Preparing for the Driverless Revolution

July 2017
Introduction

Key findings

Rapid pace of market transformation

Ride-sharing revolution

Capture value to invest in roads

10 years to transition

Role of government – protect society’s goals

Without community acceptance there is no driverless

Cross-functional collaboration is key

Don’t regulate too early

Build on global learnings

Cities have the power

Data is the new oil

Freight

Drones and Hyperloops

Options for governments

Acknowledgements

Further reading
Introduction

Governments across the world acknowledge that automated vehicle technology is here and that, within ten years, driverless vehicles will be at the core of their national system of intelligent mobility.

In the meantime, governments confront a range of challenges in common – including repositioning local markets and regulation, reshaping government institutions, reassessing planning assumptions, interpreting benefits for society, assuring safety, capturing a financial return for the community from the new commercial uses of public roads and emerging business models.

In April 2017, Roads Australia, the national peak body for road infrastructure stakeholders, led a delegation of senior government and transport industry officials on a global study visit to find out how international jurisdictions are preparing for their driverless roll-out.

This report offers insights into what we learnt from public and private enterprises in the USA (San Francisco and Pittsburgh), the UK and Sweden. It discusses options for governments and industry to take forward in this new world.
Key findings

Ride-sharing is transforming us right now
- Dramatic growth in London, Paris and USA – Uber Pool is next
- Public transport and vehicle ownership are in sudden decline
- Ride-sharing will evolve into driverless fleets
- Existing car companies are completely revising their businesses.

All new vehicles fully driverless within 10 years
- There will be a mixed driverless & manual fleet for up to 20 years
- Shared driverless and manual road sections/lanes within 5 years
- Driverless trials are now common place overseas – Australia must accelerate
- Truck platooning will be first.
Challenges to the role of government

- Road user charging must anticipate the transition (charge the new, not the old)
- Future projects & concessions must allow for likely change
- Governments should capture value for the community through the new uses of the network
- Expect urban roads to be managed by private fleet operators & government concessions.

Emerging issues

- Drones and Hyperloop technology is progressing and we need to plan for it
- Big data is essential for driverless vehicles to operate safely and should be shared to benefit the public
- Consumers are unprepared and public acceptance is vital to achieve the greatest societal benefits from the automated vehicle
- Prepare for an age of unknown unknowns as a mix of new technologies and services come and go.
Overnight, the roll-out of new mobility business models will merge into existing urban transport networks.
Rapid pace of market transformation

The digital era is the key driving force of the next transport frontier. Inflexible transit will morph into a system of customised mobility.

Automated and electric vehicle technology, combined with the popularity of the sharing economy has triggered rapid transport market transformation. Our heavily subsidised public transport system is about to turn into a user-driven and contestable consumer good. In this environment global customer expectations rather than preferences of policy makers may drive the outcomes.

Connected transport customers will access bespoke mobility services from any organisation, based anywhere in the world. Overnight, the roll-out of new mobility business models will merge into existing urban transport networks, all courtesy of internet connectivity and consumer demand.

In San Francisco, Lyft revealed it would launch extended services to an additional 100 US cities in 2017 increasing their target customer base to 72% of the population and 231 million people. The pace in which digitisation is driving transformation across the spectrum of passenger and freight transport infrastructure and service provision is extraordinary.

The expense of private vehicle ownership and the increasing personal cost of commuting due to congestion is a familiar global story. All countries highlight the inefficiency of owning a personal motor vehicle.

Lyft predicts that due to the availability of customised mobility, citizens of major US metropolitan cities will no longer own a private vehicle by 2025.

Customer acceptance will drive the pace of change. Increasing the number of people who trial the safer, affordable, more enjoyable, point-to-point journey where the driving task is left to a machine, will accelerate community buy-in and will drive phenomenal growth for automated vehicles (estimated at a global market value of £4.3 billion by 2025).

Progressive private enterprise racing to capture mobility market share are speeding up the commercialisation of transport, advancing innovative solutions quickly and transforming this market into a retail environment of fast moving mobility services.

As automated vehicle technology reduces in price and relies on electricity, automated vehicle fleets are expected to emerge, creating opportunities to upgrade, expand or replace existing inefficient transport service networks. Competition between potential fleet operators is intense and their business plans are closely guarded. They may be more advanced than they admit.
Ride-sharing revolution

The dramatic rise of the sharing economy and the global shift to ride-sharing are parallel drivers of transport market transformation. Ride-hailing itself is just the beginning – the ability to pool and share the fare (Uber Pool) will be the real game changer.

