# INSIGHT FROM OPERATION OF A CAMPUS-BASED BICYCLE SHARE SCHEME

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## INTRODUCTION

With the increasing emphasis on sustainable transport, there is growing interest around the world in initiatives designed to increase the use of the bicycle as a transport mode. While the provision of adequate infrastructure and supporting transport polices (Pucher and Buelher, 2007, 2008) along with travel behaviour change support (Rose and Marfurt, 2007) are recognised as critical in increasing bicycle use, having access to a bicycle to ride is clearly a pre-requisite to increasing use of the mode. It is in that context that Bicycle Share Schemes have a potentially valuable contribution to make since they provide participants with access to a fleet of bicycles. A distinction can be drawn between those bicycle share schemes designed for community use and those focussed on a residential community (De Magio and Gifford, 2004).

New bicycle sharing schemes (BSSs) are appearing in cities around the world with much of the emphasis on community wide schemes. The technology underlying the schemes has changed over the years and now information and communications technology is being used to control access and monitor use of the bicycles. Australia is set to join countries in Europe, North America, South America and Asia with the launch of its first city-wide, community BSSs in two cities (Brisbane and Melbourne) in 2010. However, unlike all the other countries with existing BSS, Australia is the only jurisdiction where these schemes have to operate in an environment of mandatory bicycle helmet use.

Monash University, in Melbourne Australia, launched a campus-based BSS in 2009. Access to this scheme is limited to students resident in on-campus accommodation. To the author's knowledge this is possibly the first BSS operating in a jurisdiction where bicycle helmet use is mandatory. Insight from the Monash scheme is therefore potentially valuable in highlighting the issues arising with implementation of these schemes in that regulatory environment. The

purpose of this paper is to describe the Monash BSS, characterise it in the context of international BSS initiatives and report results from a survey of registered users of the scheme. The survey results provide insight into bicycle usage patters, helmet usage and user perceptions of the bicycles and the scheme's operation.

This paper is structured as follows. It begins by providing background on the development of bicycle share schemes which considers the evolution of the technology that underlies the schemes, their purpose and common operational challenges. That sets the scene for describing the Monash BSS and examining how it relates to international BSS initiatives in terms of its purpose and design. Results of a survey of registered users are then presented and operational experience examined. The final section of the paper outlines the conclusions drawn from this research and identifies future directions for this project.

# BICYCLE SHARE SCHEMES – A PRIMER

To enable the Monash bike share scheme to be appreciated in the context of other BSSs, it is appropriate to begin with some background on these schemes. Originally BSS were implemented with donated bicycles , however, modern schemes have evolved in sophistication, requiring substantial resources in order to make fleets of several thousand bicycles available for public use. These fleets are often funded through a combination of public sector subsidy, advertising revenue and user fees. Here we consider the evolution of the technology that has underpinned these schemes, examine the purpose of these schemes from a transportation perspective and highlight common operational challenges.

## Evolution of BSS technology

From humble beginnings where bicycles were made freely available to the community, the schemes have evolved to make greater use of technology to control access, identify users and manage where the bicycles are parked (Table 1).

The first BSSs were established by community groups in the 1960s. These early BSSs saw donated bicycles painted alike and left in the street for public use. These schemes relied purely on 'the idea of civic responsibility' (Bonnette, 2007) and lacked any accountability for the user or deterrents for thieves. First generation BSSs, characterised by absence of locking, ultimately failed. The White Bicycle project, the first of these schemes launched in Amsterdam, lasted a few months. Milan, Italy set up a similar scheme over a decade later but it suffered the same fate (DeMaio, 2003).

The second generation schemes sought to address the problem of share bikes not being returned by fitting a locking mechanism to each bicycle and providing dedicated docking stations for the bicycles. The locks typically required a coin deposit in order to release the bicycle from the docking station (Bonnette, 2007). The user inserted a coin into a device fitted to the bike which released the bike but retained the coin. A similar approach is used in some countries today to gain access to supermarket trolleys. Once the user has completed their journey they return the bicycle to a station and retrieve their coin by relocking the bicycle.

Second generation schemes used bicycles built for 'utility and durability' (DeMaio, 2003). These bicycles, which included an adjustable seat along with a single gear and solid rubber tyres to reduce costs of production and maintenance, were also readily identifiable as share bikes. The parts were specially modified so that they did not fit with other bicycles, negating their usefulness to thieves who wished to strip these bicycles for parts.

Table 1: Evolution of BSS

| Stage | First Scheme | New Features | Major Issues | Success of schemes | Notable Schemes |
|---|---|---|---|---|---|
| **1st Generation** | 1968 'White Bicycle' Amsterdam | - Organised by community groups<br>- Freely available<br>- Donated bicycles<br>- Bicycles painted alike | - No locking<br>- Variable locations | Generally lasted a few months before all bicycles stolen | |
| **2nd Generation** | 1991 Farso & Grena (Denmark) | - Coin locking mechanism<br>- Stations at set locations<br>- Readily identifiable, purpose built share bikes | - Anonymity of users<br>- Limitation on deposit | Most failed due to theft | Bycyklen Copenhagen Operating since 1995 |
| **3rd Generation** | 1997 'Vélo à la carte' Rennes | User accountability: -Subscription required; -Identification at each use<br>Costs to the user: -Subscription Fees; - Use Fees<br>- Improved bikes and docking stations with use of advanced technology (e.g. smartcards) to identify users | - Higher cost | Many schemes operating successfully | Vélib Paris Operating since 2007 |

The first large scale 2nd generation scheme was set up in Copenhagen in 1995 (Bycyklen, 2009) and still operates today –which is an exception rather than the rule for second generation schemes. Most attempts to establish these schemes have failed, suffering the same issues as the first generation schemes. The 'anonymity of the customer', and the limitation of the deposit which usually amounted to the highest denomination coin on circulation in the country (equivalent to not more than a few dollars), meant that second generation share bike schemes were still severally hampered by theft (DeMaio, 2008).

Third generation BSSs made use of advanced technologies in order to tackle the problems of the earlier schemes (DeMaio, 2003). The main developments focus on the issue of accountability by recording which user is in possession of a share bike at any given time. This allowed providers to hold users responsible for the bicycles and to take recourse if they failed to return them. Access is usually controlled by either a mobile phone or card, with the latter being the most popular. In the phone-based systems, users call a number printed on the share bicycle and quote the ID number printed on the bicycle. The operator then provides an access code which can be used to unlock the bicycle. The share bikes are returned by a similar process whereby the user calls the provider and informs them that they have locked the bicycle and where it is now located. The majority of modern BSSs are card-based, third generation schemes. These are characterised by the use of swipe card, credit card,

smartcard or Radio Frequency Identification (RFID) card to access the share bike. Terminals are located at each share bike station where users can touch or swipe their card allowing the system to identify them and release a bicycle (Quay Communications, 2008). The incorporation of a form of user ID also allows for a broader charging scheme which can include a subscription fee along with variable charge depending on the duration of use.

