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Travel Demand Management
and its Application at
Australian University
Campuses

by

Jo Hynes
Geoff Rose

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ABSTRACT: This paper provides an example of how TDM could be applied in Australia with particular reference to university campuses. After considering the different characteristics of Australian university campuses in general, three Melbourne campuses were chosen as representative case studies. These consisted of an inner city campus (University of Melbourne), an inner suburban campus (Swinburne University) and an outer suburban campus (Monash University). Structured interviews were carried out with student and staff representatives involved with transport on campus. The interviews revealed a lack of consideration given to transport as an issue (as opposed to parking) at the three campuses. A subsequent survey was conducted of university administration representatives from campuses around Australia. That larger survey confirmed that Australian university campuses do not have any defined policies or decision making processes focused on campus transport issues.

A model campus TDM program is developed based on the review of the available literature and the information on university travel characteristics collected from the three detailed case studies. Although the program is simple, it provides a basis on which individual campuses can establish a TDM program and then develop it further to complement their specific conditions.

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AUTHOR: Jo Hynes
Geoff Rose

INTRODUCTION

In general, the traffic engineering profession has largely concentrated on managing traffic, particularly road traffic, after the actual decision to travel and the mode to be used, has been made. However we are increasingly recognising the potential of improving system efficiency by managing the actual demand for travel.

As the demand for travel grows, the demand for infrastructure to satisfy travel demand also increases. As existing infrastructure becomes more and more congested there is often pressure for a new road, bridge, train line, parking complex, etc. to be built (ie demand satisfaction rather than demand management). The costs of providing this new infrastructure are likely to increase, not only in terms of monetary expenses but also in terms of amenity (eg. through loss of available open space). It seems inevitable that the focus must shift from “what do we sacrifice to build the road?”, to “what do we sacrifice not to build the road?”. That is, are there other measures we could be taking to satisfy the demand without providing additional infrastructure, or by providing additional infrastructure but at a reduced scale.

Through these and other issues the concept of Travel Demand Management (TDM) has developed. TDM can be defined as:

“intervention (excluding provision of major infrastructure) to modify travel decisions so that more desirable transport, social, economic and/or environmental objectives can be achieved, and the adverse impacts of travel can be reduced” (Institution of Engineers, 1996)

Many TDM applications, especially in the United States, have focussed on large employment sites (Ferguson, 1990; Dowling et al, 1991; Ferguson et al, 1992). These generally have the characteristics of thousands of people congregating on site on a regular basis and of being stand alone facilities (eg an office park) yet still have an overall body which can implement and administer various TDM measures. Based on these characteristics, university campuses provide a good example of site at which TDM could be applied in Australia. They have large numbers of people attending each day, (generally thousands of staff and students, with students substantially out numbering staff). They are generally contained within one site, or have a large ‘main campus’, and have a single administrative body. University campuses are often expanding in terms of enrolments which puts pressure on existing infrastructure which in turn (as discussed above) results in pressure for new infrastructure, especially carparking, creating a need for consideration of TDM concepts. Further, most university campuses display similar transport characteristics, which provides the potential to develop a basic model campus TDM program that could be applied at almost any university campus across Australia.

The aim of the research was firstly to develop a model TDM program (ie a program for applying various TDM measures) for Australian universities which could be generally applied at individual campuses to produce benefits in terms of reducing drive alone travel to that campus. Secondly, the research aimed to identify some of the factors which may influence the implementation of a campus TDM program.

The research was carried out in several phases. It included a literature review, detailed data collection at three university campuses in Melbourne chosen to be representative, in terms of their transport characteristics, of the spectrum of campuses to be found in Australia, and a broader survey of 13 other universities around Australia to explore the generalisability of the results from the three sample campuses. This data was then reviewed, leading to the development of a general TDM program that could be applied at almost any university campus across Australia. The program was kept simple, bearing in mind the changes which would need to be made in transport management practices on campus before it could be implemented. The specific components were therefore those which were applicable to all three 'typical' campuses identified, with examples of how they could be implemented at these campuses.

This paper summaries the findings of the detailed investigation of the three universities, presenting a general overview of the travel characteristics of university campuses and the issues raised through this data collection, particularly those which would influence both the content and implementation of a TDM program. An overview of the TDM program developed and suggestions to assist in implementation are provided, along with examples of current initiatives in the application of TDM at Australian university campuses.

GENERAL UNIVERSITY TRAVEL CHARACTERISTICS

In understanding TDM, it is useful to consider travel in terms of an individual trip. A trip is made because someone has a need to go from one place to another (ie the demand for the trip), but to make the trip there must also be the supply of a suitable transport mode. TDM manages the demand for travel by considering both demand and supply components.

Often the supply characteristics of travel are seen simply as the various transport modes provided, however the supply for travel can be viewed as having three components, namely:-

- infrastructure, that is the actual physical provision for various modes, some examples include roads, trains, trams, buses, bicycle and walking paths, car parking, etc.;
- support services, that is the services provided to facilitate the use of the various modes, for example a car pool scheme, the provision of public transport timetables, the preparation and distribution of bicycle route maps etc.; and
- management (an institutional dimension), which refers to the methods used to manage the infrastructure and services components of supply, for example the policy and decision making processes in place to address transport overall as well as specific issues which may arise.

