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ABSTRACT: Travel Demand Management (TDM) initiatives are widely applied by transport planners to establish and enable appropriate use of critical transport infrastructure. This paper considers the specific case of TDM in an education precinct (university) context drawing on international experience to date, with examples of TDM measures that have been introduced in university settings. The important role of regular surveys of staff and student travel behaviour is highlighted, particularly as part of a Sustainable Travel Plan (STP). A comparison of TDM Measures implemented as part of University STPs is discussed using recent experience from Australia as a case study. An important message of this paper is the need to propose a new focus on Education precinct TDM in the light of the COVID-19 pandemic. The paper thus explores the international evidence on the influence of changing travel and study practices in response to COVID-19 before considering, with reference to Australia, the role of Return to Campus plans which have been developed to encourage COVID-Safe Travel in a university context. The paper concludes with a call to learn more about the emerging and intended commuting patterns of university staff and students "post-pandemic" or under "living with COVID-19" and the requirements of TDM implementation plans in the developing university environment.

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1   Introduction

Travel plans have become an important part of policy in recent years and represent an emphasis on managing infrastructure, encouraging sustainable and active travel and discouraging private vehicle use. Universities are major trip attractors that require the infrastructure needed to support large volumes of commuters, notably students, on an almost daily basis. Prior studies show that through a combination of education, increased awareness and modifying attitudes through Travel Demand Management (TDM) initiatives, a modal shift away from private cars may be achieved. From March 2020, lockdown measures in many countries in response to the COVID-19 pandemic limited unnecessary transport and actively encouraged individuals to work and study from home where possible. With the emergence from successive lockdowns, journey to work patterns have been substantially reset as the result of COVID-19 (Beck and Hensher, 2020a and b). Universities have had to adapt their current teaching styles during 2020 and beyond. Whilst studying from home (SFH) has subsided in Australia for primary and secondary education, it largely remains in place for tertiary education, and in many instances international students are now studying from their home country and continue to do so even though international borders are progressively opening (largely due to available airline flights). The physical absence of tertiary students has had a significantly large impact on public transport (as well as on local suppliers of student accommodation, and other support industries and services). With the easing of restrictions, many students are showing a keen interest in hybrid modes of teaching and learning. The move to online teaching in universities has been maintained in many universities with a mix of small group teaching and online lectures throughout 2021, continuing into 2022. It is timely, therefore, to revisit the role of education precinct TDM (ideally delivered as part of a Sustainable Travel Plan) and the role it can play in influencing travel behaviour within university communities.

The paper is structured as follows. We begin with a review of literature around the definition of Travel Demand Management (TDM) and some brief examples of TDM measures in practice, before moving to consider the less explored case of TDM in an education precinct (university) context. Education precinct TDM is reviewed in an international context. The important role of regular surveys of staff and student travel behaviour is highlighted. Case study examples of TDM measures that have been introduced in university settings and their effectiveness are presented. Acknowledging the important role of University Sustainable Travel Plans (STP) for the effective delivery of education precinct TDM, the following section comprises a comparative review of the TDM measures that have been introduced on several university campuses in Australia. Given the dramatic influence of COVID-19 on university operations, the influence of changing travel and study practices in response to COVID-19 is reviewed and the key components of the return to campus plans developed to encourage COVID-Safe Travel in a university context (where publicly available) are also discussed.

2   Literature context

2.1   Defining TDM

Travel Demand Management (TDM) initiatives are applied by transport planners to establish and enable appropriate use of critical transport infrastructure. There is an extensive literature on TDM. Meyer (1999) defined TDM initiatives as an 'action or set of actions aimed at influencing people's travel behaviour in such a way that alternative mobility options are presented and/or congestion is reduced'. Gifford and Stalebrink (2001) note that TDM has gained attention since the 1970s primarily as a result of significant increases in travel that have not been accompanied by increases in infrastructure capacity.

TDM strategies are normally applied as a package including measures as 'sticks' (or 'push' measures) to directly discourage private car use (e.g., parking restrictions or regulations), as well as 'carrots' (or 'pull' measures) to increase the attractiveness of sustainable travel modes. Noting the synergies with Mobility-as-a-Service (MaaS), Farahmand et al. (2021) examine the potential role of MaaS as a TDM tool to influence commuting mode choice. They collect data from employees that commuted to work by public transport and private or lease cars (excluding bicycles and scooters) in the Netherlands, and their findings suggest that MaaS could be seen as a promising element in TDM strategies. A current trial at the University of Queensland is testing MaaS in a university context.

Babb et al. (2014) define TDM as the application of demand strategies to improve the efficiency of the transport system and propose a TDM matrix (Figure 1). The TDM matrix identifies nine categories of specific travel demand instrument which are classified as push, pull or travel behaviour change instrument (see Table 1). A travel plan provides a useful framework for implementing TDM management tools in a way that can be tailored to enable travellers to maintain their desired lifestyle whilst encouraging the adoption of low carbon mobility solutions, consistent with increased working and studying from home. Examples of university's sustainable travel plans (STP) are discussed later.

Table 1: Defining TDM (based on Babb et al., 2014)

| |
|---|
| Travel demand management measures include incentives (pull measures) and disincentives (push measures) to enact travel behaviour change which should be aligned to delivering outcomes which are consistent with broad sustainability goals. In addition, TDM measures may provide information or education to affect people's perception of or attitudes towards travel alternatives with intention being behavioural modification. Push measures are designed to make travel by SOV [single occupancy vehicle] less attractive. Pull measures improve the competitiveness of alternate travel options, including no-travel. Behaviour modification programs rely on changing travellers' perceptions or attitudes toward alternate travel options |

Travel Demand Management Matrix - Summary
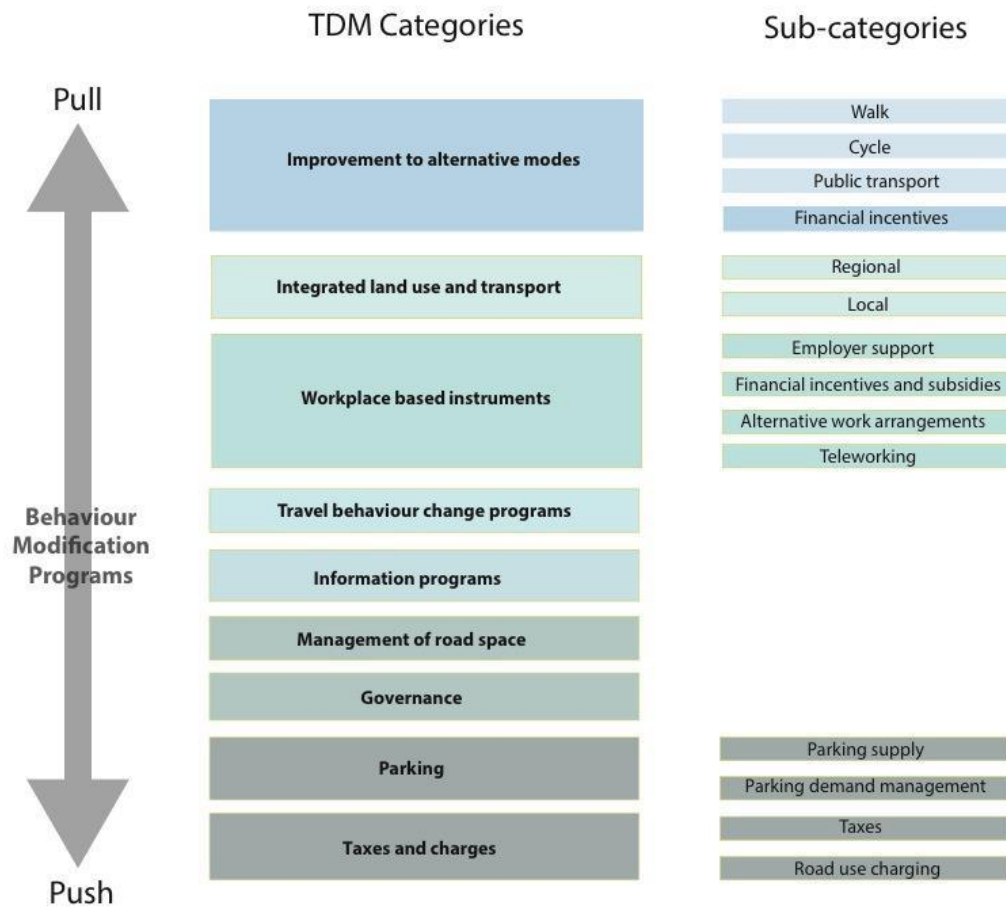
Figure 1: The Travel Demand Management Matrix (Babb et al., 2014)

