gillett Foundation, p6.
[127] Mr Siorokos, transcript of evidence, 20 June 2016, p4.
[128] Submission 7, Amy Gillett Foundation, p6.
[129] Mr Guy Stanford, Motorcycle Council of NSW, transcript of evidence, 20 June 2015, p45.
[130] Mr John Wall, Manager, Road Safety Technology, Centre for Road Safety, Transport for NSW, transcript of evidence, 17 June 2016, p10.
[131] Submission 4, Motorcycle Council of NSW, p5; Submission 7, Amy Gillett Foundation, pp4-6.
[132] National Transport Commission, Response to Supplementary Questions, Questions 3 and 4, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf viewed September 2016.
[133] Submission 17, NSW Government, p35.

to ensure that there are safe interactions between vehicles operating at different levels of automation during the transition period to full automation.[134]

4.15 In the preliminary trialling period, where AVs are present in close proximity with vulnerable road users, such as cyclists travelling at differing speeds, separation may remain the best solution.[135] One solution may be allowing vehicles to drive in an automated mode in lanes next to or with cyclists only when this is proven to be as safe as for manually driven vehicles.[136]

4.16 Vulnerable road users, however, stress the need to ensure that AVs are comprehensively tested with regard to their interactions with motorcyclists, cyclists, and pedestrians and that the manufacturers and software developers are made responsible for ensuring the safety of vulnerable road users. [137] [138]

Identifying the vehicle

4.17 Because computers see and understand the world differently, they will drive differently than people. This may cause problems in mixed traffic environments where other road users may have difficulty in reading and reacting to the behaviour of an AV. [139] Police must also be able to investigate and prosecute offences where AV technology is concerned.[140]

4.18 Almost all of the 11 minor accidents reported by Google to have occurred during the six years of its 'self-driving car project', have involved rear-ending where the vehicle stopped suddenly at a red light. In the view of some experts, this has occurred because a human driver would have gone through the yellow light and not stopped so quickly. If the motorist in the car behind had been aware that they were following a Google car, they could anticipate that it would be programmed to follow the road rules to the letter and might therefore stop abruptly. In that case, the motorist behind would be able to brake and avoid the accident.[141]

4.19 Just as humans may misunderstand or fail to anticipate the behaviour of an AV, there are situations where the AV may not be able to predict the behaviour of the human driver or other road users.[142] At a four way intersection, AVs may not be able to follow the subtle body language and eye contact used by human drivers to decide who has priority. As well, human drivers need to know what to expect from cars arriving at an intersection. Similarly, at construction sites, AVs

[134] Dr Roderick Katz, Director, Amy Gillett Foundation, transcript of evidence, 20 June 2016, p25;Mr Rice, transcript of evidence, 20 June 2016, p40.

[135] Submission 5, Bicycle NSW, p1.

[136] Transurban, Response to Supplementary Questions, Question 2, 8 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10070/Response%20to%20Supplementary%20Questions%20-%20Transurban.pdf viewed September 2016.

[137] Submission 4, Motorcycle Council of NSW, p6; Mr Stanford, Delegate, transcript of evidence, 20 June 2016, p44.

[138] Submission 7, Amy Gillett Foundation, p6.

[139] Andrew Ng and Yuanqing Lin, 'Self-Driving Cars Won't Work Until We Change Our Roads - and Attitudes', WIRED Opinion, 15 March 2016, https://www.wired.com/2016/03/self-driving-cars-wont-work-change-roads-attitudes/ viewed September 2016.

[140] Submission 17, NSW Government, p45.

[141] Professor Walsh , transcript of evidence, 20 June 2016, p11.

[142] Submission 17, NSW Government, p17.

will not be able to follow hand signals from a construction worker. The construction worker and any drivers nearby need to be aware of this.[143]

4.20 If a human sees a truck with a 'Makes Wide Turns' sign, a human driver knows how to adjust driving accordingly. If children are distracted by an ice-cream truck across the street, the human driver knows to slow down in case they dash towards it.[144] It is predicted that, ultimately, computers will be far better drivers than humans and, for that reason too, it may be useful to distinguish them from cars driven by humans.[145] Artificial Intelligence experts note that in the long term there is an interesting interplay where people's driving changes to adapt to AVs and developers change AVs to adapt to people's driving.[146]

4.21 Artificial Intelligence experts have also suggested that it would be prudent, during trialling and the transition phase, to require AVs to be visually distinctive and immediately recognizable to help other road users to know what to expect. Proposed methods of identifying the vehicle include requiring special number plates, as with learner drivers, as well as, possibly, installing standardized signal lights.[147] [148]

4.22 In trials which have commenced in Singapore, test vehicles are to be identified with a special decal and other markings. [149] Japan has also used a number plate to identify the test vehicle in on-road trialling.[150] [151] During the recent 2016 European Truck Platooning Challenge, six brands of automated truck were driven in platoons to the Netherlands on public roads from several European cities.[152] All trucks involved in the challenge had flashing lights installed on their corners although there was no other signage used.[153]

4.23 Requirements for making AVs visually distinctive have not been made universal in trials which have commenced in other jurisdictions, either in Australia or

[143] Submission 1, Professor Toby Walsh, UNSW and Data61, p2.

[144] Andrew Ng and Yuanqing Lin, 'Self-Driving Cars Won't Work Until We Change Our Roads - and Attitudes', WIRED Opinion, 15 March 2016, https://www.wired.com/2016/03/self-driving-cars-wont-work-change-roads-attitudes/ viewed September 2016.

[145] Submission 1, Professor Toby Walsh, UNSW and Data61, p2.

[146] Professor Walsh, transcript of evidence, 20 June 2016, p11.

[147] Andrew Ng and Yuanqing Lin, 'Self-Driving Cars Won't Work Until We Change Our Roads - and Attitudes', WIRED Opinion, 15 March 2016, https://www.wired.com/2016/03/self-driving-cars-wont-work-change-roads-attitudes/ viewed September 2016.

[148] Submission 1, Professor Toby Walsh, UNSW and Data61, p2.

[149] Singapore Government, Joint News Release by Land Transport Authority (LTA) and Ministry of Transport (MOT), 'Self Driving Vehicles Will Transport Singapore's Transport Landscape', 12 October 2015, https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=e6dc5dff-8892-4f7f-9a3e-c89d29c0642c viewed September 2016.

[150] Submission 17, NSW Government, p66.

[151] Nissan Motor Company Ltd, Press Release, 'Nissan LEAF with Advanced Driver Assist Gets Japan License for Road Test', 28 September,2013, http://www.autoblog.com/2013/09/28/semi-autonomous-nissan-leaf-certified-road-use-japan-video/ viewed September 2016.

[152] European Truck Platooning Challenge, https://www.eutruckplatooning.com/home/default.aspx viewed September 2016.

[153] Australian Driverless Vehicle Initiative (ADVI), Response to Supplementary Questions, Question 2, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10069/Response%20to%20Supplementary%20Questions%20-%20Australian%20Driverless%20Vehicle%20Initiative%20(ADVI).pdf>viewed September 2016.

internationally.[154] However, a number of jurisdictions have taken steps to ensure that the community is kept informed about trials. The legislative framework established for an AV trial in South Australia, conducted in November 2015, included making details of upcoming trials publicly available and tabling by the Minister of a report in Parliament within six months of the trial.[155] Guidelines for trials developed in the United Kingdom and New Zealand require engagement of the organisers with the local community.[156] In Singapore, roads are required to have prominent signboards to give information to the public about the testing and to facilitate easy recognition by road users.[157]

4.24 The most appropriate approach for NSW will need to be derived through a number of stages, including consultation and trialling.[158] The National Transport Commission (NTC) has advised that requirements for visually identifying AVs will be considered in the development of national testing guidelines and a safety assurance framework.[159]

DRIVER LICENSING, TRAINING AND BEHAVIOUR

Licensing

4.25 The advent of AV technology raises questions about the future of the driver licensing function in the longer term. How does an automated system comply with the requirement to hold a drivers licence?[160] Licensing requirements are set by State and Territory laws, all of which assume that the driver is a human.[161] Possible future approaches to licensing vehicle operators are currently being explored at the national level by Austroads Research. Transport for NSW and Roads and Maritime Services are participating in this national research project.[162]

4.26 One of the issues which the NSW Government will address following the NTC's report will be to examine the NSW legislative and regulatory framework to ensure that the role of human occupants in an automated vehicle is clearly

[154] Submission 1, Professor Toby Walsh, UNSW and Data 61, pp1-2.

[155] Submission 17, NSW Government, pp62-63.

[156] National Transport Commission, Response to Supplementary Questions, Question 3, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf viewed September 2016.

[157] Singapore Government, Joint News Release by Land Transport Authority (LTA) and Ministry of Transport (MOT), 'Self Driving Vehicles Will Transport Singapore's Transport Landscape', 12 October 2015, https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=e6dc5dff-8892-4f7f-9a3e-c89d29c0642c viewed September 2016.

[158] Australian Driverless Vehicle Initiative (ADVI), Response to Supplementary Questions, Question 2, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10069/Response%20to%20Supplementary%20Questions%20-%20Australian%20Driverless%20Vehicle%20Initiative%20(ADVI).pdf, viewed September 2016.

[159] National Transport Commission, Response to Supplementary Questions, Question 3, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf, viewed September 2016.

[160] Submission 6, National Transport Commission, Appendix 1,NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p8.

[161] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, pp 6-7.

[162] Submission 17, NSW Government, p56.

defined.[163] Amendments will also be made to the Road Transport legislation to ensure that the use of higher levels of AV technology (SAE Levels 4 and 5) are legal on NSW roads. A dilemma for regulators is to make sure that regulatory changes do not lead to a weakening of existing regulatory controls of conventional vehicles requiring a licensed driver.[164]

4.27 Special licensing for AV operation may be warranted for the operation of Level 3 AVs, conditional upon certain pre-requisites such as a person having completed a test and training course or minimum number of hours of operation. To ensure against manual skill loss, Level 3 licensing may require proof of completion of refresher training or de-activation of autonomous features in the vehicle on a periodic basis. As vehicle automation increases to Level 4 and 5, a new licence class may be necessary for those wishing to drive manual vehicles, or to drive AVs manually (if manufacturers provide this option). Until vehicle automation reaches Level 4 and 5, ADVI has suggested that current licence restrictions remain for those who are currently non-drivers for reasons such as impairment or disability.[165]

4.28 Semi-AVs would still require the driver to be licensed to take control of the vehicle for part of the journey.[166] In heavy rain, snow or on bad roads, the driver may need to take over. Drivers may therefore still need to have all the skills they have today.[167] While some high level AVs may not require a driver to operate them,[168] it is noteworthy that, to date, those US states which have AV legislation require every AV on public roads to have a set of manual controls present in the vehicle. Further, a licensed human driver must directly supervise from inside the vehicle at all times when in operation.[169] [170]

4.29 Another question to be considered is whether vulnerable road users, in particular cyclists, should be licensed to ensure that they have competency in navigating safely in a mixed fleet. In this regard, bicycling advocates have stressed the need for all road users to have accessible training and public education programs to equip them with the traffic skills necessary for the transition period when it may no longer be sufficient to communicate with other road users via eye contact and body language.[171] [172]

4.30 Licensing requirements are also being reviewed internationally. In the United Kingdom, for example, transport authorities are reviewing the relevance of the minimum age for driving in the context of vehicle automation.[173] At the same

[163] Submission 17, NSW Government, p56.

[164] Submission 17, NSW Government, p44.

[165] Submission 16, Australian Driverless Vehicle Initiative (ADVI), p11.

[166] Submission 17, NSW Government, p20.

[167] Mr Marcus Burke, Project Director, Heavy Vehicle Compliance and Technology, National Transport Commission, transcript of evidence, 17 June 2016, p42.

[168] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p54.

[169] Submission 11, Dr Gary Ellem, p2.

[170] Submission 17, NSW Government, p55.

[171] Dr Katz, transcript of evidence, 20 June 2016, p25.

[172] Mr Rice, transcript of evidence, 20 June 2016, pp39-40.

[173] Mr Siorokos, transcript of evidence, 20 June 2016, p5.

time, younger people are demonstrating a social shift away from the need to own a vehicle or to hold a drivers license.[174] Some of these issues will not be resolved until there is greater certainty about the implications of implementation or market maturity to enable regulation.[175]

Education and training

4.31 The nature of learning to drive may change significantly as motor vehicles progress to higher levels of automation. Transport authorities will need to decide the extent to which occupants of AVs require training, experience, and minimum fitness standards or knowledge of road transport law before 'using' an AV.[176]

4.32 Elements of the current driving test such as parallel parking may not be as important as preparing for a monitoring task and knowing how to respond to a request to intervene when the automated systems requires human input. Training and re-training will be vital to ensuring the safe use of AVs.[177]

4.33 Loss of skill due to overreliance on technology is a major consideration for future driver education and training. Drivers of semi AVs which rely on automation may fail to use their manual driving skills over long periods of time. This may diminish their ability to take back control of a Level 3 AV if requested; or to take control voluntarily of a self-driving vehicle that allows for manual control.[178]

4.34 One approach under consideration to counteract skill degradation is to require drivers, as part of the licensing system, to periodically drive manually, as is required in the aviation industry.[179] Major changes towards automation in flying aeroplanes since the 1960s have resulted in pilots using manual skills for minor segments of time during a typical flight, although their monitoring and practical competence is still needed and reinforced by continuous professional training in case of emergency.[180]

4.35 Driver licensing conditions, restrictions and training will need to be reviewed periodically, as further technological developments occur, to address de-skilling of AV drivers and their reduced capability to manage complex driving situations such as high-speed merging and the negotiation of unsignalised intersections.[181]

4.36 Problems with over-reliance on technology may occur when drivers delegate full responsibility for driving tasks to an AV system or when they delegate responsibility for other driving tasks that the system was not designed to address. Over-reliance can also occur because of a loss of vigilance or drivers

[174] Ms Huey, transcript of evidence, 17 June 2016, p33.