## Purpose of BSSs

Explicit objectives are not always articulated when BSSs are implemented. Norland and Ishaque (2006) note that the schemes act primarily to enhance mobility and provide a convenient access and egress mode for public transport. The literature highlights the links between BSS and public transport use, their ability to reduce reliance on cars, their stimulus effect to increase bicycling and their potential to improve health and environmental outcomes. Those aspects are considered in the subsections below.

### *Enhance Public Transportation*

It is common for share bicycles to be seen as the new form of public transport for inner city centres which can cater for daily utilitarian travel demands (Britton, 2007). The presence of a BSS scheme can also complement existing public transport services. They can both improve the access to the public transport network for some travellers while reducing the dependency on it for others. BSSs are substantially cheaper than existing public transportation for both providers and commuters. Share bikes generally have no wait time and require no operator or driver beyond the commuter themselves. Share bikes also have the ability to provide transport at times when traditional public transport is unavailable or is in limited supply such as late at night and when services are interrupted.

Operators of most existing BSSs have found that a significant portion of trips are generated by users commuting to and from work or university. In Lyon in France, 85% of morning trips using Vélo'v are made by commuters (Beroud, 2004) while, 60% of Barcelona's 'Bicing' subscribers use the share bikes in their commute (Quay Communications, 2008). A majority of long term Vélib subscribers in Paris also use the system in their commute (Nadal, 2008). Following a review of a number of operational schemes, Quay Communications (2008) found that over 40% of trips are linked with public transport. Share bikes can encourage new users onto public transportation by increasing the area that can be reached quickly from each public transport stop.

While extra users may be encouraged onto some public transport services others are likely to experience reduced demand after the implementation of a BSS. Public transport services that are commonly utilised to transport commuters relatively short distances (a few kilometres) are most likely to experience reduced demand. Commuters may prefer the convenience and directness of share bike over existing modes. Surveys of users of Bicing and Vélo'v found that over 50% of trips on each service directly replaced public transport and the figure for Vélib is even higher at 65% (Quay Communications, 2008). This can have the effect of reducing the strain on existing services and thereby improving the attractiveness of these services for commuters who are not utilising the share bicycles.

*Reduce Car Use*

Traffic in inner city areas can be a major issue and a significant benefit of share bikes is their ability to replace car trips and thereby reduce congestion and pollution. Besides encouraging a shift towards public transport over long distances, share bikes can also have a direct impact on the number of cars present in a city. In Lyon for example, it has been estimated that 1,000 inner city car trips a day are eliminated by Vélo'v (Buhrmann, undated). In Barcelona, 10% of Bicing trips replace the use of private cars (Quay Communications, 2008) and 20 % of Vélib users report driving less since the scheme was introduced (Nadal, 2008).

*Increase Bicycling*

While BSSs obviously directly increase the number of bicycles in use they have also been shown to increase the use of private bicycles. BSSs increase the profile of bicycling in a city, even when they are not in use, and this can lead to increased presence and acceptance of bicyclists (Buhrmann, undated). Bicycle traffic in Lyon increased 500% since the introduction of Vélo'v with only a quarter being attributed to the share bikes (DeMaio, 2008), Barcelona experiencing an increase of 50% in daily bicyclists after Bicing was introduced (BicycleOff, 2008) and Vélib is claimed to have increased the local sales of bicycles in Paris by 35% (DeMaio, 2008). Reports suggest 'a pattern of people first using (share bikes) to get back on the bicycle, and then to go out and buy a bicycle for other uses' (Britton, 2007).

*Enhance Bicyclist Health and Safety*

There is increasing evidence of the role that active transport can plan in improving health (Garrard, 2009). Just over 61% of trips on Bicing in Barcelona (Quay Communications, 2008) had come from a less active mode of transport. In Lyon, France, 96% of Vélo'v users are new bicyclists (Beroud, 2006). These results suggest that share bike schemes have the potential to increase physical activity and therefore potentially deliver important heath outcomes.

The ability for BSSs to increase bicyclist numbers also has the potential to increase safety for all bicyclists through a 'safety in numbers effect' (Jacobsen, 2003) which leads to a reduction in the per-bicyclist frequency of crashes with motor vehicles. There is evidence of this effect in Paris where a 24% increase in bicycle use resulted in only a 7% increase in accidents (Erlanager, 2008). This effect also means that those already bicycling also benefit.

*Deter bicycle theft*

When Bycyklen was started in Copenhagen its primary goal was the reduction in thefts of private bicycles. European studies have found that two thirds of bicycle thefts are 'convenience thefts' where the thief only wishes to use the bicycle and not to keep it (DeMaio, 2003). The logic behind Bycyklen was that if everyone has access to a public bicycle then the motivation behind 'convenience thefts' would be removed and theft of private bicycles would drop.

## Common operational challenges

While most modern BSSs have succeeded there have been plenty that have failed. The problems that have brought down these systems are the same as those experienced by most BSSs. Theft and vandalism are the biggest concern and have caused the failure of most unsuccessful, early generation BSSs. Redistribution can also be a concern for many BSSs. These issues are explored below.

*Theft and vandalism*

The first generation of BSSs were undermined by theft. Share bikes were simply not returned after use and consequently, no large scale first generation scheme remains in operation. Most second generation schemes suffered the same fate with the small deposit required not providing enough motivation for many of the anonymous users to return the share bike. The exception remains Bycyklen in Copenhagen which continues to operate as a second generation scheme relying on deposit of a coin (approximately $US 4) for access. The third generation schemes were developed with the hope that user identification could prevent most thefts.

While user identification does greatly reduce the prevalence of theft from BSSs, it still remains the main issue for most modern schemes. Vélib suffers greatly from theft with 7,800 disappearing in its first 18 months of operation (Bremner, 2009). In contrast, Bicing in Barcelona experienced less than 200 thefts in 12 months from its 6,000 share bikes (BicycleOff, 2008). This represents only 3% of share bikes, much less than the nearly 25% average annual theft rate reported in Paris, assuming Vélib experienced a constant rate of theft over first 18 months.

