THE WARREN CENTRE

NSW Future Transport Roadmap 2016

Comment, January 2017

https://future.transport.nsw.gov.au/technology/program/overview/get-involved/feedback-form/

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.

Our Response

This forms the response of The Warren Centre to the Future Transport Roadmap. We support the thought leadership and foresight behind the Future Transport Roadmap and the associated forums that were facilitated in 2016. We respond positively to the Roadmap and offer input on the implementation and integration of these disruptive technologies, and we provide our thoughts on other serious considerations.

This response follows our consistent submissions to consultations by the National Transport Commission on automated road vehicles in Australia including thoughts on potential economic and social benefits that can be realised by encouraging autonomous vehicle innovation in Australia as well as considerations for on-road trials and supporting public research capacity in these domains. The Warren Centre arranged a public engagement panel discussion entitled, *Planes, Trains and Automobiles – the future of transport* featuring panellists from Uber, Splend, Boeing and the Australian Centre for Field Robotics. As part of Spark Festival (Sydney Start-up Week 2016) festivities, The Warren Centre organised an event entitled *The Calm Before the Swarm,* featuring work of industry and start-ups in the area of automated systems. We will aim to continue engaging the public in our own translation of the rapid technology changes underway in 2017.

The Warren Centre for Advanced Engineering Ltd
School of Information Technologies Building J12
University of Sydney NSW 2006
T: (02) 9351 3752 • F: (02) 9351 2012

E: warrenc@sydney.edu.au • W: thewarrencentre.org.au
twitter.com/thewarrencentre • facebook.com/thewarrencentre

ABN: 27 132 821 688

In this response to the NSW Future Transport Roadmap we address questions posed in Chapters 1-3. We specifically address the following questions:

1. Are there any refinements to our analysis or other factors in the broader environment that should be considered in formulating a customer-focused Technology Roadmap?
2. Are there technology applications that you would include or exclude from the list of those with greatest impact on the future of mobility?
3. Are there other technology-driven disruptive changes to behaviour that need to be considered in any of the four scenarios?
4. Are there other emerging technologies that have potential to significantly influence mobility behaviours in any of these scenarios? If so, what are they and what will be the impact?
5. Are there any other high-level strategies that we should consider, and if so, what would be the key recommended next-step, 'no regrets' initiatives?
6. Are there any specific measures you would recommend to optimise in-flight initiatives to take account of recent developments with emerging technologies?
7. Are the key changes that need to be made in the way we engage with industry being addressed? What other matter should be considered?

Executive Summary

Autonomous vehicles, digital technologies and battery technology solutions are rapidly developing and converging and now offer the potential for transformative impact on mobility, infrastructure, safety, and employment. Understanding and preparing for the upcoming revolution will position Australia to take leadership in the commercialisation of these technologies and drive value home. We support the Roadmap position on the opportunity these technologies provide to better quality of life in NSW and the economic opportunity there is in commercialising these technologies. We celebrate Australian public sector research experience and expertise in researching, incubating and commercialising enabling technology, and offer that this expertise should be leveraged in developing solutions unique to Australia and exporting them to the world. Technology enablers across the innovation system should be recognised and supported. On-road trials are a prominent area where Australia can proactively address regulatory limitations, opening roads to international partners to stimulate collaboration, to encourage cooperation and to promote Australian technology leadership globally. Cybersecurity remains a serious safety risk in connected systems and cybercrime is a potentially disruptive technology that can negatively impact implementation and uptake of intelligent transport systems.

Introduction – the promise of automated vehicles, disruptive technologies and future transport

Industry estimates predict the global autonomous vehicles market to be worth $87 billion by 2020. Further, by 2040 it is estimated that four in every 10 vehicles on the road will be fully autonomous (Accenture, 2015). 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. The intensity of global competition 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 such as 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) and India will define unique requirements and an open region for innovation and market penetration.

