Submission for Inquiry into Automated Mass Transit

Mass Transit Transition

Presently Australian mass transit is nearly all about trains, buses and trams. Expect this focus to change and during the 2020s Australian mass transit appears likely to partially transition to driverless taxi (point-to-point) travel. The emphasis of this submission is mainly on this driverless taxi travel which can include "last mile" travel and just taxi travel.

Mass Transit Risk

Much of Australia's present mass transit may be obsolete in ten years. Five years from now, it may be obvious that driverless taxis will permanently replace most and perhaps all of Australia's presently existing mass transit.

Driverless Vehicles Future Impact

Driverless vehicles are already in use on Australian roads. They are very small in number but during the next two decades their number is likely to become so large that they outnumber all other vehicles and even perhaps become the only vehicles allowed on roads.

As driverless vehicles come to be the main road transport, the mix of vehicle types will change. One type of driverless vehicle that will become important will be the driverless taxi. It could well become the most important driverless vehicle type. In the main, driverless taxis are likely to be fleet vehicles that are company owned driverless electric cars.

Driverless vehicles future impact is a matter that is gaining attention. A major report about the matter was prepared by the thinktank RethinkX. The report, titled "Rethinking Transportation 2020-2030", is by suitably expert professionals and appears to be a standout "big picture" report covering many of the consequences resulting from the future impact of driverless vehicles. The report is available at https://www.rethinkx.com/transportation and is the basis for much of the following. Although the report is primarily for the USA, the report predictions should also be good for Australia as well.

Driverless Taxis

Driverless taxis are forcast to provide inexpensive travel that will have a cost that will be below $0.20/km. This low cost is forecast to make driverless taxis a very popular type of transport. Driverless taxis are also anticipated to have other advantages that improves their function.

To justify the $0.20/km driverless taxi rate, an estimate and sensitivity analysis for the vehicle total operating cost is provided. This information is the attached "Sensitivity Analysis for Mobility-as-a-Service Vehicle". This sensitivity analysis shows vehicle cost will likely be between $0.05/km and $0.19/km. The central case value is $0.12/km

One of the references listed in this submission is "Cost-based analysis of autonomous mobility services". In this paper the "driverless taxi rate" was determined to be about $0.50/km which is 4 times the $0.12/km rate given in the RethinkX report. This a substantial disparity and there are good reasons for a substantial part of the disparity. However, the large disparity indicates that any current estimate of the

driverless taxi rate will be an estimate that has a large error and that the error could be more than +/- 50%.

Soon after their introduction, driverless taxis can be expected to replace existing taxis by fare undercutting. After this, expect fare competition between driverless taxi fleets that should in due course reduce typical taxi fares to below a cost of $0.20/km.

Car Ownership

The present all-up cost of car ownership is roughly $1.00/km. Of this, about $0.20/km is running cost.

As driverless taxi fares trend downwards, car ownership will lose its appeal for many car owners. Many car owners can be expected to dispense with their cars once taxi travel cost drops below car ownership travel cost. When taxi fares are down to about $0.20/km it is likely that, for most people, car ownership will be permanently over.

Driverless Taxi Numbers

A typical driverless taxi will be operated about 10 to 15 hours or more every day. As individual car ownership numbers drop, driverless taxi numbers will increase. Should driverless taxis be used for most city travel, the number of driverless taxis in use in Australia should grow to about one million. This number will be about 10 times or more than the present number of taxis and ride-share vehicles such as the Uber vehicles

When the number of Australian driverless taxis is in the hundreds of thousands, taxi call time should be much reduced. As well, driverless taxi ride-sharing should become more popular because it is likely to be quite practical.

Driverless Taxi Convenience.

