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A SUCCESSFUL TOD WILL REINFORCE BOTH THE COMMUNITY & THE TRANSIT SYSTEM?

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INTRODUCTION

Transit-oriented development (TOD) has become the dominant urban growth planning paradigm in Australia and is recognised as a way to encourage economic revitalisation, community diversity, and travel alternatives.

Transit-oriented development (TOD) — compact, mixed-use, and pedestrian friendly precincts around transit stations — is an increasingly popular strategy for encouraging smart growth in Australia. Western Australia has implemented policies and programs that facilitate intra- and inter-governmental cooperation to promote TODs.

Perth, the capital of Western Australia is best described as a low density city in contrast to California as the most populated state within the USA, with 18 times as many people as Western Australia. It also has the largest rail network in the USA.

The urban densities of major metropolitan statistical areas in California range from 3,369 people per square mile in San Diego to 4,717 people per square mile in the San Francisco. The New York/Northern New Jersey urban population density is 4,203 people per square mile while Perth experiences the lowest population density for any major Australian city with 2,754 people per square mile.

Although Perth has low population and employment densities accompanied by high levels of car ownership and use, it also has a relatively high proportion of its total workforce located within the Central Business District (CBD) and a relatively high proportion of public transport usage per capita on rail (See Table1).

Table 1. Comparison of Los Angeles, San Francisco, San Diego, New York, and Perth

		<i>Los Angeles</i>	<i>San Francisco</i>	<i>San Diego</i>	<i>New York</i>	<i>Perth</i>
Urban density	persons/ha	24.1	20.5	14.5	18.0	10.9
Job density	jobs/ha	11.2	8.9	6.6	9.5	4.6
Proportion of jobs in CBD	%	4.1%	13.9%	5.8%	20.7%	19.2%
Metropolitan gross domestic product per capita	USD	\$28,243	\$37,154	\$26,508	\$34,395	\$21,995
Length of road per person	m/ person	3.7	4.5	5.3	4.9	9.1
Parking spaces per 1,000 CBD jobs	spaces/1,000 jobs	627	157	767	66	630
Total length of reserved public transport routes per 1,000 persons	m/1,000 persons	39.5	53.1	44.9	92.4	82.0
Passenger cars per 1,000 persons	units/1,000 persons	527.4	599.6	555.1	444.0	658.1
Daily public transport trips per capita	trips/person	0.09	0.21	0.05	0.29	0.14
Mode split of all trips						
Nonmotorized modes	%	9.5%	11.6%	5.8%	16.1%	9.1%
Motorized public modes	%	2.3%	5.4%	1.5%	8.6%	3.7%
Motorized private modes	%	88.2%	83.0%	92.8%	75.2%	87.2%
Total public transport boardings per capita	boardings/person	49.1	93.6	27.0	131.5	59.5

Source: Kenworthy and Laube; the International Association of Public Transport's Millennium Cities database (data represents 1995).

The problem for TOD today is the same as that identified by Curtis in 1999: "There appears to be a misalignment between strategies and actions, with little evidence of implementation that achieves balanced transport outcomes" (p. 349).

OVERVIEW

The increasing number of rail passengers travelling has led to an increased demand for car parking at stations. In order to manage this demand, more sustainable ways of getting to and from the stations need to be found, rather than relying on cars.

The primary aims of this work have been to determine the best ways to reduce out-of-vehicle travel burden and improve transit users' experience at stops, stations, and transfer facilities. In order to achieve this it has been essential to consider the development of various improvements at stops, stations, and transfer facilities and to understand how these improvements affect people's travel behavior. In gaining and understanding this it is important to recognize that transit systems' primary focus is clearly their passengers and the perceptions and needs of these passengers.

Over the years Perth City continues to grow more dispersed and automobile-oriented. In an effort to accommodate increasingly dispersed patterns of trip-making many transit systems, including the Perth metropolitan areas, now require transit users to make frequent transfers among lines, modes, and operators. As such, transit stops and stations are integral parts of transit networks, playing an important role in connecting multiple transportation modes and systems. The effectiveness of these connections governs waiting and walking times at transit stops and stations and, in turn, travelers' choices (ie whether or not to take a particular transit trip). Given the effect of travel time on travel choices, good connectivity at transit stops and stations is critical to overall transportation network effectiveness.

An example of this is presented by the New Mandurah Line which will demonstrate sustainability in action through:

- reducing the use of motor vehicles and encouraging public transport use by locating residential and commercial/mixed use development close to major public transit services;
- encouraging pedestrian activity and bicycle usage by providing pedestrian and cycleway linkages within the project area, and connecting the project area to the surrounding community;
- generating local business opportunities, resulting in increased local employment opportunities;
- encouraging energy efficient housing options; and
- providing a mixture of affordable housing options.

PASSENGER SURVEY

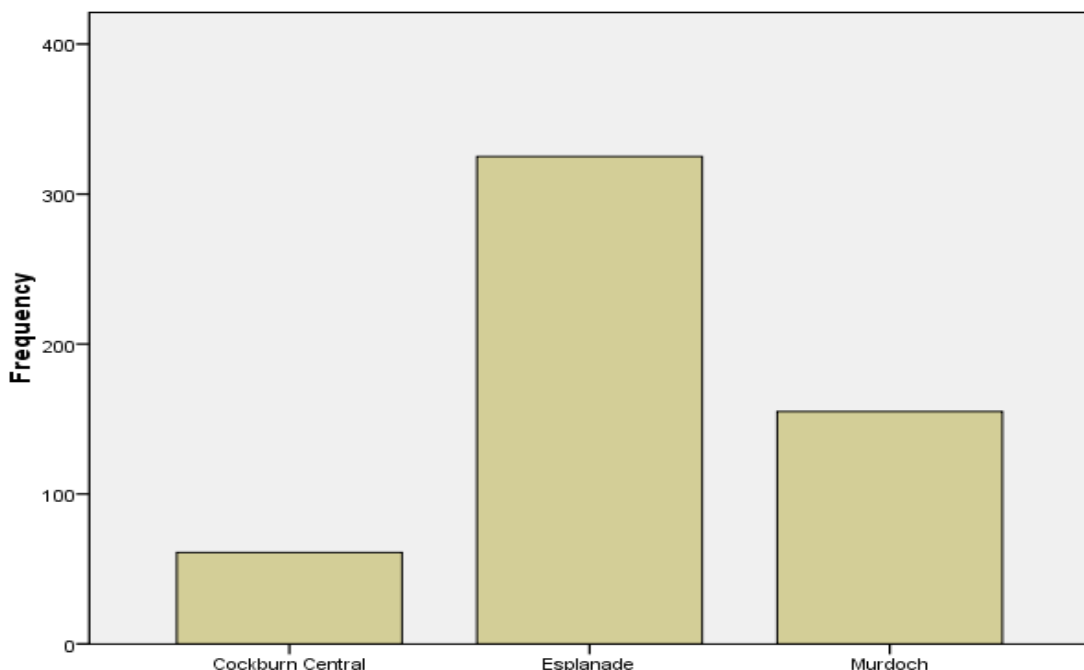
In 16th March 2009 we surveyed approximately 550 transit users at 3 selected transit stops and stations in Perth metropolitan, the Esplanade;(325 respondents) Murdoch; (155 respondents) and Cockburn Central; (61 respondents) stations as random stations on the new rail Mandurah Line to obtain railway user information during weekdays. (See Figure 1) The following section describes in brief the data collection and passenger survey results.