Parallel and complementary to the development of autonomous cars and associated technologies has been an unrivalled growth of digital technologies including connected systems, internet of things and smart devices. Embedded and mobile systems are growing pervasive in society and supporting new paradigms in productivity and mobility. Coupled with growth of machine learning capabilities, these new generation systems are adaptable, capable and may herald significant productivity advantages. As such, society is at a point of transition, from manual labour to automation, manual processing to digital decision making, and human-in-the-loop to completely autonomous operations. The transition will forever affect our patterns of consumption, production, and employment (World Economic Forum, 2016). Concurrent to technology creation, there is a set of broader socio-economic, geopolitical and demographic drivers of change which will be both interdependent with and independent of technology growth (Schmidt & Cohen, 2010). New business models such as peer-to-peer and 'share economy' are socially acceptable, even preferable, to the 'Digital Natives' Generation of consumers.

The confluence of these two growth curves opens the path for intelligent transport systems to significantly transform infrastructure, employment, training, and the mobility of citizens. In the 21st century, information mobility will be as crucial as the physical mobility of citizens.

There are significant safety benefits to be realised with the integration of intelligent transport systems into Australian roads. In 2011, the Centre for Road Safety estimated that driver factors were present in 7725 of accidents in NSW, while mechanical factors contributed to only 886. More recently, in 2016, the NSW Roads and Maritime Authority states that at least 14% of all crashes involve the driver being distracted by something inside or outside the vehicle. As many as one in ten fatalities have been directly attributed to driver distraction. In a 2014 report, the Bureau of Infrastructure, Transport, and Regional Economics estimated that the total economic impact of road crashes is $27 billion per annum, including the financial burden placed on health care systems. By addressing limitations of human drivers and developing more comprehensive safety systems and communication between the car and stationery infrastructure such as traffic lights or street signs, intelligent transport systems technologies will deliver significant economic and social benefits.

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, comprehensive 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 regular weekly innovation communications and through public events that highlight transportation innovation and entrepreneurship. We caution that excessive or narrow regulation can stifle innovation. We commend the NSW Department of Transport for the foresight and thought-leadership presented in this Future Transport Roadmap, and we are encouraged by the insight and expertise demonstrated in the scenarios of future mobility presented. We offer some additional ideas as well as considerations to introduce these technologies.

Value of the industry

There are differing estimates for the value added to the global economy assignable to the commercialisation of automated vehicle technologies. We present some figures here to indicate the full scope of global value, a fraction of which could potentially flow to Australia's shores.

In 2015, as mentioned above, Accenture reported that the global autonomous vehicle (AV) market could exceed $87bn in value. Fagnant and Kockelman (2015) from the United States collated data including follow-through benefits for the health system and in congestion reduction to suggest economic impacts reaching $196bn with a 90% AV market penetration rate. Manyika et al. (2013) estimated global AV impacts of $200bn to $1.9tn by 2025, assuming that 5-20% of all driving is either autonomous or semi-autonomous and accounting for the value of higher productivity of in-vehicle travel time, whereby the occupants can undertake other activities enroute to their destination.

Australia's role and benefits accrued

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 would 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 autonomous systems research in 1996 and participated in the original 2007 DARPA autonomous cars Grand Challenge. The Centre has created and demonstrated valuable technology around algorithm development, artificial intelligence, and systems automation. 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. Another leading commercialisation example is the AutoStrads technology, a fully autonomous straddle carrier currently operating at the Port of Brisbane and in Sydney's Patrick Terminal. The technology, developed in a domestic partnership between the University of Sydney and Patrick Corporation has been spun-out to Kalmar Global, a multinational shipping and logistics firm. The technology has been globally commercialised at automated ports in London and other locations.

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 and digital systems.

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. In October 2016, The Warren Centre engaged with the Sydney start-up community to facilitate a series of panel sessions to engage industry, academia and the general public around machine intelligence, autonomous systems and advanced computing.

Further, there is significant Australian public research capacity in smart systems and mobile computing. Agencies such as CSIRO and Data61 are at the forefront of co-operative intelligent transport systems and also are making significant strides in large set data analytics, data management, and processing. Privacy issues are a key concern and are being studied and addressed by domestic law faculties.

This is only a high-level snapshot of domestic 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 the global market. This moment in time 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 an enabling regulation environment 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.