Though broadly driven by private enterprise, our international colleagues convinced us that governments need to be aware of the unintended consequences that the dramatic roll out of ride-sharing is having on their goal to keep public transport core to the movement of people.

Both the US and UK report 8–9% reductions in mass transit patronage attributed to increasing on-demand services and ride-sharing; San Francisco has seen a parallel increase in road congestion as a result. Sweden, is the only exception. The Swedish Government is confident that citizens will not desert public transport, and continue to promote and invest in public transport as the DNA of their mobility as a service model; although Sweden regulates ride-share in the same way they do taxis.

However, there is advantage for mass transit systems as part of the new mobility mix. One US State Government subsidises Uber to alleviate congestion on their mass transit system by offering complementary first and last mile journeys. Disabled customers benefit too. A US State Government Department employs Uber to deliver cost effective mobility for disabled customers.

Ride-sharing and driverless fleets are closely linked. Ride-sharing operated via an automated vehicle fleet is expected to extract vast society benefits. Though yet to be proven, the optimal use of road space is expected to reduce congestion where cars continue to pick up and drop off multiple passengers on one perpetual trip. Inefficient bus services will be replaced. Requirements for car parking are expected to be greatly reduced and exacerbated by decreasing private vehicle ownership. Conversely, city space for pick up and drop off points within walking distance to transport connections is becoming increasingly valuable.

The ride-sharing models offered by Uber, Lyft and others on the horizon will also evolve over the next 5–20 years into fleets of driverless cars. This will have dramatic consequences for car ownership and will challenge many of the assumptions which governments and the community make about transport delivery, road user charging and government provision of transport infrastructure as a community service.

The world-changers are delivering models that will deliver real congestion-busting societal benefits.
Capture value to invest in roads

Declining private vehicle ownership and ride-sharing growth are already eroding the potential benefits of current road user charging models being trialled for light vehicles – even before they are introduced.

There may be little point in developing road user charging models based on current conditions if, in the meantime, private vehicle ownership is in significant decline. Moreover, fewer vehicles and more passengers per vehicle miles travelled suggest that, very quickly, government revenue currently captured from road networks will no longer be sufficient to fund roads.

Customer demand continues to drive better, more affordable access to transport. The private sector will respond with new journey experiences as the system transitions to electric driverless, payable in whichever way one should choose.

However, paying for the mobility service is only one portion of value to be captured per ride.

The other, is to raise and return value to the public taxpayer, guardians of hundreds of thousands of kilometres of public road space and infrastructure, and the vital enabler of any intelligent land-based mobility system. Land values of road space that could potentially be made available for other uses will become valuable. Even simple title changes should not be overlooked.

International government leaders suggest that ownership of public roads will not substantially change in the foreseeable future, however, existing concessions may need to be reviewed.

Sweden are comfortable that existing regulation supports investment in their road network, so there appears no impetus for change. Uber is considered a taxi service in Sweden and is licenced so to pay their fair share.

Generally, the majority of countries visited were ahead or equal to Australia in terms of progress in relation to technology advancement and administrative preparation for the driverless rollout. However, many governments may be stuck in time as mobility as a service ramps up. The value currently given to the public through highly subsidised transport services is slowly being mopped up by commercial operators the longer nations are without a mechanism to capture value from road users.

It became clear that a user pays system for roads is worth pursuing. The most critical elements are that every user, either commercial or private operator, is charged fairly and that any new arrangements are introduced at the cornerstone of change. Existing ride-hailing companies agree. Governments still have a window of opportunity to capture the value of road space, road infrastructure and associated road assets before the emerging business models take off. The introduction of ride-share and driverless fleets are seen as core intervals. Retrospective action will disrupt private sector business investment in improving customer journeys.
10 years to transition

Self-driving technology is simply a new feature of the modern motor vehicle. Once connected, it’s a proposition society can take advantage of.

In Sweden, Ericsson estimates the digital transformation will take 5–10 years to resolve before full connected, co-operative and automated mobility can begin to be successfully implemented. So while mobility as a service, automated buses and truck platooning are maturing today, automated taxi and delivery fleets, driverless ‘driving’ and new mobility will become more prevalent from 2021 in line with the strengthening 5G network.

