Submission No 11

DRIVERLESS VEHICLES AND ROAD SAFETY

Organisation: University of Newcastle

Name: Dr Gary Ellem

Position: Project Manager for Future Industries, The Tom Farrell Institute

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Dr Gary Ellem

[redacted]

[redacted]

Affiliation:

Project Manager for Future Industries
The Tom Farrell Institute
University of Newcastle, Australia

Submission to the NSW Government Inquiry into Driverless Vehicles and Road Safety in NSW.

Introduction:

The US National Highway Traffic Safety Administration (NHTSA) has developed a policy for autonomous vehicles that outlines levels 0-4 for the increasing levels of autonomous driving capability that may be possessed by a vehicle (see http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development).

The autonomous capability of the levels are as follows:

No-Automation (Level 0): The driver is in complete and sole control of the primary vehicle controls – brake, steering, throttle, and motive power – at all times.

Function-specific Automation (Level 1): Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.

Combined Function Automation (Level 2): This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.

Limited Self-Driving Automation (Level 3): Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

Full Self-Driving Automation (Level 4): The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

As of the 4th Feb 2016 the google car now meets the requirements for **Level 4** according to the NHTSA, meaning that the car itself is capable of being listed as the driver and no other licenced driver is required to operate the vehicle on public roads (see http://isearch.nhtsa.gov/files/Google%20--%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm). In applying for this ruling, google claimed that the intervention of a human driver would decrease the safety of the vehicle operation, and the NHTSA has agreed with this assessment.

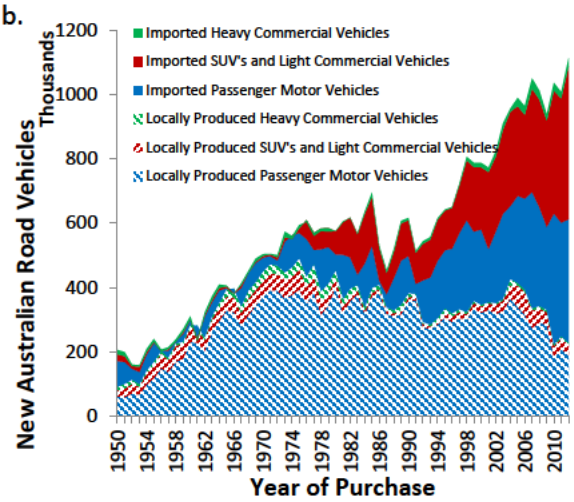
While the national level NHTSA has agreed that the google car meets the Level 4 standard, state laws in the US prevent the car from being operated on public roads. This is because those US states that have autonomous vehicle legislation require every autonomous car on public roads to have a set of manual controls present in the vehicle, and a licenced human driver directly supervising from inside the vehicle at all times when in operation. State legislators have been reluctant to alter this requirement despite the NHTSA ruling.

What does this mean for NSW and Australia?

NSW and Australia has become increasingly car dependent since the 1950's as increasing car ownership has enabled the developed of the suburb. Approximately 80% of trips are now via the private passenger car in NSW (walking accounts for most of the rest), which is a strategically poor outcome given that the state doesn't manufacture cars and has negligible oil production. This means that imports of cars and oil for the NSW transport system make up around 20% of goods imports to the state and reduce state GDP growth by at least 4% each year. This is the largest single point of stress in the NSW balance of trade and is reflected in the broader Australian economy.

a.

b.



