

Understanding Ownership and Use of Powered Two Wheelers in Melbourne

Geoff Rose¹, Russell G. Thompson¹, Babak Amani¹ and Rod McClure¹

¹Institute of Transport Studies, Monash University, Clayton, Victoria 3800

Email for correspondence: russell.thompson@monash.edu

Abstract

Increasing concerns over traffic congestion, safety, availability of energy sources and environmental issues such as pollution and climate change have led to growing interest in sustainable urban transport. These challenges arise from the rapid growth of motor vehicle ownership and use in urban areas. While most of the focus has been on motorcars, the role, use and sustainability impacts of Powered Two Wheelers (P2Ws) have received relatively little attention by comparison.

Sales of P2Ws in Australian cities have grown rapidly during the last decade, but there is little knowledge of the factors that influence the ownership and use of P2Ws in Australian cities. This paper identifies characteristics of the households who have P2Ws as well as the usage patterns of P2Ws in Melbourne.

A range of disparate data has been analysed in an effort to understand the complex demand patterns associated with P2Ws. The insights gained will be required to develop policies for managing P2Ws in the context of a sustainable urban transport mode.

The Victoria Integrated Survey of Travel and Activity (VISTA) conducted in 2007 was used for exploratory analysis. Characteristics of households with P2Ws as well differences between the purpose and duration of trips using P2Ws and other vehicles were determined. An extensive patrol survey was undertaken in Melbourne's Central Business District (CBD) to gain insights into the role of P2Ws in commuting demand.

1. Introduction

The increasing concerns over congestion, safety, availability of energy sources and environmental issues such as pollution and climate change have led to growing interest in sustainable transport. These challenges arise from the rapid growth of motor vehicles ownership and use in urban areas ([Tollman and Rose 2008](#)). While the motorcar is the focus of much attention in the context of sustainable mobility ([Sperling and Gordon. 2010](#)); motor cycles and motor scooters have received relatively little attention in comparison. Increasingly the term Powered-Two-Wheel (P2W) vehicle is being used cover a range of two or three wheel vehicles from mopeds (low power motor cycles typically with engines less than 50cc and usually with a maximum speed of 50 kph) to motor scooters and motorcycles (Victorian Government, 2009). In the context of sustainable mobility, the opportunities P2W vehicles present have not been investigated in detail (Rose, 2009).

Many P2W studies have a road safety focus because these vehicles are over represented in crash statistics both in Australia and overseas ([Christie et al. 2001](#); [Christie 2002](#); [Harrison and Christie 2005](#)). The motorcycle's environmental performance, and in particular its exhaust emissions, have attracted research interest. While motorcycles produce more CO, NO_x and HC emissions in comparison with gasoline powered passenger cars, their CO₂ emissions are much lower ([Vasic et al. 2006](#)).

Both the safety and environmental impacts are a function of the extent of use of P2W vehicles. However there is little knowledge of the patterns of ownership and use, or the factors influencing ownership and use of P2W vehicles in countries like Australia. This paper reports insight into the ownership and use of P2W vehicles in Melbourne based on analysis of existing data sources and a CBD focussed survey of parked P2Ws. The research reported here is part of a broader study examining the management of P2Ws as part of a safe, sustainable transport system.

The structure of this paper is as follows. The following section provides insight from an initial review of the literature. The study approach is then outlined before the insight obtained from the various components of the analysis are presented. The final section summarises the conclusions and identifies future research directions.

2. Literature Review

There is relatively little literature which deals with P2W vehicle ownership and use especially in the context of western countries. Studies from eastern Asian countries predominate ([Hsu et al. 2007](#); [Priyantha Wedagama 2009a](#); [Dissanayake et al. 2010](#); [Wen et al. 2011](#)) however the overall trend and attitudes toward P2W ownership and usage would not be expected to be consistent with conditions in western countries. While increasing income in developing countries is associated with increase in both car and motorcycle ownership, in developed countries economic growth has seen the stronger growth in car ownership ([Lai et al. 2007](#)).

2.1 P2W Ownership

Worldwide there is on average 33 mopeds and motorcycles per 1000 persons. Countries with the highest numbers of mopeds and motorcycles include China (about 100 million), India (about 40 million) and Indonesia (with 30 million) followed by Thailand, Vietnam and Japan ([Roger 2008](#)). The top eight countries all have ownership levels in excess of 100 per 1000 persons while Australia is ranked 115th with 18 per 1000 persons (www.worldmapper.org). P2W ownership in Australia is similar to that in Chile (18), USA (17), New Zealand (21), the Netherlands (25) and the UK (28).