In California, there is uncertainty regarding the exact timetable of the driverless roll-out and the timeframe to transition to a fully connected and automated road network. However, there is consensus that automated vehicles are 10 years away, that the driver to driverless fleet transition will be slow and that a mixed fleet is expected to remain for some time.

In Pittsburgh, Carnegie Mellon University Professor Raj Rajkumar agrees. The complexity of the human driving task will take 10 years to decipher. It will take time to test and provide certainty across many scenarios. Pittsburgh being the perfect automated vehicle test bed with over 400 bridges, range of topographic options and a full set of seasonal weather conditions that challenge most human drivers.

Governments are still working to assess an appropriate system of liability. Sentiment suggests that manufacturers of the driverless system will ultimately bear responsibility. This will evolve short term as high automation capability (SAE level 4) is a realistic expectation before 2025.

What about transitioning the infrastructure? In simple terms, the US are initially focused on good delineation. Without it, driverless vehicles cannot move without maps. Box dots are being phased out. Line-marking is being improved. Mapping is being resolved by the private sector as a competitive differentiator in the driverless market, many relying on artificial intelligence to predict on-road scenarios and human behaviour. Generally, governments are currently focused on testing immediate, viable options, then exploring how to retrofit existing infrastructure to enable connected autonomy. One key road block seems to be in cases where road assets are owned by different stakeholders who have a different scope of responsibility.

The US is focused on introducing DSRC technology into the network to enable a connected future. Sweden on the other hand is focused on the use of 5G technology for their trials. Ericsson is predicting broader introduction of 5G within 5 years, enabling the roll out of driverless vehicles from around 2021.

The sophistication of digital infrastructure will advance quickly. Virtual and artificial intelligence will complement the growing sophistication of mapping to enable predictive functions. Sidewalk laboratories in New York already exist to invite city level innovation such as sequencing flow and predictive modelling. The customer is the now the city.
The world of connected autonomy can only be enabled as fast as the progression of technology.
Role of government – protect society’s goals

The advancement of safe and energy-efficient automated technology is the key concern for governments we visited. The tough questions on how we make automated vehicles relevant to society’s needs and goals are still being resolved. Road safety and community acceptance is deemed paramount to the success of a driverless world. Adherence to strong de-carbonising regimes is another.

In Sweden, there is a strong mindset to support the needs of society first, then through cross-collaboration, open opportunities for industry to fulfill those needs. In the US and UK, the focus is to strengthen industry first.

Regardless of any new, emerging, disaggregated business model, driverless product or service, the ultimate system of mobility is a performance-based system to deliver on society’s key goals.

Research, development and innovation are important but projects and activities must be clearly linked to the needs of society. Government can play a leadership role in facilitating trials and encouraging innovative partnerships with industry.

To well-position the government for change, Sweden’s Ministry of Enterprise and Innovation structures housing and transport in the same department as markets and regulation to provide a strong central policy focus for all. It is a small policy team that relies heavily on its delivery agencies for implementation.

Drive Sweden is a strategic innovation program where all sectors of society work together to understand the possibilities of smart mobility. Sweden sees the proliferation of connected and automated vehicles as opening up a new tool box to help Sweden meet its transport goals.

The central role of government in a driverless world is to support the goals of society

Safety first, social equity, reduction in environmental impact, improving liveability, public health and recouping value for assets the public own. Protecting these goals should be the initial focus of governments looking to cement their role in the driverless future.
Without community acceptance there is no driverless

Governments need to articulate their objectives and goals associated with connected and automated mobility and work with the community to buy-in to those objectives, with a particular focus on betterment.

Public and private enterprises across the world agree there is zero community tolerance for failure of a driverless vehicle.

Alphabet Inc’s X has collected data on 2 million miles self-driven on public roads and 1 billion miles driven annually in simulation. Caltrans monitors every disengagement during an automated vehicle trial in its state, and while there have been mishaps, they positively report a trend of decreasing disengagements since testing began.

More fair and equitable access to transport for customers of all mobility needs are set to be revealed. The Pennsylvania Department of Transport described a trial outcome involving one of its blind citizens, where automated vehicles significantly reduced what was normally a 4-hour return trip to collect dry cleaning. Automated vehicles will offer the freedom of movement for everybody, with every day challenges.