Technology enablers

Riding the wave of intelligent systems innovation are a series of independent and interdependent technology enablers. A convergence among electric vehicles, share economy disrupters and autonomous vehicles technology development is observed. According to the report *Automotive revolution – perspective towards 2030*, forces of accelerated digital technologies, sustainability and changing consumer preferences around ownership are directly giving rise to a unique convergence among diverse mobility, autonomous driving, electrification and connectivity (McKinsey and Company, 2016). These trends will lead to leveraging of 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 infrastructure planning and regulatory reform. Technology enablers should be considered independently and interdependently.

Quantifying the benefits of ridesharing alone shows improvement in travel times, lower air pollution and reduced consumer costs. Szell, Ratti and Santi in an NYU Working Group Paper, *Trip sharing in the era of self-driving cars,* show that while trip sharing has the potential to decrease the number of vehicles needed by up to 40%, self-driving technology has the potential to multiply these savings due to efficient "stacking", requiring minimal space between cars on the sides or in front. Santi et al. (2014) show through rigorous analysis of New York taxi data that shifting to ridesharing and car-pooling options can reduce the daily number of taxi trips from 400,000 to 100,000, leading to significant emissions reductions and a decrease in the potential for traffic jams. Uber is not the only player in the ridesharing business. Patents filed in 2015 show that Google and Amazon are also investigating rideshare capabilities within their self-driving car networks (Condliffe, 2017). Recent tussles between Uber and the California DMV with respect to autonomous road trial permits offers insight into the challenge of regulating these systems and their introduction. There are lessons to be learned from these scenarios, but the technology enablers should be permitted to innovate within a framework of safety for the general public. As NSW is currently doing with the Roadmap, governments must engage proactively to understand the rapidly changing technology scenarios.

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 local technology enablers is recommended.

Response to NSW Transport Roadmap

Chapter 1 – Why Future Transport?

As addressed above, there is significant Australian public sector research capacity in technology creation, commercialisation and leadership in the area of intelligent transport systems. We commend the 'environment' as presented in Chapter 1 of the Future Transport Roadmap, however we discern that there is limited discussion of the local expertise ecosystem within NSW and Australia. In planning and delivering mobility, as well as in unlocking the value in the transport system, Australia plays an exciting role in developing technologies and understanding future scenarios. To capture value in the future global market, Australia must lead technology creation, and this must happen cohesively with the NSW future transport direction. Government should stimulate the innovation ecosystem and provide appropriate incentives for start-ups, big business and research institutions to enable commercially viable technology solutions.

We also encourage better contextual understanding of the convergence of electric vehicles, autonomous systems, rideshare disrupters and intelligent systems. Acknowledging leading technology positions and opportunities in NSW will foster technology commercialisation and market leadership and will allow benefits from NSW to flow to the rest of Australia and to the world, which will in return present more benefits at home. Cost savings to consumers are profit streams that could flow to the domestic capital market or alternatively will flow off-shore to corporations innovating overseas.

Chapter 2 – Scenarios of Future Transport

We commend the foresight and thought-leadership behind the four scenarios presented: (1) individual self-driving cars, (2) shared on-demand mobility services, (3) super-commuting aggregated connectivity options (self-driving bus fleets feeding into on-demand cars in the city) and even (4) why bother travelling when services can come to you. We also support the notion that big data, personal mobile systems, and integrated systems will be at the heart of all of these scenarios. We wholeheartedly support the final statement at the end of the chapter, 'while government can exert some influence over how these future scenarios unfold, the overriding responsibility is to enable a dynamic market environment that responds to the needs of customers and the community'. The government as an enabler, adopter and incubator of technologies is the right step forward for innovation broadly in Australia.

We respond to the question about technology-driven disruptive changes to behaviour that need to be considered as well as emerging technologies that have the significant potential to influence mobility behaviours in any of these scenarios here. A significant issue which has not been thoroughly addressed in the Roadmap 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, utility companies, 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.

Cyber risks affecting autonomous cars can broadly be categorised into three areas: complexity, connectivity and content.