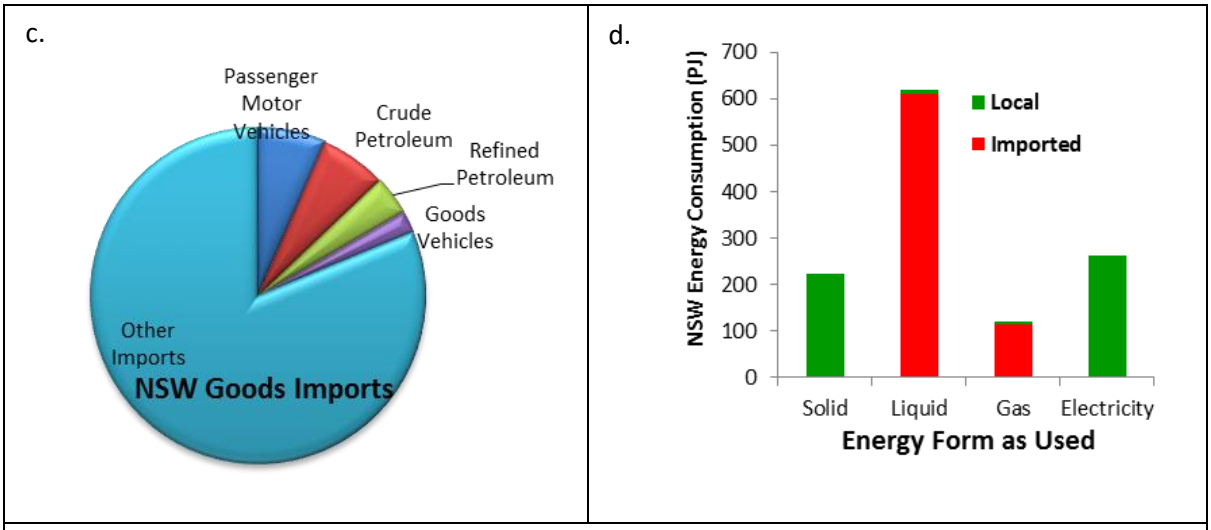


Figure 1: a. Car dependence in NSW cities means that travel is dominated by the private passenger car[1] b. Practically all road vehicles in NSW are manufactured elsewhere and imported – this is a national trend[2] c. The importation of items for the transport sector are reported spearately, but collectively make up around 20% of NSW goods imports and is the most significant single source of economic leakage for the state[3] d. Liquid fuel use is the major energy security issue for NSW, the predominant use of liquid fuels in NSW is in road transport[4]

NSW and Australia therefore not only face the challenge of improving vehicle safety and reducing congestion, we also face the strategic task of reducing transport related economic leakage and improving energy security associated with liquid fuel dependence. This means strategically reducing the number of imported vehicles per head of population and switching from imported liquid fuels to a domestic energy replacement.

The emergence of Level 3 and Level 4 driverless vehicle technologies are strategically interesting to NSW not only because of the considerable advantage these technologies may have on reducing the frequency and severity of road accidents, but also because they offer for the first time a pathway for breaking car dependence in urban and suburban environments.

Level 3 & 4 driverless vehicles could conceivably be sold and operated as private passenger vehicles, but more importantly they could also be used in a fleet configuration designed to offer transport as a service without the added cost of a human driver (Level 3 vehicles would require a supervising driver that could remotely pilot the vehicle for situations where the driverless technology was not yet capable). This could radically reduce the cost of personalised transport and delivery services, allowing competition with the private passenger car on cost and performance in the suburbs using substantially fewer vehicles and domestic electricity as the energy source.

Based on studies completed by the MIT/Singapore team for Singapore, a driverless taxi system servicing urban and suburban NSW is likely to require 70-90% fewer cars to do the same transport task as the existing fleet of private passenger cars (see http://ares.lids.mit.edu/fm/documents/toward_systematic.pdf). A driverless dynamically routed bus would reduce the numbers and costs for users still further, and would actually become more effective during the morning and evening peak travel times. These driverless vehicles are almost certainly going to be electric as this will be the cheapest and easiest way to manage the vehicle

[1] NSW Bureau of Transport Statistics, Transfigures Travel in Sydney, Newcastle and Illawarra, 2012 release
[2] http://www.aaintelligence.com.au/
[3] http://www.dfat.gov.au/geo/fs/nsw.pdf
[4] Australian Bureau of Resources and Energy Economics 2011

energy system. Taken together this means that an electric driverless taxi/bus system would carry a dramatically reduced car and oil import burden for the state and is our clearest strategic pathway for improving the economic outlook of the state in the mid to long term.

In addition to improving the energy and economic security of the state, the ability for a relatively small number of driverless taxis/busses to replace a large number of private vehicle trips means that a surprisingly fast reduction in accidents and congestion is possible. This is likely to result in significant savings to the NSW government health and infrastructure budgets through reduced accidents and new road spending (see http://ussc.edu.au/ussc/assets/media/docs/publications/1507_Digital_Infrastructure_Report.pdf).

The state level barrier legislation in the US means that there is a window of opportunity available for proactive Australian regulators to attract the interest of international driverless vehicle developers such as google. NSW could do this by creating a proactive set of regulations that act to accelerate the integration of Level 4 driverless vehicles and driverless transport services into the state road transport system.

Other opportunities for driverless vehicles:

Level 3 and 4 driverless vehicle technologies can conceivably be adapted to many road transportation tasks, and indeed there is active research and development on a wide number of fronts. Some of these applications are in the automation of current vehicle classes such as heavy vehicles, light trucks and passenger vehicles, while others such as light weight package delivery vehicles designed to operate on the road or footpath propose completely new vehicle categories which are not covered in current regulatory frameworks.

An example of this is the domino's driverless pizza delivery vehicle which has a format similar to a mobility scooter and is designed to operate as walking pace on footpaths[5]. It is also easy to conceive of a higher speed light weight package delivery vehicle designed to operate on the road rather than the footpath. This is an obvious accompaniment to the logistics chain for online purchases, which is currently one of the fastest growing logistics segments.

Specific responses to inquiry terms of reference:

Response to item 1:

"The capacity of driverless vehicle technology to deliver improved road safety outcomes including a lower road toll, and fewer accidents and injuries to drivers, pedestrians and other road users."

I shall only comment briefly on this capacity other than to say that the vast majority of accidents are caused by the driver and the development of driverless vehicle technologies have emerged in part from the ongoing development of driver safety aids. The emerging evidence of current systems such as the google car suggest that driverless vehicles can have a safety record at least as good as human drivers, and better in terms of not being the cause of accidents.