Information collected included:

- trip origin and destination
- means of getting to and away from the train system
- transfer characteristic behaviors within the system

The surveys used were developed working with the assistance of representatives of the Public Transport Authority (PTA) of Western Australia and included the above characteristics as they were considered essential to system planning. These surveys clearly had a much stronger travel behavior focus than the previous (2008) Customer Satisfaction Surveys conducted by the PTA.

Figure1. The survey stations distribution



DATA COLLECTION

The data collection for the survey was successful in terms of the number of responses from passengers, with 550 distributed (face-to-face interviews) a total of 544 valid surveys were obtained from across the 2 stations. It is considered that the data collection exercise provided acceptable and reliable evidence for each of the individual stations.

The intent of the data collection was to obtain information about who was using rail services at the selected stations, how they were accessing the station and additionally, the most important determinant of user information with a transit stop or station – attractiveness of the services based on frequency and reliability in an environment of personal safety, and only indirectly the physical characteristics of that stop or station.

Passengers were approached and asked a series of questions regarding both the travel and train stations' characteristic of their trip. In order to capture users of a majority of the trains serving the selected stations data was collected during the morning peak hour (7 AM to 9 AM) and afternoon peak hour (3 PM to 5 PM) on 16th March 2009, The weather was clear during the survey and no major problems were observed that would affect the use of the Perth rail system.

Survey data collected was oriented to obtain information with the following survey objectives:

- Origin purpose;
- Mode of access to the public transport system;
- Destination address;
- Destination purpose;
- Egress mode from the public transport system
- Household car ownership availability for the trip made;
- Journey made by car;
- Ticket type; and gender/age.
- Customer satisfaction
- Suggestions

Data collected was entered into an Analytical Software SPSS and Microsoft Excel for validation and analysis. The survey data was sorted and a cross-analysis of potentially relevant passengers factors such as travel frequencies, preferred station locations, and variations among sub-groups (age, gender, profession, and place of residence) was consequently obtained.

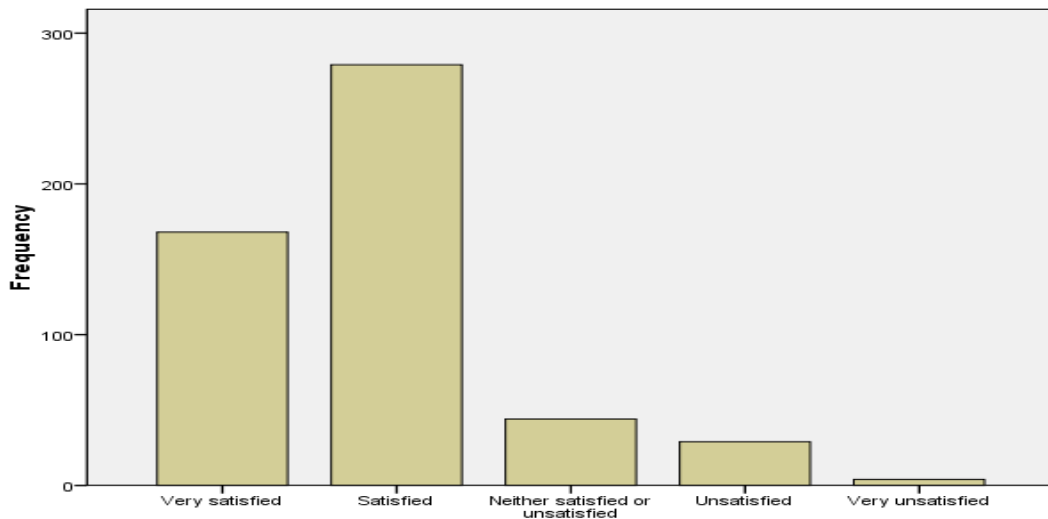
SURVEY HIGHLIGHTS

Passenger Origin-Destination Data

The principal objectives of the travel surveys were to determine the methods used by Passengers to get to and from the rail system and to identify transfer patterns within the system during a given trip.

Overall, survey results support the observation of user satisfaction with the New Mandurah Line experience and indicate that, in general, they are least happy with factors related to access, followed by some factors related to security and safety and connection and reliability. When we considered the level of satisfaction and importance ratings in tandem, factors that require improvement at the nine stops and stations surveyed pertain most to security and safety, connection and reliability, and least to amenities. (See Figure 2)

Figure 2. Overall satisfaction with the bus and train services



The travel survey developed for each selected train station was a similar version to that applied to selected adjoining bus stops.

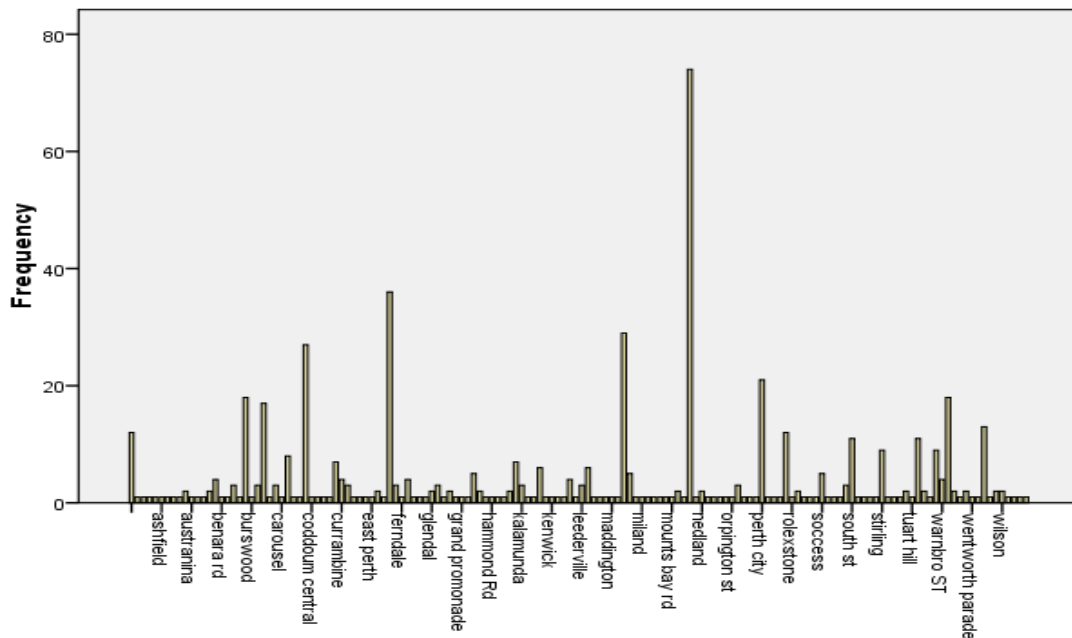
In total, 550 Passengers were asked to report their first station boarded and last stations disembark for their one-way trip.