[175] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p53.

[176] Submission 17, NSW Government, p44.

[177] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p54.

[178] Submission 16, Australian Driverless Vehicle Initiative (ADVI), p8.

[179] Professor Regan, transcript of evidence, 17 June 2016, p26.

[180] Submission 13, Transurban, p3.

[181] NSW Transport Cluster Submission to the National Transport Commission's Discussion Paper on Regulatory Options for Automated Vehicles, July 2016, p9, http://www.ntc.gov.au/submissions/history/?rid=91793&pid=8247 viewed September 2016.

misunderstanding the functionality and limitations of the technology. This creates problems when the system is no longer active, such as when drivers use a non-equipped vehicle or when drivers are required to regain vehicle control.[182]

4.37 Educating users of AVs about the capabilities and limitations of AV technology and ensuring that AVs provide timely warnings when the system requires human intervention will be necessary to counteract the problem of over-reliance.[183] Training the driver to monitor the automatic system and maintain vigilance will be a challenge for the car maker. Manufacturers are considering sensors to ensure the driver's hands are on the wheel and cameras to monitor fatigue.[184]

4.38 There is a risk of motorists placing excessive trust in AVs before it is warranted. For example, where current autopilot features on some vehicles still require motorists to keep their hands on the wheel and eyes on the road, there have been several high-profile examples of drivers posting videos of themselves ignoring or circumventing these requirements.[185]

4.39 Different brands have different mixes of technology. Two brands may use the term 'autopilot' but what the function actually does and the expectations of the driver can be quite different. While the technology is evolving, it remains difficult to make the terminology consistent or to know the exact mix of technologies being used in higher levels of automation.[186] Drivers therefore need to understand that there may be differences in the functions depending on the make of the vehicle and level of automation. Concern has been expressed that manufacturers are currently able to update the software in the vehicle without a licensing or training program being in place.[187]

4.40 Training will be needed to make drivers and road users aware of a range of issues relevant to safe interaction between non-automated vehicles and AVs. This includes knowing what to expect from other road users so that they are not distracted by seeing a driver engaged in an unconventional activity, such as reading a book.[188][189]

4.41 Education about the functions and behaviour of AVs will need to be delivered to vehicle drivers as well as law enforcement officers,[190] and the vehicle maintenance and repair industry.[191] [192] Public trials and demonstrations of AVs will help the general public to become familiar with the technology at first hand.

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[182] Submission 17, NSW Government, p37.

[183] Submission 17, NSW Government, p37.

[184] Mr Burke, transcript of evidence, 17 June 2016, p43.

[185] Transurban, Response to Supplementary Questions, Questions on Submission 13, Question 1, 8 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10070/Response%20to%20Supplementary%20Questions%20-%20Transurban.pdf viewed September 2016.

[186] Mr Burke, transcript of evidence, 17 June 2016, p42.

[187] Dr Ellem, transcript of evidence, 17 June 2016, p53.

[188] Submission 16, Australian Driverless Vehicle Initiative (ADVI), pp10-11.

[189] Mr David Pickett, Volvo Car Australia, transcript of evidence, 17 June 2016, p18.

[190] Submission 17, NSW Government, p42.

[191] Mr Ian Faulks, transcript of evidence, 20 June 2016, p36.

[192] Submission 14, Insurance Australia Group, p8.

In a trial in Greenwich, UK, later in 2016, Londoners will have the chance to drive an AV and take part in workshops discussing the future of AVs in Britain.[193]

4.42 Following the first Australian on road trials of AVs, coordinated by the ARRB Group's Australian Driverless Vehicle Initiative (ADVI) in South Australia in November last year, further plans or trials have been announced in Western Australia[194], Queensland[195] and the Australian Capital Territory[196].

4.43 In conjunction with the Smart Innovation Centre, launched earlier this year by Transport for NSW, ADVI foreshadows that a trial of AVs will be arranged in the future to enable the NSW public to interact with the technology.[197] Transport for NSW has identified the Bays Precinct, located within two kilometres of Sydney's city centre, as a development opportunity for an AV demonstration zone. Transport for NSW has advised that it will seek to engage the public in the trial so that people can become familiar with a driverless vehicle and understand how it would manoeuvre itself in a normal driving environment, which is structured and built for the purpose.[198]

Alcohol and drug use

4.44 It is estimated that around 90 per cent of crashes are caused by human error behind the wheel of a car, whether through inattention, distraction, drugs, alcohol or tiredness.[199] The extent to which AVs could assist in preventing accidents caused by drink or drug driving is yet to be fully clarified. On the one hand, it may not be a problem if a person under the influence uses a shuttle pod for transport.[200] However, if the vehicle needs to be programmed to set the route and destination, engage the self-driving function, or to intervene in case of an emergency or malfunction, and the operator is alcohol or drug impaired, that remains a drink or drug driving offence.[201]

4.45 In New South Wales, the *Road Transport Act 2013* requires drivers or persons occupying the driving seat on a road to submit to roadside drug and alcohol testing. Relevant offences and penalties apply, including to drivers of current

[193] Mashable Australia website, Media report, 'Londoners can sign up to try driverless cars in Greenwich', May 14 2016, http://mashable.com/2016/05/13/driverless-car-trial-greenwich-london-gateway/#p7qdbRKJxZqN viewed September 2016.

[194] Hon. Dean Nalder MLA, Minister for Transport, Western Australia, Media Statement, 'Trial of Autonomous Vehicles', 9 February 2016, https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/02/Trial-of-autonomous-vehicle.aspx viewed September 2016.

[195] Omni Channel Media, digital publishing, Tech Exec website, 'QLD Commits to Building Out Driverless Car Strategy', 1 June 2016, http://techexec.com.au/qld-commits-to-building-out-driverless-car-strategy/ viewed September 2016.

[196] Canberra Times, 8 March 2016, http://www.canberratimes.com.au/act-news/barr-wants-canberra-to-be-test-site-for-driverless-cars-20160308-gndam3.html viewed September 2016.

[197] Australian Driverless Vehicle Initiative (ADVI), Response to Supplementary Questions, Question 3, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10069/Response%20to%20Supplementary%20Questions%20-%20Australian%20Driverless%20Vehicle%20Initiative%20(ADVI).pdf viewed September 2016.

[198] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p10.

[199] Mr Siorokos, transcript of evidence, 20 June 2016, p2.

[200] Mr Faulks, transcript of evidence, 20 June 2016, p36.

[201] Submission 9, Mr Ian Faulks, p12.

vehicles incorporating different levels of automation.[202] Such provisions could continue in legislation without being a barrier to more AVs.

4.46 In the view of Transport for NSW, drink and drug driving laws will continue to be important in the immediate and mid-term, assuming that it is likely that a mixed fleet with different levels of technology will prevail on NSW roads for a number of decades. In the case of vehicles with less than full automation, there is a strong need to ensure decision making and driving skills are not compromised by drugs and alcohol. As new technologies with higher levels of automation emerge, factors that influence drink or drug driving behaviour may change, or other risky behaviours associated with drink driving may emerge. Offences and penalties may need to be restructured accordingly.[203]

4.47 Transport for NSW has stressed that it is important that the significant benefits achieved by NSW drink and drug driving policy over the past 35 years are not compromised. Clear and unambiguous evidence that fully AV technology can comprehensively address the risks would be required to support changes that weaken, or are perceived to weaken, drink and drug driving laws.[204]

LIABILITY

4.48 The current regulatory and legal framework in Australia supports the legal operation of connected and automated vehicles up to Level 3 automation. Unresolved issues about responsibility, liability, allocation of risks and availability of insurance must be resolved before vehicles with Level 4 and 5 automation can be legally and safely operated in the general road environment.[205]

Determining responsibility for a crash

4.49 The varying degrees of automation create an array of complex liability issues which impact on road users, car manufacturers and insurers.[206] The added complexity of liability arising from AV technology is due to two main factors. Firstly, more parties could be responsible for a crash, including government and private road managers, should AVs become dependent on road infrastructure to operate safely. Secondly, some AVs will require humans to take over the driving task at different times.

4.50 When is a crash caused by the automated driving system as distinct from being caused by the human driver?[207] The failure of a human driver to intervene and

[202] Transport for NSW, Response to Supplementary Questions, Question 4, p4, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf viewed September 2016.

[203] Transport for NSW, Response to Supplementary Questions, Question 4, p4, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf viewed September 2016.

[204] Transport for NSW, Response to Supplementary Questions, Question 4, p4, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf viewed September 2016.

[205] Submission 17, NSW Government, p21.

[206] Submission 3, Insurance Council of Australia, p1.

[207] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p96, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

stop a vehicle from crashing may be partly the fault of the manufacturer if driver vigilance controls are inadequate or the human-machine interface is poorly designed. However, the driver or other passengers may also be found to have liability if they foresee a crash and do not intervene. Liability in such cases will depends on the facts of each case and include factors such as whether the occupant was licensed to drive and had the physical and mental capacity to intervene.[208]

4.51 Three broad areas of law encompass liability; tort, contract and product liability. Some jurisdictions have no fault legislation. The legal system also allows for joint, several and contributory liability where a manufacturer, operator or service provider could contribute in part to a collision and be held liable for this contribution, even if not wholly responsible. Manufacturers are already subject to product liability and this is likely to increase in importance as vehicles become more reliant on automated driving systems to perform driving functions.[209]

4.52 Clarifying whether human monitoring of an automated driving system is 'control' will help define liability, particularly in relation to vehicles which have conditional automation. However, the issue remains complex because any technical or mechanical malfunctions that were the fault of the manufacturer would continue to be subject to product liability laws. The human driver's responsibility to monitor and intervene could create joint or contributory liability. The interaction between the driver and product liability is potentially unclear and depends on the facts of each case.[210] Legal researchers caution that cost recovery for personal injury in the case of an accident involving a higher level AV would not be easy under the current legal framework. [211]

A driver's duty of care

4.53 Consideration should also be given to identifying requirements for a driver's duty of care when using an AV. Regardless of current licensing requirements, people occupying AVs must be capable of dealing with problems that are likely to arise. There may be a need for a competency-based system to ensure that people can respond to reasonably foreseeable problems. These responses may be a variation on current licensing requirements or through induction training by the vehicle manufacturer.[212]

4.54 A number of states have compulsory third-party personal injury schemes, often funded through, or in addition to, registration payments. They provide compensation for personal injuries sustained in crashes on public roads. Some of these are on a no-fault basis. Others, as in New South Wales, are fault based.[213]

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[208] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p96, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[209] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, pp95-96, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[210] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p97, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[211] Mr Brady, transcript of evidence, 20 June 2016, p21.

[212] Submission 17, NSW Government, p68.

[213] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p102, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed 10 August 2016

Currently, an at-fault driver is held responsible for any damages caused as a result of an incident and the at-fault driver's insurance company covers the costs associated with those damages. If, after investigation, the cause is found to involve the actions or negligence of other entities, such as the manufacturer, the insurance company can pursue them to recover their costs.[214]

The manufacturer's duty of care and vulnerable road users

4.55 In the case of highly or fully AVs, prima facie responsibility could eventually shift from the human driver to the manufacturer or automated driving system. However, responsibility would remain with the human driver in the case of partial or conditional automation.[215]

4.56 Some manufacturers have already announced that they will accept liability for their AVs in certain conditions.[216] In the longer term, compulsory CTP schemes could change if the prima facie liability shifts from the at-fault driver to the manufacturer or automated driving system. This shift in liability, along with potential changes to vehicle registration, could affect how CPT schemes are funded.[217]

4.57 In relation to manufacturers' liability, organisations representing vulnerable road users have urged the need to consider the manufacturer's duty of care in relation to vulnerable road users such as bicycle riders and pedestrians. They express concern that designers of AV technology will prioritise the safety of vehicle occupants ahead of non-occupant road users, including vulnerable road users.[218] They note that, currently, if a human driver kills or seriously injures a pedestrian and is found guilty of negligent driving, that person can be gaoled. This is a major deterrent influencing the driver to exercise care. They stress that the liability of company directors, software providers or the mapping agency must be resolved in black letter law before permitting highly AVs on roads and that liability should not be left to the courts to be apportioned.[219]

A nationally consistent approach to insurance

4.58 Insurance industry representatives have urged a nationally consistent approach on road rule and statutory personal injury schemes.[220] Ultimately, insurers would like to change to a non-fault based, 'First Party' scheme. Under such a scheme, someone who injures a person in an AV would not have to go to court to prove fault. The insurance company would work out liability behind the scenes on the basis of a much more seamless structure than under the current system.[221][222] A

[214] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p98, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed 10 August 2016.

[215] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p98, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[216] Mr Pickett, transcript of evidence, 17 June 2016, p19.

[217] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p102, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[218] Submission 7, Amy Gillett Foundation, p5.

[219] Submission 15, Pedestrian Council of Australia Ltd, pp2-3.

[220] Submission 3, Insurance Council of Australia, p2; Submission 14, Insurance Australia Group, p2.

