Initial Scan of Policy/Issues Relevant to Autonomous Vehicle Development and Deployment

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1) Introduction

Throughout the world, governments are considering the potential disruptive impacts of autonomous vehicle technology. It is widely expected that those countries that implement adaptive and successful transitions to shared autonomous mobility will reap social, environmental, and competitive advantages (European Commission, 2016; Franklin, Palmer, Jemelkova, & Boonen, 2017; MIT Technology Review Insights, 2017). Internationally, then, many governments are striving to stay at the forefront of technological developments. Governments that choose not to embrace new technologies will need to develop strategies for managing their place in an international community with different, and possibly conflicting, priorities.

This document is an early output from a project exploring the implications of changing transport systems. The project has a particular focus on autonomous vehicles (AVs) and their implications for the wellbeing of older people and ageing populations. It aims to facilitate proactive decision making about the future of transport in New Zealand. A summary document covering the wider content of the project to date is available (Fitt et al., 2018).

This document aims to support forward-planning, additional research initiatives, and public consultation by transport officials and other relevant stakeholders by summarizing the results of a pilot policy scan of national AV regulation and initiatives. In it, we explore some of the concerns that are influencing contemporary government policies relating to autonomous vehicles. We start with three that are shared internationally: safety and ethics, liability and insurance, and policy for ageing communities. We then move on to present policy profiles for each of three different political jurisdictions that have identified different policy priorities and particular ways of addressing these. These policy profiles can support debate about the direction or directions that New Zealand policy makers should take when planning for future transport systems.

2) Context and Challenges

This report is an early output from a project focusing on the implications of AVs for the wellbeing of older adults and an ageing population in New Zealand's urban environments. A number of New Zealand's government ministries (including Transport, but also Health and Social Development) would be influenced by the adoption of autonomous vehicles into our transport system. These ministries are likely come under increasing pressure to develop cohesive strategies for relevant domain-specific regulatory initiatives and for ongoing anticipatory cross-ministry cooperation coordination. Extensive public consultation, community engagement, horizon scanning, anticipatory planning, and policy coordination will be needed to manage the repercussions of changes to transport systems both in New Zealand and further afield. Collaboration between policy makers, technology developers, regulators, insurance providers, and consumer advocates will also be needed to facilitate progress on the many diverse—and currently uncertain—challenges to which changes to transport systems will lead (Chopra, 2017).

As transport systems evolve, policy makers will be faced with complex and multifaceted decisions.

This document aims to inform discussion and decision making in New Zealand through reporting on policy directions, initiatives, and aspirations around the world. It reports on the findings from a pilot scan of international policy relating to AVs. The scan took place between 8 November and 4 December 2017 and drew from three data sources: official public policy documents, published scholarly research, and mass media. The large amount of recent material available indicates the global salience and rapid development of relevant policy. Findings also demonstrate the interconnections between changes to transport systems and urban and rural development, social inclusion and equity, sectoral unemployment and job creation, innovation and economic competitiveness, wider technology developments (including the internet of things, smart cities technologies, and artificial intelligence), and environmental policy (particularly with respect to climate targets and mitigation).

This document is divided into two main subsections. The first section focuses on policy concerns that are shared internationally. Our policy scan revealed a particular focus on three major categories of concern about transport systems that are being addressed or discussed in a policy context:

1.   Safety and ethics

2.   Liability/insurance

3.   Ageing communities

These three categories of concern are likely to be of ongoing international importance and (assuming no major disruptions to globalised vehicle markets) New Zealand's transport systems are likely to be heavily influenced by policies and technologies developed elsewhere.

The second main subsection focuses on the particular policy approaches of a range of different countries. Throughout the world, central and local governments are considering the potential impacts of anticipated changes to their own specific transport and mobility conditions. Deloitte argues that:

> "the question facing urban planners is how today's expanded mobility ecosystem can help advance public policy goals such as encouraging higher productivity and reducing congestion, while bringing related benefits such as fewer traffic accidents, better air quality, and a smaller urban footprint for parking" (Viechnicki, Khuperkar, Dovey Fishman, & Eggers, 2015)

It is, indeed, common to see AV technology presented as a panacea for current transport problems and dilemmas such as these, but it seems more likely that competing interests and priorities will vie for resolution (Hopkins, 2017). Planners may not be able to achieve higher productivity *and* lower congestion *and* fewer accidents *and* better air quality *and* reduced parking footprints *and* the many other policy goals we might seek to address, including better outcomes for older people. In this context, different policy priorities are likely to result in very different outcomes. Recognising this range of policy priorities and outcomes, this report provides three jurisdiction-specific in-depth policy profiles. Each of the jurisdictions profiled has a very different approach to mobility transitions. While each jurisdiction's policies are multifaceted, the United States focuses on economic competitiveness, Singapore seeks to reduce car dependence, and the European Union prioritises climate policy. The three initial profiles give a sense of how different jurisdictions are prioritising policy goals and profile the associated wide range of emerging regulatory models and public policy initiatives that are emerging.

Planners will have to prioritise amongst the many public policy goals that could be facilitated by autonomous vehicles.