The provision of infrastructure generally depends on a number of factors, for example the provision for car parking will depend partly on the space available. In contrast, the provision of public transport will depend partly on the other attractors in the area and on the location of the campus relative to the public transport network. University campuses generally have a wide range of support services available to both staff and students, with some provision of transport services included, such as a car pool scheme or the distribution of public transport timetables. With regard to the institutional component of supply, university campuses generally have an administration department called, for example, "Facilities and Services" or "Property and Buildings". This department is generally responsible for all facilities on campus, including the transport facilities, both in terms of the provision of these facilities

and the day to day management of them. In addition each campus usually has a student union or some other form of student service organisation which provides information on the facilities to students.

In terms of travel demand, universities provide a wide range of education services through the various courses offered hence university campuses generate a diverse range of travel demand characteristics. For example both students and staff may attend the campus on either a full-time or part-time basis. Students may be either under graduates or post graduates, and staff may be academic or non-academic. Visitors to the campus also generate a demand for travel on a casual basis. These groups all operate to different timetables so can generate quite different, often irregular, travel demand patterns. For example, full time non-academic staff may keep standard business hours, while part-time students may have a very irregular timetable.

This range of supply and demand characteristics highlights why university campuses are suited to testing the application of TDM in Australia. In terms of supply, campuses generally have several travel options available and are in the position to provide services to support these options and encourage the use of alternative modes. In addition universities have the management structure to be able to implement a program over the whole site. Conversely, the demand patterns of those attending university campuses may make implementing a successful TDM program more difficult, since those on campus undertake study and/or work to thousands of different timetables.

In order to develop a general campus TDM program, it was necessary to study the supply and demand characteristics of Australian university campuses in more detail. In general there are two extremes in terms of university campuses and their transport provision in Australian cities. At one extreme are the campuses which are well served by alternative modes but have very limited car parking provision, and at the other extreme are campuses which have a substantial car parking supply but have limited provision for alternative modes.

The first extreme is generally typified by an inner city campus, that is in or close to the CBD. Since Australian cities are generally served by radially (CBD) oriented public transport systems, being close to the CBD means they are close to public transport and may in fact be served by several routes and by several modes. The campus chosen for investigation in this category was The University of Melbourne's Parkville campus.

At the other extreme are campuses which are located in outer suburbs. Their distance from the CBD means that they could be located between two radial arms of the rail network yet not close (ie within walking distance) of either. This generally reflects poor decisions, in terms of public transport access, which were made when the site was originally selected as the location for the campus. The campus chosen for investigation in this category was Monash University's Clayton campus.

There are many other campuses which fall somewhere between these two extremes. For example campuses which are not in the CBD, yet are sufficiently close to the city to suffer the constraints of space and have better public transport provision than campuses in the outer suburbs. Swinburne University's Hawthorn campus was chosen as reasonably representing this middle ground between the extremes.

DETAILED INVESTIGATION OF UNIVERSITY TRAVEL CHARACTERISTICS AND THE IMPLICATIONS FOR TDM

General Characteristics of the Campuses Under Detailed Investigation

The University of Melbourne's Parkville Campus

The campus is located approximately 1km from the Melbourne CBD. The campus has been established for over 100 years. It is located between two major hospitals and is surrounded by residential and retail development, including a popular restaurant and retail area only one block away. The campus itself is built up with virtually no space available on campus for expansion. There are many services (eg. retail, banks, post office, etc.) available on campus. There is also accommodation provided for up to about 2,000 students in residential colleges.

The campus is well served by public transport with trams running along both its east and west border, and it is located less than 1km from a major city train station. There are also buses running close to the campus. The roads surrounding the campus are generally congested during peak periods. There are boom gates at all entrances. There is only limited parking available on campus with spaces allocated only to staff or to people with special needs. There is a seven year wait on average for an on-campus parking permit. There are walking/cycle paths to the north and west of the campus however not immediately surrounding the campus, although walking paths within the campus are well protected and maintained.

Swinburne University's Hawthorn Campus

Located approximately 6km from the Melbourne CBD, the campus serves both Swinburne University and TAFE students. Like the University of Melbourne campus, the surrounding area is long established and built up, although the land use is almost entirely residential with some commercial/retail use. At the time the research was undertaken there were few services on campus, however services were readily available in a shopping area immediately adjacent to the campus, there was also no on campus student accommodation available.

The campus is reasonably well served by public transport with a train station located almost within the campus and a tram running close to its western border. The roads surrounding the campus are generally congested in peak periods. There is limited parking provided on campus (although additional parking is now available following the completion of a multi-storey carpark), however there are some remote parking areas (which are served by shuttle buses to campus), parking permits are readily available for both staff and students. There are no walking/cycle paths around the campus however walking paths on the campus are, as for the University of Melbourne campus, well protected and maintained.

Monash University's Clayton Campus

This is an outer suburban campus, located about 20km from the Melbourne CBD. There has traditionally been many green field sites surrounding the campus which have been developed, often as industrial research and development uses. The campus is spread over a far greater area than either of the other campuses, with potential for even further development. Like the University of Melbourne campus there are many services provided

on campus. There is some student accommodation provided on campus, located a few minutes walk to faculty buildings.