Sammer and Saleh (2009) note that, when implemented effectively, TDM measures (which they categorise as including regulatory, pricing planning or persuasive policies and which can be fiscal and non-fiscal) can contribute to the realisation of a more efficient transport system, improved environmental conditions and improvements in safety as well as revenue generation to invest in alternative transport systems.

Mott MacDonald (2021) introducing their TDM Toolkit define TDM as "an umbrella term for the application of strategies and policies to reduce travel demand, or to redistribute this demand in space, mode or in time" (p 8) and go on to suggest that an effective TDM plan comprises three key pillars: the creation of capacity, network management and travel behaviour change solutions.

Transport for New South Wales define TDM as "the application of a focused, data led strategy that seeks to change demand on transport networks by redistributing journeys to other modes, times, routes or removing the journey altogether". They note that TDM is most effectively applied when there is a reason for change (for example relocation of staff or introduction of new transport alternatives). It has been typically applied in large event scenarios, but is now integrated into urban transport strategies, infrastructure projects within a movement and place framework and is currently integral in the response to the COVID-19 pandemic (Figure 2).
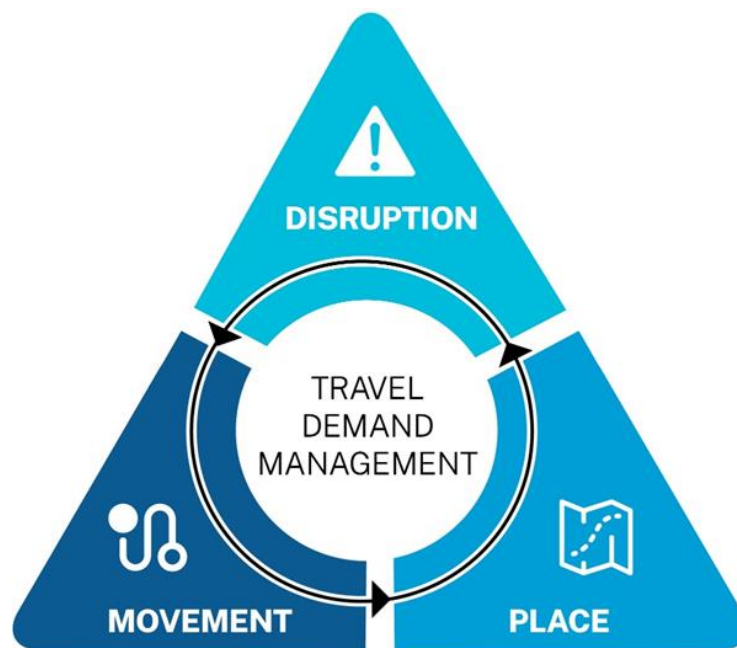
Figure 2: TDM in New South Wales

2.2   Examples of TDM measures

Mahmood et al. (2009) note that TDM initiatives encompass the desire to optimise transportation systems for commuters through measures to encourage enhanced accessibility, predictability, information, choice and system performance. There is a large set of potential management tools to support the desire for more sustainable transport behaviours. Several are considered briefly below and where relevant, reference is made to the influence of COVID-19.

2.2.1   Positive incentives for active transport modes

In several European countries, cyclists can claim rebates for every kilometre cycled into work. For instance, in the Netherlands, where cycling rates are the highest in the world (Harms & Kansen 2018, p.4), cyclists can claim €0.22 for every kilometre cycled to work via tax credits[1]. In response to the COVID-19 crisis, the French government announced a Sustainable Mobility Package, which includes up to €400 per year, tax free, for employees who can prove their use of sustainable transport modes, including car-sharing and cycling[2]. A focus on encouraging active modes can be supported by the introduction of *bike- and walk-to-work days*. Employers can organise and publicise an annual or monthly 'bike-to-work day,' with accompanying events and bike maintenance services. It can also encourage offices or departments to designate 'bike champions' to motivate colleagues to participate. *Cycling and road safety lessons* provide confidence for people with little experience of cycling. Local authorities can partner with local NGOs to provide free road safety and bike maintenance lessons. Another measure to promote active travel is the introduction of *'car-free street' or 'open-street' days*.

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[1] https://english.cw.com.tw/article/article.action?id=2306

[2] https://www.fleeteurope.com/en/shared-mobility/france/features/france-advances-sustainable-mobility-allowance-avoid-congestion?a=DQU04&t%5B0%5D=mobility%20allowance&t%5B1%5D=France&t%5B2%20%5D=COVID-19&curl=1

This involves the closure of selected main streets on Sundays and public holidays for use by pedestrians and cyclists. This practice was first used in Bogotá in the 1970s with its Ciclovía days and has since spread around the world. It has proved enormously popular wherever it was introduced (Barclay, 2017), although the possibility of abstraction from other sustainable modes remains an issue.

2.2.2 Regulatory instruments to support more sustainable transport behaviours

Examples include the introduction of vehicle speed limits and overtaking laws which can significantly affect cycling safety, and perceptions of safety (Aldred, 2016). COVID-19 has resulted in increases in walking and cycling, the provision of open streets, pop up cycle lanes and widened pedestrian access (according to the European Cyclist Federation[3], London implemented 75 km of pop-up cycle lanes, and Milan 51 km). Similarly, in some countries "smaller cities" have collectively announced and implemented pop-up cycle lanes; this is the case in France (Nelson et al., 2021). Some cities have responded with regulations designed to increase cyclist safety; Brussels, for instance, reduced speed limits to 20 km/h in the city centre[4]. Traffic rules prioritising cyclists and pedestrians in shared road spaces are another option, especially at crowded junctions (International Transport Forum, 2020).

Parking management is another example of a regulatory instrument. Parking takes many forms, including pick-up and drop-off zones, loading/construction zones, commuter parking, event parking mobility spaces, carshare pods, EV charging stations, etc. Parking policies should be embedded in both transport and land-use plans with links to other relevant plans. During the pandemic the goals of parking policies have been to provide free parking for essential workers, and to limit the use of public transport and encourage the use of private vehicles in order to prevent the spread of the virus; with obvious disadvantage in a sustainability context (Nelson et al., 2021).