3) International policy concerns

Safety and ethics

The question of AV safety can initially seem like a straightforward technical and certification matter. However, our policy scan reveals that safety concerns intersect with a myriad of social, ethical, and moral considerations that will complicate new regulations and public outreach. Four fundamental regulatory and policy issues loom:

First, expectations shape public acceptance of risk and collisions. Brenda Powell Wells, Risk Management and Insurance Program Director at East Carolina University notes, *"we expect computers, lacking in emotion, lacking in distraction, will be able to drive much better than human"* (McKinney, 2017). Societies may, therefore, be more sensitive to computer failures and hence more reactive to AV collisions and problems, than they are to the established risks of personal driving. As Ajay Chopra argues, *"machine error will be judged much more harshly than human error due to the expectation of precision"* (Chopra, 2017). This may lead to a situation in which public appetites for AVs are lower than forecasted because of poor perceptions of safety, even if AVs are statistically safer than human driven vehicles. Regulators thus may have to address challenges associated with different social perceptions of the risks originating from different sources (Hutson, 2017; International Risk Governance Center, 2016).

Second, safety is influenced by the composition of the vehicle fleet, rather than by just the specifications of individual vehicles. It is common to see assessments of the implications of automation that focus solely on a perceived endpoint at which all vehicles are autonomous (see for example Fagnant & Kockelman, 2014; Meyer, Becker, Bösch, & Axhausen, 2017). However, in the medium term especially, we may encounter situations where the national fleet comprises a mixture of vehicles with different levels of automation and human engagement. Regulators will need to consider transition policies to account for the different safety risks present when different combinations of vehicles (with users with different levels of driving skill) share the road (Ramsey & The Drive, 2017).

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Third, there is a specific set of safety concerns associated with vehicles that require a human driver to be available to retake control. Recent research in the United States indicates that human beings have a pronounced tendency to risk-taking behaviour that can rapidly undercut the efficiency and safety advantages of AVs. For example, the behaviour of some of the volunteers testing Tesla's autopilot software has been described as *"totally reckless"* (Lafrance, 2015). Similarly, participants in recent Google research (who had signed a contract agreeing to stay alert and engaged with the vehicles) were filmed watching the scenery, playing video games, or searching the back seat for belongings (Lafrance, 2015). It may be harder to resolve these behavioural issues, than to remove all

responsibility from human drivers. A recent Wired article, reporting on an interview with Erik Coelingh, Head of Safety and Driver Assist Technologies for Volvo, concluded that:

> "A car with any level of autonomy that relies upon a human to save the day in an emergency poses almost insurmountable engineering, design, and safety challenges, simply because humans are for the most part horrible backups. They are inattentive, easily distracted, and slow to respond." (Davies, 2017)

Some vehicle technology developers have decided to bypass technology levels that require the engagement of a human driver. Regulators will need to establish positions on whether partial automation (and particularly Level 3 automation) is sufficiently safe to operate on public roads and on the legal requirements for both drivers and vehicles.

Fourth, there are complex ethical and moral considerations associated with a machine making safety decisions (Greenemeier, 2016). AVs may have to respond to situations in which there are moral trade-offs, such as scenarios in which a collision is unavoidable but it is possible to make a decision about who or what to hit. There may be broad agreement that human life must be prioritized over property; consensus may be harder to attain if the autonomous vehicle must choose between different lives. The field of experimental ethics has explored such conundrums in some detail. The Trolley Problem, articulated by British philosopher Phillipa Foot in 1967, puts forth a series of decision-scenarios in which a trolley (or train) is about to crash. There are no perfect, or even good, options, but rather a set of moral trade-offs. Researchers at MIT have brought the Trolley Problem up to date by creating a set of hypothetical decisions involving AVs.[1] Research exploring such moral dilemmas found that most respondents believed that AVs should sacrifice their passengers to avoid killing a greater number of unknown others (Bonnefon, Shariff, & Rahwan, 2016). Paradoxically, perhaps, this research also found that most people would prefer to use a vehicle that would protect its occupants at

Regulators will have to decide whether to allow market mechanisms to determine a vehicle's 'ethical algorithms', or whether to regulate in accordance with wider societal mores.

any cost. Regulators will have a role in assessing whether to allow market mechanisms to determine a vehicle's so called 'ethical algorithms', or whether to regulate in accordance with wider societal mores.

Extending these concerns, it is important to recognise that morals and values (on which ethical algorithms could be based) can be culturally specific. There may not be a universally 'correct' answer to how an AV should respond, if, for example, it had to choose between hitting a young boy or an old woman. Indeed, people in different social groups may respond to the dilemma differently, leading to more complexity for programmers and regulators. Anti-discrimination laws (as for example, in Germany) could also exacerbate the implementation of uniformly acceptable self-driving algorithms (Rainie & Anderson, 2017). Algorithmic fairness and transparency is likely to become a pressing regulatory issue that encompasses autonomous vehicles.

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[1] These moral dilemmas can be explored at http://moralmachine.mit.edu/.