The campus is located several kilometres from a train station however it is well served by buses, with bus stops consolidated in a campus bus interchange located on one edge of the campus. There are several thousand carparking spaces provided on campus for student and staff permit holders. Permits are limited and are allocated at the start of each year first to staff then students so parking is generally more readily available for staff. The permit scheme is graded such that red permits (which are only available to staff) are more expensive with only one permit issued per space, while blue permits (allocated at a rate greater than one per space) do not guarantee a space will be available. There is a large parking area located adjacent to the campus which does not require a permit and is served by a shuttle bus. As for the other campuses, there are not really any walking/cycle paths around the campus however those within the campus are well protected and maintained.

Results of Detailed Campus Investigations

The investigation of the three campuses was carried out through structured interviews. Six interviews were carried out in all, that is one university administration (staff) and one representative from the student association at each campus. The appropriate respondents were chosen, based on their role within the university, their knowledge and experience in the area of transport on campus, and their ability to give either a student or university perspective. At each campus the respondent in this category was working in an area related to transport policy and its implementation. The student representative was actually employed by the student union or association in a similar role. The same list of questions, regarding both the demand and supply characteristics of their campus, was used in both the student and staff interviews and the same interviewer (Jo Hynes) conducted the interviews in all cases, so as to limit any bias that may be introduced.

Information regarding demand was generally obtained through records such as the resident postcodes of students and staff and previously collected travel data (Bennett et al, 1988; Benjamin et al, 1995). As expected this data showed that most University of Melbourne students travel by public transport to campus, while most Monash University students travel by car, with Swinburne students falling between the two. This information indicated that, for example, a TDM program focussed on an inner city campus may use incentives such as subsidising (beyond existing government subsidies) public transport fares and services and providing up to date information on routes and timetables to try and encourage those using public transport to ensure they continued using it and to encourage others. In contrast, a TDM program focussed on a suburban campus may use disincentives such as increasing the price of parking or limiting parking permit availability to try and discouraging car use. Other demand information included residence postcode information for staff and students which showed more people living further from campus for the suburban campus than the inner city campus. This information could be used to determine areas which could be served by a park and ride service or improved public transport services.

With regard to supply, in each case it was relatively simple for respondents to provide details of infrastructure provision on campus. Information regarding the provision of support services, particularly car pooling schemes, was also readily available, although this area of supply tended to be the domain of the student rather than staff representatives. The most difficult, and perhaps the most important issue to arise from the interviews was that of

institutional support and management.

The three campuses, despite the differences in infrastructure, have very similar support service provision. Among these are a car-pool scheme at each campus, 'ride to uni' days held to encourage cycling at each campus, public transport timetables distributed and public transport tickets sold at each campus and security escorts for people walking around campus out of hours. There are some individual services at each campus, for example Monash University's Clayton campus offers secure bicycle locks for hire, the University of Melbourne's Parkville campus produces a map of 'light' (ie well lit) paths on campus and Swinburne University's Hawthorn campus operates a free 'night bus' service dropping people anywhere within two kilometres of the campus.

There are also many similarities between the institutional supply characteristics of each of the campuses. For example, none of the campuses has an explicit transport policy. Each campus has slightly different transport decision making processes, however the decisions themselves are generally made on an ad hoc, 'needs-to' basis. That is transport is seen as a reactive rather than a pro-active issue. Monash University and the University of Melbourne both have committees as part of the decision making process, however they are 'parking' committees rather than 'transport' committees. At all three campuses, most transport decisions are implemented by the department responsible for facilities on campus, however major decisions (in terms of cost and/or controversy) are referred to the Vice Chancellor or the University Council.

Although the university administration at each campus seemed comfortable with the level of student representation in transport decisions, the student representatives were generally less comfortable. The interview survey results showed a general prevailing attitude that the infrastructure characteristic of supply is a university administration issue and the service characteristic (particularly services such as a car-pool scheme) is a student union (association) issue. It is obvious why this would be the case as the university administration controls the facilities on campus and the student union does not control facilities, rather it provides support services. However, for a TDM program to be successful it must have management support, which means the university administration must be more prepared to consider itself a service provider as well as an infrastructure provider.

Under the current system of managing transport and transport issues on campus, the TDM measures which are being applied (although they are not being recognised as TDM measures) have largely been instigated and managed by the student organisations. The problem with this is that the university administration and staff see these activities as relating to students, rather than to the campus as a whole. In fact these activities are equally important and equally applicable to both staff and students. This shows that university administrations, as part of assuming the role of service provider, must also take responsibility for ensuring TDM is seen as an issue for the whole campus rather than just students.

Based on the results of the interviews carried out at the three campuses, the above suggestions, if adopted, would require major changes in attitudes on campus. However, if these changes do not occur, no campus TDM program, regardless of how well it is developed, is likely to be effective. Due to the importance of the role of the university administration in ensuring the success of a TDM program, it was necessary to establish

whether the attitude at the three campuses investigated was in fact representative of Australian university campuses. In order to achieve this, further interview surveys were carried out with university administration representatives from thirteen university campuses across Australia.

