

Regulatory options for automated vehicles

Comment on National Transportation Commission Draft Report 2016

About the Warren Centre for Advanced Engineering

The Warren Centre brings industry, government and academia together to create thought leadership in engineering, technology, and innovation. We constantly challenge economic, legal, environmental, social and political paradigms to open possibilities for innovation and technology to build a better future.

The Warren Centre advocates for the importance of science, technology and innovation. Our 30 years' experience of leading the conversation through projects, promotion, and independent advice drives Australian entrepreneurship and economic growth.

This forms the response of the Warren Centre to the National Transport Commission Draft Report on Regulatory Barriers to Automated Road Vehicles in Australia. This follows our original comment on the February 2016 issues paper and our attendance at the stakeholders briefing in Sydney in June 2016. We respond to this draft paper by specifically issuing comment on on-road trials and vehicle design and standards, and by also highlighting cybersecurity as an issue that we believe has major implications for safe operation of such vehicles and which has not been adequately addressed up to now.

Our response is limited to Questions 1, 6 and 11.

Executive Summary

The current rapid commercialisation of autonomous vehicle technologies is an opportunity for Australian innovation to be connected to a high value global market. Platforms established in the coming three years may yield global leadership for decades to come. We support NTC's policy proposals for road trials on case-by-case exemptions basis with national guidelines (Q1) and vehicle designs on case-by-case exemption until international standards are developed (Q6). With regards to cybersecurity risks, we recommend industry best-practice forums and supportive engagement by highly capable cyber security experts to assess risks and develop solutions. By following an approach of permissive regulation, the Warren Centre believes that Australia will be well prepared to capture economic and public safety benefits from emerging autonomous vehicles technology.



Introduction

At the 1964 New York World's Fair, automakers took centre stage. General Motors exhibited the Firebird IV concept car, hailed as the car of the future. GM anticipated 'the day when the family will drive to the super-highway, turn over the car's controls to an automatic, programmed guidance system and travel in comfort and absolute safety at more than twice the speed possible on today's expressways' (Gao, 2014). Ford introduced the Mustang that same year. Ford Division's general manager anticipated selling 100,000 during the first year, but actually sold more than 400,000 (Gao, 2014). Unlike the Mustang, perhaps the Firebird IV was too transformative for the exuberance of the 1960s. Fast-forward to 2016, merely 50 years later, and a transformative era is underway with most major car manufacturers seeking to bring General Motors' dream to reality.

The intensity of global competitiveness and innovation throughout the automotive value chain is heralding remarkable technology advances including interactive safety systems, vehicle connectivity and ultimately self-driving cars. While once mechanical to its soul, the next-generation car will be based on platform innovation, and driving this wave are companies never heard of in the golden 60s-- Tesla, NVIDIA, Cohda Wireless and Bosch amongst others. Research labs in Pittsburgh, San Francisco, Stuttgart, and London are leading the charge, and increasingly growth from emerging markets such as China (where automotive sales have tripled over the past decade (Gao, 2014)) and India will define unique requirements and an open region for innovation and market penetration.

The Warren Centre recognises that this boom holds unique opportunities for Australia to be a significant global player, to drive large domestic investments, to promote our unique R&D capability and to advance interests, especially improved safety technology. We advocate for a positive, cohesive and sustainable regulatory response. We have monitored the growth of this business segment, commented on the platform innovation model and fostered to some degree interest in the local expertise ecosystem both through our weekly innovation newsletter and through events that highlight transportation innovation and entrepreneurship. We caution that excessive or narrow regulation may stifle innovation, and we argue that technology leaders in the community must have their voices heard and their recommendations addressed. The NTC's consultation approach is commended.

We believe that the policy pathway for autonomous technology by necessity involves broad innovation reform to allow Australian companies to realise their competitive advantage abroad, to capture value from research output, to contribute to global safety development and to engage in international supply chains. We acknowledge the conclusion from the policy options document that this is a difficult area to draft permissive regulations, particularly when considering liability, privacy and infrastructure. We believe that sharing best practices globally and opening Australian roads to more international testing could support the knowledge base to yield best-in-class domestic regulation that is productive, efficient and safe. An international lessons learned approach is preferable to 'reinventing the wheel' on regulation.