The four issues highlighted above are of international concern and some international dialogue and consistency is likely in policy and regulatory responses, even while recognising that some culturally specific responses are also likely to emerge.

Insurance and liability

Changes in the prevailing safety context are likely to result in changes to insurance and liability conditions. Again, concerns around insurance and liability are of international scope, although some pre-existing differences between legal jurisdictions will influence international and domestic responses. For example, in New Zealand, ACC provisions simplify liability and insurance issues through providing cover for any injuries sustained in a vehicle collision regardless of who was at fault (Ministry of Transport, 2009). A number of other jurisdictions (like the United Kingdom, Sweden, and most US States) have compulsory third party insurance laws for drivers (Ministry of Transport, 2009). Most of the currently available policy information on issues of insurance and liability originates from the United States, which has a primarily private model of insurance provision and a comparatively litigious approach to road traffic incidents.

Available information indicates that AVs are expected to have highly disruptive impacts on insurance industry business models. The major challenges to creating insurance and legal systems for smart mobility transitions include:

1)   How to determine and apportion collision liability between a user, vehicle supplier, software manufacturer, and software installer;

2)   How to assess liability and damages when a non-autonomous vehicle is in a collision with an autonomous vehicle, or when vehicles with different levels of autonomy collide;

3)   How to certify and insure inexperienced drivers who may need to take over the wheel in certain situations with partially automated vehicles.

In a situation of high autonomy, driver's licenses may become obsolete. This would cater well to an emerging generation that has known nothing but autonomous vehicles since childhood, as well as to individuals who have physical or cognitive impairments that limit their ability to obtain a driver's licence. However, in a mixed fleet scenario (especially one in which vehicles can operate autonomously in some, but not all, conditions), more complex revisions to driver licensing may be needed.

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In addition, widespread adoption of autonomous vehicles could have substantial implications for law enforcement agencies. For example, in New Zealand, traffic and vehicle regulatory offences constitute almost 20% of police station proceedings and of charges prosecuted against adults (New Zealand Police, 2017; Statistics New Zealand, 2017). These include proceedings or charges for exceeding speed limits or limits for alcohol or other substances. Such offences may be

reduced or entirely prevented under certain conditions of autonomous vehicle use. Accordingly, the National Transport Commission of Australia, an independent statutory body that is charged with managing Australia's transition to autonomous vehicles, recommended in a recent discussion paper that those who ride in fully autonomous vehicles should be exempt from drink and drug-driving laws (National Transport Commission, 2017). This may be an early demonstration of how quickly the transition to autonomous vehicles could disrupt existing laws, policies and cultural norms.[2]

Ageing

The ageing of populations is an international concern. In New Zealand, the proportion of the population aged over 65 is projected to increase from less than one sixth in 2016 to between one quarter and one third in 2068 (Statistics New Zealand, 2016). Very similar rates of increase are projected in the US (Mather, 2016), and in Japan ageing has taken place, earlier and faster (ILC Japan, 2013). By 2005, Japan had the highest global proportion of older people with over 20% of the population aged over 65 (ILC Japan, 2013). There is currently a great deal of speculation, in countries with ageing populations, regarding the potential positive impacts of autonomous vehicles (see for example Haratsis, 2016; Polonetsky, 2016; Transport and Infrastructure Council, 2016). These benefits could range from social inclusion and cultural vitality to more productive and remunerative retirements. Speculation and early research in this area has yet to lead to substantial and widespread policy initiatives, but work seems likely to accelerate.

In the US, the baby boomer generation—members of which started turning 65 in 2011—contributes strongly to population ageing. The number of people over the age of 65 in the US is expected to increase from around 43 million in 2012 to nearly 84 million by 2050, and Heaps (2017) argues that *"Roughly 20 percent of baby boomers are at risk of being elderly orphans without any family to transport them where they need to go."*

Florida is sometimes described as the oldest state in the US (in terms of average population age) (Gillen & Dwyer, 2015) and the Florida Department of Transportation has begun to study systematically the attitudes of older citizens toward adopting autonomous vehicles (FDOT, 2016). It has found that the key issue is trust in vehicle safety and operation. In addition:

> "Retiring from work is often the primary cause of changing travel needs [and] older adults often remain dependent on cars, yet may cease driving at some point, typically due to deteriorating eyesight and safety concerns. However, walking, biking, or public transit may not provide viable options due to health restrictions, distances, or lack of connection to destinations." (FDOT, 2016)

Consideration of the potential implications, for an ageing population, of changing transport systems is underway but is still in its early stages.

Japan is currently in the lead with respect to forward planning for older passengers and autonomous systems, in part because it is experiencing a rapidly ageing population relative to other countries. The Robot Shuttle, developed by Japanese company DeNA Co., is a self-driving bus that is being trialled on routes between a service centre and a health-services complex. Despite the density of

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[2] A potentially useful research topic beyond the scope of the current project would be to consider the potential implications for public health of relaxed laws relating to intoxication and transport.

cities such as Tokyo, the Robot Shuttle is focused on both older people and on remote rural communities, since "*smaller towns in Japan are greying even faster than cities, and there are just not enough workers to operate buses and taxis*" (Tajitsu, 2017). Countries with later and more slowly ageing populations may be able to learn from Japanese approaches, although the peak of Japanese ageing may occur too early (ILC Japan, 2013) for Japan to take full advantage of the benefits of a highly autonomous vehicle fleet.