Factors identified as influencing motorcycle purchase and use include their performance, convenience, the freedom they provide, parking availability ([Prabnasak et al. 2008](#)) at low or no cost; and their ability to manoeuvre through traffic and thereby save time ([Hsu et al. 2003](#); [Leong et al. 2007](#); [Priyantha Wedagama 2009a](#)). Fuel prices and traffic congestion are other variables found to influence motorcycle purchase and use ([Coxon 2002](#); [Jamson et al. 2004](#); [Blackman et al. 2010](#)). Of course the reliability and convenient of cars ([Hsu et al. 2007](#)) especially for longer trips along with their greater passenger carrying capacity ([Priyantha Wedagama 2009b](#)) and the insulation they provide from hot and rainy weather makes them preferred alternative to the motorcycle. Consequently, Powered Two Wheelers are popular in warm southern European countries ([Yannis et al. 2007](#)) and many Asian countries. Age is another important variable as motorcycle ownership is prevalent among younger age groups in Europe Asia ([Sanko et al. 2006](#)) and also more commonly owned by people with less education ([Hsu et al. 2003](#)) most likely reflecting an income effect. In western countries there is a growing segment of older, returning riders who purchase a motorcycle for primarily recreational use (Haworth, 2010)

There are differences in the reasons underlying car and motorcycle purchase decision in eastern Asian countries ([Lai et al. 2007](#); [Priyantha Wedagama 2009b](#)) compared to developed countries. Most of the parameters and conditions described above from income level to less concerns about safety when purchasing or using motorcycle are not the same as in developed countries. When exploring factors underlying P2W ownership in the U.K., Jamson et al. ([2009](#)) found important difference between riders' attitudes depending on whether they were new riders, long-term riders or returning riders (those who have returned to riding a motorcycle after a break). Long-term and especially returning riders had a preference for higher powered or sportier motorcycles and engaged in more leisure trips. Returning riders gave more value to status and image while long-term riders thought about the suitability of the motorcycle for leisure activities. In contrast, new riders favoured lower capacity P2Ws including mopeds or scooters for commuting trips giving more value to economic factors and convenience. Table-1 summarizes the five most important reasons underlying motorcycle purchase decisions, for the three groups of riders.

That same U.K. research found that the nature of motorcycle ownership has changed from 1950's to the 1990's. Table-2 highlights the priorities underlying motorcycle purchase decisions over those decades changed from concerns about independence, style and speed, which were associated with increases in engine size to more priority towards running cost and congestion with more purchase of lower engine capacity vehicles in the 1990's ([Jamson et al. 2009](#)).

Table 1. Rank ordered reasons for purchasing a motorcycle ([Jamson et al. 2009](#))

Reasons	New Rider	Long-Term Rider	Returning Rider
1 st reason for purchase	Love Motorcycle	Love Motorcycle	Love Motorcycle
2 nd reason for purchase	Freedom	Freedom	Leisure Activity
3 rd reason for purchase	Avoid Congestion	Leisure Activity	Freedom
4 th reason for purchase	Cheaper Running Expenses	Avoid Congestion	Avoid Congestion
5 th reason for purchase	Parking	Maintenance	Image related

Table 2. Ranked Reasons behind P2W Purchase Decisions in the U.K. ([Jamson et al. 2009](#))

1950s, 1960s, 1970s	1980s	1990s
Independence	Independence	Running Cost
Type of Activity	Type of Activity	Congestion
Leisure	Leisure	Style
	Style	Image
		Speed

Bruge et al (2007) used data from the UK in a discrete choice model to examine the choice of the number of motorcycles which a household owned. The model demonstrates the significance of a range of socio-economic factors in explaining motorcycle ownership. Respondents in the 25 to 50 year age bracket, who were not employed in professional or managerial roles, were male and resided outside metropolitan areas in households without children were more likely to choose to own at least one motorcycle.

2.2 P2W Use

Only a relatively small number of studies have been conducted of usage as a function of P2W type (make, model and engine capacity).

A study conducted in Greece ([Yannis et al. 2007](#)) collected data from individuals about the annual mileage ridden on moped or motorcycle along with annual mileage by car. Yannis et al. (2007) sought to explore those measures of usage (which were treated as the dependent variable in the analysis) as a function of the some demographic characteristics of the respondents. They found that the mileage driven by cars and motorcycles initially rises with the age of the driver (rider) but then declines at higher ages. For mopeds a different relationship was observed with annual mileage ridden on a moped declining with the age of

the rider. The vehicle engine size has shown a trend in which by increasing engine size of motorcycle usually the yearly mileage ridden increases perhaps reflecting greater recreational use of higher powered motorcycles. In Greece, Yannis et al. (2007) found that for short trips especially in residential areas, when both cars and P2Ws are available, there is a preference to use the P2Ws. However for long distances and trips outside residential areas, the car is preferred mode of travel in Greece (Yannis et al. 2007). More than other modes, the time spent riding is usually regarded as enjoyable by riders, and it has a positive impact on use (Burge et al. 2007).