2.2.3 Information as a TDM tool

The role of personalised travel planning (PTP) in the workplace context is discussed in more detail below. It has long been a truism that for a public transport service to be used, the public must know where and when the service is provided (Nelson, 2018), although this is always easier for rail than bus. It is important that travellers (regular and prospective) are aware of the available services, both pre-trip and enroute, and there is considerable evidence that easily understandable journey planning information fosters confidence in public transport (Mulley et al., 2017). During the pandemic, journey planners have been modified to help travellers plan their journeys more safely by showing whether physical distancing can be observed.

Personalised Travel Planning (PTP) is a well-established targeted marketing technique that identifies people willing or able to reduce their private car use, and then provides them with personalised travel information in the form of personalised journey plans.

2.2.4 Working from Home (WFH) as a TDM tool

Working from home (WFH), or teleworking, has long been a component of the TDM toolkit. The outbreak of the COVID-19 pandemic was associated with a rapid move to WFH as stay at home orders were implemented. Significantly, it appears that COVID-19 may have broken the resistance of many employees and employers to working from home (Beck and Hensher, 2020a and b; Hensher et al. 2022). Many employees have enthusiastically embraced hybrid modes of working, while employers'

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[3] COVID-19 Cycling Measures tracker. https://ecf.com/dashboard

[4] https://www.brusselstimes.com/brussels/107383/coronavirus-city-of-brussels-lowers-speed-limit-to-20-km-h/

benefit from reduced expenditure on the provision of office space. The significance of the impact of WFH means that it should now be recognised as a transport policy lever (Nelson et al., 2021).

In the longer-term, the growth of WFH *may* allow public transport providers to flatten the peak, however, this will be offset by lower revenues and the potential need to boost capacity in suburban areas if more people move around the suburbs during off-peak times. There is also the potential for the development of serviced offices in suburban areas allowing people to work out of home and enjoy the networking and collaboration without travelling into central office areas. In their analysis of the sustainability potential for telecommuting, Budnitz et al. (2021) suggest that experience during the pandemic is also likely to have altered the way that work and non-work practices are bundled, further underlining the value of easy access to local non-work activities and services.

2.2.5   TDM in a workplace context

The introduction of TDM initiatives in travel plans via the workplace can give employers the unique ability to influence travel behaviour of large numbers of commuters; importantly, both the journey to work, and travel within the course of work, can be addressed.

Transport for New South Wales (TfNSW) undertook a huge business employee consultation as part of their "Travel Choices" TDM initiative (beginning in 2015) to reduce AM peak hour vehicle traffic entering, leaving and circulating within the Sydney CBD area impacted by the preparation for the light rail works, which included the reorganisation of CBD bus services. "Travel Choices"[5] is a free resource to help individuals, businesses and organisations prepare for and adapt to the changes to Sydney's transport network.

2.2.6   The role of Sustainable Travel Plans

Travel plans can be developed for different environments where large numbers of individuals travel daily to and from, including offices, schools, universities and hospitals (Logan et al., 2020). Rye et al., (2011) noted that travel plans had by then become an important part of policy statements in the UK with significant potential to solve transport problems and meet CO_2 reduction targets. Workplace travel plans (Department for Transport, 2009) are commonly seen as interventions designed to change employee travel behaviour which are instrumental in reducing congestion and pollution during commuter travel (Vanoutrive, 2019). Evidence suggests modal shifts of 10 - 20% in journey-to-work can be achieved following a co-ordinated personalised travel planning (PTP) campaign, although context is very important (Cairns et al., 2004; Cairns et al., 2010; CHUMS, 2016). This approach builds on earlier work relating to the development of voluntary travel behaviour change programmes based around identifying individualised marketing, such as the TravelSmart project in South Australia (Zhang er al. 2013). Riggs (2015) suggested that TDM initiatives cannot be used in isolation and should be introduced in parallel with outreach and marketing which provides individuals with alternatives that work for them personally. Ison & Rye (2008) note that site-specific problems with congestion, parking and/or transport-related staff recruitment need to be addressed to ensure TDM initiatives and travel plans work together.

3   Education precinct TDM

Education Precinct TDM has been less widely studied, and Logan et al. (2020) note that while TDM initiatives have begun to feature predominantly in transport planning and programmes over several

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5   https://www.mysydney.nsw.gov.au/travel-choices

decades, an understanding of the role and influence of TDM initiatives within a university context is still emerging.

Mulley and Reedy (2016) note that tertiary education institutions, particularly those in central and inner-city locations are large trip generators attracting trips from students and staff; thus, TDM initiatives within a university setting have the potential ability to influence tens of thousands of commuters. For example, the University of Sydney is on the fringe of the CBD, has approximately 73,000 students enrolled and places great pressure on the nearest railway station. A number of early contributions to the literature included a comprehensive review of TDM in a university context by Toor and Havlick (2004) and Bond and Steiner (2006) for the US; Hensher and King (2002) and Curtis and Holling (2004) for Australia, and Watts and Stephenson (2000) for the UK.

As regular travel surveys, often implemented as part of a travel plan (see Tables 2 and 3), have become more commonplace (although not necessarily implemented regularly) so the knowledge of the characteristics of staff and student travel behaviour has increased (see for example, Rybarczyk et al., 2014; Ribeiro et al., 2020; Duque et al., 2014). A detailed review of student and staff commuter behaviour is given in Logan et al. (2020). Students tend to have lower incomes (while recognising that there is a cohort of wealthy international students in most university communities), so their travel choices are constrained by costs and influenced by work and other commitments additional to university study leading to complex travel patterns. A recent analysis of a 10-year dataset of staff and student travel patterns[6] at the University of Aberdeen (Logan et al., 2020) found that, compared to staff, students travelled on average more by greener transport methods, predominantly walking or cycling, though they showed greater variation across the full range of available travel options. By contrast, staff show greater consistency in choice of travel methods but with a much greater tendency to drive to work individually, reflecting the convenience of the car (Ribeiro et al., 2020); a case in point would be the need to teach at night. Klöckner and Friedrichsmeier (2011) suggested that the mode of transport chosen by university students was influenced by situational and psychological factors. They described situational factors as including the availability of infrastructure by mode, public transport accessibility, trip characteristics and cost, whereas psychological factors included the individuals' intentions, belief, norms and attributes. Whereas students, in smaller and medium-sized cities (at least), generally may have more consistent accommodation location (student rentals tend to be in the same area year to year and university provided accommodation is often closer to the academic campus), staff choice of housing is more flexible generally due to higher incomes and more stable lifestyles (Logan et al., 2020). Writing in a Sydney context, Mulley and Reedy (2016) point out that for students, their socio-demographic profiles, including age and income, indicate they have a tendency to be public transport users, particularly as they will also have more flexibility than other groups to change their residential location to minimise travel time and cost as they are less likely to have dependents or own property. This echoes the findings of other campus-based studies, which have shown student mode choice to be strongly influenced by demographic and physical factors as well as perception of available choices (see for example, Zhou et al., 2018 in the United States; Sultana et al., 2018 in the United States; Moniruzzaman and Farber, 2018 in Canada). Hensher and King (2002) in a study at the University of Sydney found quality of public transport to/from campus, pedestrian routes through the campus and pedestrian safety within and near campus to be among the top 5 most important environmental issues.