The survey consisted of twenty five questions, some with multiple parts. Most questions were multiple choices with an option of “Other”, if necessary. Open-ended questions were succinct and to-the-point, such as “What is your age last birthday?”, so that responses could be tallied straightforwardly.

Surveys were not considered to be valid if they did not report a “first” and a “last” station (which, of course, had to be different from the first station). Results for these distributions are:

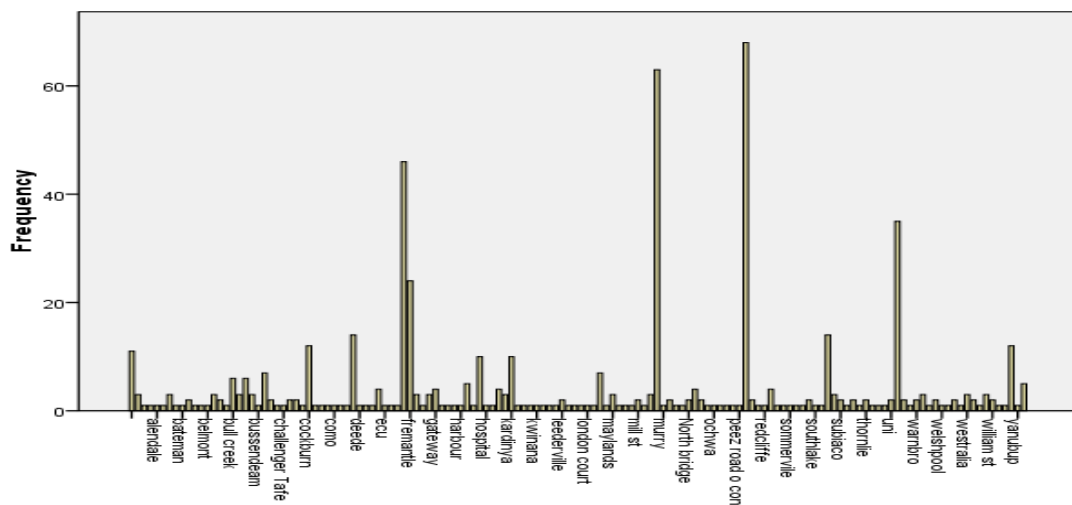
- **Origin:** On the New Mandurah Line, the distribution of station boardings was spread fairly evenly across stations, including Esplanade, Murdoch and Cockburn Central. Nearly 10.1% of respondents stated that they boarded at either Esplanade (Perth City) or Perth City Station (Murray St.); 13.6% at Murdoch and approximately 8.5% at Mandurah. (See Figure 3)

Figure 3. The distribution of station boarding



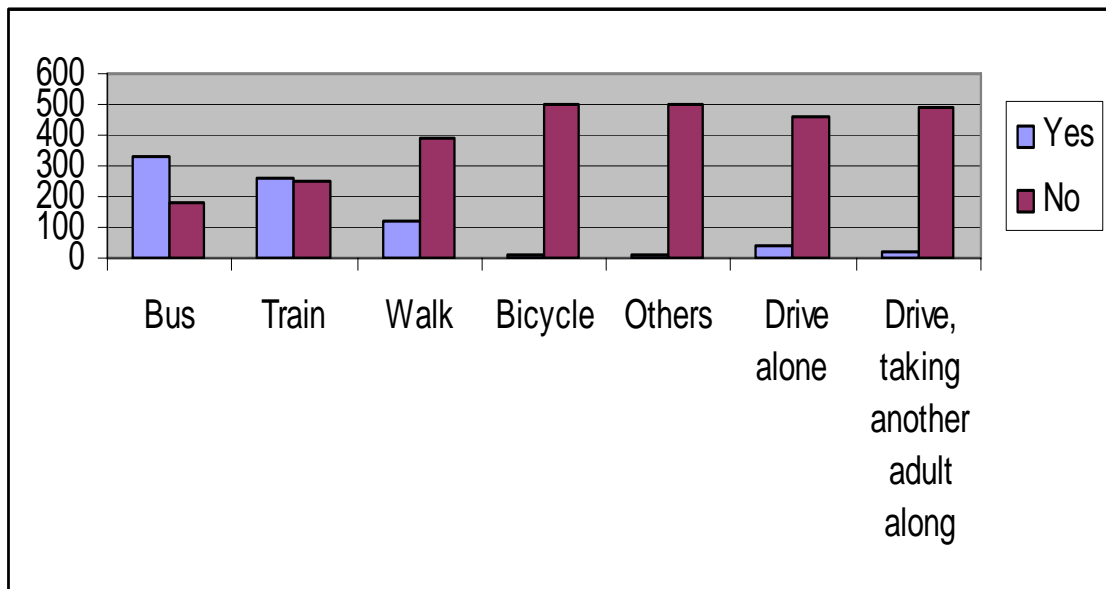
• **Destination:** for the new Mandurah Line, approximately 12.1% of all respondents stated that they alighted at Perth City Station (Murray St.); 11.6% at Murdoch and approximately 8.5% at Esplanade (Perth City). Nearly 6.4% of respondents said they alighted at University of Western Australia bus stop. (See Figure 4)

Figure 4. The distribution of station embarking



• **Method of Access:** (43.0%) of respondents reported they had driven to the station and (54.0%) said that they don't drive car to the stations. (See Figure 5)

Figure 5. Travel access



Question 22 “To get to your destination do you use” eight options were provided (1) Bus;(2) Train;(3) walk (4) bicycle;(5) others;(6) drive alone;(7)drive taking another adult along; (8)get a ride with others/car-pool. Question 22 was developed to be consistent with other related studies and to permit easier comparisons with results from other studies.

Question 22 was compared with a Murdoch University focus groups intercept survey in August 2008. The group’s aim was to build understanding about staff/student attitudes and travel behaviour. The following Figures (6 and 7) show comparisons between our March 2009 Murdoch Train and Bus Stop Station Survey. The new Mandurah train line was started in December 2008.