[221] Professor Regan, transcript of evidence, 17 June 2016, p23.

national liability framework agreed by manufacturers, insurers and other relevant parties would ensure the same level of personal injury cover regardless of where in Australia the accident occurred.[223]

4.59 Austroads is currently investigating the impact of AV technology on registration, licensing and compulsory third party insurance arrangements.[224] On 29 June 2016, the NSW Government announced a broad plan for CTP Insurance scheme reform, introducing 'no-fault' compensation, and extending protection to an extra 7,000 road users who are not covered under the current 'at-fault' scheme.[225] The Government has also announced the introduction of an innovative new pricing system for taxis and ride-share services that will make premiums fairer and more affordable.[226]

Black box technology

4.60 Concerns about liability mean that AVs need to log actions in sufficient detail to enable the tracing of causation and to clarify whether the driver was in control at a particular time. Black box technology is essential until Level 5 automation is achieved and while control is shared between the human driver and the automated driving system.[227] Highly automated, stand-alone vehicles, such as Tesla and Volvo models, available in the USA, have a large storage capacity for data in their AV systems. However, vehicles such as the Google people-less pod car, which are networked, might not have the same level of data storage in the vehicle.[228]

4.61 It is critical that third parties such as insurers and coroners can access the black box or event data recorder (EDR)and that the data is in a format that enables interpretation to identify and agree fault.[229][230] In the United States, the National Highway Traffic Safety Administration (NHTSA) has proposed a regulation which would make EDRs mandatory on all new passenger vehicles sold in the United States. Although over 90 per cent of the new cars and light trucks sold in the United States already come with EDRs intended to capture information about the final seconds before a crash, these are installed voluntarily by the manufacturers.

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[222] Ms Tracy Green, Executive General Manager, Customer and Underwriting, Insurance Australia Group Ltd, transcript of evidence, 17 June 2016, pp57-58.

[223] Submission 14, Insurance Australia Group, p11.

[224] Submission 17, NSW Government, p56.

[225] The Hon. Victor Dominello MP, Minister for Innovation and Better Regulation, Media Release: NSW Motorists to Benefit from CTP Reforms, 29 June 2016, https://www.finance.nsw.gov.au/about-us/media-releases/nsw-motorists-benefit-ctp-reforms viewed September 2016.

[226] The Hon. Victor Dominello MLC, Minister for Innovation and Better Regulation, Media Release: Green Slip Overhaul to Benefit Point-to-Point Vehicles, 4 July 2016, http://www.maa.nsw.gov.au/about-us/news/media-release-old/green-slip-overhaul-to-benefit-point-to-point-vehicles viewed September 2016.

[227] Submission 14, Insurance Australia Group, p16.

[228] Dr Tranter, transcript of evidence, 20 June 2016, p17.

[229] Mr Burke, transcript of evidence, 17 June 2016, p45.

[230] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p99, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

The NHTSA's current rules also specify certain types of information which must be recorded if a vehicle is equipped with an EDR.[231]

Reliance on roadside infrastructure

4.62 Depending on the technology paths adopted, there could be greater reliance on roadside infrastructure to ensure the safe operation of AVs. For example, if an automated heavy vehicle relies on C-ITS vehicle-to-infrastructure connectivity to receive warnings that the vehicle is approaching a low bridge, and the signal fails, resulting in a crash, a case could be made that the road manager was, at least partly, liable.

4.63 Currently the civil liability of road authorities varies across state and territory, with limitations being imposed on liability in a number of cases. It is unclear what the impact of these limitations on liability will have on the safe operation of AVs in relation to substandard physical or digital infrastructure. Austroads is currently investigating the emerging requirements for road operators to support automated vehicles. The NSW Transport portfolio has advised that industry may be potentially responsible in contributing to upgrades of roads in relation to C-ITS and AVs, given the limited budgets of road agencies.[232]

Other liability issues

4.64 Insurers will require guidance on liability in a range of complex scenarios; for example, how to assess liability and determine compensation in relation to cyber-attack or hacking of automated driving systems. Liability also needs to be analysed and agreed upon where vehicles have been retrofitted with automated features.[233]

4.65 Because the complexities are likely to increase with the emergence of highly automated vehicles, it is perhaps too soon for governments to take legislative action.[234] However, consumers will need guidance as to the impact of AV technology on liability as well as an assurance that they can access compensation without going to court.[235] For the immediate future, the NTC has recommended that governments support the automotive and insurance industries in developing best practice guidelines on AV liability issues, including fault and causation in complex scenarios and agreeing to share event data with third parties such as insurers.[236]

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[231] Congressional Research Service Report, Bill Canis and David Randall Peterman, *"Black Boxes" in Passenger Vehicles: Policy Issues*, July 22, 2014, http://fas.org/sgp/crs/misc/R43651.pdf, viewed September 2016; Traffic Safety Administration, Department of Transportation, http://www.nhtsa.gov/cars/rules/rulings/EDRNPRM4--June1/index.html viewed September 2016.

[232] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, pp100-101, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[233] Submission 14, Insurance Australia Group, p16.

[234] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p106, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.

[235] Submission 14, Insurance Australia Group, p12.

[236] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, pp104, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

DATA GENERATION, USAGE AND PROTECTION

4.66 Key considerations with AV technology are how the large amount of data collected and transmitted by AVs will be used to improve transport, and how the broader technology framework will support the use of connected and automated vehicles.[237] The large volume of data collected and transmitted by CAVs will be a rich source of real time information to support a range of transport activities. The capacity of networks to manage and store this data will also become a critical issue.[238]

4.67 The NSW Centre for Road Safety currently runs the Cooperative Intelligence Transport Initiative (CITI) project which involves the testing of C-ITS technology with a particular focus on heavy vehicles. The initial CITI trial has found that connected vehicles collect and transmit large amounts of data, both from interactions with each other and with infrastructure, as well as through their on-board systems. An increasing amount of data will be collected and transmitted as the use of CAVs expands. This will allow integration with other transport activities, providing a vital source of real time information which can be used to improve road safety through more precise traffic management.[239]

Private sector access to data

4.68 A wide range of organisations in both the public and the private sectors will seek to gain access to the data generated by AVs and connected infrastructure. The private sector is already using information for commercial intelligent transport system purposes. For example, navigational systems are available on the market, which provide consumers with live updates based on the consolidation of the location and speed of other users of the commercial application.[240]

4.69 Manufacturers will require access to the data to monitor technological performance and to ensure that any modifications are maintained to the correct standard.[241] As with airlines, much of this data will be transmitted to the manufacturing centres outside Australia.[242]

4.70 Private insurers will need to access data recorded before and during an accident in order to determine cause and liability. Insurers have noted that the cost of premiums could be reduced and the processing of claims made faster provided there is no 'friction' in gaining access to the necessary data.[243] Additional parties, involved in the delivery and service of AVs, may also have access to data; for example, a third party may be responsible for the maintenance of vehicle sensors or the update of over-the-air mapping data.[244]

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[237] Submission 17, NSW Government, p7.

[238] Submission 17, NSW Government, p10.

[239] Submission 17, NSW Government, p68.

[240] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p44.

[241] Mr Burke, transcript of evidence, 17 June 2016, p45.

[242] Dr Tranter, transcript of evidence, 20 June 2016, p15.

[243] Ms Green, transcript of evidence, 17 June 2016, pp58-59.

[244] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p41.

Public sector access to data

4.71 It is likely that there will be a range of circumstances in which government agencies will require access to AV information. These include investigating safety data in order to assess the performance of vehicles; crash investigations by police and coronial officers; criminal investigations seeking to identify the location of a victim, suspect or witness; and counter-terrorism surveillance.

4.72 Data generated by AVs will also be vital for research purposes during the conduct of trials. Some jurisdictions, such as California and South Australia, have regulated specifications that on-road AV trials include a requirement that data is captured and made accessible to the government.[245] State, territory and local governments will have a major role to play in the management of data as road infrastructure owners and managers.[246]

4.73 A large amount of the information generated by AV technology will be very precise location information based on Global Navigation Satellite Systems (GNSS). Some AVs could also use C-ITS technology or generate open data which could be freely accessed by third parties.

The generation of personal information

4.74 At this stage, it is not known whether the data will be personal information, that is, the extent to which the location and behaviour of an individual will be identifiable from these data sources. It is possible that the ability to identify an individual will vary across different types of AVs and will depend on the mix of technologies used and operational models. For example, the likelihood of being able to identify the user of a non-ticketed people carrier is perhaps lower than a privately owned AV relying on vehicle-to-infrastructure C-ITS technology.[247]

4.75 Personal information generated by AVs could be much broader than location information. It could include data attributes such as time, seat occupancy, vehicle speed, telephone and social media use.[248]

4.76 One of the policy challenges for AVs is that there is no single technology road map to deployment. It is therefore difficult to say at this stage whether they will generate personal information. Austroads is commissioning a privacy impact assessment to determine whether the types of data messages planned to be used in C-ITS should be considered personal information. It will recommend any

[245] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p45.

[246] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p21.

[247] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p44.

[248] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p107, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

actions to address any identified privacy issues when it reports on its research later in 2016.[249]

Consumer concerns

4.77 A potential operational barrier to the successful introduction of AV technology is consumer uncertainty about how personal information will be protected and who can access the data and in what circumstances.[250] Sharing of personal information is widely accepted in everyday activities such as the use of mobile phones, Facebook and traffic information sharing apps.[251] [252] Sharing of personal information generated within AVs may be reasonably required for certain safety, public policy or law enforcement purposes.[253]

4.78 However, there are other scenarios which the community may not view as being reasonable uses of personal information or which could require additional checks and balances. Examples include AV operators selling personal information to third parties for marketing and advertising purposes; enforcement agencies 'fishing' for speed offences by matching AV data to speed zone maps; local authorities accessing location data to identify parking offences; or vehicle users being able to access the history of a vehicle and personal information relating to a previous user of the vehicle.[254]

4.79 Further clarification is required as to who will require the information; in what form it will be available, and whether it is necessary for personal information to be part of the data or whether aggregate datasets would be sufficient for use by institutions and other parties.

4.80 There will also be a need to educate the community about the privacy issues in relation to AV technology. Consumers could make informed choices in situations where they might be offered the opportunity to 'opt-out' by switching off the automated technology and consequently the transmission of location information.[255] Consumers may be willing to trade off privacy provided they are informed of the reasons and the benefits which they receive in the form of improved road safety and mobility.[256]

[249] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, pp108-109, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[250] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p44.

[251] Professor Walsh, transcript of evidence, 20 June 2016, p11.

[252] Mr Brady, transcript of evidence, 20 June 2016, p14.

[253] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p107, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[254] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p107, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[255] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p110, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[256] Professor Walsh, transcript of evidence, 20 June 2016, p11.

Privacy protections and risks

4.81 Australia's existing privacy protections would be likely to apply to AV technology if AVs are found to generate personal information. These consist of the Australian Privacy Principles (APP) contained in the *Privacy Act 1988*, which apply to private sector organisations with a turnover of more than $3 million, and Commonwealth agencies. These are supported by Information Privacy Principles (IPP) which apply to most state and territory agencies.

4.82 AVs would also be regulated by Commonwealth, state and territory surveillance device laws, which prohibit covert surveillance of individuals through the use of surveillance tracking devices. In the view of the NTC, the privacy risks, for the medium term, could be managed within the current privacy and surveillance frameworks operating in Australia.[257]

4.83 The Office of the Australian Information Commissioner (OAIC) has recently released a draft *Guide to Big Data and the Australian Privacy Principles* for public comment.[258] The Guide will facilitate big data activities while protecting personal information.

4.84 A number of big data privacy challenges are addressed in the Guide. These include notice and consent, collection and retention minimisation, as well as use limitation. The draft Guide outlines key privacy requirements and encourages implementation of the Privacy Management Framework. The OAIC has stated that while the Guide is intended for use by entities covered by the *Privacy Act 1988*; it advises that it could also be useful as a model for better personal information handling practices for organisations not subject to the Act.[259]

4.85 Government agencies engaged in enforcement actions have much greater access to personal information under privacy laws than do private sector organisations. The NTC has suggested that the benefits of AVs may not be realised if consumers are uneasy about government access to personal information. It should therefore be made clear to them in what circumstances government authorities may need to access vehicle data and how they will use the information. The treatment of automated data must also be consistent across enforcement agencies and jurisdictions.[260]

4.86 In 2013 the NTC investigated privacy issues in relation to C-ITS technology. It found that the current privacy framework under the *Privacy Act 1988* and the APPs, was adequate to regulate private sector handling of personal information

[257] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p108, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.
[258] Office of the Australian Information Commissioner, Draft Guide to Big Data and the Australian Privacy Principles, May 2016, https://www.oaic.gov.au/resources/engage-with-us/consultations/guide-to-big-data-and-the-australian-privacy-principles/consultation-draft-guide-to-big-data-and-the-australian-privacy-principles.pdf, viewed September 2016.
[259] PS News, Independent News for the Australian Public Service, Edition No 506, Updated Tuesday 31 May, 2016, http://www.psnews.com.au/aps/506/news/privacy-guide-takes-on-big-data-challenges?utm_source=aps506&utm_medium=email&utm_content=news1&utm_campaign=newsletter_aps> viewed September 2016.
[260] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p109, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

generated by C-ITS. However, the study identified a need for stronger privacy restrictions on government access to C-ITS data in some circumstances.