4) Policy profiles

Policy profile: United States of America

Policy model: Market-led innovation and regulatory flexibility

The citizens of the United States drive an estimated 3 trillion miles per year (Associated Press, 2016). In this large and geographically dispersed country, driving and the personal automobile—since the 1950s at least – symbolize individual freedom. The United States has urban models that range from the highly-innovative San Francisco/Silicon Valley corridor to densely packed cities such as New York, sprawling cities such as Los Angeles and Tempe, Arizona, and remote rural areas.

The US focuses on light-touch regulation that connects mobility system transformation to national economic competitiveness and rapid innovation.

The United States is also home to many of the large transport and technology corporations that are well-established, highly competitive, and seeking to dominate the emerging AV industry and its affiliated services. As Larry Burns, Professor of Engineering at the University of Michigan and advisor to Google notes:

> "If a first-mover captures a 10 percent share of the three trillion miles [driven in the US] per year and makes 10 cents per mile, then the annual profit is $30 billion which is on par with Apple and ExxonMobil in good years. … The potential is huge" (Lafrance, 2015).

With Google, Apple, Tesla, Uber, and the legacy car giants (such as Ford and GM) all competing in this space, the United States will inevitably contribute to the shape of many of the technological dynamics of emerging AVs and smart cities. The AV race between China and the United States is also likely to be fierce as each exploits technological innovation to achieve or maintain geopolitical dominance.

In the US, regulatory complexity is ensured by a constitutional requirement to balance the prerogatives of the federal government (which has authority over the highway system and safety standards) and the state governments (which typically handle driving and car registrations and urban and regional development). The federal government is considering framing regulation and safety standards for AVS, but most of the legislation currently enabling progress towards AV use is operative at the state level. As of 23 October 2017, twenty-one states had passed legislation relating to autonomous vehicles (NCSL, 2017). The National Conference of State Legislatures has developed an autonomous vehicles legislative database (NCSL, 2017) that provides up-to-date, real-time information about state autonomous vehicle legislation in the 50 states and the District of Columbia.

Examples of legislation current at time of writing include California's requirement for self-driving cars to publicly report crashes and how often humans have to retake control, Michigan's mandate that high-tech AV manufacturers must cooperate with the legacy automotive industry (Detroit, Michigan, is the heart of the US automobile industry), and Arizona's position that a standard vehicle registration is sufficient for operation of an AV. In addition, Arizona, Delaware, Massachusetts, Washington, and Wisconsin each have executive orders relevant to AV deployment.

At the federal level, in September 2016, the Obama Administration released a Federal Automated Vehicles Policy, focussing on measures to ensure vehicle safety (NHTSA, 2016). The Trump Administration recently replaced this policy with Automated Driving Systems 2.0: A Vision for Safety (NHTSA, 2017). This revised policy maintains the focus on safety but emphasises the voluntary nature of safety assessments and prioritises lighter-touch regulation that connects mobility system transformation to national economic competitiveness and rapid innovation.

The US model is likely, on the one hand, to produce rapid innovation, build new fortunes and industries, and create cleaner and greener technologies through market-led incentives rather than top-down regulation. However, this volatile, voluntary, and fragmented approach could also leave sizeable gaps between 'smart cities'[3] and disconnected areas as well as between those who do and do not have access to the full range of smart mobility options. The issue of potential job losses will also create significant political barriers to rapid deployment of AVs. Finally, the cultural significance of the car and potential public backlash against 'Big Brother' data systems and the power of large tech companies could stall US momentum toward smart mobility.

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[3] In 2014, the consulting firm Frost and Sullivan identified eight key aspects of a Smart City: smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizen. Autonomous vehicles and connected transport systems move communities closer to the realization of a fully Smart City (Frost & Sullivan, 2014; see also Singh, 2014).

Key policies and regulation: United States of America

Name: Federal Automated Vehicles Policy
Status: Issued, September 2016.
Link: https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016
Key foundations: Goal is to provide policy guidance for AV safety and a baseline for ongoing research and consultation. Proposes development of a voluntary AV safety assessment covering 15 safety categories including data recording and sharing, privacy, system safety, and ethics.

Name: Automated Driving Systems 2.0: A Vision for Safety
Status: Issued, September 2017.
Link: https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf
Key foundations: Replaces earlier Federal Automated Vehicles Policy. Reduces the previous 15 assessment areas to 12, targets rapid transition to AVs and discourages policies that impede progress towards automation. Aims to foster innovation, support industry, encourage new entrants, and promote communication between stakeholders.

Name: Self-Drive Act
Status: Passed by House of Representatives, September 2017.
Link: https://www.congress.gov/bill/115th-congress/house-bill/3388
Key foundations: Gives NHTSA jurisdiction over states in regulating AV design, performance and safety. Will need to be reconciled with the Senate's AV Start Act. National Association of Transport Officials fear that state and local governments will be marginalized.