Results of Australia-wide Campus Investigations

Unlike the interviews carried out at the three previous campuses, this survey was not intended to give detailed information on the transport supply and demand characteristics on campus. Rather the survey was designed to collect sufficient information to establish how other campuses relate to the three interviewed previously, in terms of physical provision for various transport modes and more particularly the policy and decision making processes for transport on campus. A survey form was prepared based on the questions asked in the previous interviews.

'The Good Universities Guide' (Ashenden and Milligan, 1995), was used to identify major Australian metropolitan campuses. A list of nineteen campuses was prepared. A telephone interview was then carried out with the person from each campus recognised as being in charge of transport facilities and transport decision making on campus. Only one interview was undertaken at each campus because the level of interaction between staff and students was not an issue, rather the survey was trying to determine the way in which transport was treated on campus in terms of transport policy and decision making. Several of the people contacted were not available to answer questions immediately, so were sent a copy of the questionnaire by facsimile, and then either telephoned or sent their response in return. Thirteen responses were received.

The university campuses surveyed varied in distance from the CBD, from being at the edge of the CBD to nearly 20 kilometres away. The number of students on campus is difficult to compare because for some campuses the total number of students is given, while most have only the number of under graduate students, however there is a broad range from about 6,000 to 20,000 students. The number of parking spaces on campus varied, with the general trend being that the number of on campus car parking spaces increased with distance from the CBD. Most campuses were served by bus only, with the inner city campuses being also served by train and/or tram. The Queensland University of Technology Gardens Point campus also has a ferry service, the University of Western Australia used to have a ferry service but it has now ceased operations. All campuses had some bicycle parking, although the type of parking varied, and all had walking paths through the campus. These results indicate that the three campuses interviewed previously (Melbourne, Monash and Swinburne) do not have any markedly different characteristics from other university campuses around Australia.

The results showed that the findings from the previous interviews were representative. None of the campuses surveyed had a transport policy. Some campuses had development policies or master plans which included a traffic management component, or had even undertaken traffic management studies, however the focus was on car travel rather than an overall transport policy. Each campus had at least one committee who dealt with transport issues, although the emphasis was generally more on parking and traffic rather than say cycling or public transport.

In summary, the survey confirmed the issues resulting from the detailed investigations, namely:

- a general lack of university administration support for innovative and alternative transport schemes such as car pooling with the main focus at all campuses being the provision of car parking;
- lack of cooperation, or at least coordination, between staff and student representatives; and
- generally low priority given to transport issues (other than carparking) by the university administration.

This finding is significant, because the way in which transport is currently dealt with as an issue at Australian university campuses is more likely to inhibit rather than enhance the potential for TDM. That is, transport issues are generally dealt with on a reactive rather than a pro-active basis. When a transport decision does need to be made, there is no campus transport policy on which to base the decision, or assist decision makers towards an overall goal. Students, staff and other groups who have an influence on, or who are influenced by, transport on campus are consulted either through their representation on campus committees, or if they make a complaint regarding a particular issue (eg bicycle security).

The following section presents the model TDM program which was developed for use at Australian university campuses. This program, although offering some suggestions for its implementation and administration, assumes that the university campuses have addressed the issues raised here and are willing to adopt and fully support a TDM program. This is because a change in attitude cannot be brought about by a TDM program, it must be achieved by the universities themselves before a TDM program can be considered. It is hoped that the information provided here will enable universities to re-evaluate the way in which transport issues are dealt with at Australian university campuses and encourage them to improve transport policy and decision making practices, thereby enabling them to adopt a campus TDM program.

A MODEL CAMPUS TDM PROGRAM

The model TDM program, which is intended for application at all metropolitan university campuses around Australia was developed based on measures which would be applicable at different types of campuses and therefore which would be included in individual TDM programs for each of the three campuses investigated. The program is outlined below in terms of the incentives and disincentives for four modes of travel: car travel, public transport, cycling and walking. Some suggestions for administration of the program are also included. At the end of this section, the tailoring of the program to individual campuses is discussed with particular reference to the inner, middle and outer metropolitan campus types as previously identified.

Suggested TDM Measures to Discourage Drive Alone Car Use

Car Pool Scheme

All of the three campuses investigated already had a car pool scheme either established or being established on campus. However, none of the schemes included all of the following eight components that are recommended, based on the existing campus car pool schemes and the facilities available, for a general campus car pool scheme.

(i) Matching Scheme

Although there is computer matching software available, the time involved in collecting and inputting the detailed data required by the program means it is really only useful for schemes which have a large number of registrations, where it is too hard to match people manually. It is therefore suggested that a manual method be used, at least until such time as a computer matching method becomes cost efficient.

(ii) Guaranteed Ride Home (GRH) Scheme

Car pool schemes can benefit from a GRH Scheme (Schreffler, 1991; Greenwood, 1992). This involves providing those who have car pooled with a 'back up' way of getting to/from the campus if there is an emergency or their lift is not available (e.g. through the provision of taxi fare). There are potential problems with successfully implementing a GRH Scheme at university campuses since a scheme which offers monetary loans, even if they are only small dollar amounts, needs funding and is open to abuse.