The above figures highlight considerable variations in theft rates with the rate in Paris eight times higher than that in Barcelona. This may be partially explained by a higher bicycle theft rate in France, approximately 30% higher than Spain (OECD, 2009), but other factors may also contribute. The explanation offered by JCDecaux is that the design of the locking mechanism may be to blame (Bremner, 2009). They have indicated that thefts may be occurring due to ‘tourists and first-time users not docking (the share bikes) carefully’. This suggests a fault with the design of the docking stations is ultimately responsible for the large number of thefts. Locals who are aware of the fault may regularly seek out share bikes for use or theft that are left unlocked. This also presents a problem for registered users who may forfeit their deposit if the bike is stolen even if they were unaware that they had not successfully docked the bike at the end of their journey.

The value of the deposit held for use of may also contribute to thefts. For example, in the case of the Paris Vélib system, the deposit is $US250 while the actual cost of each share bike is $US600, more than double the deposit (Bremner, 2009). While Vélib share bikes are more expensive than many ordinary bicycles, the deposit amount is less than half the value of the SB and likely less than the cost to purchase a new bicycle. This can create the

situation where it is 'cheaper to steal a bicycle-share bicycle than to buy a new one' (New York City, 2009).

The examples noted above highlight the different levels of theft experienced in across these cities. There is potential to learn more from the Barcelona experience by exploring the reasons why that system has experienced substantially less theft and vandalism. It would be valuable to understand the relative contributions of the infrastructure, or design, of the system, as opposed to underlying social/psychological factors including the sense of ownership and/or respect for community owned assets. Likewise it would be valuable to have a greater understanding of what might contribute to those factors being linked to differences in behaviour in different cities/contents.

Another major concern for BSSs is vandalism of the bicycles and stations. The most common vandalism found in Paris has been tyre slashing but share bikes are susceptible to having individual components stolen or broken to the extreme of being discarded in trees and rivers (Bremner, 2009).

*Redistribution*

Redistribution refers to the need for operators to relocate share bicycles in response to an unequal distribution of demand between stations. Peak periods are often the cause of this issue with commuters moving towards common central city locations and stations becoming full. In Paris this is so common that the operators have built in a system of offering free extra time to users who arrive at a fully occupied station (Nadal, 2008). The other major factor that brings about the need for redistribution is hilly terrain. Users are often keen to use share bikes to travel downhill but may choose another form of public transport for the return journey. The operators of the Paris Vélib system must relocate share bikes uphill everyday (Thomas, 2008) and the system requires 50 employees to keep share bikes evenly distributed around the city (Dworschak, 2007). In this context, there is the potential for electric power assisted bicycles to play a role in reducing directional differences in use. However, existing BSS have focussed almost exclusively on provision of human powered bicycles. One exception from California, was a research project established to explore the potential for pooled access vehicles (specifically bicycles, electric bicycles and the Segway Human Transporter) to bridge the so called 'last mile' in transit operations by providing access to workplaces from suburban rail stations (Shaheen & Finson 2003).

# OVERVIEW OF THE MONASH UNI-CYCLE SCHEME

In 2009 Monash University launched a bicycle share scheme at its Clayton campus in Melbourne, Australia. The project was initiated through the Office of Environmental Sustainability as part of a range of initiatives to improve sustainable transport for the campus. The design for the scheme was developed during 2008 by students in industrial design as part of a class project undertaken for the Office of Environmental Sustainability. Apart from developing the overall concept for how the scheme would operate, the students developed a design for unique bicycle and parking station for a future stage of the scheme. Since funding was not available to use the new bike design from the start, a decision was made to launch

the pilot with a fleet of reconditioned bicycles. A group of the industrial design students played a major part in getting the scheme operational, taking on the task of finding and reconditioning a fleet of bicycles and designing details such as the locking and parking arrangements. Funding for the bicycles, locks, parking rail modifications etc was provided by the Office of Environmental Sustainability.

The Monash University Uni-cycle pilot, as it is known, became operational in February 2009, at the start of academic year. The scheme was essentially a residential bicycle sharing scheme focussed on students living in the Halls of Residence, the main on-campus student accommodation complex, housing 1000 students. The Halls are located on the north east corner of the campus (Figure 1) about 750m from the centre of the buildings on campus. While the majority of the campus is relatively flat, it is a downhill ride from Halls to campus. A major two lane, two way road circles the campus and most carparking is located adjacent to the ring road. Inside the ring road the campus is largely a pedestrian precinct.


Figure 1: Aerial view of campus

## Purpose of the Scheme

It is appropriate to reflect on the purpose of the scheme even though explicit objectives were not documented at the time the scheme was developed. The scheme appears to have been motivated by a desire to increase the use of bicycles on the campus. The schemes' developers hoped 'that students would see other students riding bicycles' and 'it would be appealing for more students to follow suit' (Monash University, 2009). This is in line with the objectives described earlier for BSSs. There was the potential for the safety in numbers effect to bring benefits to both share and regular bike users. However there was also the potential for more conflict with pedestrians as bicycle use increased on campus although the generally low speed environment meant that serious injuries were unlikely.

From a mobility perspective the share bikes were most likely to replace walking trips for access to campus and were not therefore going to result in reductions of car trips for

commuting. There was a recognition that students may wish to use the bicycles for travel off campus and as a result locks were available for loan from the office at the Halls of Residence. Students had to leave a student card as a deposit in order to borrow a lock. It is possible that some local motor vehicle trips could therefore be avoided by a change of mode to the share bikes.

The potential role that the BSS could play in enhancing access to public transport was not a major motivator for the introduction of the scheme. However since these schemes have clearly played a valuable role in that context overseas there was potential at Monash particularly given that public transport services adjacent to the Halls of Residence were not particularly good. Two bus services operated along the roads adjacent to the Halls but these served limited destinations and had relatively low frequency. More extensive and frequent services were available from the Campus bus interchange which was about one kilometre from the Halls of Residence.

## Scheme Design

On the evolutionary scale noted earlier, the Monash Uni-cycle scheme would be classified as essentially a 2nd generation scheme since it is very similar to Bycyklen in Copenhagen. While users had to register to get access, the user is not identified when checking out a bicycle and so the scheme does not reflect 3rd generation technology. The Monash Uni-cycles were fitted with a locking mechanism that allowed them to be secured to modified bicycle loops throughout the university. The parking rails were modified by welding on a section of chain which was used to attach the pin needed to lock the bike to the rail. The locking mechanisms on the bicycles are almost identical to those operated with coins in second generation BSSs except that they required a special key. The modified parking rails and the key are shown in Figure 2.