Policy profile: Singapore

Policy model: Balanced, light-touch regulatory stance

Singapore is a small and highly technologically developed city-state that intends to be a global player in the autonomous vehicle sector. Leveraging its strengths in higher education and in public science

Singapore's government is explicit about its goal of incentivising alternatives to private car ownership.

and technology investment, Singapore markets itself as the optimal AV test-bed for the world (Singapore Ministry of Communications and Information, 2017). It leans on its key strengths of compact urban form, innovative capacity, tech-friendly population, and high-quality urban infrastructure and has facilitated partnerships with a range of relevant global

firms.

Singapore's strong interest in AV technologies is founded on contextual factors including being land-poor and manpower scarce (Meng, 2017). Autonomous public transport could help to create a dense but *"car-lite environment, where Singaporeans feel less of a need to own and move around in their own private vehicles"* (Meng, 2017). Autonomous buses could also provide last-mile public transport options connecting the city-wide Mass Rapid Transit (MRT) train system and dispersed destinations without requiring bus driver recruitment. Singapore's government links rapid development of autonomous vehicle solutions to a more encompassing policy vision of becoming a 'Smart Nation' in which clean, sustainable, and accessible transport options are available across all social strata. Following the launch of the government's Autonomous Vehicle Initiative in 2014, aimed at providing an environment for collaboration and testing of AV technologies, a range of AV bus and taxi trials have taken place (Lim, 2016; McSpadden, 2016; Tung, 2016). Further, in 2016, a four-wheel self-driving Personal Mobility Device focused specifically on mobility enhancements for older people, young people, and people with disabilities was launched (Smart Nation Singapore, n/d).

Singapore has a relatively authoritarian political structure, but also exemplifies a forward-thinking and visionary small state that connects the technical, social, economic, and cultural dimensions of mobility transitions and attempts to balance government stewardship of the transport system with the innovative capacity of citizens and companies. Singapore's 'light touch' regulatory model will combine the government's role in ensuring safety and compliance with incentives to build a competitive and innovative technology sector. A 2017 amendment to Singapore's Road Traffic Act creates a regulatory sandbox within which the Land Transport Authority will have significant autonomy and flexibility in creating appropriate regulations for 21st century mobility systems.

Key policies and regulation: Singapore

Name: Road Traffic (Amendment) Act 2017
Status: Passed, February 2017
Link: https://sso.agc.gov.sg/Acts-Supp/10-2017/Published/20170321?DocDate=20170321
Key foundations: Aims to support transport innovations, especially for public transport, while safeguarding users' interests. Gives Land Transport Authority (LTA) flexibility to adjust rules in response to rapid technology developments to facilitate AV trials on public roads. Also reduces liability for AV operators involved in collisions.

Policy profile: European Union

Policy model: Cooperation and collaboration of member states

The European Union is currently in the process of strategizing for autonomous mobility futures and harmonizing regulation across the EU member states. Like Singapore, the EU has adopted a model that seeks to balance regulators' roles in setting essential standards for safety while also encouraging ongoing innovation and economic development. The EU is distinct in its concerted focus on the privacy, data protection, and cyber-security issues raised by automation technologies. Any use of personal data gleaned from AVs must comply with strict EU data protection laws and be gathered with the informed consent of the user (European Commission, 2016).

The EU approach also explicitly links the issue of smart mobility to climate policy. It has made a binding commitment to cut greenhouse gas emissions to at least 20 percent below 1990 levels by

The EU approach links the issue of smart mobility to climate policy, job creation, and economic development.

2020 (European Union, n/d). Autonomous vehicles are seen as a part of the climate emissions reduction strategy, though the positive environmental effects of AVs are dependent upon uncertain future outcomes such as the mainstreaming of electric cars and public acceptance of a sharing model versus private ownership (Pyper, 2014).

The EU approach also explicitly links smart mobility to job creation and economic development. The European Commission expects that market potential of AVs and associated service industries could eventually reach dozens of billions of euro annually and create hundreds of thousands of jobs (European Commission, 2016). It acknowledges, however, that there will be a delay before such benefits materialize. In the shorter term, job losses in certain sectors are highly likely and social support mechanisms will be needed.

The EU seeks to develop anticipatory approaches that can respond flexibly to the uncertainties inherent in system change of this magnitude. Acknowledged policy challenges include the need for a legal framework to provide investors with legal certainty, the need for EU funding for priority projects, and continued collaboration with EU partners and international stakeholders. The EU also seeks to address issues around systems interoperability, to avoid market fragmentation, and maintain EU competitiveness. While transport ministers are taking the lead in policy development, the EU acknowledges that the issue is multifaceted and will require, at a minimum, strong cooperation with industry sectors and telecommunications regulators.

The EU is developing strategies to deploy, by 2019, a Cooperative Intelligent Transport System (C-ITS), in which communication exists between vehicles, infrastructure, and users. A C-ITS will provide a baseline for the eventual development of smart cities, while also improving safety, efficiency, energy consumption, and emissions in the near- term.