Complexity risk refers to the difficulty in securing complex autonomous vehicle technology systems which could potentially contain up to 100 million lines of code, compared to the F-35 fighter jet which has eight million lines of software code. Interconnected subsystems, external connections, and connections to personal devices through various channels and data spectrums increase complexity risk. Connectivity risk is the increased exposure that autonomous vehicles have to cyber-hacking through connection to a local or global network. Interim solutions such as that posed by Waymo to completely disconnect their cars from the internet do little to address the broader challenge. Connectivity risk will also affect stationary road infrastructure that is integral to the intelligent transportation network. Content risks refers to the danger of compromised personal information due to the interconnectivity of these autonomous cars and our mobile phones which increasingly contain credit card details, passwords, business connections and personal data such as mobile phones. Each of these risks need to be mitigated (Automotive, 2016).

As this technology develops, it may be difficult to isolate who owns the data and who manages the data connectivity. It is expected that multiple vendors will supply software and hardware systems within one 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 impractical to separate mission-critical from non-mission-critical components (Simonite, 2016). Further, an environment of secrecy prevails amongst vehicle manufacturers around detected cyber hacks and their corrective solutions (Perry, 2016). This secrecy stems from a lack of communication and willing cooperation to mitigate these risks. Understanding 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. Updated Australian Design Rules should impose minimum design requirements to protect automated vehicles and associated infrastructure from cybersecurity attacks (Clayton Utz, 2016).

Chapter 3 – Five key technology strategies

We respond to high-level strategies that should be considered in the Roadmap for future transport. In particular, we provide an in-depth study of on-road trials and the need for permissive regulations in this regard. Opening Australian roads and associated infrastructure as a global test bed could improve domestic technological capacity and capability. Testing could drive some value home.

There 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 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. Nevada was the first jurisdiction to legislate in 2011. Nevada's rules are similar to legislation enacted in Florida and California in 2012 and the South Australia amendment in 2016. These leading regulations are addressed primarily to the development and testing of autonomous vehicles on public roads (Tranter, 2016). On 20 September 2016, the US Department of Transportation released federal policy for automated vehicles. As part of the policy document a 15 point safety assessment was outlined which covered a range of issues including how driverless cars should react if their technology fails, measures for passenger privacy, how the car communicates with other road users, and also how automakers should approach the digital security of driverless vehicles (Kang, 2016). The agency urged driverless-car manufacturers to prove their technology validation and to share performance data collected by the vehicles. As of publication, a number of states in the US are considering or have passed autonomous vehicles legislation with the aim of opening on-road trials on their public roads. Michigan and Florida, as of December 2016, are the only two jurisdictions that enable on-road testing without a driver (Weiner & Walker Smith, 2017).

It is 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.

Some further thoughts

Liability: The liability and insurance challenges of autonomous driving systems are being addressed now in many global jurisdictions. The English common law of horse and buggy negligence evolved into automobile common law negligence in the early 20th century. Statutory reform was required, sometimes in multiple passes. The speed of the commercial introduction of autonomous systems will be rapid and will require proactive engagement at the NSW, Commonwealth and COAG levels across multiple areas of tort law, consumer/product liability law, contributory negligence and integrated insurance regulation. The challenge is to adopt systems definitions that enable the market and the legal system to assess liability effectively. We note the excellent work being undertaken now by the National Transport Commission "Draft Report on Regulatory Barriers to Automated Road Vehicles in Australia", related inquiries, public engagement and submissions by Australian law firms. We encourage domestic collaboration across jurisdictions as well as alignment to international professional societies and NGO bodies. As examples, NSW should, through the NTC's work, align State policies to the work of the Society of Automotive Engineers International (SAE) and its SAE J3016 definitions and consider the work of the United Nations Working Party on Road Traffic Safety and the Vienna Conventions on Road Traffic.