With a focus on safety, Volvo’s Drive Me trial is a world-first initiative involving 100 ‘normal’ families to make full self-driving a reality for an everyday commute, working with real people of all ages, lifestyles and experiences on real roads to better understand the human-machine interaction when driving.
Cross-functional collaboration is key

Governments are increasingly viewing mobility start-ups as entrepreneurial partners, and not competition. Continued collaboration with innovators is now a high priority.

We expect more successful cross-functional partnerships between governments, research institutes and mobility providers to grow and identify new market opportunities together, which in turn enable appropriate and timely regulation linked to society’s key goals.

Governments must work closely with manufacturers to understand optimal systems for different environments. Understand the limitations and the opportunities. To make ambitious programs like the Drive Me trial work well, cross-functional collaboration is essential.
Don’t regulate too early

While internationally, bills relating to connected and automated vehicles are in the late stages of being gazetted, innovators advise regulators not to regulate too early. Regulation will need to dance carefully to allow for innovation. The guidance received during the visit is to keep regulation open until an issue is proven. Allow inventors time to test and navigate the capabilities.

Enable an environment where the incubation of ideas is comfortable for innovators. Nashville, Tennessee is an up and coming technology centre, replacing Austin, Texas who Silicon Valley now deem too restrictive to operate in.

International governments agree that there should be no patchwork in the implementation of regulation for connected and automated vehicles.

There is a heavy dependence on the National Highway Traffic Safety Administration in the US as federal safety regulator to provide a consistent framework. Currently safety guidelines are voluntary while they await the 8 year process to confirm the safety standard.

In Sweden, the Drive Me and Drive Sweden initiatives are shaping regulatory reform for self-driving vehicles in Sweden, and the Ministry are confident that it has most of what is required for developing the next generation transport system.

International manufacturers suggest nations review their import rules to make it as easy as possible to process automated vehicles. Importing large volumes for use as fleets was highlighted as a priority.

Build on global learnings

Currently there are regulatory lag times in many global jurisdictions to get trials up and running. Internationally many trials have similarities.

An observation made by delegates from the study visit is that there is an opportunity for true international collaboration to better understand trials and investigations already underway. Federal and State Governments are well-positioned to build on global learnings to focus on local challenges and produce valuable trial results all jurisdictions can share.

Developing a list of common global challenges to explore can offer an efficient way to receive information sooner to develop strategies to evolve infrastructure, shape transport and urban transport planning frameworks and inform investment decisions to enable the driverless future.

San Francisco’s shuttle bus trial on Treasure Island, Sweden’s Kista Urban ICT Arena, Drive Me, UK AutoDrive, ADAS&ME, NordicWay and Uber automated vehicle trials are a handful the world has on show.

Develop a list of common global challenges to explore
Cities have the power

US Federal initiatives such as Smart City Challenges are inspiring cities to develop visions that transform urban mobility. San Francisco may have missed out to Columbus, Ohio, but has benefited because it accelerated the introduction of programs to advance car-pooling, deliver on vision zero goals and fund automated vehicle bus trials.

While much of the regulatory power generally sits within Federal and State Governments, many local municipalities are using grass roots initiatives (such as ‘Every Place Counts’) to work out how to rationalise city space, reduce the need for private vehicles and revitalise urban spaces.

The challenge is now an opportunity for urban planners to accommodate smart mobility options within limited urban spaces. Planners working collaboratively to blend community need with access to reliable transport, and adapt to private enterprising ambitions, can provide vibrant cities settings for continued investment in transport enabling assets and technology.

Add to that, millions of car parks that for years have swallowed up valuable city space are expected to be released back to the people.

The automated vehicle will progress only as fast as its ability to connect to the intelligence it needs to operate safely. The next-generation mobility services will not only come in the form of vehicles; a cloud system where data can be shared in a cross-functional way and new innovative services can be developed will take place.

Hence, the collection, use and sharing of real-time data is now the cornerstone of not only the driverless system, but the future of intelligent mobility.

The ether is filling fast with connected clouds that act as data interchanges between public and private enterprise. Private customers enjoy value-added and personal services, while public clouds continue to feed information important to protect society’s key goals. For example, connected traffic clouds protect safety of road workers and assist to manage traffic.

Cyber security is of concern; however, governments continue to go beyond best practice in information security to develop strategies to protect their information.

There is an opportunity to unlock valuable information for public benefit as a condition using the road asset to deliver a mobility service.