Since the scheme was conceived as a sustainable transport initiative a decision was made to recondition old bicycles to provide the fleet for the scheme. For ease of use by both men and women, a step through frame design was selected. A group of industrial design students was engaged to work over the summer to locate and recondition the bicycles. They travelled to garbage tips, transfer stations and hard rubbish collection points all over the state to retrieve old bicycles. Many of the share bicycles were built entirely from parts. Figure 3 shows an example of the bicycles. To reduce maintenance issues, the bikes were fitted with a single gear and back pedal brake. Each bike was fitted with a basket, seat release for height adjustment, mud flaps, a kick stand and the locking mechanism. They were all painted the same light green colour and branded as a ‘Monash Unicycle’. In an effort to reduce abuse and vandalism each bike was fitted with a decal high on the cross bar which read ‘This bicycle was built by industrial design student’ and was followed by the builder’s name.

A total of 58 share bikes were completed for the launch of the scheme. While they were of a similar design they were not identical. This meant that the process of rebuilding each bicycle was time consuming as parts were matched to the size requirements of each bicycle.

Figure 2A: Locking mechanism on bike


Figure 2B: Key required to unlock bike

Figure 2: Share Bike Locking mechanism

Figure 3: Step through design of the Monash Share Bikes

## Scheme Implementation

Given the limited fleet size available to launch the scheme, it was decided to limit the registration numbers to ensure adequate bicycle availability. Nearly 200 students living at the on-campus Halls of Residence registered for the scheme. There was no charge to register or use the bicycles. Each registered user was given a starter pack which included a helmet, a map showing the location of the of modified bicycle parking loops on campus, front and rear bicycle lights and a key to access the bikes. Registered users were also required to attend a briefing session which described how the scheme was developed and operated. In an effort to reduce abuse and vandalism, the session emphasised the role the industrial design students played in building the bicycles. In addition to describing the operation of the scheme and arrangements for locking the bicycle both on and off campus, consideration was also given to safe riding practices and pedestrian safety issues.

Two students who had worked on building the bicycles were each employed for four hours a week to take care of the routine maintenance of the fleet. Anecdotal evidence suggests that this was not sufficient resourcing to stay on top of the maintenance requirements. The non-uniformity in the fleet meant that matching parts to bicycles was difficult and consequently, some minor repairs proved to be time consuming thereby reducing the number of repairs which could be undertaken each week.

# INSIGHT FROM USERS OF THE MONASH BSS

In the second half of 2009 a survey of registered Monash Uni-cycle users was undertaken to provide insight into how and why users were making use of the bikes and their concerns about the design and operation of the scheme. This section reports results from the survey.

Since all registered users were Monash students living in the main student dormitory complex there were contactable via their student email accounts. The registered users were sent an email which invited them to participate in the survey by clicking on a link embedded in the email. Those who wished to participate were then directed to a web site where the survey could be completed on-line. The registered users were first contacted via email on a Monday morning and advised that the survey would remain open for one week. A reminder/thank you email was sent on the following Monday and the on-line survey web site was locked at 5 PM on that day. Since some socio-demographic information had been collected at the time when the students registered it was possible to quantify not only the response rate but also to assess the representativeness of the responses. We consider first the characteristics of the respondents and then turn to the analysis of the responses.

## Response rate and respondent characteristics

The recruitment email was sent to 191 students who were registered for the BSS. Of those, 18 email addresses proved to be inoperable (associated with students having left the university) resulting in a contactable population size of 173. From those, 69 responses were obtained, corresponding to a response rate of 40 %. While not a-typical for travel related surveys (Richardson et al, 1995), the response rate was about twice that achieved by Norland and Ishaque (2006) in their evaluation survey of a share bike scheme in London. In the case of the London survey, there was a small financial incentive, in the form of about $10 in free access to the bike share scheme, to complete the survey. The response rate on the survey of the Monash share bike scheme users was about twice that achieved in another survey of first year Monash students who participated in a general travel behaviour change program (Rose, 2008) and that reported by Kaplowitz et al (2004) for an email survey of US undergraduate students. While the response rate that was achieved was clearly higher than for comparable surveys, it would have been preferred if it was even higher to reduce the risk of non-response bias influencing the results. However, the availability of limited socio-demographic information collected at the time of registration meant that it was possible to obtain additional insight into the representativeness of the respondents.

Table 2 compares the distribution of gender and enrolment status (international versus domestic student) for the population of registered users and for the respondents. While there is very good agreement in the gender split there is a higher proportion of international students amongst the respondents than in the population (70 per cent versus 60 per cent).

Table 2: Socio-demographic distribution of registered users and survey respondents

| | | Registered users (%) | Survey Respondents (%) |
|---|---|---|---|
| Gender | Female | 39 | 38.5 |
| | Male | 61 | 61.5 |
| Enrolment status | International | 60 | 69.7 |
| | Domestic | 40 | 30.3 |

There was no incentive for users to complete the survey apart from it being acknowledged in the recruitment email that their feedback would assist in improving the system over time. There is always the risk that surveys of this nature will appeal to individuals who are either very satisfied or very dissatisfied with the scheme. As will be described shortly, the respondents were indeed generally satisfied with the scheme however they provided extensive feedback on areas where they felt the scheme needed to be improved. While the risk of sample bias is acknowledged, the respectable response rate and generally good socio-demographic match suggest that the respondents provide an adequate representation of the population of registered users.

## Usage Patterns

For the week preceding the survey, respondents were asked to indicate which days they used the share bikes to travel both on and off campus. Figure 4 shows that between 60 and 70 per cent of respondents reported using a share bike on campus during the week. Off campus use is much lower during the week, with between 2 and 8 per cent of respondents indicating they used the bikes to travel off campus during the week. Usage reduces by about half on the weekend (to about 40 per cent of respondents) but the proportion of on and off campus use is about equal.

Apart from the use of the share bikes in a particular week, the respondents were asked how often they typically ride the share bikes to on and off campus locations. Figure 5 shows the results which again highlight the very different usage patterns on the weekdays versus weekends. While over three quarters (77 %) of the respondents indicated they are either regular or very regular users of the share bikes on campus, only about 16 per cent indicated they used the bicycles that frequently to access off campus locations. About half the respondents have never used the share bikes to access an off campus destination.