Data and analytics: Potential regulatory issues surround regulation of spectrum allocation, data uptake and analytics. There is attention garnered towards spectrum used by autonomous vehicles when communicating with other vehicles, road infrastructure (sensors, beacons, indicators, etc.) and (in some models) pedestrian devices. This contributes to a digital infrastructure challenge and more broadly management of large streams of data (International Transport Forum, 2015). It is important that regulation does not prohibit or inhibit safe technology experimentation and adoption (National Highway Traffic Safety Administration, 2015). Allowing the industry to address spectrum and data management protocols appears to be a widely supported view. In particular the benefit of allowing industry to address these protocols is that it promotes creative approaches to mapping the terrain, recognising and managing obstacles, and dealing with sudden emergency scenarios. Allowing industry to assume leadership allows the technology creators to assess whether optimum decision making should occur within the computer of the vehicle itself or whether safer and more efficacious decision authority is distributed across a broader communication network among multiple vehicles operating on the same road. Vehicles may also interact with stationery infrastructure such as red lights or variable speed limit signals. Whether optimisation requires increased infrastructure, satellite based augmentation or a more sophisticated computer inside the vehicle can be options that the industry addresses within broader regulatory controls surrounding the distribution of driver data and public safety (Dia, 2016). Clearly the government must oversee public health and safety, but regulation should not unnecessarily preclude desirable solutions that may evolve in this rapidly developing area.

Conclusions

Capturing value in the global intelligent transport systems market will drive Australian productivity and enable better quality of life. Australian technology research, development and commercialisation is already at the forefront in the areas of autonomous systems and machine intelligence. Promoting this research capacity and providing further avenues for commercialisation should be an essential government endeavour. Enabling on-road trials across Australian states provides an essential first-step to promoting our interests and allows for technology and talent to flow to Australian shores. Understanding and regulating for the real risks of cybersecurity will prove to make these systems safer and more accessible. Overall, we are excited by the foresight demonstrated in the NSW Future Transport Roadmap, and we look forward to seeing this work develop and continue.

By following the approach outlined in this submission, the Warren Centre believes that NSW will be well prepared to capture economic and public safety benefits of the upcoming intelligent transport systems industry.

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

Contacts

Ashley Brinson
Executive Director, The Warren Centre for Advanced Engineering
ashley.brinson@sydney.edu.au, (02) 9351 3752

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.

http://thewarrencentre.org.au/

Bibliography

Accenture, 2015. *The new road to the future: The benefits of autonomous vehicles in Australia,* Sydney: Accenture.

Anderson, J., Heaton, P. & Carroll, S., 2010. *The US Experience with No-Fault Automobile Insurance: A Retrospective,* Santa Monica, CA: RAND Corporation.

Anderson, J. et al., 2014. *Autonomous Vehicle Technology: A Guide for Policymakers,* Santa Monica, CA: RAND Corporation.

Anisi, M. & Abdullah, A., 2016. Efficient Data Reporting in Intelligent Transportation Systems. *Networks and Spatial Economics,* Volume 16, pp. 623-642.

Automotive, T., 2016. *Cyber Security in the Connected Vehicle Report,* London: TU Automotive.

Bell, J. et al., 2015. *Translating research for economic and social benefit: country comparisons,* Melbourne: Australian Council for Learned Academies.

Blum, J., Eskandarian, A. & Hoffman, L., 2004. Challenges of Intervehicle Ad Hoc Networks. *IEEE Transactions on Intelligent Transportation Systems,* 5(4), pp. 347-351.

Cerotti, D., Distefano, S., Merlino, G. & Puliafito, A., 2016. A Crowd-Cooperative Approach for Intelligent Transportation Systems. *IEEE Transactions on Intelligent Transportation Systems.*

Chaturvedi, M. & Srivastava, S., 2016. Multi-Modal Design of an Intelligent Transportation System. *IEEE Transactions on Intelligent Transportation Systems,* pp. 1-11.

Clayton Utz, 2016. *Driving into the future: Regulating driverless vehicles in Australia,* Sydney: Clayton Utz.

Cohen, M. & Sundararajan, A., 2015. Self-regulation and innovation in the peer-to-peer sharing economy. *The University of Chicago Law Review.*

Condliffe, J., 2017. *New Patents Hint that Amazon and Google Each Have Plans to Compete with Uber.* [Online]
Available at: https://www.technologyreview.com/s/603389/new-patents-hint-that-amazon-and-google-each-have-plans-to-compete-with-uber/
[Accessed 18 January 2017].