4.87 Subsequently, the then Standing Council on Transport and Infrastructure recommended that, if individuals can be identified from safety message data broadcast by C-ITS devices, specific legislative protections be developed to define the circumstances when organisations, which are exempt from privacy principles, including law enforcement agencies, may access C-ITS personal information. The NTC has suggested that a similar approach could be taken in relation to government agency access to data generated by AVs. [261]

4.88 A precedent for placing legislative limits on the use of tracking information is available under Australia's Heavy Vehicle National Law (HVNL). The Intelligent Access Program (IAP) is a national program developed in partnership with all Australian road agencies. It uses satellite tracking and wireless communication technology to remotely monitor where, when, and how heavy vehicles are being operated on the road network. Under the HVNL, an Intelligent Access service provider can disclose information to police for law enforcement purposes, but only if there is a warrant. This provision also applies to accessing GNSS information linked to an individual heavy vehicle driver, which is recorded in the electronic work diary (EWD).[262]

4.89 The NTC's current Regulatory Review of Regulatory Options for Automated Vehicles has pointed out that the privacy risks of automated vehicles will primarily depend on the technologies adopted and the extent to which AVs generate personal information. Because of this, the NTC has taken the view that, while legislative controls on the use and access to AV information by governments may be warranted in the longer term, until the privacy risks are better known, the current application of privacy and surveillance laws should sufficiently protect consumers' privacy.[263]

4.90 If the approach recommended by the NTC is adopted, industry and governments would use existing privacy principles and surveillance laws to manage privacy risks. Existing privacy principles have already been applied to a wide range of technologies and sectors. Within the current regulatory framework, a privacy impact assessment (PIA) is a tool which can be used by industry and government to help identify and manage privacy impacts. Although not specifically required under the *Privacy Act 1988*, a PIA can help organisations to map the flow of personal information and design systems to minimise transactions of such information as much as possible.[264]

4.91 The NTC's current regulatory review has highlighted the need for further clarification and refinement before developing policies and regulations in relation

[261] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, pp45-46.

[262] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p45.

[263] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p115, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[264] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p113, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

to the protection of personal information associated with AV technology. Outstanding issues include a number of possible disadvantages if the existing regulatory framework is relied upon to manage privacy risks. These disadvantages include the possibility that there could be inconsistent treatment of personal information across organisations; the fact that not all Australian jurisdictions have legislated privacy or surveillance device protections; existing privacy provisions do not apply to small businesses and law enforcement activities; and existing privacy provisions may be inadequate to address industry issues relating to commercial access to vehicle data.[265]

Security risks

4.92 The development of AV technology means that the current in-vehicle systems are considerably more complex. Ensuring that these are secure from hacking is crucial for deployment.[266] Additional design rules could introduce new standards related to technology performance to ensure trusted systems can cooperate, protect privacy and prevent hacking. On the other hand, responsibility could remain with industry to agree and maintain technology performance standards.[267]

4.93 Volvo Car Australia advised that it takes precautions in relation to downloads to upgrade performance of its vehicles. While a software download would be done to upgrade apps or the navigation system, any upgrade of the vehicle system relating to safety critical operations would be done under a safety recall using proprietary equipment for downloading to cars. Volvo told the Committee that vehicle hacking should be a criminal offence.[268]

4.94 E-security may become critically important when an AV is fully connected with other vehicles (V2V) or interfacing with road infrastructure (V21) and a road transport management system.[269] The question of liability in the case of cyber-attack or hacking of automated driving systems and compensation for any resulting loss, injury or damage is a key issue for ongoing consideration.[270]

4.95 The risk of hackers impacting the function of AVs has not yet been fully explored. However, Transport for NSW advised the Committee that there is a significant amount of work occurring internationally to address C-ITS security as well as vehicle security more broadly. The security model evolving is referred to as a Security Credential Management System (SCMS), which is based on a Public Key

[265] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p113, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[266] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p6.

[267] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p32.

[268] Mr Pickett, transcript of evidence, 17 June 2016, p20.

[269] Submission 9, Mr Ian Faulks, p7.

[270] Submission 14, Insurance Australia Group, p16.

Infrastructure (PKI). Both the US and Europe are currently developing an SCMS to support trial deployments.[271]

4.96 Internationally, Australia is represented on the EU-US ITS Task Force Standards Harmonization Working Group, a joint project of the European Commission and United States Department of Transportation. Australia is represented by Transport Certification Australia (TCA), a national government body responsible for providing assurance in the use of telematics and related intelligent technologies, and supporting the current and emerging needs of Australian Governments.[272] [273]

4.97 Regulations covering vehicle security are also being developed through the United National Economic Commission for Europe (UNECE) World Forum for Harmonization of Vehicle Regulations (WP.29). This is a worldwide regulatory forum responsible for harmonising global regulations for motor vehicles and equipment, which is closely monitoring the development of AV technology.[274] [275]

4.98 A new National Policy Framework for Land Transport Technology is being developed by the Federal Department of Industry and Regional Development for the consideration of Australian Road Ministers. This policy includes action on a nationally consistent Cooperative ITS solution for Australia. Transport for NSW is represented on the Austroads Cooperative ITS steering committee which will lead the work on the national solution.[276] The extent to which IT security and related issues, such as hacking, should be addressed in Road Transport legislation is among the key issues which Transport for NSW has listed for consideration in reviewing the NSW regulatory framework further to national deliberations.[277]

4.99 A proposal to undertake local research into vehicle security is also being considered at a national level. This research would be undertaken by a Cooperative Research Centre (CRC). The Committee was advised that a decision on funding the establishment of the proposed iMOVE CRC is not expected to be

[271] Transport for NSW, Response to Supplementary Questions, Question 3, p3, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf, viewed September 2016.

[272] Transport Certification Australia, http://www.tca.gov.au/, viewed September 2016.

[273] Transport for NSW, Response to Supplementary Questions, Question 3, p3, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf, viewed September 2016.

[274] The United National Economic Commission for Europe (UNECE), <http://www.unece.org/trans/main/wp29/introduction.html, viewed September 2016.

[275] Transport for NSW, Response to Supplementary Questions, Questions 2 and 3, pp 2-3, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf, viewed September 2016.

[276] Transport for NSW, Response to Supplementary Questions, Question 3, pp 3-4, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf, viewed September 2016.

[277] Submission 17, NSW Government, pp44-45.

made by AusIndustry, within the Australian Government's Department of Industry, Innovation and Science, until, at least, the end of 2016.[278]

ECONOMIC AND SOCIAL ISSUES

4.100 The Committee received evidence from many stakeholders regarding the positive economic and social impacts from embracing AV technology. In some cases, however, the evidence was mixed so that the Committee was provided with alternative visions for the future of public transport and road congestion.

Predicted economic benefits

4.101 AV technology has the potential to provide significant economic benefits both nationally and for New South Wales. The predicted positive impacts include increased productivity; reduced time spent in traffic congestion; the reduced number of severe accidents and fatalities; efficiency gains in the transport system (increased capacity with reduced fuel consumption) and the development of spin-off industries.[279]

4.102 The Committee was told that these economic benefits are important for a country which spends twice as much per dollar of GDP on transport as the average OECD country.[280]

4.103 Road transport is the life blood of Australia. However, while the movement of people and freight drives the economy and our ability to directly interact with each other, road accidents are estimated to cost the nation more than $27 billion per annum. AV technology promises to alleviate this cost burden. A reduction of 90 per cent in accidents and potential savings of $24.43 billion in reduced road trauma are predicted.[281]

4.104 The rail and mining sectors are already demonstrating evidence of the economic benefits of AV technology.[282] The flow-on effects are expected to bring greater operational efficiency and safety to the freight industry. Transport for NSW, through the Centre for Road Safety, is conducting tests, as part of the Cooperative Intelligence Transport Initiative (CITI), to explore the use of C-ITS with heavy vehicles under Australian conditions.[283] [284]

4.105 Heavy vehicle platooning is another application of AV technology, promising greater fuel efficiency and safety in the freight industry. Platooning allows

[278] Transport for NSW, Response to Supplementary Questions, Question 3, p3, 30 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10090/Answers%20to%20Supplementary%20Questions.pdf, viewed September 2016.

[279] Submission 14, Insurance Australia Group, p17.

[280] Mr Gerard Waldron, Managing Director, ARRB Group Limited, transcript of evidence, 17 June 2016, p23.

[281] Submission 16, Australian Driverless Vehicle Initiative (ADVI), p4.

[282] Submission 16, Australian Driverless Vehicle Initiative (ADVI), p12.

[283] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p6.

[284] Submission 17, NSW Government, pp50-51.

vehicles to travel close together by accelerating or braking simultaneously, eliminating human driver reaction times.[285]

Improving transport efficiency

4.106 Toll roads and motorways make a significant contribution to the NSW, and national, economy. A recent estimate suggested the contribution of motorways nationally to be as high as $52 billion, of which $14 billion was contributed to the NSW economy.

4.107 The upgrading of road networks with C-ITS infrastructure to provide for the connectivity of AVs will make road use more efficient. A Transport for NSW trial of over 100 heavy vehicles is exploring the use of wireless technology to synchronise the vehicles with traffic lights at a sample of the busiest intersections. The aim of this is to reduce the number of truck stops and improve overall traffic flow. In a dedicated lane, AVs can travel at a much higher speed, allowing the passage of up to 4,000 vehicles per hour. Increasing motorway capacity and reducing congestion has particular significance with regard to developing the urban areas of cities such as Sydney.[286]

4.108 Since the 1950s, New South Wales and Australia have become increasingly car dependent. Approximately 80 per cent of NSW trips are now via passenger car. Imports of cars and oil for the NSW transport system are about 20 per cent of goods imported into the state and reduce the State's GDP growth by at least four per cent each year.[287]

4.109 AV technology provides the opportunity to reconfigure the transport system away from fossil fuels and from individual passenger vehicles to a publically accessible multi-modal transport system which includes vehicle sharing.[288] New economic opportunities are arising from the convergence of automated driving, electric vehicles and collaborative economic business models such as Uber, making possible new and more flexible approaches to personal mobility such as ride-sharing.[289] [290]

The international context

4.110 The AV industry is a globally integrated industry. Australian consumption represents less than 1.5 per cent of global vehicle production. Vehicles sold in Australia are mostly designed, developed and built in countries such as Japan, Korea, Europe, Thailand, India and the US. To support the roll-out of new technology, the Committee was told it will be important for Australia to take a harmonised response with European regulation, with local conditions factored into regulatory settings.[291]

[285] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p9.

[286] Ms Huey, transcript of evidence, 17 June 2016, p34.

[287] Submission 11, Dr Gary Ellem, pp2-3.

[288] Dr Ellem, transcript of evidence, 17 June 2016, p48.

[289] Mr Waldron, transcript of evidence, 17 June 2016 p26.

[290] Ms Huey, transcript of evidence, 17 June 2016, p35.

[291] Submission 14, Insurance Australia Group, p5.

4.111 There is an international race to harness the economic value of AV technologies. A recent World Economic Forum survey estimates that 48 per cent of global cities expect commercialisation of driverless vehicles within the next 10 years. Another 40 per cent of cities predict that driverless vehicles will be fully operational by 2025.[292] Australia could be a leader in testing and innovation given its unique geographic distances; ability to generate nationally consistent regulations and different climactic conditions.[293]

4.112 It is important for Australia's economic future to ensure that the regulatory settings are right in order to harness the fiscal, road safety and economic benefits of AV technology. Australia and New South Wales have the professional, technical and trades oriented skill base, capability and infrastructure to generate an alternative source of income.[294] The sharing of knowledge and information between jurisdictions is regarded as critical in ensuring that the economic and safety benefits of AV technology accrue nationally.[295] Collaboration which is occurring across government, industry and start-up sectors, such as the NSW Government's Smart Innovation Centre and the Australian Driverless Vehicle Initiative (ADVI), will create the necessary synergy to realise the potential economic benefits of AV technology.[296]

Impact on public transport

4.113 In 2015 the International Transport Forum examined the convergence of three mega trends: mass urbanisation, the sharing economy and technology. Its report concluded that AVs could have a significant impact on personal mobility and vehicle ownership. In particular, on-demand short-term AV hire could emerge as a viable alternative to traditional vehicle ownership.

4.114 A shift from vehicle ownership to on-demand short-term vehicle hire would have implications for the taxi industry, and for public transport and its regulation.[297] The Committee was told that such disruption to traditional transport patterns offers competing visions: on the one hand the possibility of more efficiently managed transport services; and on the other, commuters could be tempted away from public transport by new door-to-door services which may exacerbate existing traffic congestion.[298]

4.115 AV technology challenges the traditional concept of public transport as 'publicly owned and operated transport'. An alternative model may be 'publicly accessible' transport consisting of mass transport complemented by a range of 'multi-modal' options including taxis and hire cars which provide a personalised component integrated seamlessly with the larger transport system to replace the

[292] Submission 12, NRMA, p3.

[293] Submission 14, Insurance Australia Group, p16.

[294] Submission 14, Insurance Australia Group, p17.

[295] Mr Carlon, transcript of evidence, 17 June 2016, p9.

[296] Ms Cecilia Warren, Emerging Product Lead – Future Vehicles, Insurance Australia Group Ltd, transcript of evidence, 17 June 2016, p60.

[297] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, pp54-55.

[298] Submission 17, NSW Government, p68.

private passenger car.[299] This would be, in effect, a quasi-public-private system, in which mass transport is provided by rail and light rail connecting with transport hubs at which Google-style people pods are lined up to take people to their final destinations. Such a service model could be provided by the public transport system in conjunction with manufacturers, at the same time enabling the commuter to travel seamlessly on one ticket.[300]

4.116 Research conducted by the urban road developer and operator Transurban has identified that younger people are demonstrating a shift away from the need to own a vehicle or hold a drivers licence. Younger people are happy to access mobility services and share them with fellow travellers if it is economically better for them to do so. Transurban has noted the positive potential of smaller scale personalised transport, like the fully automated robo-taxi, to solve the 'last mile' issue which passengers face when they reach the end of the bus or train line and have to find the way to their door. Such vehicles could also serve the unmet travel needs of the younger population without a drivers licence as well as the older generation who no longer drive and for people who could not currently drive such as the visually impaired.[301]

4.117 At this stage in the development of the technology, there is no certainty about the ultimate impact of these developments on public transport. [302] Until research and modelling has been undertaken, the likely future scenarios are conflicting.