(iii) Preferential Parking

Preferential (or priority) parking (ie parking in the most convenient and secure locations) for car poolers is likely to have the most success at campuses where parking is very limited and/or expensive. It will be less effective at campuses where there is ample free or inexpensive parking provided. Car pool parking should be provided in a prime location, and should either be free or should be significantly cheaper than any other parking option. The amount of priority parking which should be provided will depend largely on the number of spaces available and on demand so it is site specific.

(iv) Van Pools

Van pools (basically a large car pool) are by no means an essential component of a campus car pool scheme, however they may be considered by some campuses. The main problems with van pools are that they need more people than a car pool and they require the provision of a 'van'. However if the university already has a van available (eg Swinburne University's Hawthorn campus has a 'night bus' that may be used as a van pool vehicle), and there is a strong demand from a particular area (eg the University of Melbourne's Parkville campus has a high proportion of students travelling from Kew, a few kilometres east of the campus), a van pool could be established.

(v) On-Site Services

All three of the campuses investigated provided a similar range of on campus services, despite the fact that they varied substantially in size (in terms of both campus area and number of people) and location. For example all campuses had child care facilities, a post office and banks either on or adjoining campus, sporting facilities, eating places, and book shops. They also had a range of personal services such as employment, medical, legal and financial services and personal and academic counselling services. These services are important and should be maintained since they significantly alleviate the need for people to make trips off campus during the day.

(vi) Flexible Work Hours

Obviously flexible work hours are not applicable to everyone on campus because the university runs to a timetable. However, post graduate students, non-academic staff, and academic staff could be granted some leeway in their start and finish times to enable them to car pool on days when they do not have classes.

(vii) Financial Incentives

Financial incentives may be used to encourage people to car pool. Car pools could enter in a lottery, or prizes could be awarded on the basis of who car pools the most. Prizes could range from a monthly cash prize, of say \$50, or a book or meal voucher for each member of the car pool, to free or discounted petrol vouchers at local service stations (which could be sponsored by the service station).

(viii) Campus Transport Coordinator

This is an essential component of not just the car pool scheme but the whole TDM important that this be someone to coordinate all available transport modes, for all staff **and** students attending campus.

This person should be jointly employed by the university and the student union and it should be made clear that their work is applicable to both staff and students. The Campus Transport Coordinator would liaise closely with both staff and student groups on campus. They would also work with external agencies and authorities such as the public transport authority. In addition, in order to implement and administer the various TDM measures, they would have direct access to those controlling infrastructure on campus (eg if they wanted to increase the number of priority car pool parking spaces), as well as direct access to funds (eg to operate the car pool matching scheme).

The Campus Transport Coordinator should not become involved with issues such as parking enforcement or management of a car park waiting list. Rather they should be employed to ensure every effort is made to encourage the use of alternative transport modes to driving alone and manage transport on campus for more efficient travel. They should have an office in the university administration building, yet will still work closely with students (eg through the student union).

Parking Pricing

Parking pricing, unlike the measures included in the car pool scheme, is a disincentive. Disincentives are difficult to introduce because the very point is to make conditions for that particular mode or component of the mode, worse for commuters. Parking pricing involves increasing the price of parking to the point that it changes people's mode choice. They may decide to car pool to share the parking costs or they may change to public transport etc. parking pricing can also be used to favour car pooling by making spaces for car pools cheaper than other spaces. The actual pricing structure and method of implementation will depend on a number of factors, so is site specific.

Suggested TDM Measures to Encourage the Use of Public Transport**Service Improvements**

Public transport service improvements are outside the control of the university, so cannot be directly included in a campus TDM program. However, the university should communicate

regularly with the public transport authority and public transport operators, through the Campus Transport Coordinator and where possible engage in collaborative undertakings to improve services. This will allow all parties to be aware of any changes to the system so they will be able to take into account these changes (eg through lecture start and finish times). It also allows the university to provide feedback on the service and suggest any potential improvements. In addition, universities may wish to pay the public transport authority to provide a special service. For example, universities which have several campuses in an urban area may wish to have a shuttle bus service between them for students and staff who need to attend classes or use libraries etc at more than one campus but not want to operate it themselves.

Park and Ride Facilities

A park and ride facility, (where parking is provided at suburban public transport stations so that people can drive the short distance from their house to the station, and use public transport for the rest of their journey, rather than drive all the way) is in a way a service improvement. Therefore like other service improvements it is largely beyond the scope of a campus TDM program. However campuses such as Swinburne University's Hawthorn campus which is particularly well served by a specific train line, may wish to encourage the public transport authority to provide park and ride areas at stations along that train line.

On-Site Support Services

There are several on campus support services which should be included in a campus TDM program. For example the sale of public transport tickets and the distribution of timetables on campus and the provision of well maintained pleasant and secure on campus waiting areas for public transport. Public transport use can also be encouraged through other on campus services. For example university housing/accommodation officers, when advising students and staff of where to find accommodation, can encourage them to consider living close to public transport facilities and provide them with information on public transport to the campus so that they are made aware of their options, and even help them determine the best route to take.

