Response to inquiry | 14 December 2018

Shaping better cities through innovations in land based mass-transit

Response to inquiry

Image: Infrastructure Victoria

ARUP

Introduction

Arup is pleased to provide this submission in response to the Standing Committee on Infrastructure, Transport and Cities' inquiry into autonomo mass transit, based on its international insight and expertise. There is no doubt that benefits can and must be realised from the automation of mass transit. However, Government needs to balance those benefits with protecting public value in the broader economy, society and the places we share.

In line with global trends, Australian cities are growing fast and changing to meet the demands of a new technologically driven population, changing workforce and volatile economics. To make sure we develop liveable and safe cities, now is the time to lay the foundations for sustainable land-based mass transit to support that growth. Automation and new energy sources bring compelling reasons to make these investments. They provide opportunities for improving road safety, air quality, operational costs and access to jobs, while also potentially changing travel behaviour and thus the structure of our city regions. Applied effectively, these technological advances can fundamentally improve current deficits of mobility and access in Australian cities and contribute to more liveable and economically stronger places.

The advent of transport autonomy has been happening for decades. Mining and agriculture have embraced autonomous vehicles for many years, having their first fully operational autonomous train in the 1970's. It is only now that it is approaching sufficient maturity to have a significant impact. The critical emphasis that we therefore advise Parliament to consider is that the technology itself is not new and should be seen as a secondary consideration. The focus should be on the total systemic opportunities to the economy, society and the environment. It must be safe, reliable and equitably deployed, no different to any other technology iteration.

Government is responsible for taking a holistic view in understanding the effects of these technologies on people and their lives, as it is Government that has the perspective beyond trade, commercial return and competition. In doing so it can materially improve the lives of Australians, avoid unnecessary spending by the private sector and direct the most important and rapid benefits to be realised quickly.

Arup can provide insight from the best examples of city planning worldwide together with a comprehensive understanding of the role transport plays in shaping our cities. As an organisation we aim to shape a better world, trying to understand challenges and opportunities for our growing cities. Our approach goes further and aims to deliver broader outcomes which support sustainable communities, improve health and encourage economic regeneration. Understanding how technical innovations in land-based transit can contribute to better cities is the key theme of our submission. Our submission provides a summary of some key issues and highlights some examples for the Government to consider that will help shape Australia's future. We would appreciate the opportunity to present our knowledge and views in more detail to further inform the Committee.

Research and innovation

Research and innovation is fundamental to Arups' pursuit of technical excellence and integral to the way it does business. Arup undertakes diverse, self-funded research projects globally. Arup by percentage of profit has the largest commitment to freely published research of any advisory consultancy. Click here to access our free publications on cities, transport, design and other topics.