We look forward to a day when autonomous technologies will decrease automobile deaths caused by human error. Accelerating the deployment of safe automation will save thousands of lives.

Forecasts for autonomous vehicles

A series of forecasts have been made as to when partial and complete autonomy will be available and also when to expect ubiquity of autonomous vehicles in the market. In May the Wall Street Journal quoted General Motors' Head of Foresight and Trends who said that most industry participants think that self-driving cars will be on the road by 2020 or sooner (Stoll, 2016). Forbes quoted Ford CEO Mark Fields that fully autonomous vehicles will be available on the market by 2020 (Baptiste, 2015). Similarly, Forbes quoted Nissan's CEO in the 2013 Consumer Electronics Show (CES) arguing that driverless cars are coming to the showroom by 2020 (Bigman, 2013). According to CTO of Intel, Justin Rattner, in a 2012 European Research and Innovation Conference sideline interview, driverless cars will be available by 2020 and argued that by then the consumer focus will be on the IT and less on the transmission (Gaudin, 2012). Elon Musk is quoted as predicting 2023 (Kaufman, 2014), US Secretary of Transportation at the 2015 Frankfurt Auto Show said 2025. In the long term, the IEEE predicted that 75% of all cars would be autonomous by 2040 (IEEE, 2012).

While some of the hype is competitive banter, it is relevant to note that since 2012, carmakers, technology solutions providers, entrepreneurs and increasingly governments are converging on a 2020 time-frame for the introduction of self-driving vehicles on common roads. This reveals an immediate challenge. Will regulations be proactive or reactive to the technology? In some senses it appears that the introduction of autonomous vehicles promises to be a rapid and unforgiving test of how quickly government and industry will adapt to disruptive innovation.

The opportunity for Australia

Australia's public research sector has significant experience and expertise in autonomous and intelligent systems. Broader innovation reform around technology creation, value capture and intellectual property will support Australia to engage and participate in international supply chains.

The Australian Centre for Field Robotics (ACFR) at the University of Sydney is a world-leading autonomous systems research facility with longstanding involvement in the research of autonomous road vehicles and intelligent systems. ACFR started in 1996 and participated in the original 2007 DARPA autonomous cars Grand Challenge. The Centre has created and demonstrated valuable technology around sensors, operations and data management for a variety of applications. Commercialisation and spin-off have been important elements of this research expertise. For example, commercialised work with autonomous mining vehicles in Rio Tinto's mine sites has proven immensely valuable for efficiently moving millions of tonnes of mined material in the Pilbara region in Western Australia. Recently GoGet and the University of New South Wales announced Australia's first industry

sponsored Autonomous Vehicle and Research and Development Program (AVRAD) based at UNSW (GoGet, 2016). This is in conjunction with the world-leading intelligent systems facility at UNSW and the broader Simulation and Virtual Reality Laboratory (SAVE) that is testing autonomous systems technologies within a virtual environment.

Flinders University in Adelaide is investigating an autonomous bus link to its Tonsley and Bedford Park campuses, which could also provide links to Flinders Medical Centre, Clovelly Park, Tonsley train station and Marion shopping centre (Zito, 2015). In further collaborative work with Volvo, Flinders University, Carnegie Mellon University, the RAA and Cohda Wireless, the city of Adelaide hosted the first Southern Hemisphere trials for autonomous vehicles (Accenture, 2015). Manoeuvres performed included lane changing, emergency braking and car-to-car communication.

Policy and regulation research is underway at Curtin University. Curtin's consumer modelling shows that autonomous cars will be within the average road-user's budget by the end of the 2020s (Accenture, 2015). The Warren Centre contributes to broad innovation advocacy and translation to the public. Recent public engagements on autonomous systems include the November 2015 Warren Centre Innovation Lecture by Prof Salah Sukkarieh of the ACFR, a February 2016 public panel reviewing interconnectivity transport entitled *Planes, Trains and Automobiles: How innovation is changing everything*, and frequent stories in our *Prototype* newsletter featuring international news on autonomous vehicles and road tests.