4.118 The possibility of more shared services emerging out of the collaborative economy suggests that there could be improvements in the utilisation of vehicles, which could be of positive benefit to the environment as well as for economics. At the same time, offering on-demand services to previously unserved travellers may drive up the demand for vehicles and services.[303]

4.119 In regional areas, where public transport is limited or non-existent, driverless vehicles could be used to provide on-demand public transport systems.[304] [305] Urban developments such as the North West growth corridor outside Sydney provide the opportunity to conduct integrated planning of transport, including a cost benefit analysis of future public transport in conjunction with the emerging options.[306] As discussed in Chapter Two, the Western Australian trial of a smaller scale pod vehicle will assess the feasibility of a last-mile service for some of the more regional residential areas in that state.[307]

4.120 The Committee was told that governments need to take a proactive approach to formulating the legislation and policy which will shape the impact of AV technology on public transport. Pricing will be a major part of achieving the

[299] Dr Ellem, transcript of evidence, 17 June 2016, p48.
[300] Dr Tranter, transcript of evidence, 20 June 2016, p20.
[301] Ms Huey, transcript of evidence. 17 June 2016, pp34-35.
[302] Mr Burke, transcript of evidence, 17 June 2016, p45.
[303] Ms Huey, transcript of evidence. 17 June 2016, p35.
[304] Submission 2, Institute of Public Works Engineering Australasia NSW, p4.
[305] Mr Siorokos, transcript of evidence, 20 June 2016, p3.
[306] Mr Roydhouse, transcript of evidence, 20 June 2016, p31.
[307] Ms Huey, transcript of evidence. 17 June 2016, p36.

outcome that is sought.[308] Much will depend on consumer take-up and use of the technology.[309] The Australian Driverless Vehicle Initiative (ADVI) is currently undertaking a national public opinion survey to ascertain how people feel about the impact of AV technology and use of public transport. This is the first Australian research to examine this issue.[310]

4.121 The NSW Government submission explained the key role which government will play in balancing public benefit and commercial considerations in the context of community interest.[311] Transport for NSW has expressed the view that governments and their agencies should encourage the use of CAVs in a manner which complements rather than replaces public transport.[312] Transport for NSW is currently reviewing the NSW Long Term Transport Master Plan for all transport across the State.[313] This will include developing technology to allow scenario planning and modelling based on changes in policy and traffic mix.[314]

4.122 Transport for NSW has predicted that data linkages between public transport usage and driverless vehicle technology will provide many opportunities to improve the metropolitan transport system, for example, by capturing individual travel patterns. It foresees new businesses emerging, such as ride-sharing services, which will lead to much more customised transport services. Transport for NSW foreshadows that people will be able to interchange across different transport modes with a quicker trip from front door to destination than is possible now. It notes that the key issue will be how to incorporate these developments in conjunction with a mass transit system.[315]

4.123 The broader societal impacts of AV technology, such as public transport, ride-sharing and taxi reform were deemed to be beyond the scope of the NTC's current regulatory review. In the view of the NTC, such issues present complex policy and planning challenges which require further research and understanding before regulatory options are considered.[316]

Vehicle and technology costs

4.124 The NSW Government advised the Committee that one of the key factors influencing the time frame for widespread use of AV technology is cost and accessibility.[317] Current prices of recently released vehicle models with technologically advanced features are prohibitive for the average person. Examples are the *Volvo XC 90*, which is currently priced from $87,000 to $95,000+ and the *Tesla Model S* which is priced from $114,000 to $270,000.[318] Spare parts

[308] Mr Waldron, transcript of evidence, 17 June, 2016, p26.
[309] Mr Burke, transcript of evidence, 17 June 2016, p45.
[310] Professor Regan, transcript of evidence, 17 June 2016, p29.
[311] Submission 17, NSW Government, p22.
[312] Submission 17, NSW Government, p12.
[313] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, pp10-11.
[314] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p12.
[315] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, pp10-11.
[316] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p27, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf viewed September 2016.
[317] Submission 17, NSW Government, p20.
[318] Information provided by telephone to Committee staff from company showrooms on 11 August 2016.

and accessories for AVs are also more expensive. For example, car headlights, which once cost around $100, may now cost from $2,000 to $3,000.[319]

4.125 Advocates for motorcyclists expressed concern to the Committee about the expense to riders if they are required to wear transponders to assist the detection of vulnerable road users by AVs.[320] The NSW Government noted, however, that the cost of the technology should be weighed against the savings achieved by reducing the number of road accidents, casualties and serious injuries,[321] the current national cost of which is estimated to be around $27 billion per annum.[322]

4.126 AVs are expected to incorporate a wide range of technologies such as radar, lidar, global positioning, digital maps, and camera vision systems, which are capable of performing dynamic driving functions, traditionally performed by humans. These functions include route finding, route following, velocity control, collision avoidance, rule compliance and vehicle monitoring. AVs which are capable of performing some or all of these driving tasks are already in existence.[323]

4.127 Compared with the implementation of seat belts throughout the vehicle fleet, which took three decades to achieve, there has been a rapidly increasing take-up of new technologies in motor vehicles. A key feature of this trend has been the growing ability of manufacturers and technology providers to reduce the cost and make the technology available more quickly in mainstream models.[324]

4.128 Further, owners are replacing their cars more quickly than in the past. Whereas the average age of a vehicle was 15 years recently; the average age of the total vehicle fleet is now 9.5 years. Because Australians are replacing their cars more quickly, it is likely that ownership of AVs will spread rapidly.[325]

4.129 To illustrate the speed at which new technology is becoming more accessible and affordable, Transport for NSW told the Committee that in 2008 a BMW with automatic breaking and an adaptive form of cruise control cost $160,000. In 2010 the price had dropped to around $50,000. Today these vehicles can be purchased in the early $20,000 price range. As the volume of production of AVs increases around the world, it is predicted that there will be further dramatic price reductions.[326]

4.130 In addition, it is likely that different new technologies will come onto the market which will also influence costs.[327] There will also be a convergence of

[319] Mr Robert McDonald, Director, IAG Research Centre, Insurance Australia Group Ltd, transcript of evidence, 17 June 2016, p59.

[320] Mr Stanford, transcript of evidence, 17 June 2016, p45.

[321] Submission 17, NSW Government, pp30-31.

[322] Submission 14, Insurance Australia Group, p9; Submission 16, Australian Driverless Vehicle Initiative (ADVI), p4; Submission 8, Associate Professor Kieran Tranter and Mr Mark Brady, Law Futures Centre and Urban Research Program, Griffith University, p4.

[323] Submission 16, Australian Driverless Vehicle Initiative (ADVI), p5.

[324] Dr Tranter, transcript of evidence, 20 June 2016, pp19-20.

[325] Dr Tranter, transcript of evidence, 20 June 2016, pp19-20.

[326] Mr Wall, transcript of evidence, 17 June 2016, p10.

[327] Mr Carlon, transcript of evidence, 17 June 2016, p10.

technologies as the market develops vehicles which meet the needs of drivers on an international basis.[328] Transport for NSW also noted that in 2005, there was no data available for any vehicles in NSW with blind spot monitoring systems. By 2015, 30,000 vehicles were fitted with this technology.[329]

4.131 Transport for NSW predicts that in the next 25 years there will be a significant shift in the traffic mix once the cost of providing the technology is reduced. At that point there will be also be changes in infrastructure with increased deployment of shared vehicles and buses and a slow decline in personal vehicle ownership.[330]

4.132 Other forecasters suggest that by 2035 many Australians, especially in urban areas, will have dispensed with private vehicle ownership altogether because the cost of using a people pod system will be less than owning or maintaining a motor vehicle.[331]

4.133 It is also predicted that as autonomous point-to-point transport services become more available and trusted, the community may accept regulation discouraging private ownership by raising the cost and skill requirements for drivers licences and restrictions on access to parking and to the road network.[332] Vehicle pricing will be a major consideration in determining the impact of AV technology on the future of the traditional public transport system and achieving an outcome which is in the best interest of the community.[333] Transport for NSW told the Committee that it will undertake further modelling and cost benefit analyses to better understand the flow-on effects.[334]

Insurance costs

4.134 The introduction of AVs raises a range of considerations for the State Insurance Regulatory Authority (SIRA) and the Compulsory Third Party (CTP) Insurance Scheme. A key factor in setting premiums is the cost of claims when a vehicle is at fault in a crash. It is likely that CTP premiums will reduce if there are fewer casualties and injuries as a result of AVs proliferating through the NSW fleet. Transport for NSW predicted that lower CTP premiums could increase competition in the CTP market as insurers try to maintain their share of premium income.[335]

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[328] Mr Craig Moran, General Manager, Road Network Operations, Road and Maritime Services, transcript of evidence, 17 June 2016, p10.

[329] Mr Carlon, transcript of evidence, 17 June 2016, p11.

[330] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p10.

[331] Dr Kieran Tranter, Law Futures Centre and Urban Research Program, Griffith University, Response to Supplementary Questions, Question 1, 5 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10072/Response%20to%20Supplementary%20Questions%20-%20Dr%20KieranTranter.pdf, viewed September 2016.

[332] Dr Gary Ellem, Response to Supplementary Questions, Question 1 (2), 5 August 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10094/Response%20to%20Supplementary%20Questions%20-%20Staysafe%20Hearing%20into%20Driverless%20Vehicles%20-%20Dr%20Gary%20Ellem.pdf, viewed September 2016.

[333] Mr Waldron, transcript of evidence, 17 June 2016, p26.

[334] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p12.

[335] Submission 17, NSW Government, p47.

4.135 Incentives to use safer vehicles and technology systems already exist in CTP insurance. A number of CTP insurers factor into the current pricing system the risks associated with vehicle type, the type of protection within the vehicle, and the vehicle use. Incentives are offered to people who have safer vehicles or safer travel patterns through a reduction in insurance premiums. Transport for NSW predicted that CTP insurance will constitute one of the systems which will create an incentive for people to take up vehicles with the automated functions which improve road safety.[336]

Heavy vehicle impacts

4.136 The reduction in the price of AV technology is forecast to make a significant safety impact on the heavy vehicle industry. A trailer with stability control currently costs around $2,000 more than one without. It has been suggested, however, that at present less than 20 per cent of new trailers include stability control. Around 365 rollovers occur nationally in the trucking industry each year. Most of these accidents are caused by the rear trailer overturning the truck. The Committee was told that the expenditure of $2,000 on technology to stabilise the trailer would be recompensed in savings on the cost of accidents.[337]

4.137 Expenditure on AV technology will also help to make the transport industry more competitive. The Committee was told that there is a saving of about 40 per cent in the running costs of a truck which is fully driverless.[338]

Cost of and responsibility for infrastructure upgrades

4.138 A key reason why level 4 and 5 AVs are not expected to be operational on a large scale for a number of decades is because the infrastructure to support the technology in all conditions and locations will take time and resources to deliver.[339] Level 3 AVs are designed to operate with existing infrastructure and their sensors are capable of detecting and interpreting existing road marking and speed advisory signs. Transport for NSW is currently exploring how higher level AVs will communicate with traffic signals and other infrastructure and what changes to signage and infrastructure are required to support fully automated and mixed fleet environments.[340]

4.139 The need for assistance from infrastructure outside the vehicle is also important because safe and reliable control decisions need to be made to protect not only the automated vehicle occupant, but also road users outside the vehicle, such as pedestrians, bicycle riders, motorcyclists and occupants of other approaching vehicles.[341] The future of communications technology, e.g. satellite coverage, may be ultimately more critical to deciding the mix of communications that will be required than the physical infrastructure of a road network.[342]

[336] Mr Carlon, transcript of evidence, 17 June 2016, p13.
[337] Mr Waldron, transcript of evidence, 17 June 2016, p28.
[338] Mr Waldron, transcript of evidence, 17 June 2016, p28.
[339] Submission 17, NSW Government, pp18-19.
[340] Submission 17, NSW Government, p36.
[341] Submission 17, NSW Government, pp18-19.
[342] Mr Moran, transcript of evidence, 17 June 2016, p7.

4.140 Uniformity of road infrastructure and signage is necessary across different jurisdictions to enable highly automated vehicles to navigate effectively. At national level, the Policy Framework for Intelligent Transport Systems in Australia provides guidance designed to ensure that the technology used in each jurisdiction is compatible and is developed around a set of agreed policy principles. This is currently being reviewed by the Department of Infrastructure and Regional Development (DIRD) at the request of the Transport and Infrastructure Council.[343]

4.141 In addition, Austroads is currently investigating the emerging requirements for road operators to support automated vehicles. The project scope includes physical infrastructure (including road signs, line marking and road geometry) and digital infrastructure (including road data and communications coverage). This work is being undertaken with a view to clarifying not only the maintenance responsibility of road operators but also their liability in relation to substandard physical or digital infrastructure.[344]

4.142 It is difficult to 'future proof' the road network while technological standards for vehicle-to-vehicle infrastructure communication, and other standards such as for road marking and signs, are still being settled. However the NSW Transport portfolio has acknowledged that it must give careful consideration to the planning of future road infrastructure, bearing in mind that it will be supporting an increasing number of CAVs and AVs.[345]

4.143 In the view of the urban road developer and operator, Transurban, the changes which are likely to be required to roadside furniture will be minor, for example, line markings on roads. It points out that participation in on-road trials involving a range of vehicles with different approaches to automation will help develop an understanding of infrastructure requirements.