The major trip purposes and pattern of use in developing countries (Hsu et al. 2003) and particularly European countries such as Greece (Yannis et al. 2007) are mostly for commuting, shopping and school. These trips mostly happen during the weekdays and daytime, instead of night or weekend trips and P2Ws are more used as a tool for the purpose of mobility and recreational use is less important. But in other developed countries like US and Canada the most common reason is touring and recreation which has produced a trend toward higher engine size P2Ws (Haworth 2010).

In terms of aggregate use, Wigan (2002) draws on Melbourne data to suggest that 0.5 % of traffic flows at any on location could be expected to be by motorcycles. He refers to this a lower-bound guide (derived from classified counts). Wigan acknowledges motorcycle use will vary by location and uses a relationship between crashes and motorcycle flows to estimate motorcycle flows at locations where there have been motorcycle crashes. That provides a flow indicator with greater geographic variability than the crude 0.5 % of traffic flow indicator.

Motorcycles typically account for under 1 % of journeys to work (Richardson, 2010). Data from the 2006 Census highlights that the six Victorian LGA's that had the highest proportion of work trips by motorcycle were all regional and even in those cases, the motorcycle accounted for only between 1.0 and 1.5 % of the trips (Richardson, 2010). However while only just over 20 % of car trips are associated with journey to work, over a third (35 %) of trips by motorcycle are for commuting. Around one third of all motorcycle kilometres travelled are for business or work purposes. Motorcycle trips typically are strongly home based (to work, shopping or social/recreational), with a much smaller proportion making additional trips during the day when compared to other motorized modes.

Wigan (2002) used data from the six years of travel surveys conducted in Melbourne to develop an understanding of the relative performance of different modes. The results show that motorcycle trips are on average longer than any other mode (except train), that they have the highest average speed and the third shortest trip time (ahead of the public transport modes). The value proposition to users possibly reflects the fact that these vehicles offer comparable or superior speed to a car but with potentially lower capital and operating costs, superior performance to the bicycle and much improved performance over public transport.

Richardson's (2010) analysis of the VISTA travel survey data from Melbourne and regional Victoria highlighted that:

- Motorcycles are used for fewer trips per day than other motorized modes (Motorcycles used on average for 2.85 trips per day versus 3.92 for vehicle driver trips)
- Although the data suggests that motorcycle trips are on average longer than car driver trips there is substantial uncertainty (reflecting the small sample sizes) compounded by what appears to be under-reporting of touring trips in the VISTA data.
- The timing of motorcycle trips is similar to that of car driver trips with about 50 % occurring in the peak periods.
- Use was dominated by males (89%) for the journey to work.

Insight into use of P2Ws in an Australian context is also provided by a study conducted in NSW (Harrison and Christie, 2005). That study had a road safety emphasis and sought to measure aggregate use (exposure). Participants in the study reported their odometer readings at two points in time about 6 months apart (roughly January and July) and also provided estimates of their riding distance in the preceding week, month and year along with their estimate of the percentage of their riding that occurred in different riding contexts, at different times of the week and for different purposes.

Harrison and Christie (2005) found that males ride greater distances overall compared to females (3637 km p.a. compared to 2760 km p.a.) and on weekdays (1233 km versus 440 km). Wigan (2002) also reported higher annual km for men compared to women motorcycle riders across all age ranges. Harrison and Christie found that commuting (in terms of annual riding exposure) was highest for riders in the youngest age quartile (782 km p.a.), relatively high for those in the second age quartile (530 km p.a.) and then dropped substantially for older age riders. The study classified the vehicles as either Traditional, Cruiser, Sports, Touring, Trail/dual use and Scooter. There was a statistically significant difference in the annual exposure across the different vehicle types with the average figures for trail/dual use and scooters (at about 1,700 km p.a.) roughly half that of the other types of P2W. Touring bikes had the highest annual km. Scooters were found to have the greatest use for commuting, where they are used for approximately twice the annual km of traditional bikes.

3. Study Approach and Methodology

As noted in the introduction, this paper seeks to obtain insight into the ownership and use of P2W vehicles in Melbourne drawing on analysis of existing data sources and a CBD focussed survey of parked P2Ws. Table 3 highlights the nature of the data sources examined in this paper and their relationship to enhancing understanding of the ownership and use of P2W vehicles in Melbourne.

Table 3 Insight into P2W ownership and use from different data sources

Data Type	Ownership	Use
Census	<p>P2W sales data</p> <ul style="list-style-type: none"> Trend in national sales over time Proportion of sales by type of P2W <p>Registration Data</p> <ul style="list-style-type: none"> Trends in registration over time Geographic distribution of ownership across the city 	X
Sample	<p>VISTA Travel Survey</p> <p>Relationship of ownership to</p> <ul style="list-style-type: none"> socio-demographic variables Relationship of P2W ownership and that of other motor vehicles 	<p>VISTA Travel Survey</p> <ul style="list-style-type: none"> Purpose of trips compared with other motor vehicles Duration of trips compared with other vehicles <p>CBD Parking Patrol survey</p> <ul style="list-style-type: none"> Parking duration by type of P2W Arrival and duration patterns Trip length distribution by type of P2W

National motorcycle sales data reported by the Federal Chamber of Automotive Industries. classify motorcycles by type but do not provide details of the location of sales. A census of motor vehicle registrations is reported annually (ABS, 2012) providing information regarding the year of manufacture, postcode, make and model of motorcycles. VISTA is a large scale household travel survey based on a 1 day travel diary with over 10,000 households in Melbourne surveyed over a 12 month period. Details of the number of motorcycles kept at each household and the modes (including motorcycle) used for trips are reported.