Figure 6. Method of Travel: March 2009 Survey

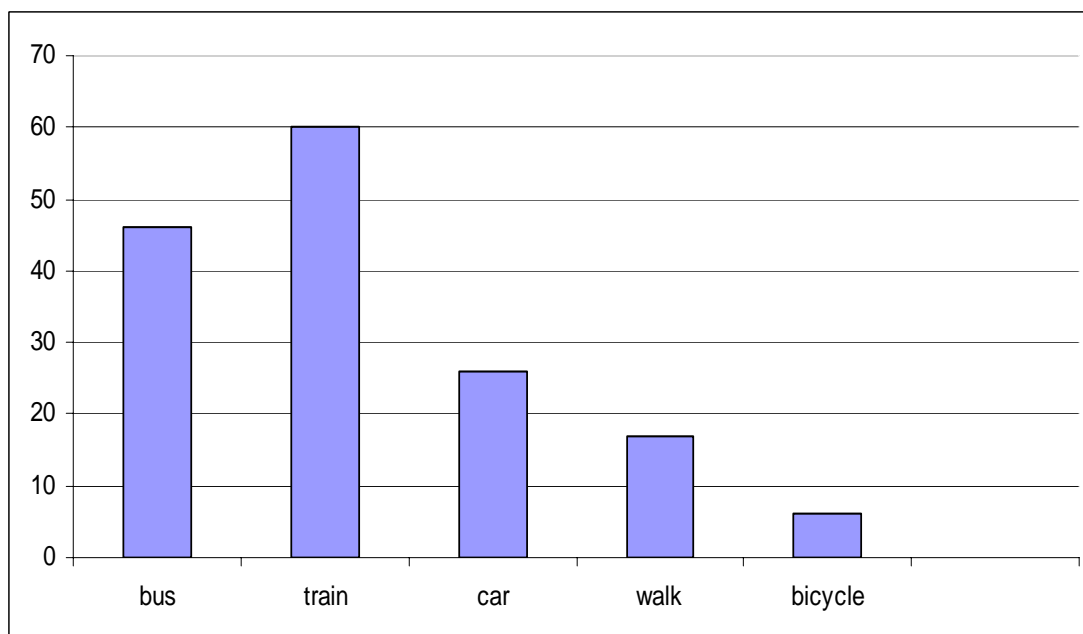
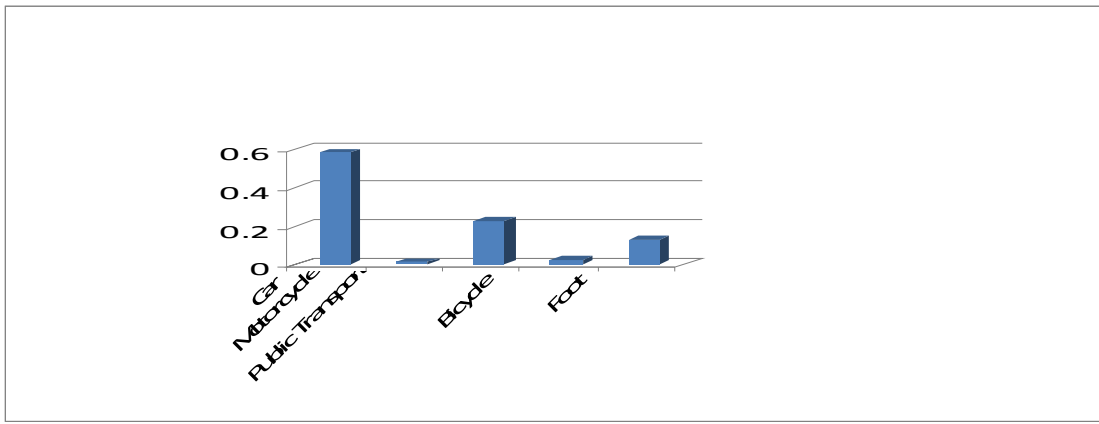
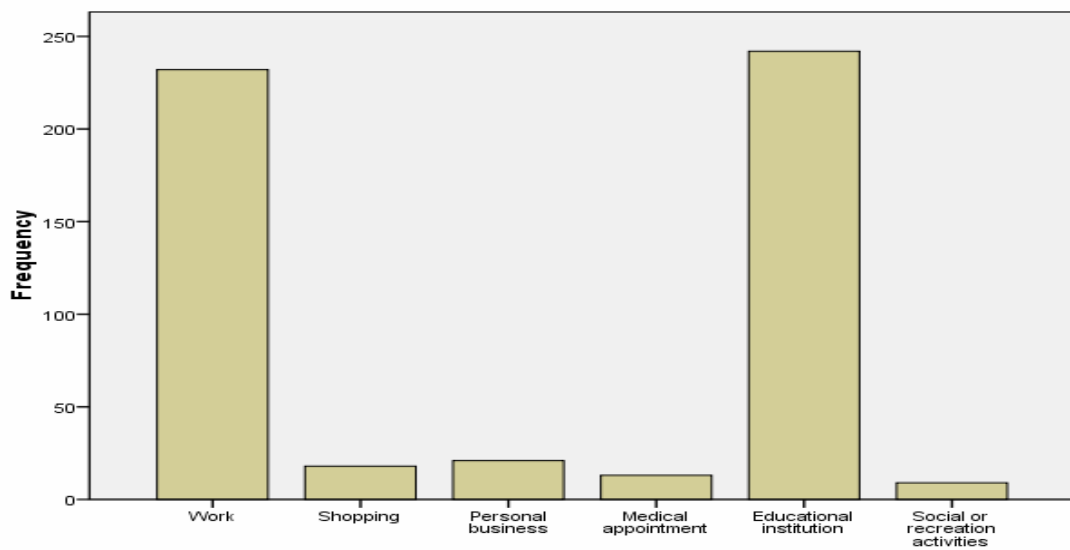


Figure 7 Method of Travel: August 2008 (Murdoch University Focus Groups)



• **Trip Purpose:** Over 45.2% of all respondents stated their trip purpose was Education. In contrast, 43.4% stated their trip purpose was work. (See Figure 8.)

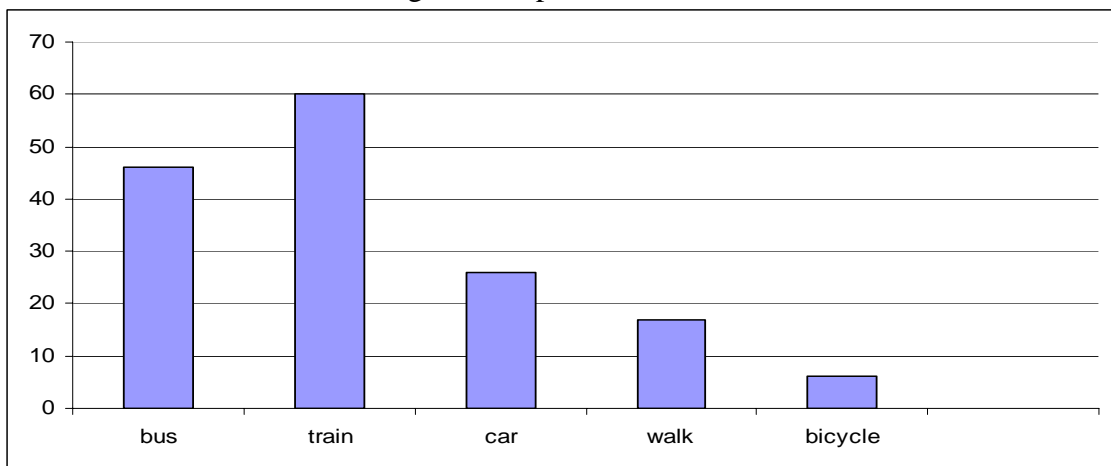
Figure 8. Trip Purpose



• **Trip Method:**

69.7% of respondents stated that the bus or train station was within walk distance of their point of origin, for the first bus or train on the trip. (See Figure 9)