Dia, H., 2016. *Who (or what) is behind the wheel? The regulatory challenges of driverless cars.* [Online]
Available at: https://theconversation.com/who-or-what-is-behind-the-wheel-the-

regulatory-challenges-of-driverless-cars-55434
[Accessed 1 March 2016].

European Union, 2016. *Declaration of Amsterdam,* Amsterdam: EU.

Fagnant, D. & Kockelman, K., 2015. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. *Transportation Research A,* Volume 77, pp. 167-181.

Freshfields Bruckhaus Deringer, 2016. *From connected to self-driving vehicles: the regulatory roadmap,* London: Freshfields.

GoGet, 2016. *Will driverless cars be in your future?.* [Online]
Available at: https://www.goget.com.au/will-driverless-cars-future/

Group of Eight Australia, 2014. *The role and importance of research intensive universities,* Turner, ACT: Group of Eight Australia.

Gurney, J., 2013. Sue my car not me: Products liability and accidents involving autonomous vehicles. *Journal of Law, Technology and Policy,* pp. 247-277.

Hudson, K., 2015. *What Uber tells us about disruption.* [Online]
Available at: http://www.smh.com.au/it-pro/business-it/what-uber-tells-us-about-disruption-20150905-gjg0ln.html

International Transport Forum, 2015. *Big data and self-driving cars,* Leipzig: ITF.

Kang, C., 2016. Self-Driving Cars Gain Powerful Ally: The Government. *The New York Times*, 19 September.

McKinsey and Company, 2016. *Automotive revolution - perspective towards 2030,* s.l.: McKinsey and Company.

National Highway Traffic Safety Administration, 2015. *Preliminary statement of policy concerning automated vehicles,* s.l.: US Department of Transportation.

Office of the Chief Economist, 2015. *Australian Innovation System Report 2015,* Canberra: Department of Industry, Innovation and Science, Australian Government.

Perry, T., 2016. *Why the Next Denial-of-Service Attack Could Be Against Your Car.* [Online]
Available at: http://spectrum.ieee.org/view-from-the-valley/transportation/safety/why-the-next-denial-of-service-attack-could-be-against-your-car/
[Accessed 18 January 2017].

Santi, P. et al., 2014. Quantifying the benefits of vehicle pooling with shareability networks. *Proceedings of the National Academy of Sciences,* 111(37), pp. 13290-13294.

Schmidt, E. & Cohen, J., 2010. The Digital Disruption: Connectivity and the Diffusion of Power. *Foreign Affairs*, 16 10.

Simonite, T., 2016. Your Future Self-Driving Car Will Be Way More Hackable. *MIT Technology Review*, 26 January.

Startup Aus, 2016. *Crossroads,* Sydney: Startup Aus.

Szell, M., Ratti, C. & Santi, P., 2015. *Trip sharing in the era of self-driving cars,* New York: NYU Marron Institute of Urban Management.

Thierer, A. & Hagemann, R., 2015. Removing roadblocks to intelligent vehicles and driverless cars. *Wake Forest Journal of Law and Policy, 5*(2), pp. 339-391.

Tranter, K., 2016. The Challenges of Autonomous Motor Vehicles for Queensland Road and Criminal Laws. *QUT Law Review,* 16(2), pp. 59-81.

Tranter, K., 2016. The Challenges of Autonomous Motor Vehicles for Queensland Road and Criminal Laws. *QUT Law Review,* 16(2), pp. 59-81.

Weiner, G. & Walker Smith, B., 2017. *Automated Driving: Legislative and Regulatory Action.* [Online]
Available at:
http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action
[Accessed 19 Jan 2017].

World Economic Forum, 2016. *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution,* s.l.: World Economic Forum.

Zhu, M. et al., 2016. Public Vehicles for Future Urban Transportation. *IEEE Transactions on Intelligent Transportation Systems,* 17(12), pp. 3344-3353.

Zito, R., 2015. *Where we are on the road to driverless cars.* [Online]
Available at: https://theconversation.com/where-we-are-on-the-road-to-driverless-cars-50079
[Accessed 1 March 2016].