Financial Incentives

Financial incentives for public transport use are more difficult to monitor than those for car pooling, however there are prize systems which could be considered and perhaps jointly funded between the university and the public transport authority.

Suggested TDM Measures to Encourage Cycling

Route Improvements

Like public transport service improvements, bicycle route improvements besides those on campus, are largely outside the control of the university. However it is possible to work with the responsible authorities to suggest improvements. For example the student transport officers at Monash University's Clayton campus worked in consultation with the local municipal council to have bicycle lanes marked on some roads leading to campus, and are now working with other councils in the area to develop a regional bicycle strategy. Examples of other route improvements which may be considered are: widened kerbside lanes on roads around the campus; route signage; lighting on off-street paths; consideration given to cyclists at traffic signals along routes leading to the campus; and attention to minor

details such as ensuring there are no pot holes along cycle routes, or that there are holding rails provided at intersections.

On Campus Facilities and Services

Public transport is often seen as the alternative to driving, however cycling offers a healthy, cheap alternative, and provides the user with more flexibility than public transport. There are several facilities and services which the university can provide on campus to encourage the use of cycling to campus, which are outlined below.

(i) Bicycle Paths and Secure Bicycle Parking

Most on campus paths are provided for pedestrians. To avoid conflicts with cyclists certain paths should either be marked as shared paths, or cycle lanes should be marked on the internal roads around campus. In busy pedestrian areas, appropriate signage should be used to advise cyclists to dismount.

One of the main facilities required for cyclists on campus is secure bicycle parking. The university should ensure that it provides enough secure bicycle parking, in suitable locations, to satisfy the demand on campus. The best type of bicycle parking to provide is a bicycle locker which allows the whole bicycle to be locked. A less secure option (and cheaper), but still more secure than traditional bike racks, is inverted U-rail parking, which allows both the front and rear wheel of the bike to be secured to the rail. Lockers for personal belongings could also be provided close to the parking so that helmets and other gear can be stored easily.

(ii) Shower Facilities

All three campuses investigated in detail had free shower facilities provided on campus for both students and staff. There were however extra showers provided for staff in that most buildings had showers in them (including the teaching buildings) but these were not generally available to students. The more buildings which have showers the easier it is for cyclists, so showers should be included in all new buildings.

(iii) Bicycle Route Maps

All of the three campuses investigated in detail had some form of bicycle route map available. These maps are important as they provide cyclists with information on the routes available and therefore help them plan the best route to take. The Campus Transport Coordinator should consult bicycle authorities, local road authorities, and local municipal councils regarding details of on and off-street bicycle paths to/from and around the campus, so that a comprehensive map of appropriate cycle routes can be prepared, distributed and displayed on campus. Maps could also show bicycle related facilities on campus.

Integration with Public Transport

In a similar way to park and ride facilities for public transport (as described above), several Melbourne train stations have been or are being installed with secure bicycle lockers. This allows people who do not want to cycle the whole distance to campus, or who are worried about bicycle security on campus, to ride part of the way and leave their bicycle in a secure location. Campuses such as Swinburne University's Hawthorn campus could work with the public transport authority to provide such facilities at local stations.

Financial Incentives

There are several examples of financial incentives which can be used to encourage cycling. For example, sponsorship could be sought from local bicycle shops so that students and staff receive a discount on presentation of their identity card or the university could subsidise membership to cycling organisations (such as Bicycle Victoria).

Suggested TDM Measures to Encourage Walking

Route Improvements

Walking paths, unlike cycle paths are already provided along almost all roads (besides freeways) in urban areas. Footpaths are provided between property boundaries and the road carriageway. This was the case at all three campuses investigated in detail. There were also some off-street walking paths provided in parkland around the campuses. These off campus paths, whether along the road or off-street, may not always be maintained to a high level of security. Since they are off campus this is not the responsibility of the university. However, the university could, through the Campus Transport Coordinator keep local authorities informed of areas which require attention.

On Campus Facilities and Services

The on campus facilities and services set out below are designed to improve conditions for those walking on campus. It is recognised that the main impediments to walking for most people are likely to be distance and security, with the latter especially an issue at night. While outside the direct control of the university, it is possible for the university to encourage people to live close to campus and to encourage the appropriate authorities to provide well lit and secure conditions for walkers off campus. With this in mind therefore, the following services may not in themselves be encouraging people to walk to campus, but they do offer the university a chance to set an example when lobbying for better off campus conditions.

(i) Pedestrian Paths

Paths within the university should always be kept to a high standard, ensuring that all areas of the campus are accessible by well maintained, well lit, (ie secure) pleasant paths. Regular checks and maintenance should be carried out of all lighting and landscaping along and around paths. The on campus paths should also connect conveniently with off campus facilities so that people are not tempted to take 'short cuts' off the paths into areas that may not be safe.

(ii) Security Services

Like on-campus paths, the three campuses examined in detail also had security services on campus. In particular all campuses currently provide a security escort to accompany people from buildings to their car or to wait for public transport, or to their bicycle. These services are actually provided from a security perspective on request from other groups rather than a transport perspective. However, it is a service which may encourage walking so it is suitable for inclusion in a campus TDM program.