Key policies and regulation: European Union

Name: ITS Directive 2010/40/EC
Status: Adopted, July 2010
Link: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1492766917530&uri=CELEX:32010L0040
Key foundations: Introduces common rules for road transport and alternative interfaces, aiming for a coordinated and effective approach across the EU. Includes specific rules on travel and traffic information systems, truck parking information, and eCall emergency system.

Name: Declaration of Amsterdam: Cooperation in the field of connected and automated driving
Status: Made April 2016
Link:
https://www.regjeringen.no/contentassets/ba7ab6e2a0e14e39baa77f5b76f59d14/2016-04-08-declaration-of-amsterdam---final1400661.pdf
Key foundations: Recognises both the potential benefits and challenges of new transport technologies and calls for a coordinated European strategy on connected and automated driving. Prioritises collaboration in technology developments, cross-border cooperation, learning by experience, strengthening European industry, and ensuring data protection and privacy.

Name: European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility. COM(2016)766.
Status: Dispatched, November 2016
Link: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1492525952008&uri=CELEX:52016DC0766
Key foundations: Presents a strategy for coordinated deployment of Cooperative Intelligent Transport Systems (C-ITS). Includes provisions for cyber-security and data protection and links to other EU initiates on growth and jobs, digital markets and industry, and low-emission mobility. Includes priorities and recommendations for action to facilitate deployment of C-ITS services in 2019.

5) Summary

Our scoping of international policy around autonomous vehicles highlights that international concerns centre on three key areas: safety and ethics; liability and insurance; and ageing communities. These three categories of concern are likely to be of ongoing importance and New Zealand's transport systems are likely to be heavily influenced by policies and technologies developed elsewhere. However, there remains potential for New Zealand to take the lead in prioritising the needs of older people and an ageing population in AV policies.

To take a lead on AV policy, New Zealand will have to address issues of safety and ethics. Many of the claims commonly made about the potential benefits of AVs are predicated on improvements in safety. Without such improvements the realisation of benefits for older people is unlikely. For example, if public perceptions of the safety of AVs are poor (even if AVs are statistically safer than human driven vehicles) this could challenge the likelihood of adoption and so the realisation of benefits. We note that it would be possible to achieve mobility and inclusion benefits without the adoption of AVs (for example through policies targeting other aspects of travel and urban form (Curl et al., 2018)). However, AVs will not have the benefits being claimed unless highly autonomous vehicles achieve widespread use.

New Zealand policy makers will also need to address changes in insurance and liability conditions. These may influence the ease with which older people can access AVs as well as the potential implications of being involved in a vehicle collision. For example, decisions around how to apportion collision liability between a vehicle user, supplier, software manufacturer, and software installer (or between autonomous vehicles and non-autonomous vehicle drivers in a collision involving both) could influence the costs of vehicles and of insurance. This could affect vehicle accessibility for low income groups, and may have an impact on the availability of different models of vehicle access (such as car sharing, ride sharing, and vehicle ownership). Changes to international insurance provisions (perhaps including liability for vehicle manufacturers for example) could also lead to a requirement to review ACC provision.

Policy profiles of three international regions have been included in this report to illustrate the different political priorities being pursued in different jurisdictions and to show how these are being addressed. New Zealand will need to identify its own policy priorities and how to achieve these in order to facilitate the wellbeing of older people and ageing populations.

References

Associated Press. (2016, 22 February). Americans drive 3.1 trillion miles in 2015, a new record. *LA Times*. Retrieved from http://www.latimes.com/business/autos/la-fi-hy-driving-record-miles-20160223-story.html

Bonnefon, J.-F., Shariff, A., & Rahwan, I. (2016). The social dilemma of autonomous vehicles. *Science, 352*(6293), 1573-1576. doi:10.1126/science.aaf2654

Chopra, A. (2017, 22 July). What's taking so long for driverless cars to go mainstream. *Fortune*. Retrieved from http://fortune.com/2017/07/22/driverless-cars-autonomous-vehicles-self-driving-uber-google-tesla/

Curl, A., Fitt, H., Dionisio-McHugh, R., Ahuriri-Driscoll, A., Fletcher, A., & Slaughter, H. (2018). *Autonomous vehicles and future urban environments: Exploring changing travel behaviours, built environments, and implications for wellbeing in an ageing society*. Christchurch, NZ: National Science Challenge 11: Building Better Homes, Towns and Cities.

Davies, A. (2017). The very human problem blocking the path to self-driving cars. *Wired*. Retrieved from https://www.wired.com/2017/01/human-problem-blocking-path-self-driving-cars/

European Commission. (2016). *A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility*. Brussels, Belgium Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1492525952008&uri=CELEX:52016DC0766.

European Union. (n/d). Climate Action. *Europa.eu*. Retrieved from https://ec.europa.eu/info/departments/communication_en

Fagnant, D. J., & Kockelman, K. M. (2014). The travel and environmental implications of shared autonomous vehicles, using agent-based model scenarios. *Transportation Research Part C: Emerging Technologies, 40*, 1-13. doi:https://doi.org/10.1016/j.trc.2013.12.001

FDOT. (2016). *Enhanced mobility for aging population using automated vehicles*. Florida Department of Transportation Research, Retrieved from http://www.fdot.gov/research/Completed_Proj/Summary_PL/FDOT-BDV30-977-11-sum.pdf.