It is important to note that the safety of a system must be assessed on a system be system basis. Just because the google car has a good track record does not mean that any driverless vehicle system will have a good track record. A key recommendation emerging from this is that for level 3 and 4 systems, system licencing should be carries out on a system by system basis i.e. the google level 4

[5] https://www.dominos.com.au/inside-dominos/technology/dru

system should be certified separately from the BMW level 4 system to an objective independent standard etc.

Response to item 2:

"The extent to which current road safety policies and regulations in NSW anticipate the introduction of driverless vehicle technology, including driverless heavy vehicles, and any regulatory and policy changes which will be required."

Current road safety policies do not anticipate both the levels of autonomy that will soon be available to vehicle operators, nor the types of vehicle configurations and applications they may be used in. This is not a phenomenon unique to NSW, it is fair to say that most jurisdictions are lagging in terms of both policy and legislative frameworks for driverless vehicles and is a measure of the rapid progress in the technology development.

If NSW is to accelerate the development and adoption of driverless vehicles and provide an encouraging local environment for technology innovators, then it must develop a proactive certification system that accepts both certifications from other trusted certification bodies as well as a proactive domestic certification system that attracts innovators to look to NSW as a test location.

Critical to positioning NSW as a test bed, is a certification system that reaches to level 4 and allows the operation of vehicles without an on board licenced driver. Risks associated with this approach would have to be managed by a series of conditions that limit the operational conditions of the vehicle such as area of operation, time of day, type of weather, presence of support infrastructure etc. This is in reality a test bed program that allows for an innovation to move through a set of staged proving points as a stepping stone to wider adoption and operation.

Given the substantial economic benefits to the state that might emerge from driverless transport services, it makes sense to develop a policy platform which focusses and encourages effort on developing these applications for driverless vehicle technologies. This may mean also looking at innovation and manufacturing policy, as well as reforms to the legislation governing the operation of taxi, hire car and bus services in NSW. In some ways this would be working towards a whole of government response to the driverless vehicle opportunity.

Response to item 3:

"The preparedness of NSW road safety regulators to meet the challenges extended by driverless vehicle technology"

NSW has not had a significant automotive manufacturing sector (other than coach building) and therefore has little experience in the certification of new and experimental vehicles. NSW is predominantly a taker rather than a maker of vehicle standards, and what activity there is in the certification of modified vehicles is currently outsourced to private automotive engineers.

If NSW is to attempt to position itself as an accelerator of driverless vehicle technologies, or specifically try to encourage those applications of most strategic advantage to the state, it will be necessary to build a NSW capability for the proactive testing and certification of driverless vehicles as well as associated infrastructure and vehicle operation legislation. Ideally this capacity would work as a close collaboration between industry and government that works towards strategic outcomes for NSW.

Response to item 4:

"The experience of other jurisdictions in Australia and overseas in adopting and adapting to driverless vehicle technology"

A number of jurisdictions are now trialling driverless vehicle technologies. This includes driverless cars, trucks, campus shuttles and personal pods operating on both roadways and footpaths.

Some jurisdictions have allowed level 1, 2 &3 driverless vehicle technologies to operate state wide, whereas others have focussed on allowing level 4 technologies in tightly controlled areas and applications.

There is no reason why both of the above approaches cannot co-exist. In fact, a hybrid approach is likely to be most effective which looks at certifying individual OEM systems for operation at a particular level in identified zones e.g. the google car may be certified at level 3 state wide and level 4 in certain zones; or the Navya driverless shuttle bus may be level 4 on campus roads but not be certified for open road use.

In the Australian context, Volvo is conducting a trial of it's level 2-3 driverless vehicle technology in Adelaide, while Navya is working with RAC in Perth to trial a level 4 driverless shuttle bus.

Regulatory principles for enabling driverless taxis and dynamically routed busses in NSW:

Principle 1: The operation of driverless vehicle systems equivalent to NHTSA Levels 2, 3 and 4 on NSW public roads or footpaths must be regulated by both system and location to mitigate risks in the development and implementation of these new technologies.

Principle 2: Driverless vehicle system developers should be able to apply for Level 2, 3 or 4 certification at any time and have their application promptly evaluated against a clear set of performance standards.

Principle 3: In approving any Level 2, 3 or 4 certification the NSW transport regulator may restrict the geographical zone of operation until certain criterion are met. The criterion may include the provision of essential operational infrastructure or data on system performance standards.

Principle 4: The driverless vehicle system developer may propose a restricted geographical zone of operation at any time as part of their Level 2, 3 or 4 application and have their proposed restricted zone of operation promptly assessed.

Principle 5: The NSW Transport Regulator should work in collaboration with driverless vehicle system developers towards a series of geographical test zones for Level 2, 3 and 4 systems.

Principle 6: The NSW government should work to align complimentary industry and innovation policy to subsidise driverless vehicle system developers that are working towards 'transport as a service' models of operation.

Principle 7: the NSW government should be prepared for novel vehicle configurations that do not meet any of the current vehicle categories for operation on a public road or footpath. It should be proactive in developing new vehicle classes that enable different end use applications if it is in the public interest e.g. small scale driverless delivery vehicles.

Principle 8: Driverless vehicle applications that contribute to reducing NSW car and oil dependence should be an area of active strategic policy development for the state.