Melbourne is the only capital city in Australia that allows motorcycles to be legally parked on footpaths for free. Motorcycles parked on footpaths must be not obstruct the free passage of pedestrians. There are also over 300 on-road parking spaces designated for motorcycles in Melbourne's CBD. Since parked motorcycles can easily be observed on footpaths and in median parking areas, a patrol survey was conducted to provide information relating to the type of P2Ws, the timing and location of parking as well as the estimated trip distances (using the postcode of the registered address made available from VicRoads).

4. P2W Sales Trends

The annual pattern of motorcycle sales (excluding mopeds) in Australia from 2003 to 2011 is presented in Figure 1. Sales grew steadily from early 2003 to 2008. Between 2008 and 2010 annual sales declined by 22 most likely due to the impact of the global financial crisis. Between 2010 and 2011 annual sales increased by 3.6 %. Over the period covered by this data, motorscooters have approximately doubled their share of P2W sales (Figure 2) from 5.5 % to 10 %.

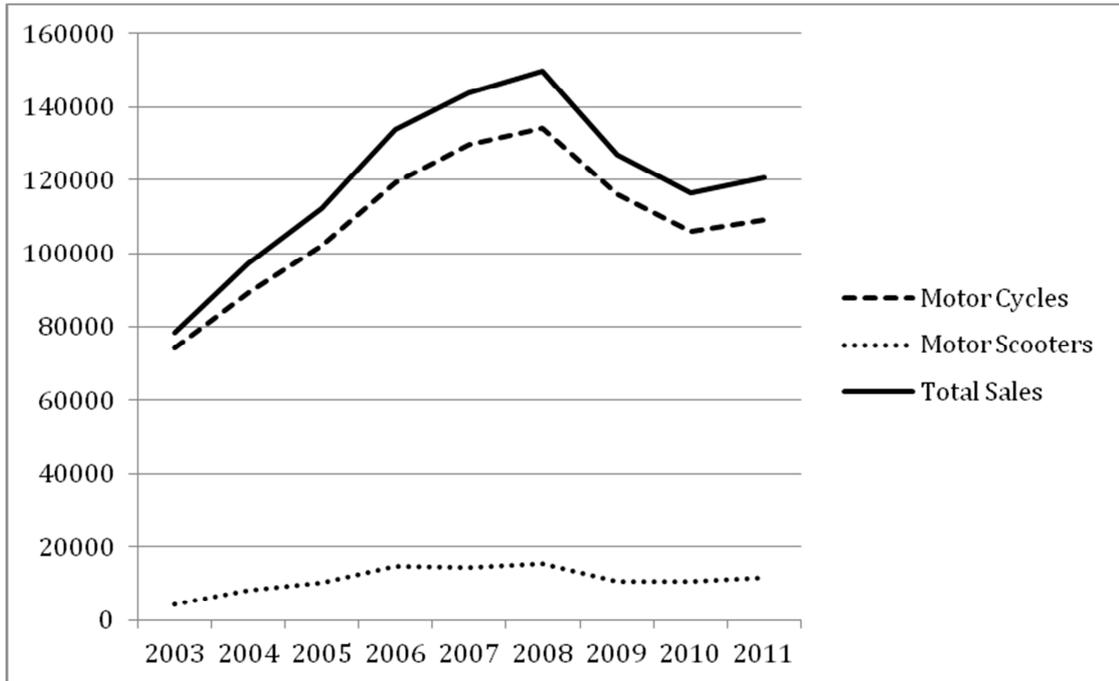


Figure 1 Trend in annual Motorcycle and Scooter sales in Australia (Source: Federal Chamber of Automotive Industries (FCAI) reports)

