PATREC

Student Edition

Potentials of Transport Technology

Exploring the potential in Perth Metro

Highlights

Various transport technology, including future mobility and transport (FMT), are explored to review their potentials to address current transport problems in local Perth Metro. Potentials of FMT are evident, however, we need a Roadmap for Perth to ensure that the benefits are maximised.

This article was prepared based on the 8-week 2020 Summer Down Under Research work undertaken by a UWA undergraduate student, under the supervision of a PATREC researcher.

Introduction

Traffic grows as the population grows without any interventions. Congestion not only increases travel time costs and crash risks but also create more pollutions, which can cause cardiovascular illnesses (Levy, Buonocore, & Von Stackelberg, 2010). Additionally, congestion impedes economic activities by lowering travel efficiencies (Sweet, 2014). To cater to growing traffic and to ease the congestion, infrastructure investments would be required, which would cause a lack of public space provision, an increase of infrastructure maintenance costs and negative environmental impacts.

In the last decade, interest in future mobility and transport (FMT) has seen consistent growth across Australia. The FMT is sought to address many transport problems, such as poor accessibility and growing congestions. This article aims to explore the short, medium and long-term potentials of transport technology, including FMT, to resolve some of the current transport problems. The potentials are considered with respect to social, environmental, and economic impact by reviewing their applicability and potential benefits when deployed in Perth metro, along Thomas Street.

Key traffic issues along Thomas Street

Thomas Street is an arterial road that is connected to a large business district and a large number of restaurants. There are about 50,000 vehicles between Monday and Friday (FY19 average) along Thomas Street (MRWA, 2020). With multiple signalised intersections situated close to one and another, the traffic condition is a stop and go situation which is a cause of traffic congestion. It is also connected to the on-ramp to Graham Farmer Freeway with a significant traffic volume.

Another important destination nearby is Perth Modern School. There are two bus stops just outside of the school, one on Roberts Road and another on Thomas Street. However, there is no dedicated bus lane or slip lane on Thomas Street, which would disrupt the traffic. Also, there are no sufficient walking and cycling paths near the school which limit the choice of travel modes. The heavy traffic along Thomas Street is also creating an unsafe environment for pedestrians and cyclists.

The middle lane at the signalised intersection between Thomas Street and Cambridge Street is not used as frequently because the vehicles heading to Graham Farmer Freeway would need to use the two right "freeway only" lanes between Railway Parade and Cambridge Street. It will be challenging to merge to the right lanes after Loftus St

Figure 1: Thomas Street

and Railway St intersection. While several cars are piling up on the far-right straight lane, not many cars are using the two right-turn lanes. Often, only three out of five lanes are used therefore the road is not fully utilised as we have observed.

Our observations showed that the sources of congestion on Thomas Street are generally due to the large traffic amount but also low road utilisation. Effective traffic management strategies, including traffic flow efficiency improvement, and improving accessibility for non-motorised modes and public transport can address many of the highlighted problems. Some of these can be provided using FMT.

Short to long-term potentials of transport technologies

Short-term potential

A potential short-term solution to poor traffic efficiency is to implement a dynamic road management system, which is a system to share traffic lanes appropriately in the case of a low frequency of specialised traffic (Wang et al., 2016). For example, when only a few cars are turning right, the left right-turn lane can be converted into a straight or right turn lane, not limited to a right turn only lane. The far-right straight lane can be signalled as freeway only lane, the middle straight lane can be converted to a straight or slightly right turn lane that can merge to freeway only lane so more cars will use the middle straight lane in order to improve road utilisation.

Often, traffic spills over to other lanes at the intersections near Hay Street and Roberts Street which hinder other traffic movements. Smart signalling can potentially prevent spillover. When cars under green light are congested, a red light should replace green light so that the traffic across can travel.

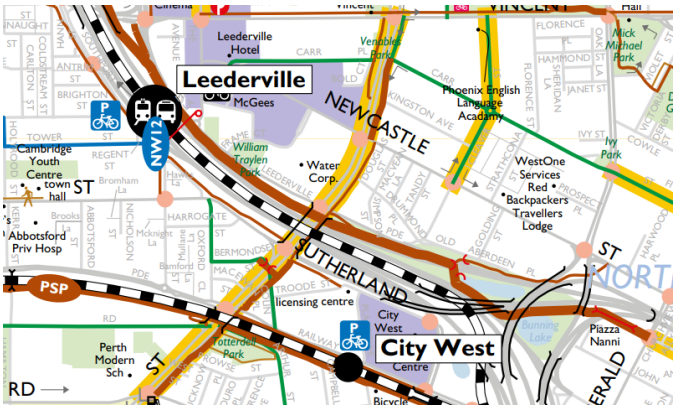

Figure 2: Close-up of Thomas Street (Loftus Street)