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6   The University of Aberdeen runs a biennial staff and student travel survey: https://www.abdn.ac.uk/about/documents/Travel2016.pdf

Rissel et al. (2013) conducted a study of how staff and students' mode of travel to university can impact their physical activity level (sample size of 3,737). Their results are drawn from an online survey of physical activity and travel behaviour at the University of Sydney. 60% of their respondents were students; and 4 out of 5 respondents travelled to the University on the day of interest (Tuesday, November 30, 2012). Most respondents used train (32%), followed by car driver (22%), bus (17%), walking (17%) and cycling (6%). Staff were twice as likely to use car as driver than students, and also slightly more likely to use active transport, defined as walking and cycling (26% versus 22%). Results from the self-reported physical activity in the sample, showed that only 41% of respondents were sufficiently active (defined by meeting physical activity recommendations of 150 min per week): 46% of respondents that used active modes were sufficiently active compared to 39% that used car or public transport. Their findings suggest that students were generally more active than staff members, and female respondents more active than male.

Engelen et al. (2019) describe the outcome of an online survey of travel behaviour and physical activity conducted at the University of Sydney which asked about travel behaviour on a specific day in September 2017 (sample size of 4,359). The survey questions were the same as those used in a similar online survey reported by Rissel et al. (2013). Approximately two thirds of survey respondents were students. Compared with 2012, there was an increase in active travel and public transport modes to the University in 2017. Trip lengths increased, with 68% of trips taking longer than 30 minutes in 2017. In 2017 respondents reported walking around 9 more minutes compared to 2012, and doing almost 10 more minutes of moderate physical activity, potentially related to active travel behaviour. Corbett et al. (2021) analysed the same dataset with a public health objective in mind. They investigated the difference in reported time spent walking in 10-minute bouts (i.e., at least 10 minutes of walking) compared to total walking time (the sum over a day) over the same period and found that participants reported spending more time in physical activity when reporting total minutes walked. These findings suggest that more walking is done across a week in short bursts of less than 10 minutes and provide evidence for future survey design when evaluating active travel (and other) interventions to promote walking.

Mulley and Reedy (2016) report on the 2015 Travel Survey of 11,900 students and staff at The University of New South Wales located in Sydney, Australia. Findings showed that 41.2% of staff and 13.6% of students travelled by private vehicle to the campus. This high-level of car use (at the time of the study) is partly explained by free parking in residential streets adjacent to the campus, low staff parking fees, public transport access times that do not compete well with the car, incomplete cycle networks and insufficient public transport services to serve the end of evening lectures (after 9:00pm).

Mulley and Reedy (2016) observe that as large trip generators for students, staff and visitors, universities generally encourage pedestrian-friendly, high amenity, sustainable campus environments which support public transport rather than car access. However, they observe that the travel plans and TDM for Universities have traditionally been primarily around the communication of options (see Tables 2 and 3 for a selection of web links on sustainable transport guidance) which they consider is unlikely to be as successful as compared to undertaking profiling and targeting transport demand measures.

3.1   Examples of TDM measures in university settings

There are many well documented examples of TDM measures that have been introduced in university settings and several are discussed below.

Stanford University – Bicycle Friendly University – Stanford University in Palo Alto, California is the only university to win the Platinum Bicycle Friendly University award – which recognises institutions of higher education for promoting and providing a more bikeable campus - three consecutive years, and maintains this accolade because of the large number of bike-related programmes and resources[7]. Stanford now has more than 13,000 cyclists on campus every day and promotes cycling in many ways, such as making route maps available, offering free bike safety classes, and providing repair stands. Stanford's bike programme includes numerous support programs for safe biking as well as making it easier to use public transport with bicycles. Bike racks are available on all Stanford Marguerite buses. Staff and students can also rent or purchase a folding bicycle. Highlights of Stanford's Platinum bicycle programme initiatives include removal of car parking spaces and installation of new bikes lanes between student residences and the core campus. The university has increased participation in "Bike to Work Day" by 39% since 2010. Twenty-one academic departments have bike-share programmes, offering a total of more than 130 bikes for staff use. Stanford University also offers free and discounted transportation programs on several bus and rail shuttle services to support the mobility needs of its community.

Measures to promote cycling – UCLA - Bike-share schemes that allow anyone to hire a bike for short trips, either from a docking station or using dock-less bikes, have multiplied dramatically in the past 10 years. A University can create its own bike-share programme to provide staff, students, and visitors with an easy new option for making healthy, sustainable on-and off-campus trips. In October 2017, the University of California, Los Angeles (UCLA) launched Bruin Bike Share where cyclists could rent bikes for (then) $7 USD an hour. Membership was charged at $7 per month or $60 per year with a UCLA affiliation. Rates were slightly higher for visitors. The scheme was terminated in June 2020 citing the impact of COVID-19 and rising costs associated with the software required.

Tokyo Institute of Technology, Japan - free bus travel - In 2003, an experiment targeting 43 student drivers was carried out by the Tokyo Institute of Technology, in which a one-month free bus ticket was given to 23 car drivers (the experimental group), and nothing was given to the other 20 car drivers (control group). The goal was to shift their primary mode of travel from car to bus. The results showed that participants' attitudes in the experimental group towards bus were more positive, and that the frequency of bus use increased, whereas the habits of using the car decreased from before the intervention, even a month after the intervention period. The increase was 20% higher than the frequency of bus use before the intervention. Furthermore, the increase in habitual bus use had the largest effect on the increase in the frequency of bus use. The results suggest that a temporary structural change, such as offering car drivers a temporary free bus ticket, may be an important tool for converting car travel demand to public transport (Fujii & Kitamura, 2003). Alternatively, 'push' measures encourage individuals to avoid individual car travel modes by making them less attractive through increased costs, or less convenient, e.g., via parking demand management (Sweet and Ferguson, 2019).

Discounted travel for staff and students - Massachusetts Institute of Technology (MIT) worked with Hong Kong's Mass Transit Railway (MTR) in September 2014, to run an experiment to investigate if discounted fares can encourage more of their staff to travel by public transport before the peak and reduce on-board crowding (Halvorsen et al., 2016). The discounted fare intervention had an effect on

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[7] https://transportation.stanford.edu/maps-resources-access/sustainable-transportation/free-and-discounted-stanford-transportation-programs

morning travel in particular, and among users that had a commuter-type of behaviour (as opposed to users who do occasional trips).

Comprehensive Mobility Services at UC San Diego - UC San Diego announced (July 2021) a new five-year exclusive agreement with Spin, a micro-mobility provider, and TransLoc, a transportation software solutions company to deliver and integrate sustainable transportation modes[8]. This initiative will build 600 shared e-bikes and e-scooters to the campus, enhanced through a network of "Spin Hub" charging stations that include digital screens showing real-time campus bus location data.