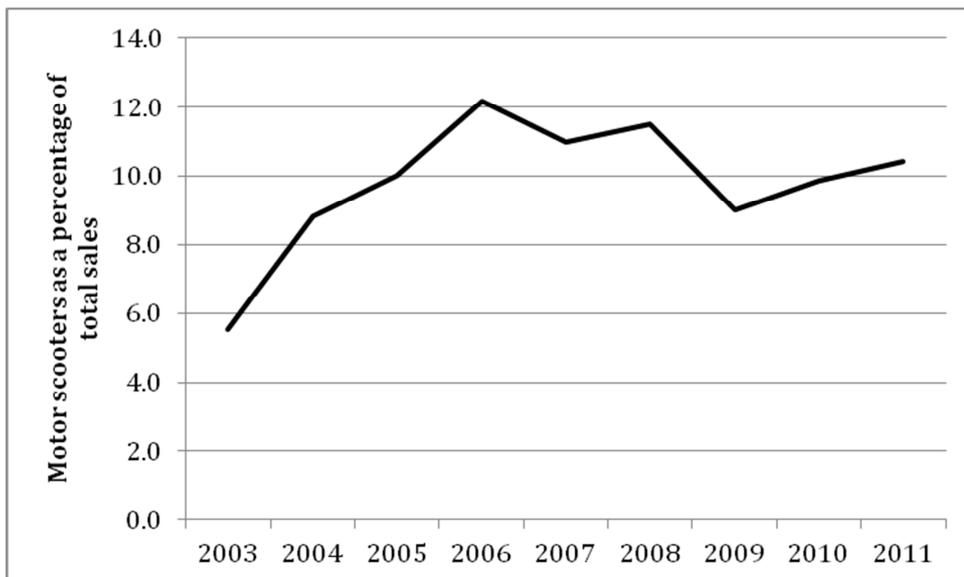


Figure 2 Motor scooter sales as a percentage of total sales

These sales figures provide insight into some important trends but they are only available at a national level. It is not possible to determine to what extent the overall changes in sales growth or the proportion of scooters varies across states. We now turn to registration data which provides insight into trends over time in Victoria but is not able to distinguish the type of P2W (i.e. motor scooter versus motor cycle).

5. Recent Trends in P2W Registrations in Melbourne

There has been considerable growth in motorcycle registrations in Melbourne since 2003. The Motor Vehicle Census data from the Australian Bureau of Statistics was used to analyse this growth. Registrations were extracted for each metropolitan postcode in Melbourne. This allowed trends to be analysed by local government area and metropolitan region (Figure 3 and Table 4).

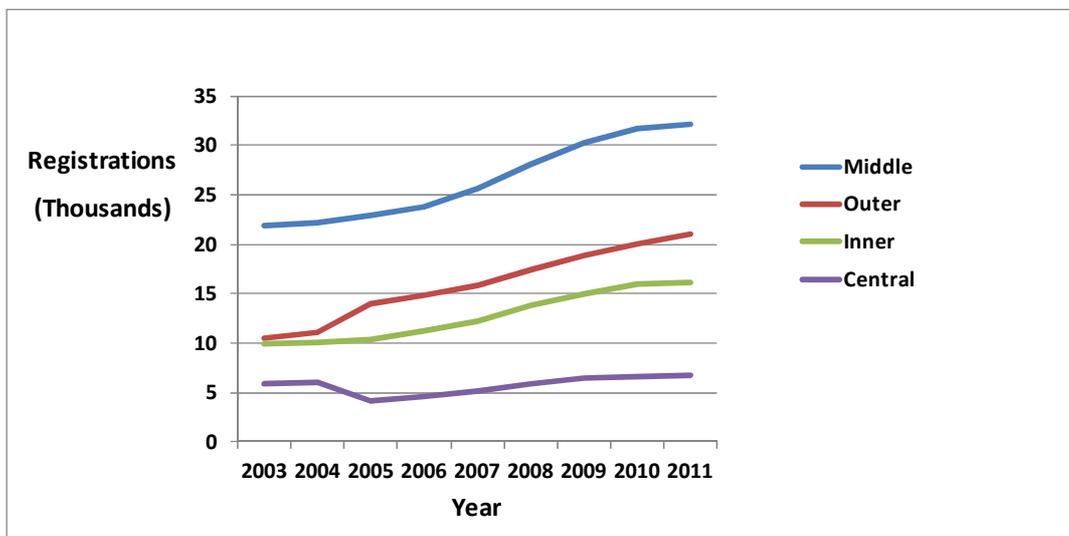


Figure 3 Motorcycle Registrations in Melbourne Regions

The largest growth between 2003 and 2010 in percentage terms was in the outer region (47%) with the lowest being in the central region (14.6%). An overall increase in registrations of over 10,000 motorcycle were recorded in both the middle and outer regions.

Table 4 Motorcycle Registrations in Melbourne’s Regions

Region	Motorcycles 2003→2010		Population 2003→2010		$\frac{(\Delta \#MC \text{ (veh.)})}{\Delta \#persons} \times 100$
	$\Delta \#MC$ (Veh.)	$\Delta \#MC$ (%)	$\Delta \#persons$	$\Delta \#persons$ (%)	
Middle	9805	44.8	97170	6.9	10.1
Inner	5970	60.0	74636	9.2	8.0
Outer	9513	90.1	276119	24.2	3.4
Central	697	11.7	51733	23.3	1.3
Total	25985	53.8	499658	14.0	5.2

6. P2W Ownership and Usage in Melbourne

An analysis of factors influencing whether a household had at least one motorcycle was undertaken using VISTA (Table 5). A number of these factors suggest that motorcycles are commonly owned by households with several persons, moderate to high car ownership with another large vehicle. This suggests that motorcycles could be commonly acquired and used for recreational purposes.