4.144 In the medium term, possible changes or upgrades to roadside furniture could include equipment which communicates with AVs driving on the motorways to provide alerts about variable speed limits, roadworks and stopped vehicles. In the longer term, when a large proportion of vehicles has been automated, more significant changes could be made to roadside furniture and to physical road structures including narrower lanes; replacing physical signs with electronic communications to vehicles; changing road configurations; and providing pavements to cater to different loading from platoons of heavy vehicles. Transurban points out that changes or upgrades are more likely to occur on motorways as these roads carry high volumes of vehicles in an environment more conducive to safe and early adoption of automation.[346]

[343] Submission 17, NSW Government, p19.

[344] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p101, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[345] Submission 17, NSW Government, p19.

[346] Transurban, Response to Supplementary Questions, Questions taken on notice, Question 1, 8 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10070/Response%20to%20Supplementary%20Questions%20-%20Transurban.pdf, viewed September 2016.

Regional and local roads

4.145 The NSW road network covers some 180,000 kilometres, of which 160,000 are managed by local government.[347] The current state-owned road network consists of 18,000 kilometres of sealed roads and 2,000 kilometres of unsealed roads; whereas council-owned regional and local roads include approximately 80,000 kilometres of sealed roads as well as 80,000 kilometres of unsealed roads. [348]

4.146 It is estimated that over 60 per cent of crashes in New South Wales are occurring on local government roads. The annual funding gap to maintain the NSW road network is estimated to exceed $447 million. Professional public works engineers have expressed concern about the additional funding which may be needed for any infrastructure upgrades needed for AV technology.[349] They note the increasing adverse impact on the condition of local government roads due to the growing use of regional and local roads by the heavy vehicle sector.[350]

4.147 Engineers also question the economic feasibility of upgrading the unsealed road network and painting line markings which may be required for level 5 AVs to navigate in rural and regional areas.[351] While road safety researchers acknowledge that a level 5 AV cannot currently function on an unsealed road without vehicle-based systems enabling it to read road lines, they emphasise that the technology is evolving very fast. While it would be very difficult to use today's technology on a gravel road, tomorrow's may have that ability. Overseas trials have confirmed the feasibility of driving a level 5 AV on unformed roads.[352] In Australia, fully automated heavy vehicles are already being driven on unsealed roads at controlled mining sites.[353]

4.148 Despite existing standards and guidelines, there are variations in the signage and road quality at local government level. In addition to ensuring that state-managed roads meet the standards required, NSW Government agencies need to work with local government to achieve a uniform standard across jurisdictions.[354]

4.149 Senior officers from Transport for NSW and Roads and Maritime Services participate in a governance committee which examines the road network across the whole state and prioritises projects and areas requiring development.[355] In addition, the NSW Government's Fixing Country Roads Program provides funding for local councils to upgrade local government and regional roads with a view to making them safe for use by heavy vehicles. This funding is secured with the assistance of Transport for NSW [356]

[347] Mr Roydhouse, transcript of evidence, 20 June 2016, p27.
[348] Submission 2, Institute of Public Works Engineering Australasia, NSW Division, Roads and Transport Directorate, p3.
[349] Mr Roydhouse, transcript of evidence, 20 June 2016, p27.
[350] Mr Roydhouse, transcript of evidence, 20 June 2016, p30.
[351] Mr Roydhouse, transcript of evidence, 20 June 2016, p30.
[352] Mr Wall, transcript of evidence, 17 June 2016, p8.
[353] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p8.
[354] Submission 17, NSW Government, p19.
[355] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p7.
[356] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p8.

4.150 How quickly change happens in relation to road infrastructure will depend on the impact of AV technology on road assets and on how the renewal of roads and new infrastructure are funded in the longer term.[357] One solution which has been suggested to ensure that regional roads are maintained at the same level as urban roads is to have a separate rural and regional road safety action plan which can attract separate funding for rural and regional roads.[358]

4.151 Future requirements for infrastructure spending will be dependent on the strategic directions taken by governments in relation to encouraging new directions in the transport system. For example, ride-sharing, with less personal ownership of passenger vehicles has the potential to reduce the number of vehicles travelling on the road and, ultimately infrastructure budgets because of the reduced need to expand road networks.[359]

Road access pricing

4.152 Motorists pay for roads either directly or indirectly via taxes on fuel and vehicle registration fees.[360] Electric cars, powered by rechargeable batteries, will be a viable option in future for more drivers.[361] The numbers of AVs and hybrids/electronic vehicles will increase at the same time. Some automated functions will improve a vehicle's fuel efficiency and consequently government revenue from fuel taxes could reduce. At the same time, it is projected that private car ownership could decrease, due to new mobility options such as shared vehicle services, thus diminishing the revenue collected from vehicle registrations. In future, the amount of road-related revenue received by governments will depend on the type and amount of fuel used by AVs, the distances they travel and the registration fees charged by governments.[362]

4.153 Some countries, such as New Zealand, have user pays systems which assign revenue back to investment in road infrastructure. Australia is not yet at the point of determining how it will collect revenue from road users as it transitions to automated and electric vehicles.[363]

4.154 There is a view among some researchers, however, that heavy vehicles should pay additional charges for their significant share in road trauma. It is estimated that heavy vehicles constitute 5.3 per cent of the national fleet and 18.8 per cent of the deaths and injuries. Articulated trucks represent 0.5 per cent of the national fleet with a reported 10 per cent of deaths and injuries. It has been suggested that, based on the estimated $30 billion a year cost of road trauma in

[357] Mr Mick Savage, Manager, Roads and Transport Directorate, Institute of Public Works Engineering Australasia, NSW Division, transcript of evidence, 20 June 2016, p30.

[358] Submission 14, Insurance Australia Group, p11.

[359] Dr Ellem, transcript of evidence, 17 June 2016, p46.

[360] National Transport Commission, Response to Supplementary Questions, Question 5, p3, 14 July 2016 https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf, viewed September 2016.

[361] Submission 10, Volvo Car Australia, p4.

[362] National Transport Commission, Response to Supplementary Questions, Question 5, p3, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf, viewed September 2016.

[363] Ms Gardiner-Barnes, transcript of evidence, 17 June 2016, p13.

Australia, articulated vehicles should be charged on average an annual user charge of $30,000 for their contribution to road trauma.[364]

4.155 At the same time, NSW road asset managers have warned of the deleterious impact of heavy vehicles on the condition of the state's road network. They estimate that the funding gap to bring the NSW road network up to a satisfactory condition to be in excess of $447 million. Road asset engineers stress that there is a very real need to investigate further how road infrastructure will be funded in the light of requirements for AVs.[365] Until the exact nature of the infrastructure that will be needed to support AVs on the road is known, it is difficult to determine what the appropriate cost recovery models might be.[366] Some stakeholders warn that a user pays road funding model may not be sufficient to fund upgrades on rural and country roads and provide equity in the development of AV technology between rural, regional and urban areas. Because of the tyranny of distance in Australia, there may be a need for universal service obligations as with telecommunications.[367]

4.156 AVs are expected to generate significant volumes of data, some of which will be precise location information based on GNSS technology. Some AVs could also use C-ITS technology or generate open data that could be freely and easily accessed by third parties.[368] There is an opportunity to implement a user-pays system based on such data. Consideration would need to be given to the equity of any type of user-pays model to ensure that people are not penalised if they have no choice but to make longer journeys. Incentives could be provided by economic modelling to encourage commuters to give preference to shared transport, for example, by charging different rates for travelling in a pool or mass transit vehicle.[369]

4.157 A report on projections for future transport revenue[370] noted that modelling conducted in the United States suggests that car sharing and self-driving vehicles could lead to a combined nine per cent reduction in average distance travelled by 2050.[371] Ride-sharing and tax reform are among the broader societal issues which provide complex policy and planning challenges. Further research and understanding will be needed before regulatory options can be considered.[372]

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[364] Mr Waldron, transcript of evidence, 17 June 2016, p28.

[365] Mr Roydhouse, transcript of evidence, 20 June 2016, p27.

[366] Mr Savage, transcript of evidence, 20 June 2016, p30.

[367] Mr Roydhouse, transcript of evidence, 20 June 2016, p30.

[368] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p44.

[369] Dr Ellem, transcript of evidence, 17 June 2016, p51.

[370] Report for the National Transport Commission, Paul W Graham and Luke J Reedman, May 2015, http://www.ntc.gov.au/Media/Reports/(68BBFA97-3FAF-4266-A478-5ED625F7559E).pdf, viewed September 2016.

[371] National Transport Commission, Response to Supplementary Questions, Question 5, p3, 14 July 2016, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10071/Response%20to%20Supplementary%20Questions%20-%20National%20Transport%20Commission%20NTC.pdf, viewed September 2016.

[372] National Transport Commission, Discussion Paper, 'Regulatory options for automated vehicles', May 2016, p27, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

Impact on road congestion

4.158 Connected automated vehicles (CAVs) have the potential to improve traffic and congestion management, thus contributing to increased economic productivity.[373] It is estimated that congestion currently costs the Australian economy about $20 billion a year.[374] C-ITS technology relies on wireless communication to warn drivers or intervene in dangerous situations, reduce traffic congestion or increase system efficiency.[375] The increasing amount of data collected and transmitted as the use of CAVs increases, will enable integration of transport activities and provide a large source of real time information that can be used to investigate and manage congestion problems.[376]

4.159 The use of vehicle to vehicle (V2V) communications will allow CAVs to travel safely in platoons with much shorter distances and smaller speed variances between vehicles, enabling increased traffic throughput with more vehicles being able to use the same road space.[377] Platooning is already proving to deliver greater efficiency in heavy vehicle transport.[378] The increased use of AVs in public transport and the platooning of public transport are, likewise, predicted to improve the efficiency of the road traffic movement across the network.[379]

4.160 On a free-flowing motorway, the maximum capacity is 2,000 vehicles per lane per hour. In a dedicated lane CAVs can travel at much higher speeds, and up to 4,000 vehicles per lane per hour, significantly increasing road capacity and reducing congestion.[380]

4.161 Reducing the number of road accidents also benefits traffic flow. Currently 25 per cent of non-recurrent congestion is attributed to traffic accidents such as vehicle crashes and breakdowns.[381] AVs also improve traffic flow by allowing synchronous responses of vehicles at intersections and improved merging.[382] It is suggested that improving the capacity of the road network may ultimately require less investment in augmenting road infrastructure[383]

4.162 Notwithstanding such positive predictions, careful consideration needs to be given to what exactly the impact of AV technology on traffic congestion is likely to be.[384] If the take up of AVs leads to greater mobility, the safety benefit may not be achieved if there is increased congestion. While greater use of shared vehicles and on-demand vehicle services could free up valuable road space and reduce

[373] Submission 17, NSW Government, p6.
[374] Mr Waldron, transcript of evidence, 17 June 2016, p23.
[375] Submission 17, NSW Government, p14.
[376] Submission 17, NSW Government, p69.
[377] Submission 13, Transurban, p5.
[378] Submission 13, Transurban, p5.
[379] Submission 17, NSW Government, p68.
[380] Ms Huey, transcript of evidence, 17 June 2016, p34.
[381] Submission 13, Transurban, p5.
[382] Mr Siorokos, transcript of evidence, 20 June 2016, p2.
[383] Mr Siorokos, transcript of evidence, 20 June 2016, p2.
[384] Submission 17, NSW Government, p10.

the need for parking areas,[385] the jury is out on whether this would reduce the size of the total fleet.

4.163 A recent study by Massachusetts Institute of Technology researchers in Singapore, considered replacing all modes of personal transportation in a city like Singapore, with a fleet of shared AVs. Using actual transportation data, the analysis suggested that using shared vehicles to meet the personal mobility needs of the entire population could reduce the fleet to approximately one third of the total number of passenger vehicles currently in operation. However, the report warned that further research was needed to quantify the extent to which traffic congestion could be alleviated.[386]

4.164 The impact that AV technology and the associated possibility of new shared and on-demand vehicle services will have on private vehicle ownership is not yet known. One prediction is that by 2035, many Australians, especially in urban areas, will have dispensed with vehicle ownership because the cost of using a people pod system will be less than owning and maintaining a motor vehicle.[387]

4.165 In the United States, the Virginia Department of Transport is encouraging car sharing to manage congestion by allowing vehicles with three or more passengers to travel free on express lanes.[388] The advent of AV technology will enable integrated planning with regard to routes and times when vehicles can access the network in order to relieve congestion. For example, deliveries to supermarkets could be done overnight instead of during the day. This would help to ensure that freight vehicles do not use the road network at the peak time for other vehicles.[389]

4.166 A suite of policy arrangements will be needed to ensure that AV technology delivers a positive result in relation to traffic congestion.[390] Such broader societal questions require further research and understanding before regulatory options can be considered.[391]

Health costs

4.167 As mentioned briefly in Chapter Two, AV technology is predicted to greatly reduce vehicle crashes, and consequently the costs to the community of treating and rehabilitating people injured in crashes.

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[385] Mr Siorokos, transcript of evidence, 20 June 2016, p2.

[386] Kevin Speiser, Kyle Treleaven, Rick Zhang, Emilio Frazzali, Daniel Morton and Marco Pavone , '*Toward a Systematic Approach to the Design and Evaluation of Automated Mobility-on-Demand Systems. A Case Study in Singapore*', http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

[387] Dr Tranter, Law Futures Centre and Urban Research Program, Griffith University, Response to Supplementary Questions, Question 1, https://www.parliament.nsw.gov.au/committees/DBAssets/InquiryOther/Transcript/10072/Response%20to%20Supplementary%20Questions%20-%20Dr%20KieranTranter.pdf,viewed September 2016.