This is only a high-level snapshot of Australian research sector expertise, but it demonstrates our assessment that Australia has distinct technical capabilities in autonomous vehicles research and commercialisation with potential to capture significant long term value in this \$87 billion global market. This is a unique opportunity to promote the advancement of this transformative innovation in a position of global technology leadership alongside the US and major European economies.

Autonomous vehicle technology may be one of several so-called platform innovation models where value is leveraged from communities of inventors, innovators, entrepreneurs, users and consumers. The transformation is predicted to occur quickly. The time for Australia to innovate rapidly is now, and regulation must be swift to open access. Globally, research, development, testing and regulation is on a fast track, and the very real risk for Australia is that it will miss the opportunity and fall in the wayside to Germany and the United States.

Policy options for autonomous vehicles

On-road trials (Question 1)

The draft report highlights that a priority barrier to autonomous vehicles in Australian roads is inconsistent rules for on-road trials in states and territories. The concerns cited are inconsistent regulations around insurance, access to data, driver training,

risk deterring industry investment and increasing trial costs. These potentially make Australia less competitive and innovative in comparison to other countries.

There are numerous case studies of successful on-road trials. South Australia hosted the first trials in Australia and the southern hemisphere (as documented above). Additionally, a collaboration between NAVYA SAS (A French company specialising in intelligent transport systems) and the Royal Automobile Club is hosting trial runs of a self-driving 15 seater bus in Perth. Trials on private roads commenced in April with public road trials expected later this year.

In Europe, the *Declaration of Amsterdam* was signed by member states of the European Union affirming the need for all states to adopt cohesive liability, data and training regulations to permit on-road trials (European Union, 2016). In the United States, road laws are managed state-by-state. In California where the majority of on-road trials were first undertaken, there was no reference of liability in the State's laws for autonomous vehicles as of 2014 (Anderson, et al., 2014). At that time, Florida, Nevada and Washington, DC laws provided liability protection for original equipment manufacturers whose vehicles were converted to autonomous control (Anderson, et al., 2014). This potentially assists technology development as it allowed retrofit on currently operating vehicles, removing the need to redesign the frame.

US regulation is developing rapidly. In December 2015 the California Department of Motor Vehicles released draft deployment of autonomous vehicle regulations for review. As of June 2016, there is increasing competition amongst the American States to lead the innovation race for autonomous vehicles. As of late 2015, nineteen states had introduced or passed legislation related to autonomous vehicles.

We support the NTC position to continue the current Australian approach – rely on exemptions, granted on a case-by-case basis and to introduce national guidelines to support a consistent approach to on-road trials. In particular, guidelines must address broader issues of data connectivity, liability of manufacturer/retrofitter and road permits for controlled (closed road) and public access trials. It is also highly recommended that European and US guidelines are considered to develop Australian guidelines. Ensuring broad consistency will enable Australian roads to be used as a test bed by international organisations without significant regulatory hurdles.

Continuing the momentum behind the South Australian road trials will assist Australian researchers and industry to capture the value that has been heavily emphasised in this submission. Research into autonomous vehicles technology and connectivity can be undertaken on Australian roads. Well-developed policy and positively permissive regulation can facilitate innovation and promote international collaboration in areas where Australia possesses comparative technical advantages. Australia will gain with international research expertise, a global spotlight on a growing industry, and the ability to showcase the nation's research and progressive policy standing.

Vehicle design and standards (Question 6)

The development of autonomous vehicles heralds a variety of different designs and concepts. Some include elements of driver functionality and hence are similar to conventional vehicles, whereas others are designed to operate autonomously and are therefore radically different. There exists a genuine challenge to regulate vehicle design standards. We understand that the Australian Design Regulations are developed in part through Australian involvement in Working Party 29 of the United Nations. We accept the NTC policy position in this regard to continue the current approach – rely on exemptions, granted on a case-by-case basis, until international standards are developed.