Table 5 Factors influencing at least 1 motorcycle being parked at a household

<i>Factor</i>	<i>Household category with substantial difference</i>	<i>Level of Significance (%)</i>
Number of persons	Single person underrepresented 4 person overrepresented	0.5
Demographic structure	Single person underrepresented Single-parent underrepresented	0.5
4 Wheel Drive (4WD) vehicle	At least one 4WD overrepresented	0.5
Ute	At least one ute overrepresented	0.5
Van	At least one van overrepresented	0.5
Truck	At least one truck overrepresented	0.5
Type of dwelling	Flats or apartments underrepresented	1
Number of cars	3 or more cars overrepresented	2.5
Year lived at address	11 -15 years overrepresented	2.5

VISTA also provides an opportunity to compare characteristics of trips using motorcycles with other motor vehicles. A number of differences were identified in the use of motorcycles compared with other vehicles based on the purpose of trips for persons living in Melbourne. Trips by motorcycles were less likely to be for accompanying someone, picking up or dropping off someone or for education than for other vehicles. However, trips for work related purposes were overrepresented by motorcycles compared with other vehicles. Trips where motorcycles were the main mode were substantially longer (average 25.7 minutes) than for trips using other vehicles (average 19.6 minutes).

7. Melbourne's CBD P2W Demand Patterns

A parking patrol survey was conducted on 15th September 2011 in Melbourne's Central Business District (CBD). The type of P2W (sports, scooter, cruiser, conventional, trail or other), location and patrol period (8-9am, 9-10am, 10-11am for footpaths & 8-9:30am, 9:30-11am, 3-4:30pm & 4:30-6pm for median parking) and registration plate was recorded for all P2Ws parked on the footpaths of the main streets (including "little" streets and main lanes) and 11 median parking areas.

A total of 1461 P2W vehicles were observed at a specific locations. Most P2Ws were observed on the footpath (1315), although a significant number (146) were observed in median parking areas. Both sports bikes and scooters dominated the observations (Table 6).

Table 6 P2W observations by type vehicle

	No.	%
Sports	606	41.5
Scooter	563	38.5
Cruiser	140	9.6
Conventional	110	7.5
Trail	34	2.3
Other	8	0.5
Total	1461	100

The peak demand occurred in mid afternoon period on the footpaths and in the late morning for medians. For all P2W types the peak demand on footpaths was early afternoon or late morning with more scooters were observed in the final period than sports bikes. For all P2W types the peak demand in the medians was late morning, with sports bikes and scooters dominating the total demand in all periods.

The sighting patterns of P2Ws were investigated. A substantial proportion of P2Ws observed on footpaths were long or medium term parkers. It was found that sighting patterns and P2W types (scooter, sports and others) were not independent with a number of significant differences between the observed and expected counts based on relative proportions:

- (i) Scooters were underrepresented in morning only sightings,
- (ii) "Others" (non scooters and sports bikes) P2W types were well underrepresented for those observed only in the afternoon,
- (iii) Scooter were overrepresented and sports bikes underrepresented in the late afternoon only sightings, and
- (iv) Sports bikes were underrepresented and the "Others" types overrepresented in the mid and late morning only sightings.

There was found to be a statistical significant difference between the parking durations and P2W vehicle types parked on the footpaths at the 10% level with sport bikes being overrepresented in the long term duration category and scooters overrepresented in the short term durations.

A statistically significant difference between the parking durations and P2W vehicle types parked in the median parking areas was also found at the 5% level with non sports bikes and scooters being overrepresented in the medium term duration category and scooters underrepresented in the short term durations.

The postcode of the registered address of the numberplates on the P2Ws observed was gained from VicRoads. Trip distances were estimated using the straight line distance between the centroid of the registered postcode and the GPO in Melbourne.

The mean trip distances for scooters (15.5km) and sports bikes (17km) was not significantly different at the 10% level. However, when distances greater than 50 km were omitted the difference in the means between scooters (10.5km) and sports bikes (13.4km) was significant at the 0.1% level. Scooters had the highest frequency trips less than 10km whilst sports bikes had the highest frequency trips greater than 10km and less than 40km (Figure 4).