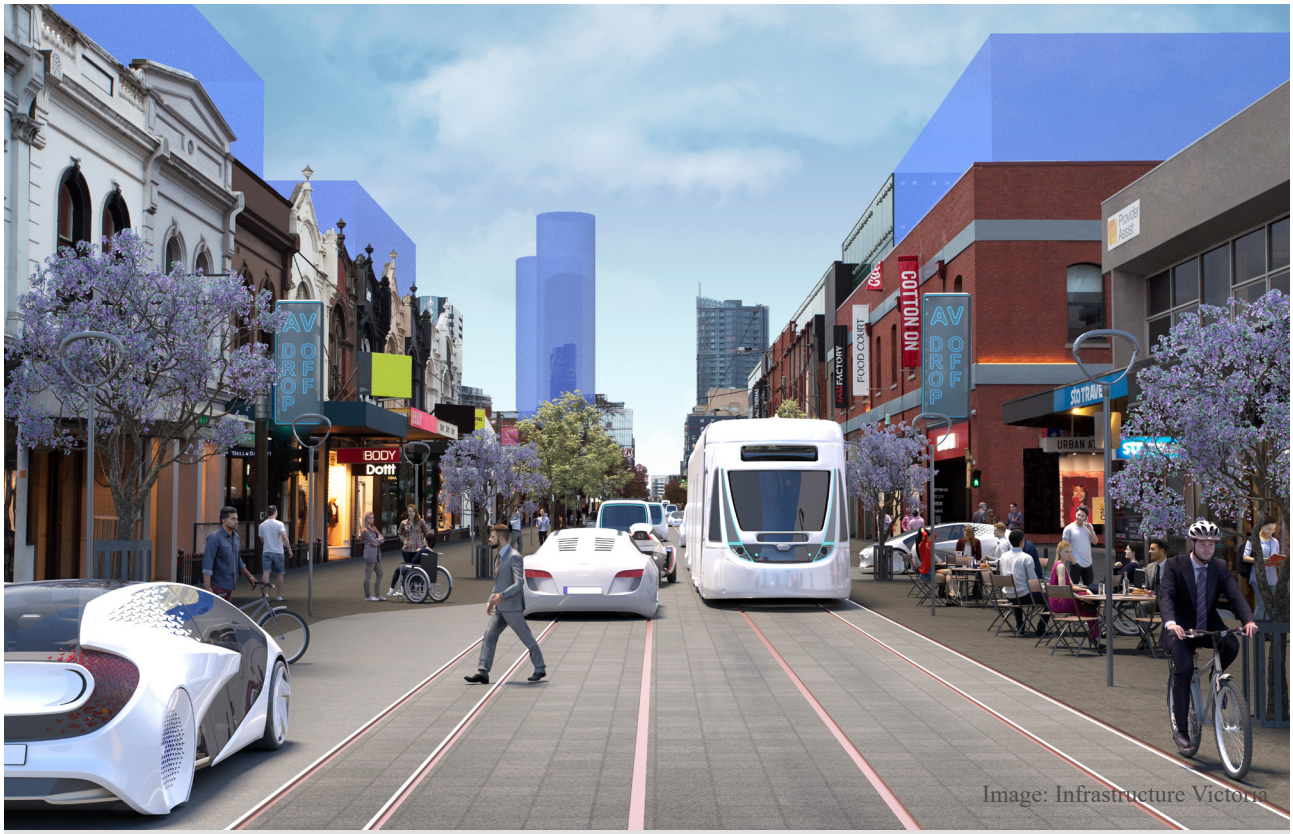

Image: Infrastructure Victoria

About Arup

Arup is an independent, global firm, owned in trust on behalf of our staff. With no external shareholders or financiers to satisfy, we can approach our work with a unique flexibility and a collective dynamism. Our independence places us in an ideal position to collaborate and advise Government. Arup is truly a multidisciplinary practice, with services ranging from consultancy advice in a range of market sectors including urban planning, business case development and transaction advice through traditional design and construction areas. Thus we provide a unique combination of strategic thinking that contributes to shaping our cities whilst understanding the issues, practicalities and possibilities of implementation.

Arup is recognised for their significant contribution to major projects worldwide, ranging from the Sydney Opera House in Australia to the Channel Tunnel Rail Link in the UK.

Using vehicle autonomy and new energy sources in land based mass-transit to shape better cities

Shaping our cities

Australian cities have developed for much of the 20th Century and early 21st Century predominantly based on low density suburban models supported by a public preference for car transit. As our cities and their transport demands are growing, it has become clear that this city model is not a scalable solution. Only recently has the public and governments realised systemically that public transport is cheaper, cleaner, more space-efficient and less-energy intensive than other modes of transport. It plays a vital role to the national economy by providing access to employment, health, education and recreation.

The growth in population and consequent activity levels will grow demand for pedestrian space in the future, solidifying the role of public transport even more. This would allow for more efficient utilisation of our road investments by transporting more people, more densely. Similarly we can avoid a huge land take for additional road capacity by transferring as many people as reasonable onto trains and buses. Transport autonomy needs to be considered in this context.

The potential impacts of technology

It is widely agreed that both transport autonomy and the application of new energy sources will significantly impact on our cities. Whether that impact is positive or negative is largely dependent on the types of vehicles these technologies will be applied to and the way they are operated.

The potential for positive outcomes comes from improvement of safety, accessibility costs for both government and individuals and air quality. Concurrently, the potential for poor outcomes arises from unconstrained use of personal autonomous mobility approaching and within the centres of our cities. Although this also holds true for non-autonomous private vehicles, the outcomes for autonomous vehicles could be far worse.