One stop shop for Travel Information - Latrobe University, Melbourne - Mulley and Reedy (2016) note that communication plays a key role in the success of any TDM programme or policy. What is communicated and how it is communicated does have a significant impact on the reception of TDM. One stop shops on campus are deemed an effective model and Latrobe University has an online one stop shop for Travel Information (Figure 3). Links to examples of university travel web pages can be found in Tables 2 and 3.
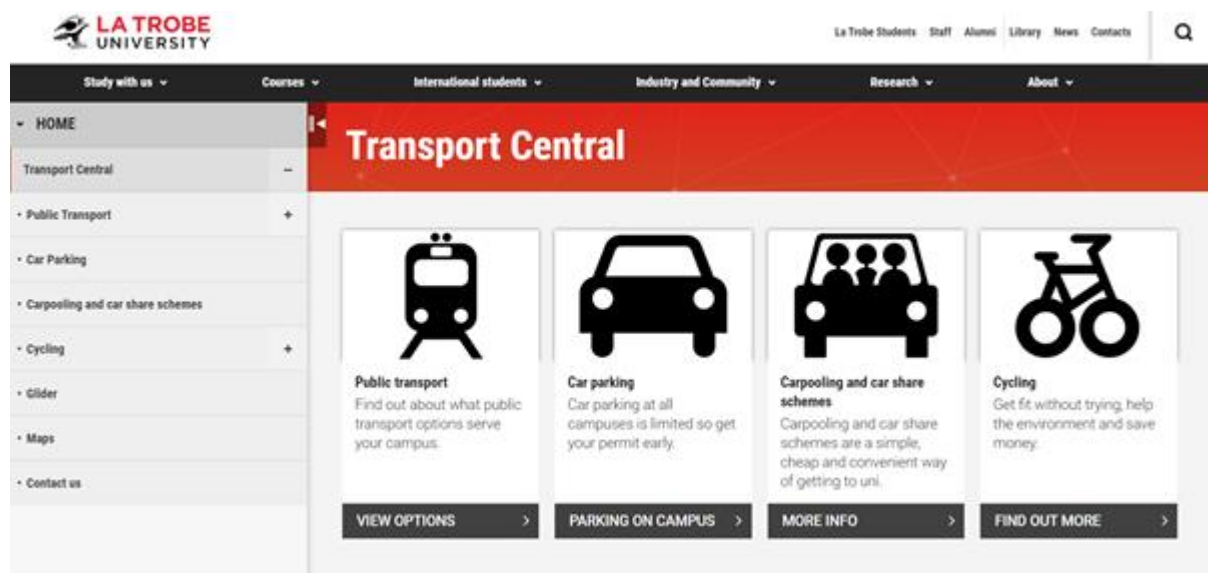

Figure 3: "Transport Central" at Latrobe University[9]

TDM initiatives at the University of Aberdeen - The University of Aberdeen in north-east Scotland has introduced a number of TDM initiatives over a 15-year period. 'Pull' measures include improved cycling storage facilities (2006), a lift sharing scheme (2007), free inter-campus minibuses (2012) replaced with an extended externally contracted inter-campus shuttle bus service (2014), and several electric vehicle charging facilities (2017). 'Push' measures include abolishing taxi travel claims between campuses (2012), the introduction of annual renewable parking permits and a reduction in the number of parking spaces (2009). TDM initiatives at the university were introduced and dovetailed

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[8] https://www.prnewswire.com/news-releases/university-of-california-san-diego-launches-comprehensive-mobility-services-powered-by-ford-owned-spin-and-transloc-301408424.html

[9] Source: https://www.latrobe.edu.au/transport-central

with Aberdeen City Council introducing paid non-residential on road parking around both campuses as condition to allow the university to obtain planning permissions for new buildings.

Logan et al. (2020) undertook an assessment of these measures on the commuting behaviour of Aberdeen staff and students drawing on the findings of a regular biennial survey. Results showed that while these measures had minimal impact on the transport choices made by staff and students the survey did provide useful insights into travel behaviour that could be used to inform future sustainable transport planning. This study confirmed that a top-down approach towards implementing TDM initiatives may miss the influence of societal indicators such as the interactions between family caring roles and gender identities on travel behaviour which are important in determining effective implementation. Results indicate that even with the implementation of TDM initiatives, external factors, including an increase in the cost of fuel, may influence a reduction of car use. A more integrated approach between large institutions could help.

4   Case-Study: A comparison of TDM measures implemented as part of University Sustainable Transport Plans

Universities experience an ebb and flow of activity throughout the year but are seldom totally 'closed' for business. While many travel plans primarily focus on staff travel, a university's travel plan must also ensure it covers the student body and all its segments, from full-time undergraduates to short and evening course participants, as well as visitors. A crucial step in any university TDM programme is the development of a robust travel plan which can serve as an effective transport management tool.

Figure 4 provides guidance on the preparation of a University Travel Plan prepared by Transport for New South Wales. Anticipated benefits will depend on the objectives established in the plan and may include:

- Reduced congestion on and around the site and precinct
- Improved transport options for staff, students and visitors
- Better access for emergency vehicles
- Improved reliability of deliveries
- Reduced demand for parking
- Demonstrated commitment to environmental sustainability.

This section discusses findings from an investigation of TDM measures implemented as part of Sustainable Travel Plans (STPs) at selected universities in Australia.

Inputs	What	Who	When	Outputs	Impacts	Outcomes
Identified needs Reduce negative impacts of site / precinct – Improve position as employer of choice – Create an active, healthy workforce						
Communications team design and production time Funds for campaign materials	Implement a branding initiative around health and active transport	Communications Team Travel Plan Coordinator	Within six months	Branded campaign Intranet articles about successes Personalised travel clinics	In 24 months: Reduce vehicle kms travelled for business by 10% Increase mode share: • cycling from 1% to 3% • walking from 5% to 8% • public transport from 65% to 75%	Meet relevant Sustainable Development Goals (SDGs) Improve corporate image
Volunteers for events	Participate in Ride2Work day and Walk2Work day	Travel Plan Coordinator	17 October 2018 6 April 2018	Ride / Walk to Work events		
Staff time to manage car pooling scheme Partnership across precinct	Launch car pooling scheme with prioritised or subsidised parking	Travel Plan Coordinator	Launch within 6 months	Car pooling scheme across precinct Communication materials	Reduce vehicles arriving at site in peak periods by 20%	Better staff/student retention Reduced staff turnover
Funds for shuttle bus Support from other businesses in precinct	Arrange staff bus service linking to nearest public transport hub and moving staff around precinct	Facilities Manager Travel Plan Coordinator	Funding – within 3 months Operating – within 6 months	Shuttle bus services	Increase staff satisfaction level from 85% to 95%. Average sick days reduced from 12 to 10 per person	Increased staff / student satisfaction
Funds for facility upgrades	Improve cycle storage and changing facilities	Facilities Manager	Work completed in 8 months	Bicycle storage and change facilities upgraded		Reduce sick days due to ill health

Figure 4: Sample University Travel Plan summary (TfNSW)

Tables 2 and 3 provide a summary of university travel planning at a selection of universities in Sydney and across the Group of 8 (Go8[10]) research intensive universities in Australia, compiled as part of a study designed to promote sustainable university travel choices. Tables 2 and 3 demonstrate that there is not always a free-standing travel plan produced, that the period of refreshment can be quite variable as is the incidence of a regular travel survey. The benefits of organising a regular travel survey of staff and students was highlighted earlier and this is one of the surest ways of developing an evidence-base analysis to inform the STP.

