DETERMINING THE POTENTIAL OF CYCLING AS AN URBAN MODE IN SPECIFIC MALAYSIAN CONTEXTS

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Determining The Potential 0f Cycling as an Urban Mode In Specific Malaysian Contexts

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ABSTRAK

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ACKNOWLEDGEMENTS

First and foremost, my sincere thank goes to my supervisor, Professor Mohemmed Rehan Karim. I am indebted for her continued support, guidance, and encouragement on my PhD journey. I would have never completed my PhD without her knowledge and advice.

Issues of confidentiality prevent me from mentioning any of the 1014 respondents who participated in this study. However, my appreciation goes to all of those who gave their valuable time in allowing me to interview them and in responding to my questionnaire survey, many of whom have maintained their interest and involvement with my work.

I owe a special thanks to all my friends in Center For Transportation Research. Thanks for all your friendship and constant helps.

My gratitude goes to my parents for their continuous support and the strength they have given to me throughout my entire life and especially during my PhD process. My parents-in-law are also thanked for their love, support and encouragement.

Love to my children Aurel, Bimo and Athar for bringing so much of happiness and strength to my life. Finally, I would like to thank, with much respect, my loving wife Inna for her continued support, patience, encouragement for all my work and for his caring, sacrificing his valuable time and his commitment for my achievements. Having you beside me has added enormous strength to my life

TABLE OF CONTENTS

LIST OF FIGURES

(Please delete this part): This list contains the titles of figures, together with their page numbers, which are listed in the text. For e.g., figures in Chapter 3 are numbered sequentially: Figure 3.1, Figure 3.2.

For title of list tables use *other title*and *TOC1* for style.

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LIST OF SYMBOLS AND ABBREVIATIONS

For example:

CC	:	Central canal
DAB	:	3,3’-diaminobenzidine
HRP	:	Horseradish peroxidase
MS222	:	Tricaine methanesulfonate
	:	
	:	

LIST OF APPENDICES

These two pages are for illustration of Table of Contents and List of Figures, please delete entire pages.

CHAPTER TITLE (HEADING 1, H1)

The body of the text should be typed with double spacing. Single-spacing is only permitted in tables, long quotations, footnotes, citation and in the bibliography.

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Table 0.1: Example

Heading	Heading
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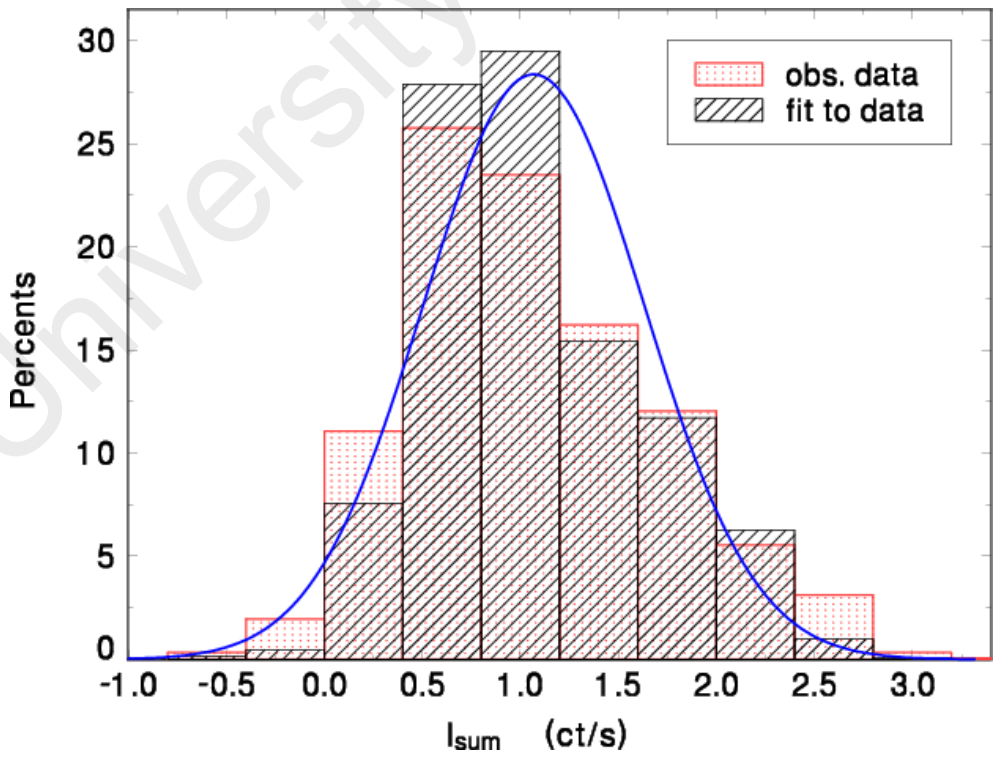

Figure 0.1: Example

NUMBERING AND STYLES

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Numbered list example

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Examples:

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Buchwalow, I. B., and Böcker, W. (2010). *Immunohistochemistry: basics and methods.* Berlin: Springer Verlag.

Caamaño-Tubío, R.I., Pérez, J., Ferreiro, S., and Aldegunde, M. (2007). Peripheral serotonin dynamics in the rainbow trout (*Oncorhynchus mykiss*). *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology, 145*(2): 245-255

Cakir, Y., and Strauch, S. M. (2005). Tricaine (MS-222) is a safe anesthetic compound compared to benzocaine and pentobaritol to induce anesthesia in leopard frogs (*Rana pipiens*). *Pharmacological Reports, 57*:467-474.