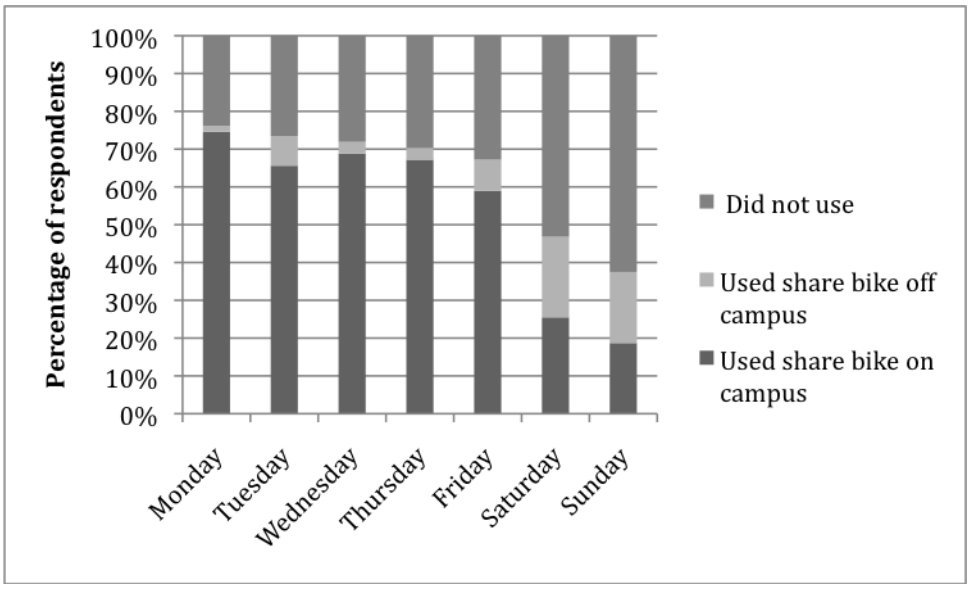
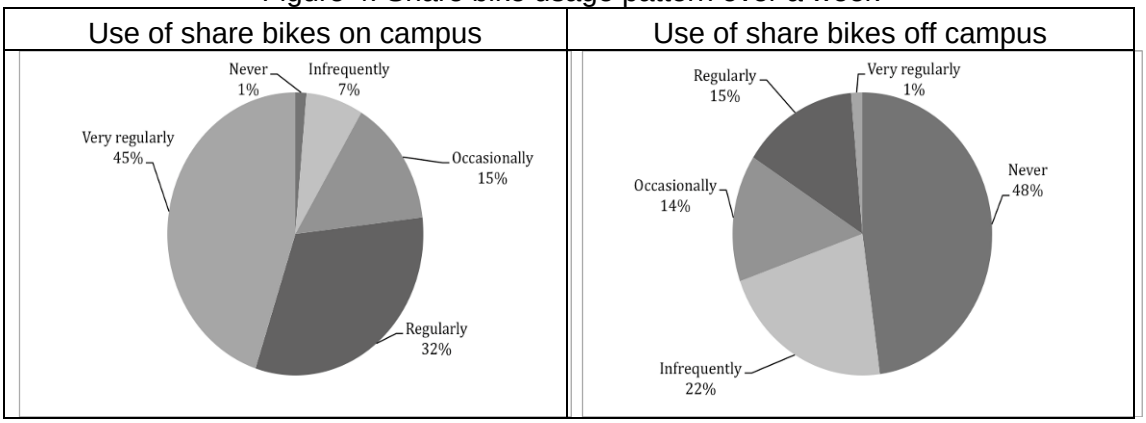



Figure 4: Share bike usage pattern over a week




Key: Response categories defined as follows: Infrequently (about once a month), Occasionally (once a fortnight), Regularly (at least once a week) and Very Regularly (more than three times per week

Figure 5: Frequency of use of share bikes for on and off campus travel

Respondents were presented with a list of destinations and asked to indicate which ones they visited on the share bikes. Table 3 summarises the responses and for the common off campus destinations the approximate riding distance is noted. Since respondents were asked to select all options which were applicable, the total for this question does not equal 100 per cent.

Table 3: Locations visited using the Monash Uni-cycles

| | Location (distance from Halls of Residence) | Percentage of respondents |
|---|---|---|
| Clayton campus | | 90.5 |
| Access to public transport | Campus bus interchange (1 km) | 58.7 |
| | Clayton railway station (2.5 km) | 9.5 |
| | Huntingdale railway station (3 km) | 3.2 |
| Shopping centre | Pinewood shopping centre (2 km) | 33.3 |
| | Brandon Park shopping centre (2.7 km) | 9.5 |
| Other | | 22.2 |

Just over 90 % of respondents indicated use of the share bikes to access the campus. Almost three quarters (71 %) indicated they had used the share bikes to access public transport – primarily via the Campus bus interchange but also for direct access the nearly railway stations located on a radial rail line serving the CBD. The Campus bus interchange is virtually on the other side of the campus from the Halls of Residence. While services radiate from the bus station, it is also the location for catching the free intercampus bus to the Caufield Campus (which is adjacent to a major railway station). By using the share bicycles to reduce the access/egress time it is possible that public transport became a more convenient option for students. Over 40 % of respondents indicated they had used the share bicycles to access nearby shopping centres, the most popular being the closest (Pinewood). Under the open ended 'Other' response students nominated a range of locations they had visited with the most frequent ones mentioned being friends houses, exploring the local area and exercise.

## User satisfaction

Using a five point Likert scale respondents were asked to indicate the extent to which they agreed/disagreed with a range of statements about the Monash BSS. Figure 6 shows that the response to the statement 'Overall, I am satisfied with the Monash Bike Share Scheme' were predominantly positive. When converted to a numerical value on a 1 (Strongly disagree) to 5 scale (Strongly Agree) the average satisfaction was 3.6. Males were slightly more satisfied than females (3.8 versus 3.4) while local students were overall more satisfied with the scheme than international students (3.9 versus 3.6).