Table 2: University travel planning – selected universities in Sydney (at September 2021)

University	Sustainable Travel Plan (date)	Travel Survey	Return to Campus Plan	Sustainable Transport Guidance for the university community (URL)
University of Sydney	√ (2015)	√ (2012, 2017, 2021)	√	http://sydney.edu.au/campus-life/getting-to-campus.html
University of New South Wales	(√) (part of Environmental Sustainability Plan – 2019)	√ (2015, 2019)	√(web summary)	http://www.facilities.unsw.edu.au/getting-uni
Western Sydney University	?		√(web summary)	http://www.westernsydney.edu.au/campuses_structure/cas/campuses/getting_to_uni
University of Technology Sydney	√ (2013)	√ (2008, 2018)	√(web summary)	http://www.uts.edu.au/current-students/managing-your-course/your-student-info/student-id-cards/travel-concessions

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10 Group of Australia's leading universities (https://go8.edu.au/)

				http://www.uts.edu.au/sites/default/files/uts-tag.pdf (brochure)
Macquarie University	(√) (part of 2009 Concept Plan)	√ (2017, 2020, biennial)	√	http://www.mq.edu.au/about/contacts-and-maps/getting-to-macquarie (includes link to 2020 Travel Survey Report)
University of Wollongong	(√) (part of 2016 - 2036 Campus Master Plan) + separate Transport & Access Action Plan	√ (2015, 2019)	√(web summary)	https://www.uow.edu.au/about/locations/wollongong/getting-to-campus/ (includes COVID-19 travel advice and a downloadable transport access guide)

Note: √ = Yes

Table 3: University travel planning – Go8 universities (not including USYD and UNSW) (at September 2021)

University	Sustainable Travel Plan (date)	Travel Survey	Return to Campus Plan	Sustainable Transport Guidance for the university community (URL)
University of Melbourne	√ (2020) (web summary only)		√ (web summary)	https://about.unimelb.edu.au/news-resources/campus-services-and-facilities/transport-and-parking https://sustainablecampus.unimelb.edu.au/transport
Australian National University	(√) * Only web summary with targets to satisfy by 2020		√	https://services.anu.edu.au/campus-environment/transport-parking https://services.anu.edu.au/campus-environment/transport-parking/catching-the-bus
University of Queensland	(√) (2016 to 2020) part of Sustainability Action Plan		√	https://my.uq.edu.au/information-and-services/maps-parking-and-transport/public-transport
University of Western Australia	√ (2020) (also part of 2021 UWA Green Impact Program)	√ (2019)	√ (web summary)	https://www.transport.uwa.edu.au/
University of Adelaide	(√) Sustainability plan including transport (2016-2020)	√ (2011)	√ (web summary)	https://www.adelaide.edu.au/infrastructure/services/transport
Monash University	(√) Part of Sustainability Strategy	√ (annual?)	√ (web summary)	http://www.monash.edu/people/transport-parking

Note: √ = Yes

Table 4 provides a summary of experience with measures implemented based on a review of selected university STPs in Australia.

Table 4: Comparison of TDM Measures implemented as part of University STPs

TDM measure	University of Sydney (USYD)	University of New South Wales (UNSW)	University of Technology Sydney (UTS)	Macquarie University (MQU)	University of Wollongong (UOW)	University of Queensland (UQ)	University of Western Australia (UWA)
Freestanding STP (date)	√ (2015)	X (2019)	√ (2013)	X (2009)	X (2016 & 2020)	X (2016)	√(2020)
Enhanced facilities for cyclists	√	√	√		√	√	√
Promote Ride to Work Day			√				
Inter-campus / campus to station shuttle Service	√	√		√	√	√	√
Sustainable Travel Guidance	√	√	√	√	√	√	√
Organised lift Sharing			√	√			√
Electric Vehicle charging facilities			√				
Improved accessibility for community with disability			√		√		√
Improved wayfinding across campuses (including enhanced facilities for pedestrians)	√	√		√	√	√	√
Promote WFH	√		√	√			
Promote AV and VC facilities as an alternative to business travel	√	√				√	

TDM measure	University of Sydney (USYD)	University of New South Wales (UNSW)	University of Technology Sydney (UTS)	Macquarie University (MQU)	University of Wollongong (UOW)	University of Queensland (UQ)	University of Western Australia (UWA)
Variety of parking permits	√			√	√		√
Reduced number of parking spaces	√		√	√			
Travel Survey (dates)	√ (2012, 2017, 2021)	√ (2015, 2019)	√ (2008, 2018)	√ (2017, 2020, biennial)	√ (2015, 2019)	X	√ (2019)
Travel pages updated with COVID-19 advice		√		√	√		

Note: √ = Yes. This table is primarily compiled from information contained with the STPs.

Experience implies that it is crucial that a STP proposes TDM measures which have a proven track record of success. Given the evidence provided in Table 4, it is relevant to ask what the impact of implemented TDM measures has been.

Enhancing facilities for cyclists (which also featured prominently in the review above) are amongst the most common measures implemented, often in association with local government initiatives. The University of Technology Sydney (UTS), a city centred located university, works closely with The City of Sydney Council. Macquarie University (MQU), which is a campus-based university located adjacent to a large business park, benefits from being part of the Connect Macquarie Park & North Ryde Transport Management Association. University of New South Wales (UNSW), located in Sydney's eastern suburbs, has advocated for segregated cycleways in the local area for many years and has around 1,000 bike racks in the Kensington campus. UNSW has seen a growth in cycling to 6% of total daily trips in 2019 from less than 4% in 2016. University of Western Australia (UWA), located near the centre of Perth, has a stated objective of becoming a leading cycling campus.

Measures to improve wayfinding to / from and across campuses are frequently incorporated within STPs, although walking as a principal mode is influenced by the residential opportunities available locally. UNSW have found that over time, people are living closer to campus and improvements to walking and cycling paths have provided further opportunity to use more sustainable modes of travel. A high number of staff and students walk to campus (over 20% of total trips in 2019 which has increased from 12% in 2016).

Parking permits and a reduction in parking spaces are widely used to manage demand. At MQU, car parking has been consolidated within four parking structures located adjacent to the four primary entry roads, so as to limit unnecessary vehicle movement through campus. University of Wollongong (UOW) has promoted convenient and affordable car parking for those who need it such as service and contractor vehicles, disabled users and regional students.

UTS enjoys high public transport use (the results of a 2018 staff and student travel survey show that 72% of staff and 84% of students use a form of public transport as their main mode and this is largely explained by the central location of the main campus which has little onsite car parking) and provides a free carpooling service. Also, UTS takes part in the annual Ride to Work day by running its own Ride to UTS day. While organised carpooling can be challenging to organise, there is evidence of a growth in informal carpooling (e.g., UOW recorded a 6.5% increase in the number of vehicles entering the campus with 2 or more passengers between 2010 and 2016). Communication remains a strong feature of sustainable transport initiatives. UTS produces a sustainable transport access guide as a downloadable brochure, and UOW has a downloadable transport access guide and a living on campus transport handbook.

Where possible, packages of TDM measures should be introduced. Results from MQU show that "drive alone" to campus has dropped from 45% (2017) to 37% (2020) while in the same period use of public transport to access campus has increased from 33% to 39%; and use of active modes has increased from 5% to 12%. The strategy has been to prioritise active modes on campus, restrict car parking and improve the bus and rail service. Similarly, UOW has implemented a three-fold vision for pedestrians and cycling, public transport and vehicular access and car parking; in 2019 nearly 50% of staff and students used public and active transport to get to the campus which was an appreciable increase from 2007 (20%).

Availability of electric vehicles (EV) infrastructure can be expected to become more prominent and this has been identified by University of Sydney (USYD) as a future measure.

5   COVID-19 and a new focus on Education precinct TDM

The COVID-19 pandemic has had a dramatic impact on travel patterns to and from places of employment and activity centres such as university campuses, hospitals and retail and leisure facilities. Journey to work patterns have been substantially reset as the result of COVID-19.