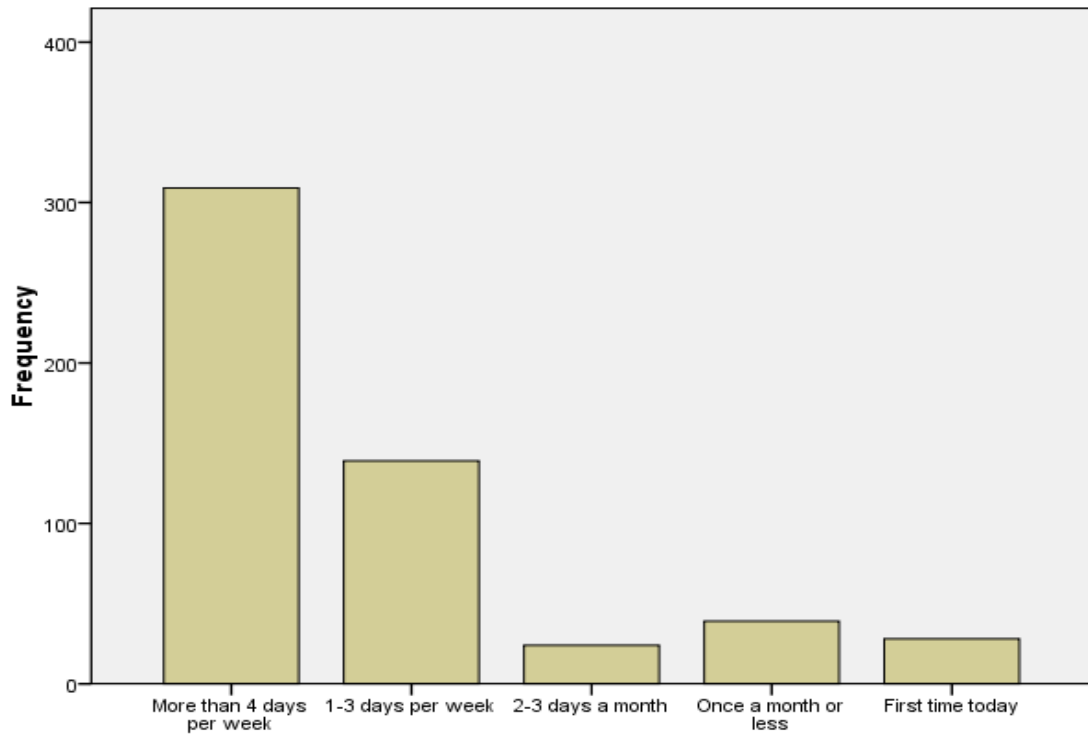
Figure 9 Trip method used



• **Trip Frequency:**

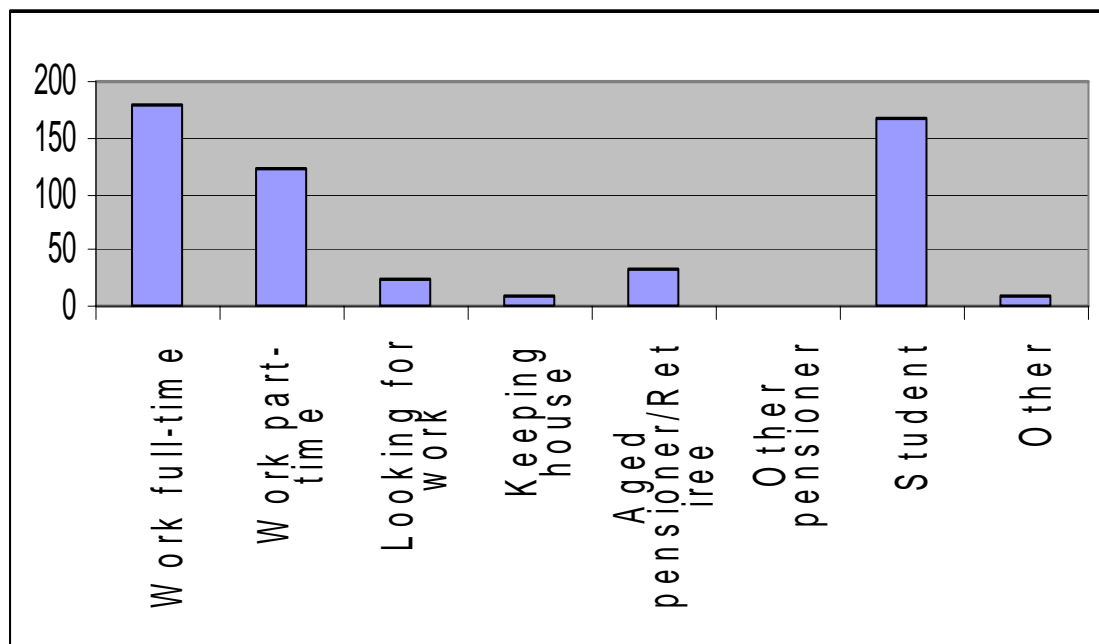
Approximately 26.7% of all respondents stated they rode the bus or train for their trip more than 4 days per week. An additional 25.7% stated they rode the train 3-4 days per week. (See Figure 10)

Figure 10. Trip Frequency



• **Employment Type:** 32.4 % respondents stated that they are employed full-time, 22.3% working part-time, 4.5% seeking work and 30.4 are higher education student. (See Figure 11)

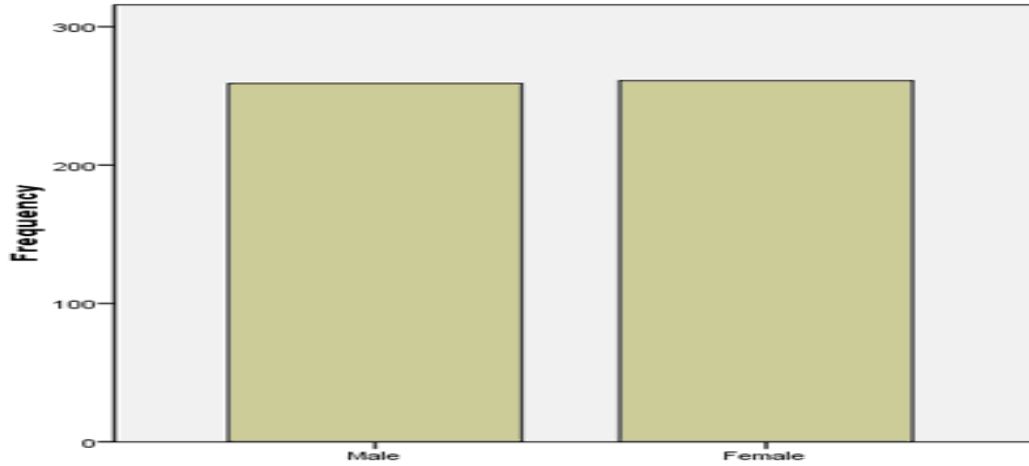
Figure 11. Employment category



Another set of questions provided demographic and other personal data about respondents, including age, gender, type of residence (own, rent), length of residence in the neighborhood, education, race/ethnicity, and number of motor vehicles available to the household.