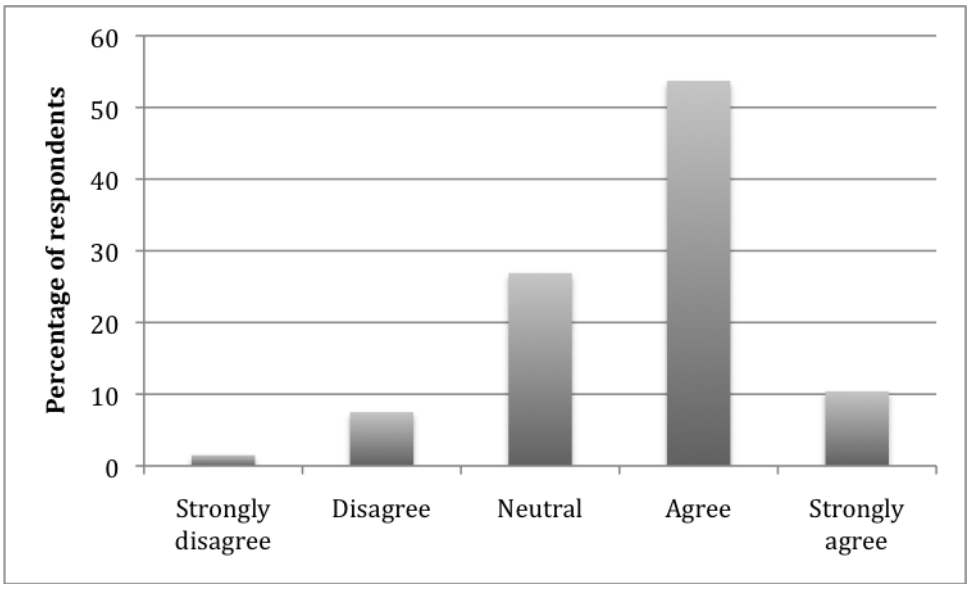



Figure 6: Extent of agreement with the statement that 'Overall, I am satisfied with the Monash Bike Share Scheme'.

A series of other statements were used to identify areas of concern with the design and operation of the scheme. The results in Figure 7 highlight that there were few strong views about the bikes being well designed, comfortable to ride and fitted with appropriate accessories. On average there was a neutral response to those aspects of the scheme with approximately the same proportion of respondents agreeing as disagreeing with the statements.

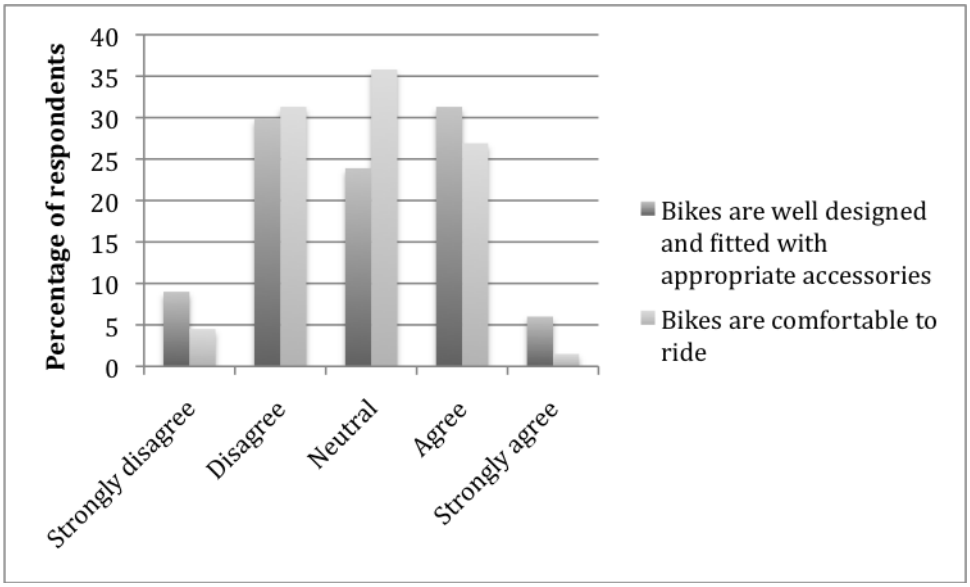



Figure 7: Satisfaction with design of the share bikes

Two other statements explored the perceptions of fleet size and maintenance. Figure 8 highlights concerns over the number of share bicycles available on campus and the level of maintenance. Around 70 % of students indicated that the disagreed or strongly disagreed that there were enough share bikes on campus and that they were well maintained. A later

open ended question sought information on the nature of reoccurring maintenance problems with common issues being: flat tyres, buckled wheels, brake problems, loose, broken or hard to adjust seats, broken baskets and snapped locks. One respondent highlighted that:

> *"The bikes are not being attended to even when they were locked to designated maintenance rails".*

Clearly there is scope to improve the maintenance practices. That in itself would help to improve the availability of bikes and thereby address the other concern about there not being enough share bikes on campus.

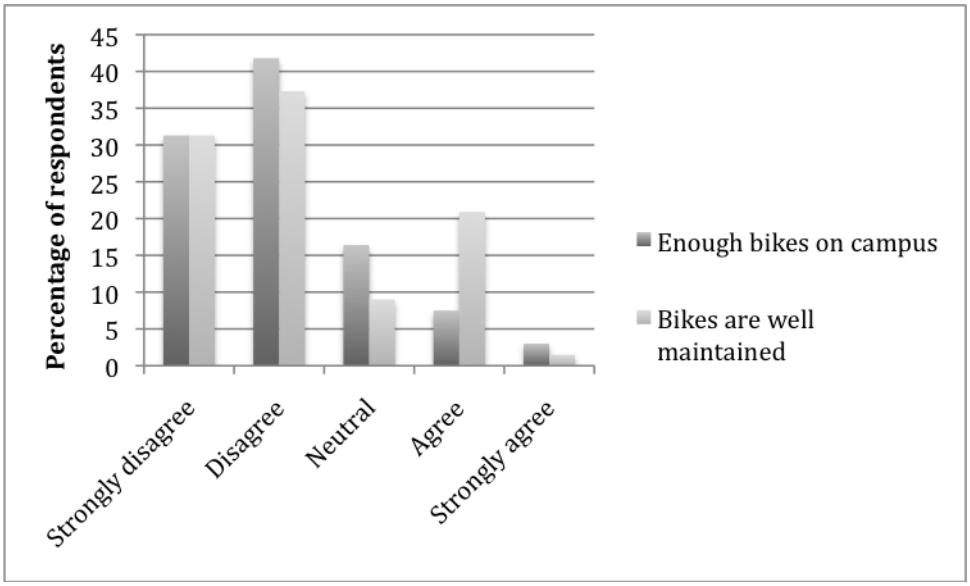



Figure 8: Satisfaction with fleet size and level of maintenance

As noted earlier, the provision of a fleet of single speed bikes was largely based on reducing the maintenance problems associated geared bikes. Respondents were asked to indicate whether they needed a bike with gears to ride on or off campus. Figure 9 shows that there were very different responses to these different riding contexts. While students did not feel that gears were needed for riding on campus (45 % disagree or strongly disagree) over two thirds of respondents (67.2 %) felt that gears were needed when riding off campus. The local topography around the campus is certainly not hilly so the desire for gears is likely to be motivated by the greater riding distance associated with accessing off campus locations (as noted in the earlier discussion) rather than the gears being needed for adverse terrain.