With the greater prevalence and experience of online learning in response to the pandemic and the likely continuation of hybrid learning as restrictions ease both staff and students may not need to travel to and from their university as regularly as previously; this could have a lasting impact on future travel choices and subsequent repercussions for transport emissions.

5.1   The university-sector response

Caulfield et al. (2021) describe a case-study developed for the re-opening of Trinity College Dublin (TCD), Ireland in September 2020 after a prolonged period of lockdown. TCD is located in the city centre and the University and city council worked together to develop planning and built environment interventions to enable staff and students to safely return to work and education. A survey was conducted in June and July 2020 (sample size of 2,653 respondents) to determine how staff and students would like to travel to TCD, when the campus fully reopened. TCD reopened on the 28th of September 2020 with a blended learning approach; laboratories and tutorials all took place on the main campus and larger lectures were conducted online. The results of the study demonstrated a willingness to embrace active modes of transport when returning to the campus – 55% of the sample said they would like to walk or cycle when the campus reopens, compared to 26.4% who said they had walked or cycled prior to the pandemic, reflecting the perceived lower risk of contracting the virus when walking and cycling. Staff and students expressed concern about using public transport to arrive at the campus and this is important due to the very high proportion using this mode pre-pandemic – 27% said that this would be their preferred mode when the campus reopens compared to 68% who said they used public transport prior to the pandemic. Caulfield et al. (2021) recommend that the

university and city work together to promote active modes of transport and enable remote learning and working to compensate for the reduction in public transport capacity.

In a recent commentary based on longitudinal data from a staff and student travel survey, Ho and Habib (2022) suggest that concern over climate change has prompted universities to improve their sustainability performance by reducing emissions from transport through policy interventions promoting sustainable modes. They analyse the mode choice over a 10-year period for students and staff at Dalhousie University in Nova Scotia, Canada and explore changes in travel behaviour caused by COVID-19. Results showed that students were more likely to walk or use public transport, while staff were most likely to use private vehicles. COVID-19 has resulted in most students reporting a shift to a new primary mode, with most opting to walk, despite a significant increase in travel distance to campus.

A study from Poland (Paradowska, 2021) explores the relationship between the experience of remote study introduced as a result of the pandemic and the resulting "deconsumption" of university commuting, to explore whether telecommuting could form the trigger for implementing a sustainable mobility policy. The study investigates students' perceptions at two universities (sample size of 404 respondents) of the advantages and disadvantages of daily travel before the start of online learning. Respondents associated commuting to the university with more advantages than disadvantages and pedestrians and cyclists were most satisfied with their prior travel experiences. Most students expected to continue commuting using the transport modes they used prior to the pandemic. It is concluded that the pandemic provides an opportunity for universities and local authorities to implement policies and actions to support active commuting.

Ceccato et al. (2021) report the outcome of a survey of 5,385 students and 1,213 staff members at University of Padova in Italy which explored travel intentions in the "new normal" conditions in which people have greater flexibility over whether to travel or not. As with other studies, perception of health risk plays a fundamental role in trip cancellation decisions, especially for public transport (see also Beck et al., 2021). Specifically, for both students and employees, the stated choice of future bicycle usage increased the probability of making the trip. It was also found that the promotion of bicycle use, bike sharing, carpooling and micro-mobility among students can effectively foster sustainable mobility habits in the new normal. Several risk-mitigation interventions in work and study settings were found to reduce the probability of not performing the trip, i.e., free hand sanitizing gel at entry points for students, and mandatory face mask usage and body heat checks for employees.

Finally, a study from Greece by Mouratidis and Papagiannakis (2021) provides new evidence on changes in a range of online activities (telework, teleconferencing, e-learning, telehealth and e-shopping) due to COVID-19 which in turn have contributed to changes in urban mobility. Findings from a nationwide survey (April – May 2020) show that substantial increases in importance were reported for telework (31% increase), teleconferencing (34% increase), online learning (34% increase), and telehealth (21% increase). The incidence of daily online learners increased seven-fold. Mouratidis and Papagiannakis (2021) suggest that urban mobility in the post-COVID-19 era is likely to depend on the degree of prevalence and acceptance of these remote online activities since it seems that a significant part of mandatory and optional travel has been replaced by teleworking and other remote online activities. It remains an open question as to what extent the observed shift towards "soft mobility" can be maintained in the long-term.

5.2 Return to campus - Experience in Australia

From June 2020, Australian universities began to implement return to campus plans. This involved the development of guidelines and protocols with a focus on keeping the community safe. As can be seen from Tables 2 and 3, return to campus planning information was generally reflected in the provision of dedicated pages for COVID-19 updates; in some cases, amendments were also made to public facing travel planning websites. Detailed return to campus plans were less likely to be in the public domain.

The 2020 travel and work survey at MQU[11] included questions related to the impact of COVID-19. Mirroring the national trend there has been a move away from public transport in favour of single occupancy trips made by car for both students and staff, although this is more pronounced for staff. 43% of employees say that they will drive alone when restrictions ease (+6% compared to pre-COVID). In addition to questions about staff and student travel by mode before and "after" the pandemic the MQU travel and work survey has made a number of recommendations with respect to future patterns of work. Their findings indicate that most employees (81%) say they would like to work remotely at least one day a week, and 56% wish to work remotely at least two days a week. In response, MQU has undertaken to:

- Leverage COVID-19 WFH experience to embed remote working culture across all employees
- Make all meetings digital by default, to enable multi-location decision making
- Work with IT to equip all new starters as flex by default
- Identify a senior remote work champion, and case study them to another manager

These proposed changes mirror those made by many other employers and have significant implications on future transport choices.

Inevitably, it proved necessary for return to campus roadmaps to be updated as the external situation has developed and more has become known about the nature of the virus. For example, the return to campus roadmap at the USYD as July 2020 was developed for the period following the first lockdown in Greater Sydney and proposed a three-step phased return to face-to-face activities across the various campus locations. This envisaged a continuation of remote learning and WFH (step 1, June 2020) followed by the finalisation of plans to bring as many students back to campus as safely as possible in Semester 2 (step 2, July 2020). This included the introduction of COVID-safe work practices such as enhanced cleaning and signage (Figure 5). In step 3 (August 2020 onwards), staff were encouraged to start to return to campus aligned with local plans and rostering and flexible work arrangements. All research activity on campus aligned with local plans. All buildings reopened with continued enhanced cleaning. Most lectures were delivered online supplemented by small group teaching face-to-face on campus. Remote study continued to be available to students impacted by travel ban.

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11   https://www.mq.edu.au/__data/assets/pdf_file/0007/1175227/2020_MQU_Travel_Survey_Presentation_reducedfilesize.pdf
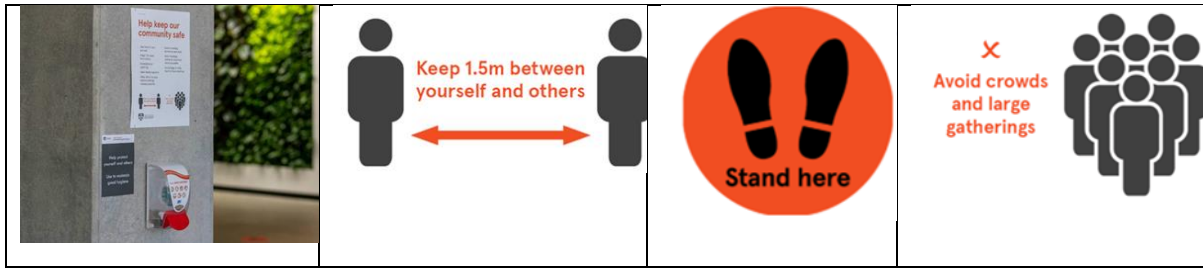
Figure 5: COVID-19 signage at USYD

A return to campus survey, which was open to all staff, ran from Wednesday 3 June to Wednesday 10 June 2020 and had a 50% participation rate, comprising of 63% professional and 37% academic staff.