Swinburne University's Hawthorn campus' night bus is an excellent example of a security service that can directly encourage people to walk to campus. As stated earlier, it is likely that most people who walk to campus will live close to campus. If they live within two kilometres of campus the night bus can drop them home, since it

will drop people anywhere within a two kilometre radius. This may be too expensive for some campuses.

(iii) On Campus Accommodation

Having on campus accommodation allows those students and staff to walk to campus. Those campuses which do have this facility should ensure that secure walking paths are provided between the accommodation and the main campus. Universities should also consider the potential for providing on campus accommodation in any new construction projects.

Promotion

Promotion of TDM measures was an issue which emerged from the campus investigations, particularly those carried out with the student representatives. Promotion of available services was considered particularly important. The student representatives felt that the services they were trying to establish (eg. priority parking for car poolers) were under utilised because people didn't know the services were available. Promotion should be considered as an important component of a TDM program. Some examples include: posters, advertising on the university homepage, a newsletter, a noticeboard for transport (eg. with maps showing the location where lifts were available/wanted for car pooling) and the running of competitions.

Other activities which could be included in a campus TDM program, as they appear to have been successful at the three campuses investigated, are specific promotional days such as 'ride to campus' days. These generally involve a competition for those who ride to campus on that day, including a free breakfast for all participants. This provides motivation and encouragement for those who ride and attracts the attention of other people on campus. These activities need not only be restricted to cycling, for example 'pool to campus' days could be hosted, or there could be a designated week where a specific mode is promoted.

Suggested Methods of Transport Policy and Decision Making

A campus TDM program should be implemented as part of an overall transport policy for the campus. The transport policy should include objectives to reduce the parking demand on campus and increase the number of, and support for, people using alternative transport modes. An effective transport policy should be developed jointly by the university administration with staff and student representatives (particularly from the student union), with input from the public transport authority, the local municipal council(s), and other relevant authorities (such as bicycle and road authorities).

Based on the information obtained from the interviews with those involved with transport decision making and implementation on campus, it is likely that to implement a transport policy (and hence a campus TDM program), a new committee or working party would be established on campus. The committee should comprise student and staff representatives, as well as members of the university administration. To be effective, such a committee should either include, or meet regularly with, the authorities mentioned above. This will ensure that the relevant authorities are working with the university and providing them with the knowledge and expertise necessary to provide the best possible transport service. The committee would also include, and may even be the appropriate authority to employ, the Campus Transport Coordinator. Once the Campus Transport Coordinator is employed it

would then be up to them to administer the TDM program and implement individual measures accordingly.

The measures which have been outlined above are deliberately broad in their description as specific details will depend on the individual campus. In order to more accurately determine what priority should be given to particular measures in a TDM program for an individual university, the Campus Transport Coordinator should begin by undertaking a data collection exercise which would include the compilation of any previously collected travel data and the collection of data on existing campus travel characteristics. This will highlight transport modes, residential areas, groups of people etc. who should be targeted by the TDM program to enable a program to be implemented in the appropriate areas. It will also aid in quantifying measures such as the number of car parking spaces which could be allocated to car polers.

There are a number of TDM measures which have not been included in this program, but which could be included in a university TDM program, in particular the use of alternative work hours and telecommuting. These are measures which are more relevant to staff at this stage, as most students are generally restricted to a set lecture and tutorial timetable so have less flexibility in their hours. The need to attend lectures (eg to be able to ask questions) means that telecommuting is less practical unless a student intends completing a course by distance education. However with advances in technology, and the capacity of people to access this technology, telecommuting may become a more realistic option. In fact the concept of distance education is already being considered as a potentially valuable both teaching and learning tool and is likely to gain more popularity among staff and students in the future.

Suggested Modifications to Tailor the Program to Individual Campuses

The TDM program gives some idea as to the range of TDM measures which could be implemented at a university campus. Although components were included in the program based on their general applicability to the three representative campuses investigated, there are components which may be more applicable to some types of campuses rather than others. Table 1 illustrates which measures are more or less relevant to each of the three campus categories.

Inner city campuses generally have a low proportion of car drivers and a high proportion of public transport users, so a campus TDM program should ensure that people aren't persuaded to change from travelling by public transport to travelling by car. That is not to encourage two existing train travellers to car pool instead. This means the program must include not only measures to encourage car pooling, but also measures to encourage public transport users. The suggested measures tackle this problem through charging for parking, even for car poolers, while offering prizes to those who use public transport. In addition, people who currently have a parking permit or who are on the waiting list for a parking permit should be specifically targeted with information on alternative transport modes on a regular basis. This should be organised by the Campus Transport Coordinator.

Outer suburban campuses are generally less well served by public transport. It is therefore more important that services which are available are well maintained and have a high degree of connectivity with other services remote from the campus (ie that buses and train timetables connect to ensure that there is not a long wait on campus and then again at the

station). A TDM program should suggest that the Campus Transport Coordinator conduct regular meetings with the public transport authorities and operators to ensure that all parties are aware of any problems. This communication will allow bus and train timetables to be coordinated, and by including the university, consideration can be given to lecture times in preparing public transport timetables. It also means the university has the opportunity to inform the operators of any problems and suggest any improvements to services.