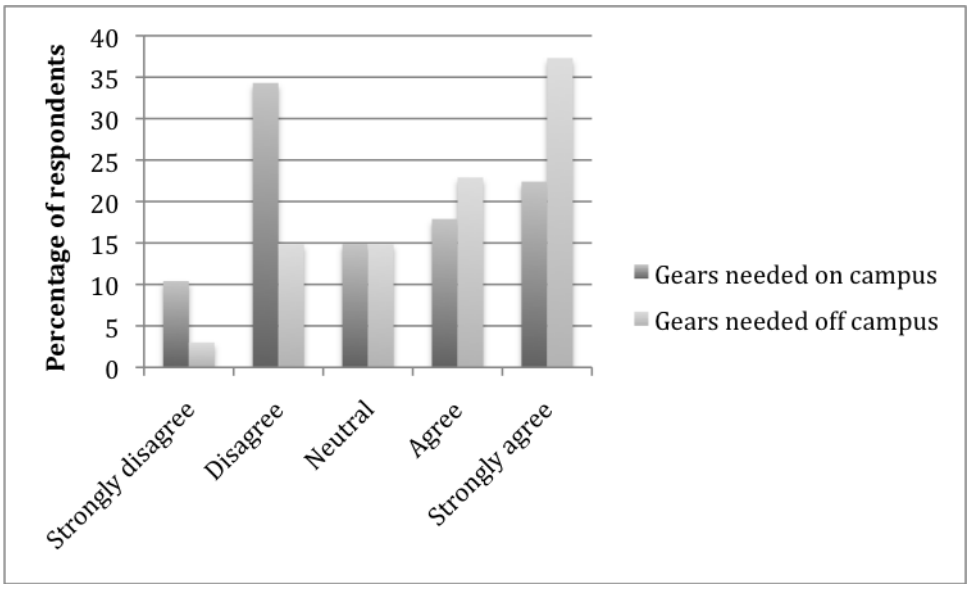



Figure 9: Respondents perceptions of the need for gears on the bikes when riding on or off campus

## Helmet use and safety perceptions

As noted in the introduction, Australia is one of the few jurisdictions that mandates bicycle helmet use. Of particular interest was the extent to which users of the share bikes wore a helmet. Respondents were asked how often they wore a helmet when riding on and off campus. Figure 10 highlights a sharp contrast in the self reported use of a helmet when riding in these two contexts. Approximately three out of four students report that they do not wear a helmet when riding on campus, while a similar proportion indicated that they always wear a helmet when riding off campus. It is acknowledged that there could well be a response bias in answering the question on helmet use since all registered users were informed at the time of registration about the legal requirement to wear a helmet. Actual helmet use would be expected to be lower than that reported. Limited observational data collected in 2009 confirms that expectation, since it indicated that only 10 % of share bike riders wore a helmet when riding the bikes on campus, yet 94 % for other riders coming onto campus on their own bicycles wore a helmet (Luzan, 2009).

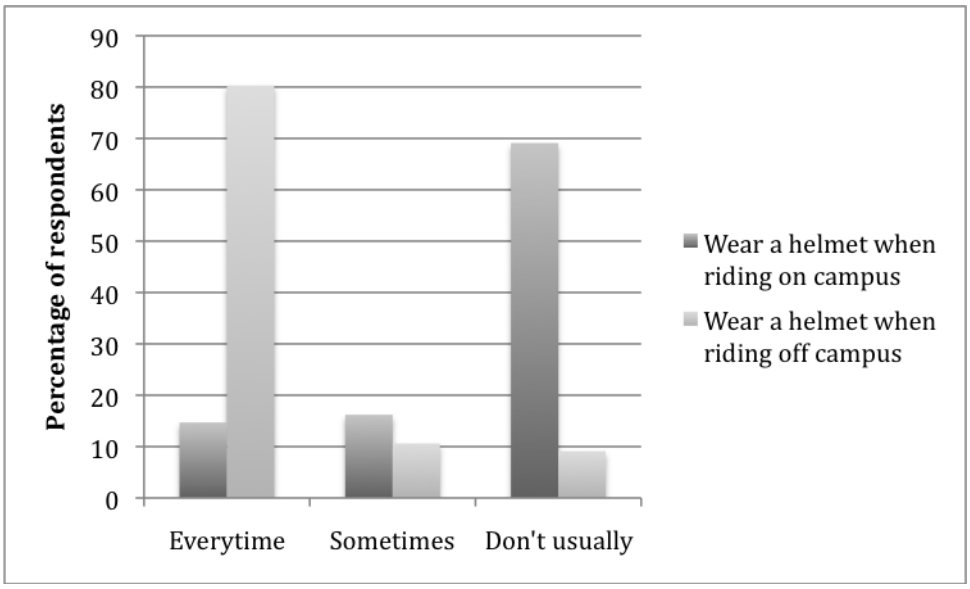



Figure 10: Frequency of helmet use

Respondents were asked to indicate the reasons why they do not always wear a helmet. In this case they were able to select all the reasons from a list that were applicable so the responses do not add to 100 %. Table 4 highlights that the most common reason cited was that the helmet is a nuisance to carry around at the end of the trip with that nuisance factor also being mentioned by half of the respondents who entered an open ended 'Other' response to this question. As noted by one of the respondents who provide an 'Other' response:

> *"I just don't feel it's entirely necessary* (to wear a helmet) *while on campus and is also a pain to carry once off the bike."*

People who ride their own bike to campus have the option of locking their helmet to the bike since they are the only person using the helmet and the bike. The share bike users don't have that option since there is no guarantee that they will be riding the same bike later that day.

Table 4: Reasons for not wearing a helmet

| Reason for not wearing a helmet | Percentage of respondents |
|---|---|
| It is a nuisance to carry round the helmet at the end of the trip | 89.8 |
| Forget to carry it and then decide to ride a share bike | 44.1 |
| I feel safe without it | 42.4 |
| It is uncomfortable | 35.6 |
| Other | 6.8 |

Riders were also asked to indicate the extent to which they felt safe riding in the on and off campus environments. As highlighted by the results shown in Figure 11, there was a much

higher degree of agreement that users felt safe when riding on campus (77.6 % agreed or strongly agreed) compared to off campus (only 28.4 % agreed or strongly agreed). The perception of the safety of the environment on campus most likely contributes to the lower use of a helmet when bicycles are ridden on campus.