Mid-term potential

As can be observed along Thomas Street, most travellers face poor accessibility and poor level of service of public transport, compared to other major international cities, as Australian cities have a low-density urban population and are spatially dispersed which makes car travel a necessity (Mulley, 2017). These conditions further increase demand for cars. Providing additional road infrastructure is not always a sustainable solution. We, therefore, explore the

the potential of Mobility-as-a-Service (MaaS). MaaS can be regarded as buying mobility services based on consumer needs instead of buying the means of mobility (Kamargianni, Li, Matyas, & Schäfer, 2016). This is enabled by integrating public and private transport providers through a universal phone application (apps) that creates and manages the trip, which users can pay per trip or a monthly subscription for a bundle of trips. For example, users can use a combination of Uber, bus/train and bike share to get to a destination from the origin. The travel mode/s can be chosen based on users' preferred cost, time and convenience.

The likelihood of MaaS becoming an alternative to owning a car is high because MaaS can offer the best option for every journey (Mulley, 2017). However, it would be challenging for a car-loving nation to shift away from private car ownership towards MaaS. According to the Australian Bureau of Statistics, Motor Vehicle Census that the ratio of the number of registered cars to population is still growing (ABS, 2020).

A study (Delbosc & Currie, 2013) showed that there seems to be a general decline in car use in Australia, especially for the millennial generation. For instance, the proportion of young adults with a drivers license dropped by between 0.9% and 1.0% per year in Victoria and New South Wales (Delbosc & Currie, 2013). The millennials are attached to their smartphones which provides a great opportunity for the MaaS app to spread in this cohort. Moreover, the millennial generation appears to have a different view of personal car ownership (Mulley, 2017). When the users who may have never owned a car, they are less sensitive about the relatively high marginal cost offered by a MaaS platform compared to the low marginal cost of owning a car. Other than the millennial generation, the general public has become more health-conscious, thus, they recognise the contribution of walking or cycling in the reduction of lifestyle disease (Mulley, 2017). Since bicycle hiring is often offered as the first and last-mile travel option in the MaaS platform, travellers are very likely to choose MaaS as a travelling option (Mulley, 2017).

Long-term potential

Newer cars are already equipped with technologies associated with an early stage of autonomy, such as Automatic Emergency Braking (AEB), Lane Keep Assistance (LKA) and self-parking function. It is not a surprise that giant car manufacturers like Volvo have announced that a new generation of autonomous cars will be in development and launched in 2020.

There are five levels of automation of autonomous vehicles (AV) by industry terminology. On the top level, the system will possess full control of the car which includes environmental monitoring, fallback control and all driving modes (Here, 2017). Due to the nature of self-governing, AVs are capable of platooning, that is vehicles operating close together at high speeds on dedicated lanes (Litman, 2014). Platooning improves road utilisation which reduces traffic congestions. AVs rely heavily on real-time traffic information sent through via high-speed internet connections (5G network).

Benefits of resolving traffic problems

Economic benefits

Transport plays a vital role in promoting economic prosperity. A convenient and reliable transport network significantly reduces overall transport costs regardless of the trip purpose. Transport's role in supporting business is to provide easy access to markets for their goods and services, as well as to help people gain access to job opportunities (VIC Department of Transport, 2012).

Economic impacts such as travel time saving, vehicle operating costs saving, crash costs saving, and environmental and external costs saving are considered in a typical economic analysis for a transport project (Chi & Bunker, 2020). Additionally, during the period of economic prosperity, more people are likely to find jobs with high wages. The increase in wages and jobs provides additional tax revenues which can be spent towards the provision of infrastructure and services. In turn, it promotes more prosperity and growth, which provides wider economic benefits (WEBs).

As previously mentioned, Thomas Street provides great access to the nearby business district. Providing an efficient transport network along Thomas Street can promote more economic activities in the nearby business district as a result. Additionally, through improving overall economic costs of using Thomas Street, the road users will also benefit from the efficiency by saving travel time and distance. From the public perspective, reducing negative environmental impacts such as pollutions and noise would also be beneficial to society.

Environmental benefits

In 2016, transportation accounted for roughly 29% of the world's energy demand and 65% of the liquid fuel consumption (Stefaniec et al., 2020). The transport sector was responsible for 25% of total energy-related CO2 emissions in 2016, around 8 gigatonnes of equivalent carbon dioxide, which is 71% more than in 1990 worldwide and not comparable to any other energy end-use sector (Stefaniec et al., 2020). This suggests the importance of considering the environmental impacts of FMT.