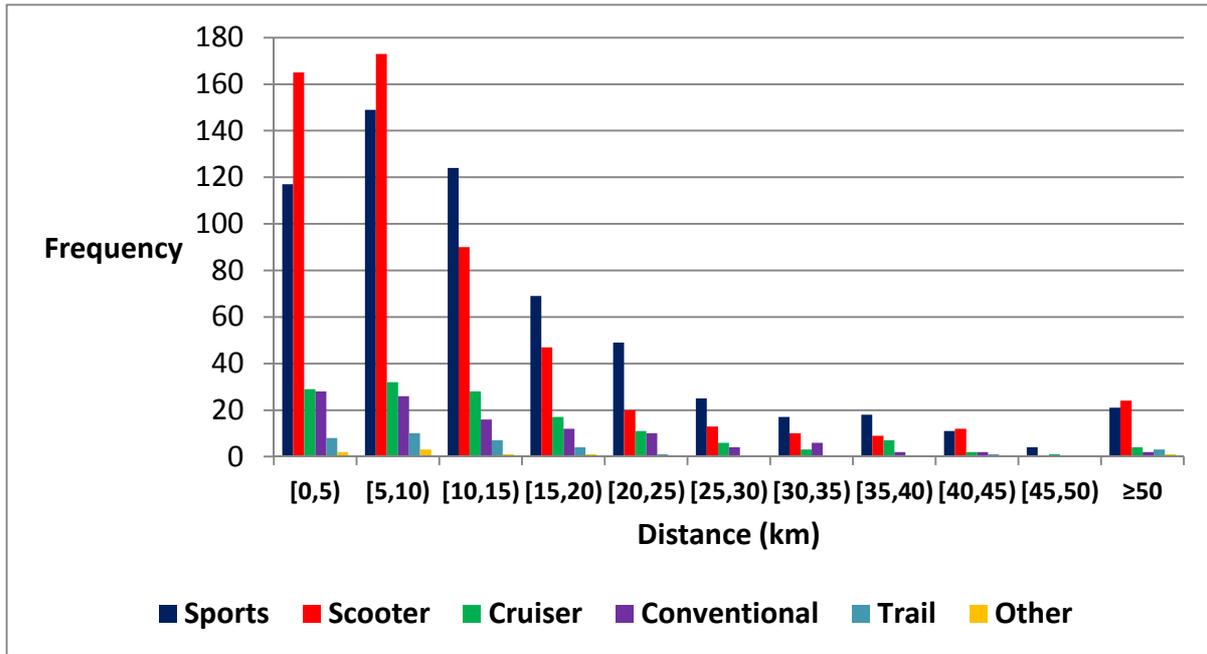


Figure 4 Frequency of Estimated trip distances by P2W type

The density of P2Ws parking on footpaths was determined by defining links that are segments of footpaths between intersections. Link densities were calculated throughout the CBD allowing the location of links with moderate or high densities to be mapped (Figure 5). Although a high proportion (around 87%) of links had a low density of P2Ws, over 30 links were observed with at least 5 P2Ws/100m parked between 3pm and 4pm. The location of these links were generally adjacent to large office complexes, not near the major retail precincts.