- **Demographic Characteristics:** The survey had a slightly higher percentage of 50.3% female Passengers than 49.7% of male passengers. (See Figure 12)

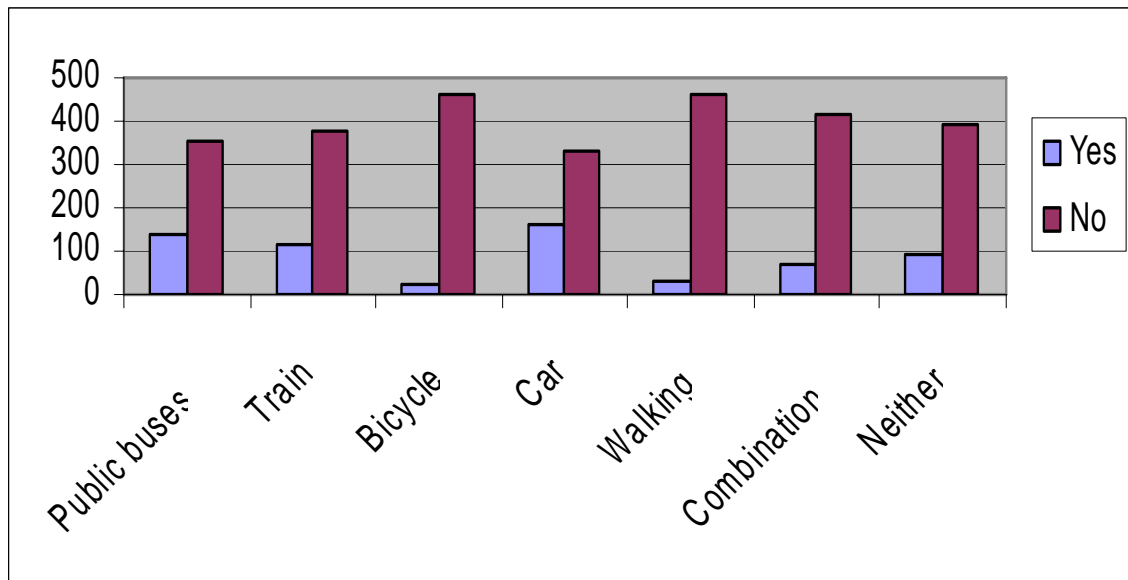
Figure 12. Passengers gender



- **Household car ownership trip made:**

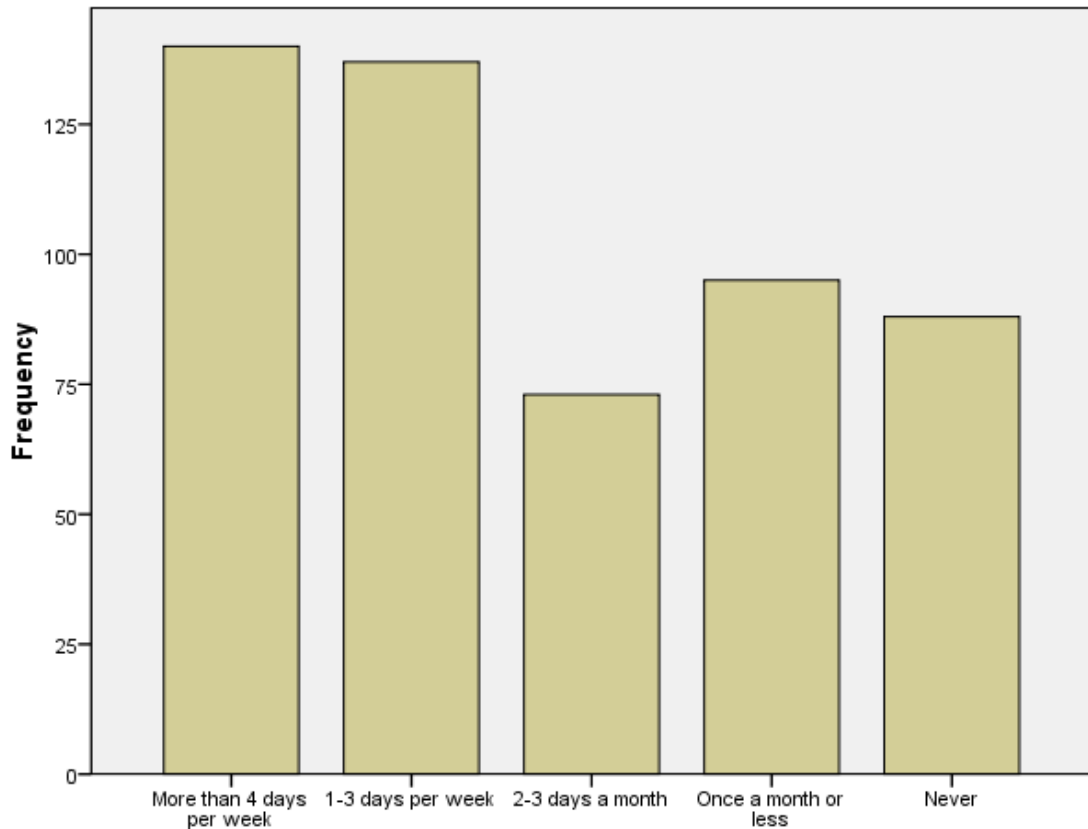
32.5% of respondents stated they were using cars in their households, with the majority using public transport - 27.8% using buses and 23.0 % using trains. (See Figure 13)

Figure 13. Household car ownership trip used



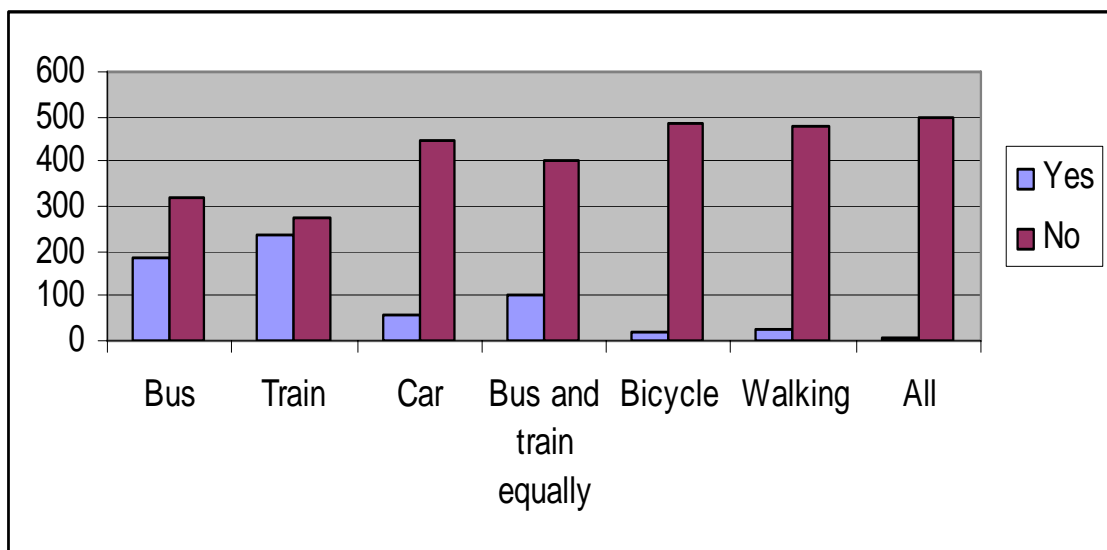
This question addressed the use of other route. Five responses were offered ;(1) More than 4 days per week (26.3%); (2) 1=3 days per week(25.7%); (3) 2=3 days a month(13.7); (4) once a month(17.85%); and (5)Never (16.5%). (See Figure 14)