Fitt, H., Curl, A., Dionisio-McHugh, R., Fletcher, A., Frame, B., & Ahuriri-Driscoll, A. (2018). *Think Piece: Autonomous vehicles and future urban environments: Exploring implications for wellbeing in an ageing society (Second ed.).* Christchurch, NZ: National Science Challenge 11: Building Better Homes, Towns and Cities.

Franklin, J., Palmer, C., Jemelkova, I., & Boonen, K. J. (2017). Who Will Finish First in the Race for Autonomous Vehicles? *FTI Journal*. Retrieved from http://www.ftijournal.com/article/who-will-finish-first-in-the-race-for-autonomous-vehicles

Frost & Sullivan. (2014). *Strategic opportunity analysis of the global smart city market: Smart city market is likely to be worth a cumulative $1.565 trillion by 2020* Retrieved from http://www.egr.msu.edu/~aesc310-web/resources/SmartCities/Smart%20City%20Market%20Report%202.pdf.

Gillen, M., & Dwyer, J. W. (2015). *The future of aging is Florida*. (FCS2209). University of Florida, IFAS Extension Retrieved from http://edis.ifas.ufl.edu/fy624.

Greenemeier, L. (2016, 23 June). Driverless cars will face moral dilemmas. *Scientific American*. Retrieved from https://www.scientificamerican.com/article/driverless-cars-will-face-moral-dilemmas/

Haratsis, B. (2016). *Position paper: Economics impacts of automated vehicles on jobs and investment*. Adelaide, Australia: Australian Driverless Vehicle Initiative Retrieved from http://advi.org.au/wp-content/uploads/2016/09/ADVI-Economic-Position-Paper-30-09-2016-3.pdf.

Heaps, R. (2017, June). Self-driving cars: Elderly could be first to embrace autonomous vehicles. *Autotrader*. Retrieved from https://www.autotrader.com/car-shopping/self-driving-cars-elderly-could-be-first-to-embrace-autonomous-vehicles-266938

Hopkins, D. (2017, 4 December). *Putting people into driverless vehicles.* Paper presented at the Transport Knowledge Hub, Wellington, NZ.

Hutson, M. (2017). People don't trust driverless cars. Researchers are trying to change that. *Science*. Retrieved from http://www.sciencemag.org/news/2017/12/people-don-t-trust-driverless-cars-researchers-are-trying-change

ILC Japan. (2013). *The aging population and aged society: A profile of older Japanese*. Retrieved from http://www.ilcjapan.org/agingE/doc/POJ_2013_1.pdf.

International Risk Governance Center. (2016). *Background Paper: Risk and opportunity governance of autonomous cars*. Lausanne, Switzerland: École Polytechnique Fédérale de Lausanne Retrieved from https://www.irgc.org/wp-content/uploads/2016/06/IRGC-workshop-Autonomous-Cars_15-16June-Background-Paper-13June.pdf.

Lafrance, A. (2015, 1 December). The high-stakes race to rid the world of human drivers. *The Atlantic*. Retrieved from https://www.theatlantic.com/technology/archive/2015/12/driverless-cars-are-this-centurys-space-race/417672/

Lim, A. (2016, 20 April). SMRT ties up with Dutch company in plans to bring driverless 'pod' travel into Singapore. *The Straits Times*. Retrieved from http://www.straitstimes.com/singapore/transport/smrt-ties-up-with-dutch-company-in-plans-to-bring-driverless-pod-travel-into

Mather, M. (2016). *Fact Sheet: Aging in the United States*. Population Reference Bureau Retrieved from http://www.prb.org/Publications/Media-Guides/2016/aging-unitedstates-fact-sheet.aspx.

McKinney, L. (2017). Autonomous Vehicles: Costs, Benefits and Public Policy Considerations. *The Current State: E-Newsletter*. Retrieved from http://www.csg.org/pubs/capitolideas/enews/cs80_1.aspx

McSpadden, K. (2016, 25 August). Singapore introduces self-driving taxis, world's first public launch. *e27*. Retrieved from https://e27.co/singapore-introduces-self-driving-taxis-worlds-first-public-launch-20160825/

Meng, N. C. (2017). *Opening Speech by Second Minister for Transport Ng Chee Meng for the Road Traffic (Amendment) Bill Second Reading*. Singapore Ministry of Transport Retrieved from https://www.mot.gov.sg/News-Centre/News/2017/Opening-Speech-by-Second-Minister-for-Transport-Ng-Chee-Meng-for-the-Road-Traffic-Amendment-Bill-Second-Reading/.