[388] Ms Huey, transcript of evidence, 17 June 2016, p37.

[389] Mr Savage, transcript of evidence, 20 June 2016, p32.

[390] Dr Ellem, transcript of evidence, 17 June, 2016, p52.

[391] National Transport Commission, Discussion Paper, 'Regulatory Options for Automated Vehicles', May 2016, p27, http://www.ntc.gov.au/Media/Reports/(049B1ED1-5761-44D5-9E3C-814A9195285D).pdf, viewed September 2016.

4.168 In its submission Transurban reported that 75 per cent of road crashes is attributable to human error, and that road fatalities and injuries are estimated to cost the economy $27 billion annually, equating to 2.7 per cent of GDP and 40 per cent of national health expenditure.[392]

4.169 Ms Michele Huey representing Transurban, gave evidence to the Committee at its public hearing on 17 June 2016. Regarding health costs she told the Committee that 1.3 million people die and more than 50 million people are seriously injured across the world on roads every year. For the 12 months leading up to February 2015 over 1,200 fatalities were experienced on Australian roads. 350 of these were in New South Wales, with the number of seriously injured being considerably more. Ms Huey said that the 'cost of road incidents—whether in the direct form of health care, rehabilitation, property damage repair or emergency service deployment or in the indirect form of lost productivity, lost output, disruption to traffic—sums up to hundreds of millions or billions of dollars'.[393]

Freedom of mobility

4.170 Partial or full automation are predicted to reshape mobility possibilities for community members who currently have difficulties accessing transport. In the future, vehicles with full automation could provide a form of 'mobility freedom', previously not available to people who would otherwise not be able to drive, including children, the elderly, people with disabilities and others who are unlicensed to drive in the current system.[394] AV technology also opens up the possibility of new modes of transport services such as ride-sharing and pooling services which may address mobility needs.[395]

4.171 Western societies are undergoing significant demographic changes, especially the increasing population of elderly people who desire to remain mobile.[396] Retirees who move to country and regional areas where public transport may not be immediately accessible frequently find themselves at risk if, over time, they are found medically unfit to drive. Level 4 and 5 AVs or shared car services will enable the elderly to continue to visit the doctor, do their shopping and have a social life.[397] As with current restricted driving licences, the elderly or those with designated impairments or medical conditions could qualify for a license to operate an AV subject to passing a certain threshold of competence.[398]

4.172 Younger people are demonstrating a shift away from car ownership, preferring to use taxis, public transport and new forms of personalised transport such as Uber. It is predicted that in future there will be robo-taxis and other forms of mobility services which will emerge with technological advances.[399] On-demand short-term AV hire could emerge as a viable alternative to traditional vehicle

[392] Submission 13, Transurban, p2.
[393] Ms Huey, transcript of evidence, 17 June 2016, p33.
[394] Submission 14, Insurance Australia Group, p7.
[395] Dr Ellem, transcript of evidence, 17 June 2016, p47.
[396] Submission 9, Mr Ian Faulks, p2.
[397] Mr Siorokos, transcript of evidence, 20 June 2016, p3.
[398] Dr Tranter, transcript of evidence, 20 June 2016, p17.
[399] Ms Huey, transcript of evidence, 17 June 2016, p34.

ownership. Disruption of current ownership patterns could lead to major changes in the taxi industry, public transport, insurance, vehicle registration and roadworthiness. For example, vehicle registration may be managed at a wholesale level by manufacturers or third party service providers.[400]

4.173 A full regulatory review of the impacts of highly and fully AVs may not be feasible until these vehicles are on the market. In the meantime, the national Austroads registration and licensing project is considering specific issues relating to vehicle registration and compulsory third-party insurance.[401] Provided there are no significant risks for citizens, commentators stress that future regulations should not impede the community from receiving the benefits of AV technology, such as improved mobility.[402] [403]

[400] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p55.

[401] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, pp54-55.

[402] Submission 6, National Transport Commission, Appendix 1, NTC Issues Paper, 'Regulatory barriers to more automated road and rail vehicles', February 2016, p20.

[403] Professor Walsh, transcript of evidence, 20 June 2016, p11.

Appendix One – Conduct of the Inquiry

The Staysafe Committee commenced *the Inquiry into Driverless Vehicles and Road Safety* on 24 February 2016, following a self-referral.

The Terms of Reference can be found on page v of this Report.

The Committee called for submissions and issued a media release on 29 February 2016. The inquiry was advertised on the Parliament's website and twitter account. Media coverage of the inquiry included television reports, newspaper and magazine articles. The media reports covered both city and regional areas within New South Wales.

The Committee members and staff attended a driverless vehicle presentation and demonstration at Volvo Australia Headquarters, in conjunction with the Australian Road Research Board (ARRB) on Monday 14 March 2016. Media attended the demonstration.

The Committee wrote to 68 key stakeholders including government, insurance companies and organisations, academics, car companies, unions and road user groups inviting them to make a submission. The closing date for submissions was Monday 11 April 2016.

In total the Committee received 17 submissions from a range of stakeholders. A full list and copy of the submissions received can be found on the Committee's webpage: www.parliament.nsw.gov.au/staysafe.

The Committee conducted two days of public hearings at Parliament House on Friday 17 and Monday 20 June 2016. Twenty nine witnesses provided evidence to the Committee. The list of witnesses can be found in Appendix Three of this report.

The transcript of evidence, along with answers to supplementary questions can be found on the Committee's webpage: www.parliament.nsw.gov.au/staysafe.

Appendix Two – List of Submissions

Submission No 1	Professor Toby Walsh, UNSW and Data 61
Submission No 2	Institute of Public Works Engineering Australasia NSW Division (Roads and Transport Directorate)
Submission No 3	Mr Robert Whelan, Insurance Council of Australia
Submission No 4	Mr Brian Wood, Motorcycle Council of NSW
Submission No 5	Mr Ray Rice, Bicycle NSW
Submission No 6	Mr Geoff Allan, National Transport Commission
Submission No 7	Ms Phoebe Dunn, Amy Gillett Foundation
Submission No 8	Assoc. Professor Mr Mark Brady and Dr Kieran Tranter, Law Futures Centre and Urban Research Program, Griffith University
Submission No 9	Mr Ian Faulks
Submission No 10	Mr Kevin McCann, Volvo Car Australia
Submission No 11	Dr Gary Ellem
Submission No 12	Mr Kyle Loads, NRMA
Submission No 13	Ms Michele Huey, Transurban
Submission No 14	Mr David Wellfare, IAG
Submission No 15	Mr Harold Scruby, Pedestrian Council of Australia Ltd
Submission No 16	Australian Driverless Vehicle Initiative (ADVI)
Submission No 17	NSW Government

Appendix Three – List of Witnesses

17 JUNE 2016, MACQUARIE ROOM, PARLIAMENT HOUSE

Witness	Organisation
Ms Clare Gardiner - Barnes Deputy Secretary Freight, Strategy and Planning Transport for NSW	NSW Government
Mr Craig Moran General Manager Road Network Operations Road and Maritime Services	
Mr Bernard Carlon Executive Director Centre for Road Safety	
Mr John Wall Manager Road Safety Technology Centre for Road Safety	
Mr David Pickett Technical Manager	Volvo Car Australia
Mr Gerard Waldron Managing Director ARRB Group Limited	Australian Driverless Vehicle Initiative (ADVI)
Mr Arjan Rensen Regional Manager, NSW/ACT ARRB Group Limited	
Professor Michael Regan Chief Scientist, Human Factors ARRB Group Limited	
Ms Michele Huey Group General Manager – Strategy	Transurban

Dr Geoff Allan Chief Operating Officer	National Transport Commission
Mr Marcus Burke Project Director Heavy Vehicle Compliance and Technology	
Dr Gary Ellem	
Mr Robert McDonald Director IAG Research Centre	Insurance Australia Group Limited (IAG)
Ms Tracy Green Executive General Manager Customer and Underwriting	
Ms Cecilia Warren Emerging Product Lead – Future Vehicles	
Mr George Karagiannakis Head of Government Relations	

20 JUNE 2016, MACQUARIE ROOM, PARLIAMENT HOUSE

Witness	Organisation
Mr Chris Siorokos General Manager Advocacy and Media	NRMA
Professor Toby Walsh Professor of Artificial Intelligence Research Group Leader	University of New South Wales Data61
Dr Kieran Tranter Associate Professor Law Futures Centre and Urban Research Program	Griffith University
Mr Mark Brady Solicitor and PhD Candidate Law Futures Centre	
Dr Roderick Katz Director	Amy Gillett Foundation
Mr John Roydhouse Chief Executive Officer	Institute of Public Works Engineering Australasia, NSW Division (IPWEA (NSW))
Mr Mick Savage Manager, Road and Transport Directorate	
Mr Ian Faulks	
Mr Ray Rice Chief Executive Officer	Bicycle NSW
Mr Guy Stanford Delegate	Motorcycle Council of NSW
Mr Steven Pearce Treasurer	
Mr Brian Wood Secretary	

Appendix Four – Extracts from Minutes

MINUTES OF MEETING NO. 6
1 pm, Wednesday 24 February 2016
Waratah Room, Parliament House

Members Present: Mr Greg Aplin MP (Chair), Mr Scot MacDonald MLC (Deputy Chair), Mr Adam Crouch MP, Mr Adam Marshall MP, Mr Nick Lalich MP, Dr Mehreen Faruqi MLC, Ms Eleni Petinos MP, and The Hon. Daniel Mookhey MLC

Officers in Attendance: Jason Arditi, Vedrana Trisic, Jacqueline Isles, Jennifer Gallagher

1. **Apologies:** There were no apologies.

2. **Confirmation of minutes:** Resolved, on the motion of Mr Lalich, seconded by Ms Petinos that the minutes of Meeting No.5, conducted on 18 November 2015, be confirmed.

3. **Briefing on 'Driverless Vehicles':** The Chair briefed the Committee on the rationale for an inquiry into driverless vehicles and road safety in NSW. The Committee viewed a PowerPoint presentation and video clips demonstrating the technology and key road safety issues.

4. **Consideration of the Terms of Reference for the *Inquiry into Driverless Vehicles & Road Safety in NSW***

   The Committee deliberated on the draft terms of reference.

   Resolved, on the motion of Mr Mookhey that the second term of reference be amended by inserting the words 'including driverless heavy vehicles' after the words 'driverless vehicle technology' and before the words 'and any regulatory and policy changes which will be required.'

   Resolved on the motion of Mr MacDonald, seconded by Mr Marshall, that the Committee adopts the terms of reference as amended:

   That the Committee inquire into and report on driverless vehicle technology in New South Wales with particular reference to:
   1. The capacity of driverless vehicle technology to deliver improved road safety outcomes including a lower road toll, and fewer accidents and injuries to drivers, pedestrians and other road users
   2. The extent to which current road safety policies and regulations in NSW anticipate the introduction of driverless vehicle technology, including driverless heavy vehicles, and any regulatory and policy changes which will be required
   3. The preparedness of NSW road safety regulators to meet the challenges extended by driverless vehicle technology
   4. The experience of other jurisdictions in Australia and overseas in adopting and adapting to driverless vehicle technology
   5. Other related matters.

5. Call for submissions

Resolved, on the motion of Mr Lalich, seconded by Mr Marshall:

- That the Committee calls for submissions and advertises the inquiry on the Committee's website by close of business on 25 February 2016.
- That the closing date for submissions be **Monday, 11 April 2016.**
- That the Chair issues a press release promoting the inquiry.

6. Proposed list of stakeholders to be invited to make a submission

The Chair referred to the proposed list of stakeholders previously circulated and invited Members to make further suggestions or to send those to the secretariat.

Resolved, on the motion of Ms Petinos, seconded by Mr Crouch, that the stakeholders, as per the list circulated and subsequently amended, be informed of the inquiry and be invited to make a submission to the inquiry.

7. Draft project implementation plan for the *Inquiry into Driverless Vehicles & Road Safety in NSW*

The Committee noted the draft project implementation plan (previously circulated) for Staysafe's 2016 inquiry.

***

11. Next meeting

The Committee adjourned at 1.37 pm *sine die*.

MINUTES OF MEETING NO. 7

1:24 pm, Wednesday 11 May 2016
Room 1254, Parliament House

Members Present: Mr Greg Aplin MP (Chair), Mr Scot MacDonald MLC (Deputy Chair), Mr Adam Crouch MP, Mr Nick Lalich MP, Dr Mehreen Faruqi MLC, Ms Eleni Petinos MP, and The Hon. Daniel Mookhey MLC

Officers in Attendance: Jason Arditi, Vedrana Trisic, Jacqueline Isles, Jennifer Gallagher

1. **Apologies:** Mr Adam Marshall MP.
2. **Confirmation of minutes:** Resolved, on the motion of Mr Crouch, seconded by Mr Lalich that the minutes of Meeting No. 6, conducted on 24 February 2016, be confirmed.
3. **Inquiry into Driverless Vehicles and Road Safety in NSW**

3.1 Consideration of submissions

Resolved, on the motion of Ms Petinos, seconded by Mr Crouch:

- That Committee receives and authorises the publication-in-full (with signatures and direct contact details redacted) the submissions numbered 1-16.
- That in preparing submissions for publication, material in any published submission be redacted which identifies or tends to identify any third party either by name; address; business name, type or location; includes any photographs; defames or potentially defames any individual third party through a description of their business or activity; or may expose any submission maker to unwanted attention.