The majority of both professional and academic staff indicated a preference to continue working from home or remotely at least some of the time. There was also an increase in preferences for how many days staff would like to work remotely post-pandemic versus how many they were working prior to working remotely. The reasons colleagues were most looking forward to returning to campus were for the social connection with colleagues, easier collaboration and greater opportunity for increased physical movement. Ability to work remotely more often was the top-ranked positive change experienced by academic staff. Staff concerns regarding returning to campus included concerns around others practising physical distancing, being able to commute safely and the use of shared spaces, as well as less flexibility with time. Respondents cited a mixture of positive and negative experiences of working remotely. Benefits listed included less time spent commuting to campus, an improved work-life balance, flexibility of work hours and the opportunity for focused work time. Challenges include reduced workstation quality, reduced physical activity and working longer hours.

As a successor to the return to campus roadmap, in May 2021 the USYD developed a COVID response plan for 2021, which outlined three potential scenarios: (A) no/low local transmission; (B) a local or generalised outbreak, allowing for possible state-wide or local restrictions; and (C) a longer-term 'COVID-normal' scenario. In late June 2021, Greater Sydney entered a period of extended lockdown which would last for 107 days. In effect, Scenario C was not entered until January 2022 as restrictions gradually lifted and international borders began to open to fully vaccinated international students from 15 December 2021 prior to fully reopening on 21 February 2022. The university maintains publicly COVID-19 web pages[12] with comprehensive guidance on keeping the campus safe and a rolling "latest updates" page.

A further staff survey was conducted in September 2021 to all continuing, fixed term, and casual staff with a view to understanding how the stay-at-home restrictions are impacting staff and their work. The response rate was 39% and of the respondents, 40% were academic staff and 60% were professional staff. The outcome prompted the VC to comment: "Unsurprisingly our staff survey also indicates that, as we start to return to campus, many colleagues prefer to work in a hybrid manner, and this is being factored into our planning so that we don't lose the considerable gains made to flexible working during this time." (Update on our return to campus plans, 14/10/21).

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[12] https://www.sydney.edu.au/covid-19/

5.3 Return to campus initiatives – the transport dimension

Not surprisingly, there is a relative consistency in the advice given to university communities around safe travel choices. UNSW, for example, have dedicated "Safe Return to Campus" guidance on their COVID-19 web pages[13]. There is some travel guidance in the Health, Safety and Wellbeing section which includes advice on using public transport safely (including a link to the TfNSW Travel Choices website), the benefits of active travel and current parking fee arrangements.

MQU have developed a very similar COVID Safe Plan[14] to that of USYD which is built around a Return to Campus Roadmap and a Return to Campus Checklist. A specific section on Transport and Travel is included and directs staff and students to information provided by the NSW Government, TfNSW and the university's own COVID-19 website[15]. MQU's "Getting to Macquarie" page makes a reference to impact of COVID-19 on commuting patterns[16].

UOW has a comprehensive set of COVID-19 pages[17]. Transport is specifically referenced in terms of precautions around the use of carpooling and the requirements for the use of masks on public transport. UOW offers specific COVID-19 travel advice via their *getting to campus* pages (Figure 6)[18]. At UOW, paid parking was suspended in March 2020 to assist those who needed to continue working or studying on the campus. Due to reduced travel requirements to the campus, shuttle buses were either suspended or operated on a reduced timetable. Measures to support physical distancing requirements included signage, implementing bus capacity limits, continuous monitoring of demand for parking and bus services, sharing of travel advice and information, and availability of hand sanitiser for UOW shuttle passengers. Data was collected throughout 2020 to understand the change in on-campus attendance and travel modes. Occupied ticket and permit on-campus parking rapidly decreased to a weekly average of 18% (April) and did not increase beyond 69% for the remainder of the year. Parking surveys carried out in streets surrounding the campus indicated that there were about 20% fewer cars parked in the study area between the February and April survey periods. Bike base entries (with parking / storage) declined from an average of 650 entries per month in 2019, to an average of 330 entries per month in 2020.

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[13] https://www.covid-19.unsw.edu.au/safe-return-campus

[14] https://www.mq.edu.au/__data/assets/pdf_file/0007/989728/MQ-COVIDSafe-Plan.pdf

[15] https://www.mq.edu.au/about/coronavirus-faqs

[16] https://www.mq.edu.au/about/locations/getting-to

[17] https://www.uow.edu.au/coronavirus/

[18] https://www.uow.edu.au/about/locations/wollongong/getting-to-campus/

Figure 6: COVID-19 travel advice - UoW

The University of Melbourne provides specific guidance on attending campus[19] including advice on using public transport safely[20] (Figure 7).

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[19] https://www.unimelb.edu.au/coronavirus/attending-campus

[20] https://students.unimelb.edu.au/student-support/coronavirus/return-to-campus

Using public transport to get to campus

You'll be required to comply with the current Victorian Government's public transport guidelines when you travel.

We encourage you to plan your travel carefully and follow physical distancing and hygiene protocols when you do. Public Transport Victoria (PTV) have announced several initiatives and improvements to help you travel with confidence, including:

- All services, stops and stations will be disinfected and sanitised every day
- PTV app has real-time travel alerts, the ability to view your travel history and other new features
- RideSpace is a new, free, online tool displaying real-time passenger volumes on trains, individual platforms and stations across the metropolitan train network
- Anyone using myki money on metropolitan public transport between 9.30am and 4pm or after 7pm on weekdays will receive a 30% discount until 2 July 2021. You must touch on and touch off on all services, including trams, for the discounted fare to be automatically applied.
- Extra train services have been added either side of the morning and afternoon peaks to assist with physical distancing on trains and platforms
- More options are available for cashless top-ups of your myki, including the PTV app, PTV website and an additional 100 Quick Top-Up machines across the network.

Figure 7: Guidance on using public transport safely to get to University of Melbourne

6   Conclusions

This paper has explored the concept of education precinct TDM and its role in the wider family of TDM measures. The impact of the COVID-19 pandemic on activity preferences and journey patterns makes it timely to revisit the role of education precinct TDM and what it can deliver in the context of a large-community such as a university. It has been observed that with the easing of restrictions, and the prospect of further virus induced stresses in the future, that many students and staff are showing a keen interest in hybrid modes of teaching and learning. The move to online teaching in universities has been maintained with a mix of small group teaching and online lectures throughout 2021 and is continuing into 2022. Similarly, many staff are interested in maintaining WFH as part of their working pattern and maintaining flexibility in their time of day travel to/from campus. Evidence from a review of several Sustainable Transport Plans in Australia demonstrates that a well-constructed travel plan can provide a useful framework for implementing TDM management tools in a way that can be tailored to enable travellers to fulfil their mobility requirements whilst encouraging the adoption of low carbon mobility solutions. Given the limited experience to date the challenge remains to learn more about the emerging and intended commuting patterns of university staff and students "post-pandemic" or under "living with COVID-19" and the requirements of TDM implementation plans in the developing university environment. This is the subject of ongoing investigation.

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