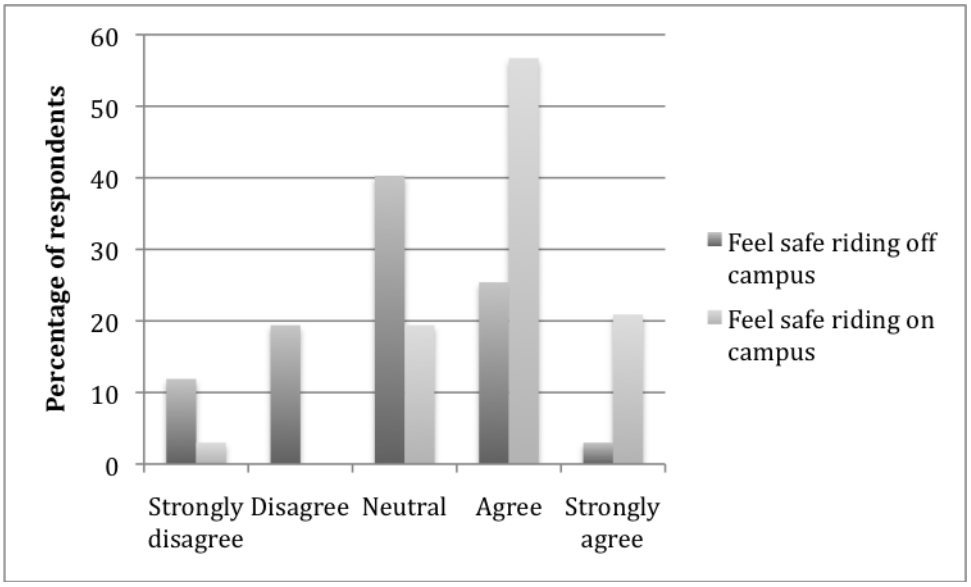



Figure 11: Perception of safety when riding on or off campus

## OPERATIONAL EXPERIENCE WITH THE MONASH BSS

The background discussion noted that BSS often suffer from abuse, vandalism and theft and may need to re-position bicycles to accommodate directional peaks in demand.

In the case of the Monash scheme there was a high need for maintenance. This may have been in part due to the variability in build quality associated with the reconditioning of the recycles bicycles. It also appeared that some of the faults were a result of abuse of the bikes – for example, pillion passengers sitting on the baskets on the back of the bike which not only bent the baskets but placed added strain on the rear wheels.

Towards the end of the 2009 academic year (about 2 months after the user survey was undertaken) there was a perception that the fleet of bicycles was reducing. At the end of the academic year only 20 of the original 58 share bicycles were recovered. This corresponds to a two thirds attrition rate after one academic year. Of those, only 10 to 15 were regarded as being able to be repaired to return them to a rideable condition. Clearly the bikes had suffered a high attrition rate. Informal discussions with users late in the academic year highlighted that students found the bikes could be unlocked by inserting the end of a teaspoon into the locking mechanism.

It also appeared likely that there would need to be effort put into repositioning some of the bicycles because bicycles were not being returned to the Halls of Residence at the end of the day. Again, informal discussions with users suggested that at the end of the day they often

preferred to walk back to Halls with friends rather than ride alone and on occasions when they looked for a share bike in the area where they finished classes on campus there were none available. Repositioning bicycles will require additional resources and add to the operating costs of the scheme in the future.

# CONCLUSIONS AND FUTURE DIRECTIONS

The launch of the Monash Uni-Cycle pilot scheme has clearly provided an excellent opportunity to experience the triumphs and challenges of bringing on-line a bicycle share scheme. The bicycles were well utilised on campus and the users were positive about the scheme, while flagging areas where it can be improved. Consistent with implementing a scheme in a low cost environment, manual locking of the bicycles was employed, in a manner consistent with a 2$^{nd}$ generation bicycle sharing scheme. While relatively simple to implement, the locks did not prove to be secure. A high incidence of abuse, vandalism and theft resulted in a high attrition rate for the bicycles.

Highest use occurred during the week – primarily to access campus – while weekend use, while about half the weekday level, was evenly split between on and off campus riding. Consistent with international experience, the Monash Uni-Cycle scheme was used extensively to access with public transport. While users where clearly satisfied with the scheme they expressed reservations about the availability of bicycles and the adequacy of maintenance practices. While there was a strong environmental logic in using a fleet of reconditioned bicycles, the use of these bicycles is likely to have contributed to the maintenance challenges the scheme faced. When compounded by under resourcing of the maintenance activities, that effectively reduced the number of share bicycles available over time. To minimise maintenance the bicycles were built with a single gear. While users perceived this to be appropriate for riding on campus there was a strong sense that gears were needed for off campus riding possibly due to the longer riding distances required to access the nearly activity centres where students wished to travel.

Helmet use was found to be low when riding on campus while users reported higher (but not 100%) helmet use when riding off campus. The inconvenience of carrying the helmet round at the end of the journey was sited as a major reason for riding without a helmet. This was compounded by the users' perception that the campus was a safe place to ride without a helmet. Similar factors may influence the behaviour of users in public share bicycle schemes which are to operate in jurisdictions where mandatory helmet use laws apply.

The university remains committed to the concept of the Monash Uni-cycle scheme. To that end, a fleet of 100 identical bicycles are being purchased and will be made available at the start of the 2010 scheme. The use of a uniform vehicle is expected to improve the efficiency of the maintenance practices. Work is on-going in an effort to improve on the locking mechanism for 2010. Another user survey will be run late in 2010 to again assess the reactions to the scheme. In that survey, more effort will be made to understand the broader travel impacts of the scheme including whether trips would have been made in the absence of the Uni-cycle scheme and if so by what mode. This is expected to provide a richer

understanding of the impact of the scheme on the student's mobility. In addition, there is scope to conduct a survey of residents living at the student accommodation centre who are not registered users, to gauge their perceptions and interest in registering for the scheme. The insight from that non-user survey would be useful in the context of decisions to expand the scheme. Observational surveys will be used to more extensively measure helmet use and also to collect evidence of unbalanced flows in the use of the bicycles which might necessitate the introduction of a redistribution arrangement for the bicycles.

## DEDICATION

This article is dedicated in the memory of James Gormley, the sustainable transport officer in the Office of Environmental Sustainability at Monash whose vision, energy and enthusiasm was fundamental to the launch of the Monash Uni-cycle scheme. James tragically lost his life in the Black Saturday bush fires which swept Victoria in February 2009, only a couple of weeks before the official launch of the scheme.

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