Autonomous private vehicles have the potential for inducing travel demand and congestion, due to inexpensive and convenient travel choices and the creation of a market that will need to drive use up to maintain profitability. Many mobility gains have the potential to be undone by not considering the desirable attributes of places we want and the capacity of the road network feeding them.

Using transport innovation to improve liveability

Technology evolves constantly and we find new ways to embrace it as the cost moves down and the effectiveness increases. Transport autonomy and new energy sources in transport are uncovering opportunities of unforeseen scale that can fundamentally improve the liveability in our cities, in addition to aforementioned direct benefits.

As an example, autonomous vehicles can influence land use and the structure of our cities by their ability to park themselves, allowing for reduction of on-street and off-street parking supply and rezoning the land into useful, active public space. For people who cannot drive a car themselves, such as the elderly, children and people with a disability, the increase in accessibility can change lives. The cost of accommodation can be reduced by not having to own land for vehicle parking. Lastly, parking on streets can be turned into footpaths, tree canopy and areas for micro-transit such as bikes, scooters and future devices to safely travel short distances.

Opportunities in dynamic transport management

The electrification and connectivity of vehicles bring potential new ways to investigate and manage travel behaviour.

Currently, financial ways to decrease private motorised travel are mostly based on taxation of fossil fuel, fees at vehicle purchase and traffic fines, all providing limited ways to influence travel behaviour. However, connected vehicles and new energy sources bring new opportunities to dynamically price transport, based on distance, time or location. This shift from taxing ownership of a vehicle to the use of it brings unforeseen opportunities to steer travel patterns. Road pricing in London, Stockholm and Milan have shown early but successful examples of this, improving urban life.

Besides management benefits, more dynamic pricing can also help solve Governments diminishing income streams. Transport autonomy is likely to reduce income through eliminating traffic and parking fines and electrification will in time eliminate fossil fuel excise. Income from new sources that also evolves to manage travel demand can help fill this income gap. This is required to secure funding for our roads and infrastructure, which will continue to be required for the foreseeable future.

For a consistent income stream, a transition strategy should be in place as soon as possible. With new business models emerging such as Mobility as a Service[1] and private vehicle ownership diminishing, now unconventional taxation methods might become more attractive, including taxing business operators who benefit from public roads to deliver services to their customers.

1 Mobility as a Service, or MAAS, can be described as an integration of transport services in a single platform, where users can easily access and compare a variety of transport options.

The role of the Australian Government in applying technology

As automation and new energy sources offer unique opportunities to shape more liveable cities, it is the role of governments to accelerate, frame and guide innovations in technology, law and society. The challenges that will need to be addressed cover many topics, including the integration of our transport systems, preservation of public safety and an increase of the resilience of our energy systems. A strategic approach is required to set the vision of our cities and define typologies of desired uses of automation.

The private sector must be encouraged to bring innovations in transport motive technology and automation to Australia. An Australian Government approach can reduce friction and waste between competing state guidelines and regulation in what, in global terms, is a small market.

The provision of a known operating environment, regulatory pricing and safety standards, insurance status, requirement for interoperability, communications spectrum availability and privacy protocols among many other layers of certainty all lower risk of private investment and ensure that innovation is delivered within the public interest.

We provide further details on challenges and opportunities for realizing autonomy in rail mass transit, road mass transit and point-to-point based transit for the Committee to consider.

Impacts of autonomous and zero-emission vehicles in Victoria

Infrastructure Victoria commissioned Arup to conduct analysis and research on the potential transport engineering impacts, risks and opportunities presented by autonomous and zero-emissions vehicles. This study, along with nine other technical studies, helped inform Infrastructure Victoria's advice and recommendations to the Victorian Government on what infrastructure is needed to support the use of highly automated and zero-emissions vehicles within the transport system.

We drew upon our national and global experts across transport and infrastructure to produce a 210-page technical report that outlines the transport engineering considerations in preparing for, and maximising the benefits of, an automated and zero-emissions vehicle future. A key outcome included identification of the role of the private sector in future development.