Figure 14. Route frequency of trip used



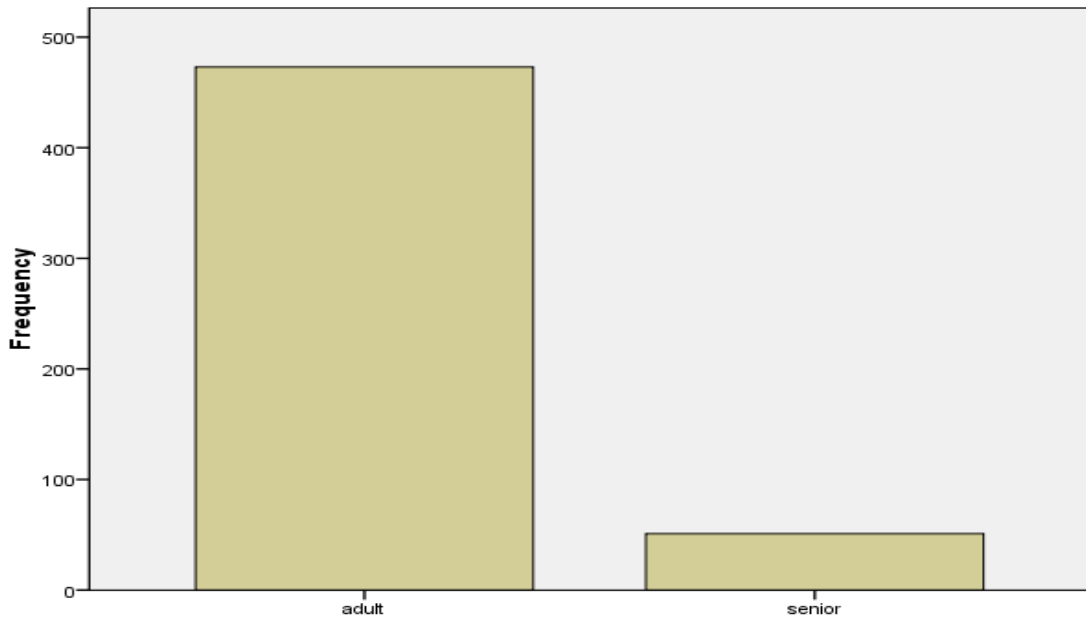
Question 17 was asked “which have you used more often?; On Peak or Off Peak, The choices included; Bus (35%), Train (44.1%), Car (10.8%), bus and Train equally (18.9), Bicycle (3.03%), Walking (4.9%) and All (1.5%). (See Figure 15)

Figure 15. Frequency of trip used



The Tickets question choices included; (1) Adult (90.3%); (2) Senior (9.7%). (See Figure 16)

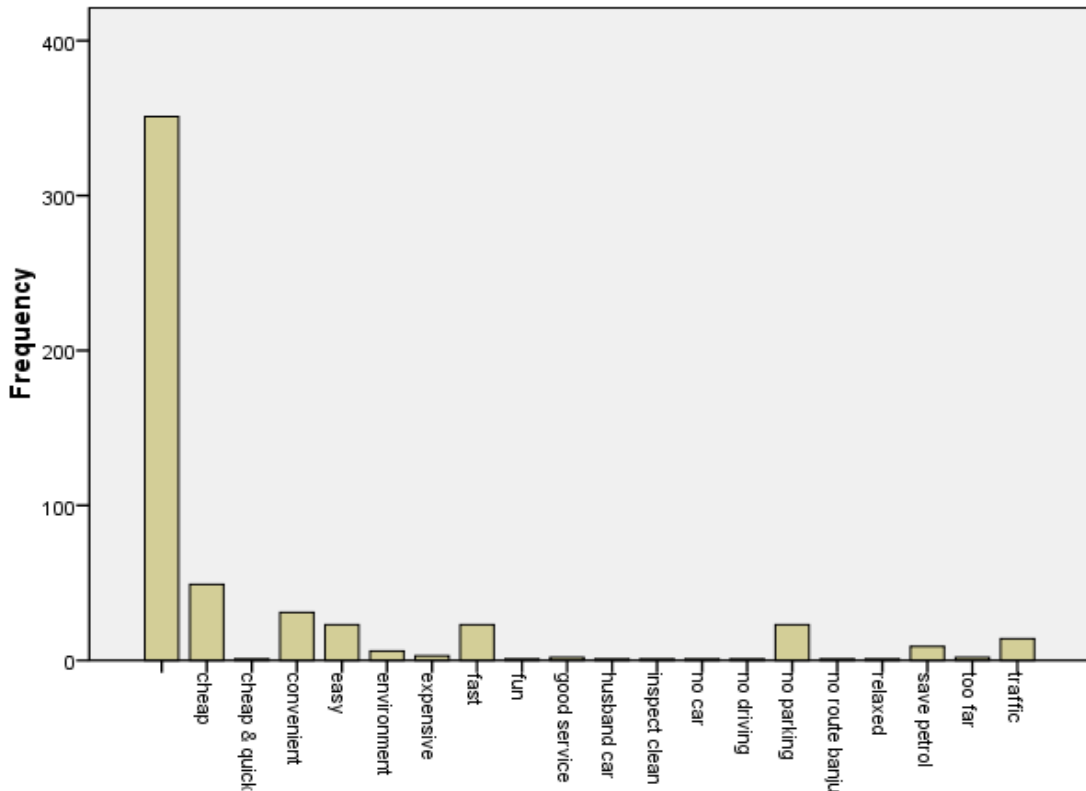
Figure 16. Fares category used



• **Information about train stations and reasons for using the public transport:**