We do however caution that as the scope for driverless vehicles increases to cars without any human involvement/monitoring, excessive regulation has the potential to stifle innovation quite significantly. Ensuring that regulations are more focused on the driving environment (e.g., the car is capable of rear-view vision as opposed to the car requires a rear-view mirror) will permit broader changes in design philosophy to allow for vehicles to emerge for different specific applications. Allowing a degree of industry self-regulation (or self-certification) and adopting a ‘medical device’ type approach to liability and safety may be a potential way forward (Cohen & Sundararajan, 2015). Such an approach would not only allow vehicles onto the road, but also allow monitoring of their performance by the auto industry, governments and insurers to build confidence.

Cybersecurity (Question 11)

A significant issue which has not been thoroughly addressed in the draft report and needs consideration is the accidental or deliberate collision of highly connected, data-driven autonomous vehicles due to cybersecurity failure. There are increasing concerns of cyberterrorism and cybercrime with numerous cases reported in high-impact situations such as major banks, insurance companies and departments of national governments.

Eriksson estimated that by 2020 there will be 50 billion connected devices including 1.5 billion vehicles (Freshfields Bruckhaus Deringer, 2016). This results in a large collection of interconnected data entry ports, particularly as autonomous cars evolve through platform innovation to incorporate features that extend through to handheld smart devices. For example, at the 2013 Detroit Auto Show, Audi demonstrated a self-parking car which can be retrieved from a garage through a smartphone app. Security questions arise from hand-held devices, vehicle-to-vehicle (V2V) connectivity communication and vehicle-to-smart-infrastructure networks.

As this technology develops, it may be difficult to isolate who owns the data and who manages the data connectivity. It is expected that there will be multiple vendors of software and hardware systems in an autonomous car, and isolating ownership for the purposes of liability and threat-tracking may prove to be difficult. According to Stefan Savage of the University of California, San Diego, due to requirements for upgrade, safety and maintenance, it is not practical to separate mission-critical from

non-mission-critical components (Simonite, 2016). Understanding these risks and developing hardware and software mitigation approaches should be a priority. Developing forums for industry best-practice and engaging cybersecurity experts at all levels of the automotive supply and value chain is essential to mitigate serious threats to safety or productivity posed by cybercrime.

Supporting evolution of technology

A convergence among electric vehicles, share economy disrupters and autonomous vehicles technology development is being observed. According to the report *Automotive revolution – perspective towards 2030*, accelerated digital technologies, sustainability and changing consumer preferences around ownership are giving rise to a unique convergence among diverse mobility, autonomous driving, electrification and connectivity (McKinsey and Company, 2016). These trends will lead to leveraged partnerships among companies presently offering these services in isolation. This convergence and possible shifts in how mobility is managed in terms of hardware and supporting infrastructure should be acknowledged and considered alongside regulatory reform. Technology enablers should be considered independently and interdependently.

Presently, development of the technology is underway simultaneously by various groups: traditional vehicle manufacturers (Daimler, Audi, Volvo, BMW, etc.); large IT companies (Google, Apple, IBM, etc.); emerging electric vehicle companies (Tesla, BYD, etc.) and niche commercial and research sector organisations. Car share (GoGet, etc.) and rideshare (Uber, Lyft/Tencent, etc.) companies are presently achieving significant local market penetration and are actively involved in autonomous systems research and commercialisation activities in Australia and abroad (Hudson, 2015). Recognising and encouraging technology enablers is recommended. Local voices should be sought and heard during the consultation phase to empower Australian innovations in this critical phase. The NTC is commended for the engagement currently underway.

Conclusions

Q1: We support NTC's position.

Q6: We support NTC's position.

Q11, Cybersecurity: We recommend developing forums for industry best-practice and supporting engagement of highly capable cybersecurity experts to assess risks and develop enabling solutions.

By following the approach of permissive regulation outlined in this submission, the Warren Centre believes that Australia will be well prepared to capture economic and public safety benefits from autonomous vehicles technology.

The Warren Centre looks forward to discuss this submission or provide further analysis to support and amplify any aspect of this submission.

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About the Warren Centre for Advanced Engineering

The Warren Centre constantly challenges the economic, legal, environmental, social and political issues raised by innovation. We collaborate with industry, government and academia to achieve globally significant outcomes.

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