To reduce environmental damages, the key is to reduce the number of on-road vehicles. Promoting non-motorised modes such as walking and cycling can reduce the demand for driving, which can be achieved using FMT as discussed. Additionally, providing good accessibility and safe environment for pedestrians and cyclists, as well as retaining existing flora and fauna can contribute to minimising negative environmental impacts.

Social benefits

One of the major roles for transport planning is to ensure all people have equal access to resources and facilities which they need (Foley et al., 2018). But for a car-based society, such fairness is difficult to achieve as not all people have access to cars. Hence, social inclusion is an important goal for planning. It not only helps people to obtain the benefits of a thriving society but also encourages people to participate and contribute, which forms a sustainable cycle of development. Australia's Indigenous communities are commonly located in fringe urban areas, or outer regional/remote Australia (Currie, Stanley, & Stanley, 2007), where access to public transport is often poor. To ensure social inclusion, it is essential to make transport available and affordable. Public transport network should be expanded to isolated areas and concession rates should be maintained to the low-income population.

The unique challenge in Australia is its diverse community where each cultural group has its unique needs for travelling. For example, the aboriginal people travel for cultural activity and kinship obligation that is a vital aspect of Aboriginal life (Currie et al., 2007). Their preferred travel mode is door-to-door mobility solution and they often travel in a large group including children (Currie et al., 2007). A demand-responsive service is better suited for them instead of scheduled services.

Concluding remarks

This article explored the potentials of various technologies through a case study of Thomas Street. It found that technology, including FMT, can provide various benefits.

Growing traffic is a challenging problem. One of the key findings is that reducing the demand for cars can provide a variety of benefits, and FMT can greatly contribute to doing so. Although there is a considerable demand for cars in Australia, young Australians' attitudes towards car ownership have changed and showed higher preference towards on-demand mobility, such as Uber, and public transport instead (Vij, Sampson, Swait, Lambides, & Hine, 2018). This shift can further be encouraged and expanded to wider generations using MaaS.

Meanwhile, smart road management system can be a foreseeable short-term solution for traffic congestions. Traffic conditions vary from seconds to seconds but the current traffic signalling and traffic lane outlines are too rigid.

In transport planning, the key to designing an efficient transport system is to maximise economic, social and environmental values to society. Further work is needed to develop a Roadmap for Perth, which would maximise the benefits.

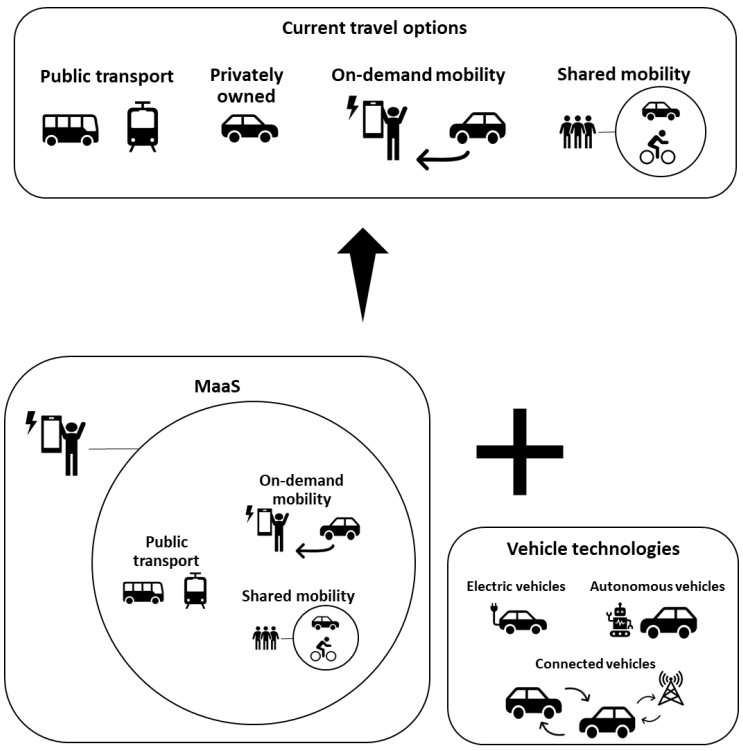

Figure 3: Conceptual representation of FMT (Chi & Biermann, n.d.)

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- Managing transport system investment risk: enhancing patronage predictions and adapting strategic asset management and appraisal processes to account for emerging trends and uncertainty
- Smart Transport Technology Roadmap

Find details of these projects from this link: https://patrec.org/core-research-projects/

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