3.2 Confirmation of dates for the public hearing

Resolved, on the motion of Mr Lalich, seconded by Mr Crouch that the Committee conducts its public hearings on 17 and 20 June 2016.

3.3 Proposed list of witnesses to be invited to the public hearings

Resolved, on the motion of Mr Lalich, seconded by Mr Crouch: That the Committee invites the following witnesses for a public hearing:

1. Professor Toby Walsh, UNSW and Data61
2. Institute of Public Works Engineering Australasia NSW Division
3. Amy Gillett Foundation
4. National Transport Commission
5. Mr Mark Brady and Dr Kieran Tranter, Griffith University
6. Volvo Car Australia
7. Dr Gary Ellem, University of Newcastle
8. NSW Government
9. NRMA
10. Transurban Limited
11. IAG
12. Australian Driverless Vehicle Initiative (ADVI)
13. Bicycle NSW
14. Motorcycle Council of NSW
15. Mr Ian Faulks

Following deliberation, the Committee agreed to seek the advice of the National Transport Commission on obtaining evidence on the impact of automation on the heavy vehicle industry.

***

5. Overview of media coverage of the launch of the inquiry

The Committee noted the circulated list of press articles and media clips publicising the inquiry.

6. Overview of national and international developments pertinent to the inquiry

The Committee noted the circulated list of national and international developments relevant to the current inquiry.

***

8. Next meeting

The Committee adjourned at 1:34 pm until 17 June 2016.

MINUTES OF MEETING NO. 8
9.00 am, 17 June 2016
Macquarie Room, Parliament House

Members Present:
Mr Greg Aplin MP (Chair), Mr Scot MacDonald MLC (Deputy Chair), Mr Adam Crouch MP, Mr Nick Lalich MP, , Ms Eleni Petinos MP, Dr Mehreen Faruqi MLC.

Officers in Attendance
David Hale, Vedrana Trisic, Jacqueline Isles, Millie Yeoh.

1. Apologies
Mr Adam Marshall MP, The Hon. Daniel Mookhey MLC

2. Confirmation of minutes
Resolved, on the motion of Mr Crouch: That the minutes of Meeting No. 7, held on 11 May 2016, be confirmed.

3. Inquiry into Driverless Vehicles and Road Safety in NSW
3.1 Consideration of submission 17 – NSW Government
Resolved, on the motion of Mr MacDonald: That the Committee ratifies the receipt and authorisation of submission number 17.

***

6. Key reports and developments relevant to the Inquiry
6.1 The Committee noted the National Transport Commission's Discussion Paper on Regulatory options for automated vehicles, May 2016.

7. Public hearing on the Inquiry into Driverless Vehicles and Road Safety in NSW - 17 June 2016

Media
Resolved, on the motion of Ms Faruqi: That the Committee authorises the audio-visual recording, photography and broadcasting of the public hearing on 17 June 2016 in accordance with the NSW Legislative Assembly's guidelines for coverage of proceedings for parliamentary committees administered by the Legislative Assembly.

Transcript of evidence
Resolved, on the motion of Mr Lalich: That the corrected transcript of evidence given on 17 June 2016 be authorised for publication and uploaded on the Committee's website.

Answers to questions on notice

Resolved, on the motion of Mr MacDonald: That witnesses be requested to return answers to questions taken on notice within ten working days of the date on which the questions are forwarded to the witness, and that once received, answers be published on the Committee's website.

Documents tendered during the public hearing
Resolved, on the motion of Mr Crouch: That documents tendered during the public hearing be accepted by the Committee and published on the Committee's website.

***

9. Next Meeting
8:45 am, Monday, 20 June 2016.

The Committee adjourned at 9. 10 am.

At 9:30 am, the Chair declared the public hearing open and witnesses and the public were admitted.

NSW Government
Ms Clare Gardiner-Barnes, Deputy Secretary Freight, Strategy and Planning, Transport for NSW, was affirmed and examined.
Mr Craig Moran, General Manager, Road Network Operations, Roads and Maritime Services, was affirmed and examined.
Mr Bernard Carlon, Executive Director, Centre for Road Safety, was sworn and examined.
Mr John Wall, Manager Road Safety Technology, Centre for Road Safety, was sworn and examined.

Volvo Car Australia
Mr David Pickett, Technical Manager, was sworn and examined.

Australian Driverless Vehicle Initiative (ADVI)
Mr Gerard Waldron, Managing Director, ARRB Group Ltd, was sworn and examined.
Mr Arjan Rensen, Regional Manager, NSW/ACT, ARRB Group Ltd, was affirmed and examined.
Professor Michael Regan, Chief Scientist, Human Factors, ARRB Group Ltd, was affirmed and examined.

Transurban
Ms Michele Huey, Group General Manager-Strategy was affirmed and examined.
Ms Huey gave a Powerpoint presentation regarding the safety benefits of driverless vehicle technology and 'smart motorways'.
National Transport Commission
Dr Geoff Allan, Chief Operating Officer, was affirmed and examined.

Mr Marcus Burke, Director, Heavy Vehicle Compliance and Technology, was affirmed and examined.

Dr Allan tendered a Discussion Paper, titled 'Regulation Options for Automated Vehicles', May 2016.

Dr Gary Ellem, Project Manager for Future Industries, The Tom Farrell Institute, appearing as a private citizen, was affirmed and examined.

Insurance Australia Group Ltd (IAG)
Mr George Karagiannakis, Head of Government and Industry, was sworn and examined.
Ms Tracy Green, Executive General Manager, Customer and Underwriting, was affirmed and examined.
Mr Robert McDonald, Director, IAG Research Centre, was affirmed and examined.
Ms Cecilia Warren, Emerging Product Lead – Future Vehicles, was sworn and examined.

Evidence concluded, the witnesses and public withdrew.

10. Next Meeting

The Committee adjourned at 5:00 pm until the next meeting, on Monday 20 June at 8:45 am.

MINUTES OF MEETING NO. 9
8.45 am, 20 June 2016
Macquarie Room, Parliament House

Members Present:
Mr Greg Aplin MP (Chair), Mr Scot MacDonald MLC (Deputy Chair), Mr Adam Crouch MP, Mr Nick Lalich MP, Ms Eleni Petinos MP, Dr Mehreen Faruqi MLC.

Officers in Attendance
Jason Arditi, David Hale, Jacqueline Isles, Millie Yeoh.

1. Apologies
Mr Adam Marshall MP, The Hon. Daniel Mookhey MLC.

2. Confirmation of minutes
Resolved, on the motion of Mr MacDonald: That the minutes of Meeting No. 8, held on 17 June 2016, be confirmed.

3. **Public hearing on the Inquiry into Driverless Vehicles and Road Safety in NSW - 20 June 2016**

Media
Resolved, on the motion of Mr Crouch: That the Committee authorises the audio-visual recording, photography and broadcasting of the public hearing on 17 June 2016 in accordance with the NSW Legislative Assembly's guidelines for coverage of proceedings for parliamentary committees administered by the Legislative Assembly.

Transcript of evidence
Resolved, on the motion of Dr Faruqi: That the corrected transcript of evidence given on 17 June 2016 be authorised for publication and uploaded on the Committee's website.

Answers to questions on notice
Resolved, on the motion of Mr MacDonald: That witnesses be requested to return answers to questions taken on notice within ten working days of the date on which the questions are forwarded to the witness, and that once received, answers be published on the Committee's website.

Documents tendered during the public hearing
Resolved, on the motion of Mr Crouch: That documents tendered during the public hearing be accepted by the Committee and published on the Committee's website.

***

5. Next Meeting
To be confirmed.

The Committee adjourned at 8: 50 am.

At 9:00 am, the Chair declared the public hearing open and witnesses and the public were admitted.

NRMA
Mr Chris Siorokos, General Manager, Advocacy and Media, was affirmed and examined.

UNSW Australia and Data61
Professor Toby Walsh, Professor of Artificial Intelligence and Research Group Leader joined the hearing by Skype.

Law Futures Centre and Urban Research Program, Griffith University
Mr Mark Brady, Law Researcher was sworn and examined.
Dr Kieran Tranter, Associate Professor, was sworn and examined.

Amy Gillett Foundation
Dr Roderick Katz, Director, was affirmed and examined.

Institute of Public Works Engineering Australasia, NSW Division (IPWEA (NSW))
Mr John Roydhouse, Chief Executive Officer, was sworn and examined.
Mr Mick Savage, Manager, Roads and Transport Directorate, was sworn and examined.
Mr Roydhouse tendered, for the information of the Committee, documents titled 'Road Asset Benchmarking Project 2014' and 'Road Management Report, May 2015'.

Mr Ian Faulks, private citizen, was affirmed and examined.
Mr Faulks provided, for the information of the Committee, a document depicting examples of registration plates for an autonomous vehicle.

Bicycle NSW
Mr Ray Rice, Chief Executive Officer, was sworn and examined.

Motorcycle Council of NSW
Mr Brian Wood, Secretary, was affirmed and examined.
Mr Steven Pearce, Treasurer, was affirmed and examined.
Mr Guy Stanford, Delegate, was affirmed and examined.

Evidence concluded, the witnesses and public withdrew.

6. Next Meeting
The Committee adjourned at 2:45 pm until a date to be set.

MINUTES OF MEETING No 10
10 August 2016
Room 1254, Parliament House

Members present
Mr Greg Aplin MP (Chair), Mr Adam Crouch MP, Mr Nick Lalich MP, Dr Mehreen Faruqi MLC, Mr Adam Marshall MP, Ms Eleni Petinos MP, The Hon Daniel Mookhey MLC, The Hon Scott Farlow MLC (observer)

Officers in attendance
David Hale, Jacqueline Isles, Jennifer Gallagher

The Chair opened the meeting at 1.03pm.

1. **Apologies**
   Mr Scot MacDonald MLC

2. **Confirmation of minutes**
   Resolved, on the motion of Mr Crouch, seconded by Mr Lalich: That the minutes of Meeting No 9, held on 20 June 2016, be confirmed.

***

5. **Inquiry into Driverless Vehicles and Road Safety in NSW**
   The Chair reported progress of the Committee's inquiry into driverless vehicles and road safety in NSW. Discussion ensued.

   Resolved, on the motion of Mr Lalich, seconded by Mr Crouch: That the draft structure, findings and recommendations previously distributed be adopted, with the addition of specific references to rural and regional issues, public transport infrastructure integration, the economic cost of autonomous vehicles, and the compatibility of autonomous vehicle technology with road access pricing**.**

6. **General Business**
   The Chair invited members to consider issues for the Committee's next inquiry, for discussion at the next meeting.

7. **Next meeting**
   The Chair closed the meeting at 1.19pm. The next meeting will be held at 1.00pm on Wednesday 21 September 2016.

UNCONFIRMED MINUTES OF MEETING No 11
21 September 2016
Room 1254, Parliament House

Members present
Mr Greg Aplin MP (Chair), Mr Adam Crouch MP, Mr Nick Lalich MP, Dr Mehreen Faruqi MLC, Mr Adam Marshall MP, Ms Eleni Petinos MP, The Hon Scott Farlow MLC

Officers in attendance
Elaine Schofield, David Hale, Jacqueline Isles, Jennifer Gallagher

The Chair opened the meeting at 1.02pm.

1. Apologies
The Hon Daniel Mookhey MLC

2. Confirmation of minutes
Resolved, on the motion of Mr Crouch, seconded by Ms Petinos: That the minutes of Meeting No 10, held on 10 August 2016, be confirmed.

***

4. Inquiry into Driverless Vehicles and Road Safety in NSW
Consideration of the Chair's Draft Report
Resolved, on the motion of Mr Crouch, seconded by Dr Faruqi: That the Committee considers the Chair's draft report chapter by chapter.

Recommendations and findings
Resolved, on the motion of Dr Faruqi, seconded by Mr Lalich: That Recommendation 1g) be amended by adding the words 'particularly during the trial and testing phase' after the words 'distinctive to other road users'.

Resolved, on the motion of Dr Faruqi, seconded by Mr Farlow: That Recommendation 1i) be amended by adding the word 'safe' before the words 'road use by a mixed fleet' and by deleting all words after the words 'mixed fleet'.

Resolved, on the motion of Mr Crouch, seconded by Dr Faruqi: That Finding 3 be amended by deleting the words 'but under a national framework' and replacing them with the words 'until such time as a national framework is introduced'.

Chapter One proposed
Resolved, on the motion of Mr Crouch, seconded by Dr Faruqi: That Chapter One, as amended, be adopted.

Chapter Two proposed
Resolved on the motion of Mr Farlow, seconded by Mr Crouch: That Chapter Two be adopted.

Chapter Three proposed

Resolved on the motion of Mr Crouch, seconded by Mr Farlow: That Chapter Three, as amended, be adopted.

Chapter Four proposed

Resolved on the motion of Mr Farlow, seconded by Mr Lalich: That Chapter Four be adopted.

Resolved, on the motion of Mr Farlow, seconded by Mr Lalich:

a) That the Committee adopts the recommendations as set out in the report, as amended.
b) That the draft report be the report of the Committee and that it be signed by the Chair and presented to the Parliament.
c) That the Committee staff be permitted to correct stylistic, typographical and grammatical errors.
d) That, once tabled, the report be published on the Committee's webpage.
e) That the Chair issues a press release announcing the tabling of the report.

***

6. Next meeting

The Chair closed the meeting at 1.26 pm to reconvene at 1.00pm on Wednesday 12 October 2016 in Room 1254, Parliament House**.**