Meyer, J., Becker, H., Bösch, P. M., & Axhausen, K. W. (2017). Autonomous vehicles: The next jump in accessibilities? *Research in Transportation Economics, 62*, 80-91. doi:https://doi.org/10.1016/j.retrec.2017.03.005

Ministry of Transport. (2009). *Vehicle insurance in New Zealand*. Wellington, NZ: Ministry of Transport Retrieved from http://www.transport.govt.nz/assets/Import/Documents/Vehicle-insurance-in-New-Zealand.pdf.

MIT Technology Review Insights. (2017). Autonomous Vehicles: Are You Ready for the New Ride? *MIT Technology Review*. Retrieved from https://www.technologyreview.com/s/609450/autonomous-vehicles-are-you-ready-for-the-new-ride/

National Transport Commission, Australia. (2017). *Changing driving laws to support automated vehicles: Discussion Paper*. Retrieved from http://www.ntc.gov.au/Media/Reports/(E5695ACE-993C-618F-46E1-A876391B8CD9).pdf.

NCSL. (2017). *Autonomous Vehicles Legslative Database*. Washington, DC: National Conference of State Legislatures Retrieved from http://www.ncsl.org/research/transportation/autonomous-vehicles-legislative-database.aspx.

New Zealand Police. (2017). *Proceedings (police stations)*. Wellington, NZ: New Zealand Police Retrieved from http://www.police.govt.nz/about-us/statistics-and-publications/data-and-statistics/proceedings-police-stations.

NHTSA. (2016). *Federal Automated Vehicles Policy: Accelerating the next revolution in roadway safety*. Washington, DC: National Highway Traffic Safety Administration Retrieved from http://www.safetyresearch.net/Library/Federal_Automated_Vehicles_Policy.pdf.

NHTSA. (2017). *Automated Driving Systems 2.0: A Vision for Safety*. Washington, DC: National Highway Traffic Safety Administration Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf.

Polonetsky, J. (2016). Self-driving cars: Transforming mobility for the elderly and people with disabilities. Retrieved from https://www.huffingtonpost.com/jules-polonetsky/selfdriving-cars-transfor_b_12545726.html

Pyper, J. (2014, 15 September). Self-driving cars could cut greenhouse gas pollution. *Scientific American*. Retrieved from https://www.scientificamerican.com/article/self-driving-cars-could-cut-greenhouse-gas-pollution/

Rainie, L., & Anderson, J. (2017). *Code-dependent: Pros and cons of the algorithm age: Theme 7: The need grows for algorithmic literacy, transparency and oversight*. Pew Research Centre Retrieved from http://www.pewinternet.org/2017/02/08/theme-7-the-need-grows-for-algorithmic-literacy-transparency-and-oversight/.

Ramsey, J., & The Drive. (2017). The Way We Talk About Autonomy Is a Lie, and That's Dangerous. *Fortune*. Retrieved from http://fortune.com/2017/03/08/the-way-we-talk-about-autonomy-is-a-lie-and-thats-dangerous/

Singapore Ministry of Communications and Information. (2017). *Tapping on the opportunities of the future economy*. Singapore Ministry of Communications and Information Retrieved from https://www.gov.sg/microsites/budget2017/press-room/news/content/tapping-on-the-opportunities-of-the-future-economy.

Singh, S. (2014, 19 June). Smart cities -- A $1.5 trillion market opportunity. *Forbes*. Retrieved from https://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/#440854fe6053

Smart Nation Singapore. (n/d). Self-driving vehicles (SDVs): Future of mobility in Singapore. *Smart Nation Singapore*. Retrieved from https://www.smartnation.sg/initiatives/Mobility/self-driving-vehicles-sdvs-future-of-mobility-in-singapore

Statistics New Zealand. (2016). *National Population Projections: 2016(base)-2068*. Wellington, NZ: Statistics New Zealand Retrieved from http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationProjections_HOTP2016.aspx.

Statistics New Zealand. (2017). *Charges prosecuted against adults by offence type and fiscal year*. Wellington, NZ Retrieved from http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7371#.

Tajitsu, N. (2017, 12 September). Japan trials driverless cars in a bid to keep rural elderly on the move. *Reuters*. Retrieved from https://www.reuters.com/article/us-japan-elderly-selfdriving/japan-trials-driverless-cars-in-bid-to-keep-rural-elderly-on-the-move-idUSKCN1BN0UQ

Transport and Infrastructure Council. (2016). *National Policy Framework for Land Transport Technology: Action Plan: 2016-2019*. Canberra, Australia: Commonwealth of Australia Retrieved from http://transportinfrastructurecouncil.gov.au/publications/files/National_Policy_Framework_for_Land_Transport_Technology.pdf.

Tung, Y. H. (2016, 19 October). LTA partners NTU to trial driverless buses in Singapore. *e27*. Retrieved from https://e27.co/lta-partners-ntu-to-trial-driverless-buses-in-singapore-20161019/

Viechnicki, P., Khuperkar, A., Dovey Fishman, T., & Eggers, W. D. (2015). *Smart mobility: Reducing congestion and fostering faster, greener, and cheaper transportation options*. Deloitte Insights: Smart Mobility Retrieved from https://www2.deloitte.com/insights/us/en/industry/public-sector/smart-mobility-trends.html.