Driverless taxis, as well as being inexpensive, will also be very convenient. More so than taxis are now. Point-to-point (door-to-door) service will be the standout convenience. Driverless taxi travel is also likely to have improved convenience that includes:

- Call time typically down to a minute or two.
- Improved ride-sharing
- Simpler fare payment
- Better route planning
- Shortened travel time
- Improved passenger safety and security

Ride-sharing

Expect ride-sharing to become hugely important and popular because of driverless taxis. Large numbers of driverless taxis will make ride-sharing travel nearly as efficient (fast) as single passenger travel. This efficiency together with ride-share fare savings is expected make ride-sharing popular. When the fare for a driverless taxi with just one passenger is $0.20/km expect the ride-share fare for 2 passengers to be

about $0.10/km each, for 3 passengers to be about $0.07/km each and for 4 passengers to be about $0.05/km each.

An important benefit of ride-sharing is that it reduces road traffic. At present, the average car occupancy rate is about 1.3 persons per car. If the car occupancy rate could be lifted to 2 there would be a noticeable drop in road traffic and traffic congestion.

Traffic Congestion

Driverless vehicles will be able to be driven much closer together than are vehicles now. With closer vehicle spacing, the capacity of roads to cope with more traffic improves and consequently there will be less traffic congestion.

Driverless vehicles will ease traffic congestion by reducing vehicle spacing and increasing car occupancy rates with ride-sharing. The reduction in traffic congestion should be significant when driverless vehicles outnumber other vehicles.

Within about 20 years or perhaps sooner, driverless vehicles should have replaced all other road vehicles. With all traffic being driverless, the roads should be able to carry at least 3 times the number of vehicles. As well, ride-sharing should have upped car occupancy rates. These improvements should all but end Australian road congestion.

The virtual elimination of road congestion will end much of the need for massive investments in road construction.

Mass Transit

The typical all-up cost of bus, train and tram travel is approximately $1.00 per passenger kilometre. In the coming decade and beyond this cost is likely to remain much the same. Automation will help reduce it by a modest amount.

In about a decade mass transit could have to compete with driverless taxis that have ride-share fares that are likely to be less than $0.10/km for point-to-point service. This competition is likely to be hopelessly one-sided and make most presently existing mass transit obsolete.

Timeline

The RethinkX report has a timeline that has driverless cars dominant by 2030. This may or may not be the reality, but driverless cars should eventually dominate our roads, just a little latter.

Mobility Platforms

Various mass transit mobility platforms are in use for Australian mass transit. They are gaining in popularity with the public. The potential for platform improvement is substantial.

Driverless taxis will require mobility platforms that the public can use to arrange driverless taxi travel. The platforms should provide the public with efficient and economical taxi travel. Ideally these mobility platforms will seamlessly interface with mobility platforms for buses, trains and trams.

Mobility platforms should have a multitude of functions so as to suit the public, government(s), mass transit operators, taxi owners, and various others.

Risk

This submission, if nothing else, flags that within several years driverless taxis are very likely to have a significant impact on mass transit. The impact, as generally presented in this submission, could be described as substantial or even as considerable. The actual impact will almost certainly be different. It may be a little different or very different. The point is that driverless taxis will be a mass transit risk. As well, the risk will be sufficiently large to justify that it be quantified. That is, the what and the when of the risk will have to be carefully estimated to sensibly decide how driverless taxi impact will affect mass transit. Normally the risk assessment would be conducted on a case by case basis. For a bus, tram and/or rail network, it would not be unusual for an assessment to take some months and be a large 6 figure cost. Nevertheless, it is a must do exercise and has to be included for in budgets. For major new mass transit infrastructure, future driverless taxi impact risk assessment is usually best conducted before or as an early part of business case development.

Transport automation is likely to affect mass transit in many new ways and mass transit operators should have risk management procedures that they are using to anticipate this. With suitable risk management procedures, mass transit operators should be identifying risks that will affect their operations and then plan accordingly.

Driverless Taxi Progress

Companies that are developing driverless cars, including taxis, are not particularly open about their plans and so to determine current progress is a substantial task. To forecast future progress is an even more difficult task. Waymo, General Motors and Ford say they will have commercial driverless taxi fleets operating before or by 2021. Other companies such as Toyota, Uber, Volvo and Tesla appear to be close to achieving similar outcomes.