For more information, click here.

Rail mass transit

With more than 30 years of technology experience it is beyond debate that autonomous rail mass transit is safer, more reliable, cheaper to operate and can deliver more services per hour on the same infrastructure footprint, made possible by segregated infrastructure. Automatic Train Operation (ATO) and Automatic Train Protection (ATP) have been introduced in various levels around the world and should be the aim of all major city passenger rail networks in Australia as a step to full autonomy. Especially in highly congested railway networks, such as in New South Wales, the potential for overcoming human failure is substantial. Currently the Pilbara features the only example in Australia of a partially automated freight rail line, while Sydney is planning to have Australia's first autonomous passenger rail line with Sydney Metro.

Australia has the opportunity to significantly progress in this area. Potential benefits include reduced energy consumption, more reliable arrival times and increased transport capacity. Minimal crossings with other transport networks make rail-based mass transit an attractive transport mode to learn about transport autonomy, which can be applied in other transport modes and to build public confidence in autonomous operation.

Autonomy of rail-based freight transport is not as far progressed as rail-based passenger transport, but has potential of equal measure. The question where in the freight chain autonomy can best be applied is still largely unanswered and needs further investigation. Options include autonomy on trunk routes, terminal transhipment or last mile delivery.

It is most likely that those parts that can be operated using electric motivation will become autonomous first. Electric powered movement increases predictability, allows for smooth acceleration and deceleration and is easy in use, therefore lowering costs of automation and operation.

Future of Rail

The Future of Rail 2050 is a thought-piece created in collaboration with Arup Rail and input from collaborators across the world. It focuses on the passenger experience, and sets out a forward-looking, inspiring vision for rail. Click here to access the publication for free.

Canberra Light Rail Feasibility and Masterplan

Road mass transit

Increased productivity of road mass transit, including passenger buses, forms the largest and most important opportunity in Australia, due to the extensiveness of Australia's road network and its low productivity.

Additionally, as inner cities feature constrained public spaces and narrow street profiles, high-capacity transport solutions are required that take up the least space. Automation of road mass transit can provide this increase in productivity, made possible by potential reductions of operational costs and safety improvements.

Autonomy of buses has been hampered by high costs, low operating life, a small supply chain of electric buses and safety risks. Existing autonomous buses are operating in very low speed, highly controlled environments. Even those to be introduced shortly and touted as operating on the public road network have significantly lower operating speeds, much higher quality of infrastructure and constant human oversight. However, as autonomy improves and sensor technology combined with machine learning become more meaningful, the potential is significant.

Government has invested heavily in autonomous vehicle trials, but many of those trials aim to demonstrate very little that would not be achieved by investors without subsidy. The Australian Government could accelerate real world delivery by funding a challenge to have electric, autonomous vehicles prove they can operate in a typical and mixed road environment. Much as the US Government accelerated autonomous light vehicle technology with its military desert trials, Australia could be the proving ground for the world. Required incentives such as safe testing grounds and a potential fleet to test, such as the Australian Defence Force coach fleet, seem to be at hand.

Strategic pathways to automation

A strategic pathway should be identified by Government to allow for rapid innovation in transit autonomy while protecting the public good. Pioneering transport autonomy in less complex transport environments such as suburban locations can help develop lessons learnt as early as possible which can be applied in other transport modes. Options to explore include platooning small vehicles together on special lanes creating extensive virtual vehicles; large vehicles operating with minimal headway; highly distributed vehicles connecting to major trunk services and many, many others. The true opportunities and constraints of these technologies can only be understood through trials on public roads. Lastly, the geometric challenge of transporting passengers and goods as densely as possible, with the greatest possible level of customer satisfaction, will always be a key driver.

Next to pioneering transport autonomy in rail, transport of freight provides a second strong case. Market forces in freight transport are a huge driver of this, as innovation can be stimulated through competition, at distributed risk and accelerated using private money. Direct potential benefits include the increase of productivity of the highway network and large safety improvements. Lessons learnt can be applied in road-based public transport, for which autonomy is more complex but offers much larger benefits for the public and the cities they live in.