Understanding Ownership and Use of Powered Two Wheelers in Melbourne

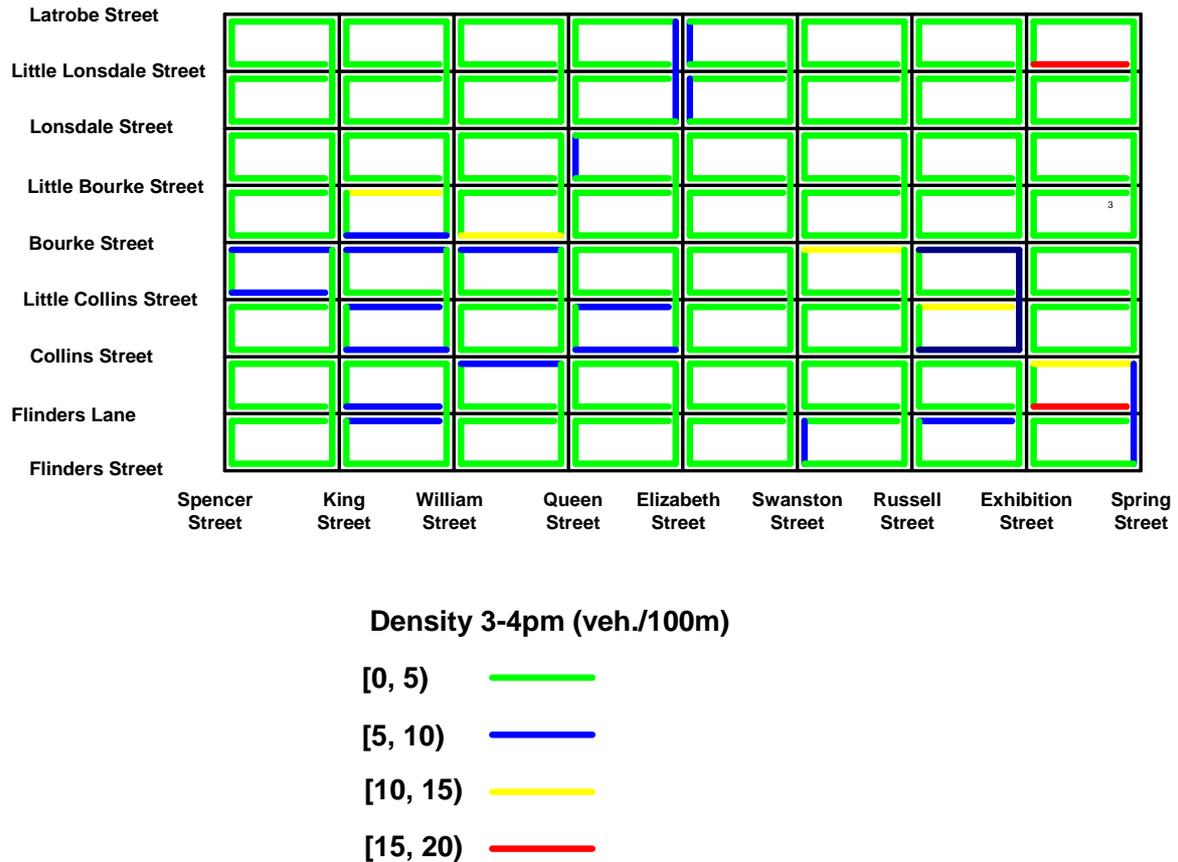


Figure 5 Schematic map of P2W densities observed in Melbourne's CBD

8. Conclusions

P2W sales and registrations are a growing segment of the motor vehicle fleet in Australia. However, there is currently little knowledge of their role, especially as a commuting mode. This paper presents preliminary analysis of P2W demand patterns in Australia. Insights into the role of motorcycles for transport in Melbourne is provided. A number of characteristics of households that have motorcycles in Melbourne were identified. The nature of P2W commuting patterns was investigated using a patrol survey conducted in Melbourne's CBD that provided some insights into the type of P2Ws used, distances travelled as well as arrival and duration patterns.

There is currently a limited range of P2W demand data available from a number of different sources. Each dataset provides some insights for understanding the complex behaviour associated with P2W ownership and usage in urban areas. This paper presents background information that is a prerequisite for developing policies for determining how P2Ws maybe able to contribute towards sustainable urban transport.

Acknowledgments

This research was supported under the Australian Research Council's Linkage Projects funding scheme (Project LP100200197) and conducted in conjunction with VicRoads, the Victorian Department of Transport, the Transport Accident Commission, the Royal Automobile Club of Victoria and the Federal Chamber of Automotive Industries. The views expressed herein are those of the authors and are not necessarily those of the Australian Research Council or any of the organizations associated with the project.

References

- ABS (2012). Motor Vehicle Census 9309.0, Australian Bureau of Statistics, Canberra.
- Bruge, P., Fox, J., Kouwenhoven, M., Rohr, C. and Wigan M.R. (2007) 'Modeling of motorcycle ownership and commuter usage'. Transportation Research Record No 2031. Transportation Research Board of the National Academies, Washington D.C. 59-68.
- Christie, R. (2002). "Investigating of Motorcycle Crash Patterns for Riders Aged 17-25 in NSW and Development of Countermeasure Strategies (Supplementary Analysis in Respect of Motorcycle Type, Make & Model)." Report for Motor Accidents Authority of NSW, May.
- Christie, R. and W. A. Harrison (2001). "Investigating of Motorcycle Crash Patterns for Riders Aged 17-25 in NSW and Development of Countermeasure Strategies." Report for Motor Accidents Authority of NSW, December.
- Haworth, N. (2010) Powered two wheelers in a changing world—Challenges and opportunities. Accident Analysis and Prevention. Volume 44, Issue 1, 2012, pp 12-18
- Harrison, W. A. and R. Christie (2005). "Exposure survey of motorcyclists in New South Wales." Accident Analysis & Prevention **37**(3): 441-451.
- Richardson, J. (2010) 'Motorcycle Travel Behaviour in Victoria'. Report prepared for VicRoads by Sinclair Knight Merz. 30 pp.
- Rose, G. (2009) Motorcycles: a growing dot on the transport policy radar. 32nd Australasian Transport Research Forum, 15pp.
- Sperling, D. and D. Gordon (2010). "Two Billion Cars: Driving Toward Sustainability." 1st ed. Oxford University Press, Oxford.
- Tollman, R. and G. Rose (2008). "Partnerships for Progress: Toward Sustainable Road Systems." Transportation Research Record: Journal of the Transportation Research Board **No. 2067**(Transportation Research Board of the National Academies, Washington, D.C.): 155-163.
- Victorian Government (2009) Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers 2009-2013. Victoria, Australia, 41 p.
- Wigan. M.R. (2002) 'Motorcycles as a full mode of transportation'. Transportation Research Record: Journal of the Transportation Research Board, No. 1818, Transportation Research Board of the National Academies, Washington, D.C., pp. 39-46.
- Yannis, G., J. Golias, I. Spyropoulou and E. Papadimitriou (2007). "Mobility patterns of motorcycle and moped riders in Greece." Transportation Research Record **2031**: 69-75.