Mass Transit Financing

At present, Australian governments spend big on mass transit. Because of driverless taxis, it is quite likely that this spending could become almost zero before 2030. Driverless taxis would be company financed with costs recovered by taxi fares.

In this submission, prices are present value and are in Australian dollars

Significant References

- Rethinking Transportation 2020-2030 - May 2017 (https://www.rethinkx.com/transportation)
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- Our Driverless Future: Heaven or Hell? (Driverless Disruption Book 2) – June 2018 https://www.amazon.com.au/s/ref=nb_sb_ss_i_1_3?url=search-alias%3Dstripbooks&field-keywords=driverless&sprefix=dri%2Caps%2C641&crid=1D4E3XYBQIB1P
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- No One at the Wheel: Driverless Cars and the Road of the Future – November 2018 https://www.amazon.com.au/s/ref=nb_sb_noss?url=search-alias%3Dstripbooks&field-keywords=No+One+at+the+Wheel%3A+Driverless+Cars+and+the+Road+of+the+Future
- The Simple Solution to Traffic https://www.youtube.com/watch?v=iHzzSao6ypE&t=110s
- Cost-based analysis of autonomous mobility services – May 2018 https://www.sciencedirect.com/science/article/pii/S0967070X17300811?dgcid=raven_sd_recommender_email

Sensitivity Analysis for Mobility-as-a-Service Vehicle

Item	Conservative case	Note	Central case	Upside case	Note
Upfront cost (depreciation)	$2.00		$6.00	-$2.00	1
Vehicle lifetime	$1.00	2	500,000 miles	-$2.40	3
Maintenance	$0.70	4	$2.90	-$1.50	5
Insurance - conservative	$1.30	6	$0.90	$0.00	
Tax	$1.00	7	$0.30	$0.00	
Platform fee	$1.30	8	$2.60	-$2.60	9
Fuel	$0.00		$1.80	$0.00	
Finance	$1.30	10	$1.30	-$0.60	11
Total cost USD per 100 vehicle miles	$24.40		$15.80	$6.70	
Total cost USD per 100 vehicle kilometres	$15.16		$9.82	$4.16	
Total cost AUD per 100 vehicle kilometres	$18.96	12	$12.27	$5.21	12
Total vehicle cost AUD/km	$0.19	13	$0.12	$0.05	13

Notes

1. This is possible by designing TaaS-specific vehicles based on modularized platform. TaaS (mobility-as-a-service).
2. Battery life of only 200,000 miles — two battery replacements but the rest of vehicle lasting 600,000 miles.
3. Vehicle lifetime of 1,000,000 miles with one battery replacement after 500,000 miles at cost of $100/kWh in 2026.
4. Maintenance increasing to 25% of ICE equivalent.
5. Maintenance decreasing to 10% of ICE equivalent. This is possible now, but further gains from automating process and redesigning vehicles and consumables for resilience could easily deliver these gains.
6. Based on current Tesloop projected cost-per-mile (in a human-driven vehicle).
7. Based on full recovery of gasoline taxes lost.
8. Based on Platform rising to 30% of cost-per-mile.
9. Based on open source platform provided for free (possibly to capitalize on other revenue generating opportunities — the Facebook/Google model).
10. Based on rate of interest rising to 10% per year.
11. Based on rate of interest dropping to 4% per year and utilization of vehicle increasing to 60%.
12. AUD/USD = 0.80.
13. Value rounded to nearest cent.

The reference for this this sensitivity analysis is the report titled “Rethinking Transportation 2020-2030” which can be downloaded from https://www.rethinkx.com/transportation.

This sensitivity analysis is for the USA. For Australia the analysis would include GST. Including for GST, the analysis indicates that for Australia the total cost AUD per 100 vehicle kilometres is likely to be between $10 and $15.