Although the exact pathway will need to be defined, various conditions can be identified for successful transition to greater autonomous operations. From a technical perspective, this includes electric vehicle power sources and adequate vehicle-to-vehicle connectivity. From a social perspective, this includes building trust with passengers, who would no longer rely on bus drivers for a sense of oversight and security.

Autonomous Rail Rapid Transit

Also known as trackless trams, this prototype is to date the most popular concept attracting many investigations. It uses advanced bus technology with an optical guidance system to find its way. The only example in the world can be found in Zhuzhou, China.

The system currently poses severe limitations, offering a limited action radius, requires separated carriageways and the optical guidance failing in snow, leaf litter or heavy rain. However, with improved guidance systems, and with improvements happening in electrification options, such systems are developing rapidly in concept to the point where they may soon become viable. A closed system is likely to be required, having to answer to conservative technical specifications.

Point-to-point transport using autonomous vehicles

The available spatial benefits of autonomy for small passenger vehicles is even more challenging for the public road network than multi-passenger public vehicles. Already, cities worldwide are experiencing an increased number of trips using “ride-share” services[1], claiming even more space. The ease of access has created more demand in combination with a perceived improvement in customer service and value for money.

Autonomy would significantly reduce the cost per kilometre, creating a more competitive market focused on providing customer convenience. That customer convenience would be at the externalised cost of significantly more vehicles operating empty, taking space away from more productive uses. Their contribution to congestion could be significant if unconstrained, as fleets of competing and autonomous Mobility as a Service (MAAS) vehicles rove the streets, being available for potential customers. Consequently, this type of transport needs to be minimised in inner cities and spatially constrained spaces.

Autonomy of small passenger vehicles appears to bring the largest opportunities in less densely populated areas. Not only because space is a more widely available resource here, but also because of large potential cost savings. Public transport is relatively expensive to deliver in suburbs, where revenue is small and bus drivers’ salaries make up the majority of operational costs. Driverless bus services could dramatically decrease public transport costs, creating opportunities for shorter local routes, less waiting time, distributed cross-regional connectivity, increased service frequency, more reliable networks and thus the promotion of more sustainable travel behaviour.

The data produced by inter-vehicle connectivity, one of the preconditions of fully autonomous vehicles, provides a potential strong instrument to monitor and steer further development. The options to governments, through pricing, regulation and restriction are useful, though it should be expected that like the private motor vehicle, people will expect unfettered access at low cost.

Heathrow Personal Rapid Transit, London

1 In the United States, private rideshare services such as UberX and Lyft put 2.8 new ride-share vehicle miles on the road for each mile of personal driving removed, for an overall 180 percent increase in driving on city streets.

The New Automobility: Lyft, Uber and the Future of American Cities. Schaller Consulting, July 2018.

Conclusion

All levels of government will play a role in capturing the benefits of transport autonomy, with state agencies having the largest operational and implementation roles, with much regulation and benefits realisation for places being captured by local governments. However, for the most rapid escalation of benefit capture, the Australian Government can have the greatest effect through influence, setting national standards and guidelines and using its taxation and funding activities to incentivise delivery.

These tasks include, but are not limited to the following.

- Identification of strategic innovation pathways that realize benefits of new transport technology as early as possible. Prioritising technological innovations in rail and freight could be part of this pathway.
- Encouragement of private businesses to bring innovations in transport motive technology by reducing friction and waste between competing guidelines and regulation.
- Identification of locations and use cases where autonomous (and non-autonomous) point-to-point transport will deliver the largest benefits, taking into account the spatial constraints and congestion in our inner cities and opportunities in suburban and rural Australia.
- Protecting public safety and public good in the rapid development of transport technology.
- Identification of opportunities to improve land use configurations in order to create more liveable and sustainable Australian cities using autonomy and new energy sources in transport. An integrated approach of land use and transport planning is required for this.

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Justin's career includes 15 years in the Victorian State Parliament, having held seven Ministerial portfolios within successive Victorian Labor Governments across 11 years, including Minister for Youth Affairs and Minister Assisting the Minister for Planning, Minister for Sport and Recreation, Minister for Commonwealth Games, Minister for Planning and Minister for the Respect Agenda.