Table 1: TDM Program Element Compatibility Matrix

Mode	Measure	Relevance By Campus Location			
		Inner	Middle	Outer	
Car	Car Pool Scheme				
	Matching Scheme	High	High	High	
	GRH	Low	Medium	High	
	Preferential Parking	Low	Medium	High	
	Van Pools	Low	Low	Low	
	On-site Services	Medium	Medium	High	
	Flexible Work Hours	Medium	Medium	Medium	
	Financial Incentives	Low	High	High	
	Parking Pricing	Low	Medium	High	
Public Transport	Service Improvements	High	Medium	Medium	
	Park and Ride Facilities	Medium	Medium	High	
	On-site Services	Medium	Medium	High	
	Financial Incentives	High	Medium	High	
Cycling	Route Improvements	High	Medium	Low	
	On-campus Facilities and Services	Paths and Parking	High	Medium	Medium
		Showers	Medium	Medium	High
		maps	Medium	Medium	Medium
	Integration with Public Transport	Medium	Medium	Low	
Financial Incentives	Medium	Medium	Medium		
Walking	Route Improvements	Medium	Low	Low	
	On-campus Facilities and Services	Paths	Medium	Medium	High
		Security	High	High	High
Accommodation		Low	Medium	High	
All	Campus Transport Coordinator	High	High	High	
	Promotion	High	High	High	

Current Initiatives in Campus TDM in Australia

Since the completion of the research on which this paper was based (Hynes, 1996), there have been new examples of initiatives undertaken which demonstrate the application of TDM at Australian university campuses. Two such initiatives are discussed below.

Curtain University (Bentley Precinct), Perth, Western Australia

Extensions are planned for Curtin University's Bentley Precinct which will see it grow by an estimated 50 percent over the next seven to eight years. Based on the existing carparking characteristics of the campus, the supply of parking would need to increase from about 6,000 to 9,000 spaces to accommodate this growth. There is not enough space available on campus to accommodate the increased requirement with at grade parking, so a

multi-storey carpark would be required. Since the cost of one space in such a structure is likely to be about \$12,000, the cost to provide 3,000 spaces is beyond the budget for the project. The university has therefore entered into an agreement with the Department of Transport whereby parking will be maintained at the current level while the university contributes to a new public transport scheme, as well as providing additional funding for improvements to cycling and walking facilities. The new public transport scheme will incorporate shuttle bus services to and from the nearest rail station, as well as a new bus service to and from the city. The service will be an express service operating at five minute intervals during peak periods and fifteen minute intervals in off peak periods. The Department of Transport has played a significant role in establishing the scheme and has liaised closely with the university throughout. They are now undertaking similar projects with other West Australian universities including the University of Western Australia and Murdoch University. Both of these schemes will be implemented with both the university and a nearby hospital through an integrated transport plan.

Monash University, Melbourne, Victoria

As mentioned previously, Monash University have a pricing structure in place at their Clayton campus such that people wishing to have a guaranteed parking space available pay a premium for a parking permit, while others pay a cheaper price for permits which are allocated at a rate of greater than one per space (however are still limited in the number issued). The university has now decided that, while maintaining the same pricing structure (and increasing prices each year according to external factors), a certain proportion of the fees collected from parking will be allocated directly to improving alternative transport modes. The funds allocated for this year will go toward such improvements as better bus shelters and a toilet facility at the bus terminal on campus.

CONCLUSION

In conclusion, a model campus TDM program was prepared which provides Australian university campuses with a tool for use in trying to create a travel efficient campus. However this tool will only be effective if universities recognise the inadequacies associated with their current methods of transport management. Campuses should prepare comprehensive transport policies which cover all available transport modes and how they interact, an appropriate transport decision making process and define roles for those involved with transport decision making on campus, particularly in regard to the interaction between university administration and student representatives, before attempting to implement the TDM program prepared.

Finally, university campuses not only provide the opportunity to manage the demand for travel on a large scale, but as prominent educational institutions they are the very sites which should be looking for solutions. Universities have a responsibility to the rest of the community to set an example to students regarding travel alternatives and the impacts of transport mode choice, so that students can likewise set an example in the community. As congestion increases in Australian cities, it is even more important that universities set the example not only to their students but to the community in general.

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AUTHOR BIOGRAPHIES

Geoff Rose is a Senior Lecturer in Civil Engineering in the Institute of Transport Studies, Department of Civil Engineering at Monash University. He has previously worked in government, academia and consulting and has consulted and/or undertaken research for a variety of public and private sector organisations. His professional interests cover intelligent transport systems, travel behaviour and non-motorised transport. He is currently immediate past Chairman of the National Committee on Transport of the Institution of

Engineers, Australia; Editor-in-Charge of the Institution's publication 'Transport Engineering in Australia' and a member of the Institute of Transportation Engineers.

Jo Hynes graduated with a Bachelor of Civil Engineering Degree from the University of Melbourne. She has worked in private consulting industry and completed her Master of Engineering Science Degree, majoring in transport and traffic engineering, at Monash University. The reserach undertaken to fulfil the minor thesis component of the Masters degree provided the basis for this paper. Jo has recently taken up an appintment at Jebb, Holland and Dimasi.