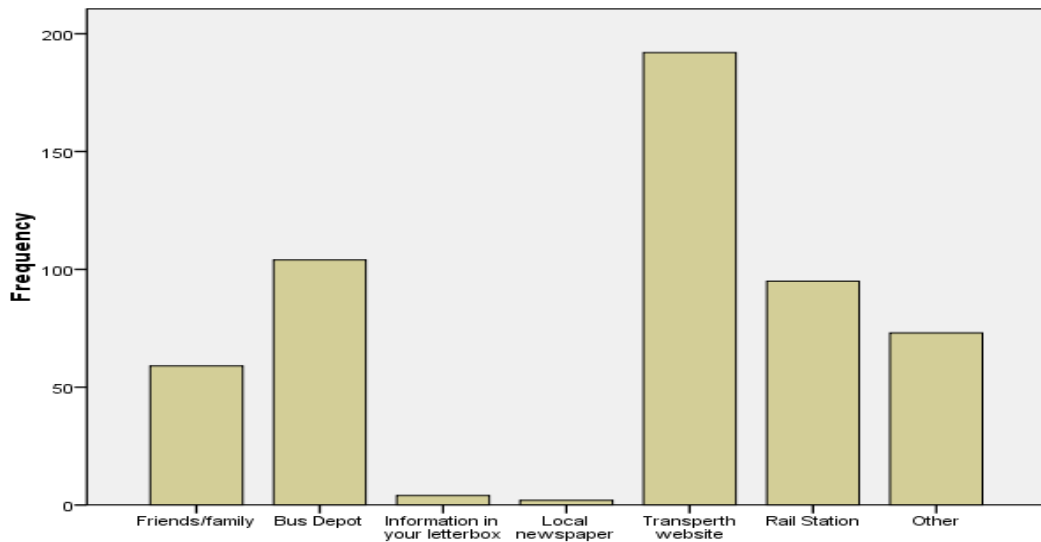
- (a) 64% of the respondents using public transport stated that the reasons for using the trains were; 9.0% cheaper, 4.4% easier, 4.2% faster, 4.2% no parking, 2.6% traffic, 1.7% saving petrol, 1.1% environmental and 5.7 convenient.(See Figure 17)

Figure 17. Reasons for using public transport



(b) 35.3% of the respondents used the PTA website to find information's about the trip time and 17.5 at the train stations and buses stops. (See Figure 18)

Figure 18. Category of Information used to find out about the trip



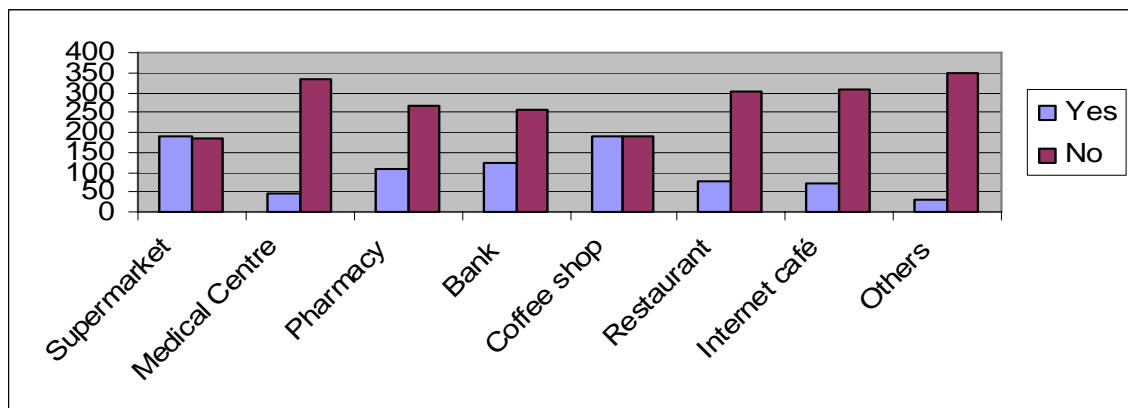
• **Train Stations facilities and conveniences:**

(a) 57.5% of respondents said they would like to live next to train station for transport convenience, In contrast, 42.5% said “No”.

(b) 72.2% of respondents said they would like to see more shops at the train station, in contrast, 27.8% said “No”.

Figure 19 shows what kind of shops or convenience stores they would like to see at the train stations.

Figure 18. Category of shops



The New Mandurah Line served as the demonstration rail transit line for the south western metropolitan area and was envisioned as the core segment of a suburban rapid transit system. Development of a New Mandurah Line was, and continues to be, viewed as an integral link to achievement of smart growth and economic development goals by providing an opportunity to promote higher density, mixed-use development patterns in conjunction with rapid transit corridors and stations.

According to the Passenger Survey Results, it would appear that the New Mandurah Line is getting people out of their cars and reducing congestion:

- For most passengers on the 3 selected stations, the option of driving was available.

- Just over half of those surveyed reported that a vehicle was available to them even though they chose to use the train to complete their trip.
- Those that had previously driven and now take the train were asked if they had travelled on the new Mandurah Line. A majority had; indicating that the train is helping to reduce traffic congestion on this major artery as it is cheaper, faster and more convenient.

The New Mandurah Line and the 9 Stations Development was created to promote transit-oriented development in the City of Perth. The intent of this development is to encourage a mix of uses and activities near the train stations, which will serve the train users, visitors, area workers, and residents. A mix of uses is an essential element necessary to encourage the New Mandurah Line passengers, maximizing rail investment and area revitalization. The development describes land uses, urban design and economic development strategies around various stations in the City of Perth.

Further, it became clear that in addition to serving the overall intent of encouraging transit-oriented development, the New Mandurah Line would also provide the foundation for the revitalisation of the three selected Stations.

The New Mandurah Line included 9 stations utilising transit-oriented development practices and others serving as mixed-use commercial activity centres.

The Cockburn Central Station and Wellard Station along the New Mandurah Line are both designed to be integrated into neighbourhoods with moderate residential densities and neighbourhood retail.

CONCLUSIONS:

After considering various ways of collecting data, in person, the only workable approach was to have someone go to the three train stations and ask people waiting on the platform to fill out the survey. In other words, we deliberately wanted to capture the responses of the morning commuters who were more likely to take the train five days a week and hence realise benefits by using public transport, walking or biking to and from the train station five days a week. So the survey had a bias toward daily commuters and not people who took the train during off-hours and on weekends and holidays.

The set of questions inquired about respondents' travel patterns. Respondents were queried about the purpose of the current trip, frequency of this kind of trip, and frequency of other uses of public transit. Next, participants were asked how they travelled to the train station, where they leave the train, and their final destination (choices were provided, along with an "other" category). Another set of questions focused on participants' knowledge about the time travel and transfer station, their current and any future plans to use it, and about factors that might encourage them to use the transfer station.

This paper describes an analysis of survey data to identify the preferences of train and bus users. The analysis of the collected data shows that the train stations and bus stops should include:

- A shopping plaza around the rail station which is a focus point;
- A cafe, convenience retail store, child care facility, aged care facility, clinic, newsagent, pharmacy and ATM;
- Office employment facilities around the main shopping plaza;
- The provision of mixed-use employment attached to dwellings within residential areas;
- A network of well lit and overlooked footpaths/cycle-ways connecting with the main plaza;

- The use of trees and buildings along all footpaths to give pedestrians and cyclists a feeling of intimacy and security.
- Full and ready access for people with disabilities and the elderly.
- The provision of a park & ride facility near the station. This would accommodate patrons living beyond the TOD where no close alternative station site exists with an exclusive park & ride.
- Discouragement of automobile-oriented uses such as auto repair and service shops, box or shed retail, and drive-thru fast food within the Station Area.
- Priority for pedestrians and bicycles in building design and street layout.
- Establishment of residential density targets in Station Area Plans to provide flexibility and encourage a variety of development intensities and heights.

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