Data is the new oil

The automated vehicle has the potential to rebuild living cities into people-centred cities.
Freight

The recent European Truck Platooning challenge was ground-breaking in that six truck manufacturers sent their test fleet to a common meeting point in Rotterdam as part of the Dutch European Union presidency.

Many countries worked to amend their legislation to enable the trial to take place. The productivity, fuel efficiency, safety and environmental benefits achieved during the challenge, offering great returns on investment for commercial vehicle manufacturers, are now shared across the world.

Driverless shuttles in semi-public environments operating at low speeds are another. Automated haulage systems in mining already take advantage of driverless benefits by running independently in closed environments.

Now Scania are playing a key role in new collaborative research involving 30 partners and 11 different countries dedicated to finding out how human users interact with automated vehicles.

The 9 million Euro project known as ADAS&ME will investigate the capability and constraints that people have as they relate to driverless technology to build trust and human proficiency in working together with automated vehicles. Many use cases are being developed and are likely to be shared by 2020.

Truck platooning is expected to be one of the early embedded applications of driverless technology on public roads.
Drones and hyperloops

Although the use of drones for commercial deliveries is increasing around the world, there was little evidence of planning by governments for the broader use of drones in the transport task.

Google and others continue their research investment in drone technology with better control systems and heavier loads now possible. Regardless, it is clear that the use of drones will continue to be market led.

California is clearly leading the Hyperloop world with a number of pod prototypes being trialled at the test track, including one developed in Australia. Although based in California, Caltrans had no plans for working transport trials at this stage, and the first governments to embrace the potential use of Hyperloops have been the United Arab Emirates for a link between Dubai and Abu Dhabi, and the Indian government.

It is clear that the use of Hyperloops for freight movement is closer to reality than passenger movements.
Options for governments

To accelerate Australia’s ability to take up the benefits of connected and automated vehicles, there are several practical options that governments may wish to consider:

- Establish a position early on the key goals for society that government wish to pursue by investing in enabling driverless technology and smart mobility solutions.
- Work to achieve community buy-in to key goals and objectives associated with connected and automated mobility, with a particular focus on betterment.
- Establish a commercial mindset and begin to become an entrepreneur for the people.
- Take a leadership role to facilitate cross-functional innovative partnerships with and between governments and industry.
- Keep regulation open until an issue is proven.
- Set up a favourable local regulatory environment to incubate start-up innovators across Australia.
- Review import processes and associated procedures to facilitate the import of innovative technology and goods to bring smart mobility online sooner.
- Develop data sharing methodologies where public and private enterprise can exchange relevant information to mutually benefit all stakeholders.
- Find a mechanism to establish true international government collaboration – particularly to share global learnings to inform local investment in research and development.
- Develop a list of common global challenges and seek to share investment and return with partnering nations – to reach a society goal sooner.
- Define the capability we need from existing infrastructure to enable smart mobility within 10 years.
- Capture value from the use of road space and road infrastructure to reinvest into roads.
- Evolve existing road user charging models to ensure that the models we choose can survive the transition to a driverless world without private motorists. The ultimate road user charging model may not be vehicle miles travelled but lease concessions to fleet operators for the road space they use. This would also remove government from directly charging road users.
- Expect that within 30 years our current road agencies may, in operational terms, be replaced by private sector fleet operations managing government concessions.
- Set cities to work by challenging their transport aspirations and mobility goals – to create national momentum.
- Shape the scope and organisation of cross-functional government departments to drive national co-ordination and establish consistency sooner for the management and administration of connected and automated vehicles in Australia.
- Facilitate the set up in Australia of additional large-scale driverless trials with the world’s industry.
- Keep under review the use of drone technology as a part of the transport task.
- Keep under review the development of Hyperloop technology to support the Australian transport task, and particularly the freight task.
Roads Australia would like to acknowledge the many international governments, innovators, private sector partners and the Australian government and industry delegation for their commitment and support to the 2017 RA Study Visit on automated vehicles.

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Acknowledgements

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<table>
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### Key individuals the Roads Australia Delegation met with during the 2017 Study Visit

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Further reading

California Department of Motor Vehicles, Deployment of automated vehicle for public operation
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California Department of Transportation, Road Charge Pilot Program
www.dot.ca.gov/road_charge/

Lyft launches in 100 more cities, Tech Crunch

Uber Pool

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Ericsson, Digital key shapes future car connectivity

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Scania contributes to European Commission ADAS&ME
www.adasandme.com/

For updates, visit www.roads.org.au/transportreform