Cameron, A. A., Plenderleith, M. B. and Snow, P. J. (1990). Organization of the spinal cord in four species of elasmobranch fishes: cytoarchitecture and distribution of serotonin and selected neuropeptides. *The Journal of Comparative Neurology, 297*: 201-218

LIST OF PUBLICATIONS AND PAPERS PRESENTED

Published works as well as papers presented at conferences, seminars, symposiums etc pertaining to the research topic of the research report/ dissertation/ thesis are suggested be included in this section. The first page of the article may also be appended as reference.

APPENDIX

(Please delete this part): Appendices consist of additional illustration of data sources, raw data and quoted citations which are too long to be placed in the text. The appendix supports the written text of the research report/dissertation/thesis. Research instruments such as questionnaires, maps or computer programmes are parts of appendix too.

Appendices can be divided into Appendix A, B, C.

This page is optional; if you do not have any appendices, delete the entire page.

ABSTRACT

The research was designed to invertigate the potential of cycling as transportation mode. There were three studies in this research, namely; first, the potential for cycling as a transportation mode for activities on campus; second, the potential of cycling as feeder mode in public transportation system; and third, the potential of cycling for the trip from home to school. The studies were chosen because the trip in the studies are short distance. The cycling are potential for short distance trips.

The first study covers the whole area of the University of Malaya campus in Kuala Lumpur, Malaysia. The second and third study cover one area in Petaling Jaya (PJ), namely Taman Medan area. Sets of questionnaire were designed and distributed and there were two (2) types of survey undertaken for this study i.e. field survey and web-based survey. A total of 1044 respondents were involved in this study.

Statistical analysis (Multivariate test) was used to investigate the significant influence of the socioeconomic characteristic on the travel behavior, while the Structural Equation Models (SEM) approach was utilized to rank the impediment factors for cycling. The regression models were develop to investigate the relationship of willingness to cycle againts the travel time and travel cost. The sensitivity analysis also conducted.

With regards to the potential for cycling around campus.The potential for cycling is very high. Health and environment concerned are the most considered as the reason for cycling. While the main constraint for cycling is the rainy day. As the result in this study, regarding the cycling facilities, the majority of respondents suggested the exclusive bike path for cycling around campus.

Regarding the potential for cycling in accessing public transit facility, most respondent mentioned that they are not willing to cycle if the cycling facilities from their residence to public transit facilities are available. Males were more likely to consider for cycling than females, the highest potential of cycling in accessing public transport facilities is students. Most of the employees, housewife and unemployed wouldn't like to cycle if cycling facilities are available. The majority of respondents suggested that, they are not willing cycle to public transit stations due to safety concerns. For both males and females also concern about safety as the reason why they do not cycle to public transit facility. With regards to cycling facility suggested most respondents concerns are about safety along the route from their residence to public transit facility, they suggest the exclusive bike path.

For the potential for cycling to school, most parents do not allow their children to cycle to school. The percentage of mothers whom do not allow cycling is higher than fathers. The different is significant. The road safety concerned was shown by parents on the cycling facilities suggested. The parents concerned on dangers from other traffic on the road are very high. As the result, regarding cycling facilities, the majority of parents suggested exclusive bike path for their children to go to school. No one would let their children ride their bicycle on a road mix with other traffic, most of them proposed an exclusive bike path for their children.

ACKNOWLEDGEMENTS

First and foremost, my sincere thank goes to my supervisor, Professor Mohamed Rehan Karim. I am indebted for her continued support, guidance, and encouragement on my PhD journey. I would have never completed my PhD without his knowledge and advice.

Issues of confidentiality prevent me from mentioning any of the 1044 respondents who participated in this study. However, my appreciation goes to all of those who gave their valuable time in allowing me to interview them and in responding to my questionnaire survey, many of whom have maintained their interest and involvement with my work.

I owe a special thanks to all my friends in Center For Transportation Research., Taufika Ophiyandri Ph.D, Masrilayant Ph.D and Arniza Fitri M.Eng. Thanks for all your friendship and constant helps.

My gratitude goes to my parents for their continuous support and the strength they have given to me throughout my entire life and especially during my PhD process. My parents-in-law are also thanked for their love, support and encouragement.

Love to my children Aurel, Bimo and Athar for bringing so much of happiness and strength to my life. Finally, I would like to thank, with much respect, my loving wife Mimi for her continued support, patience, encouragement for all my work and for her caring, sacrificing his valuable time and his commitment for my achievements. Having you beside me has added enormous strength to my life

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LIST OF ABBREVIATIONS AND SYMBOLS

ANOVA	Analysis of Varians
CI	Consistency Index
KL	Kuala Lumpur
KTM	Keretapi Melayu
PJ	Petaling Jaya
PJS	Petaling Jaya Selatan
s	required sample size.
χ^2	the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N	the population size.
P	the population proportion (assumed to be .50 since this would provide the maximum sample size).
d	
αmax	Maximum Eigenvalue
U_{in}	Alternative utility i for decision maker n
$X_{in1}, X_{in2},...,X_{inK}$	Number of variable K that is determine the attributes of alternative I for decision maker n
$\beta, \beta_2,...,\beta_K$	Inferential coefficients of available data.
Pn	The probability of mode n
Y	The manifest variables for the latent endogenous variables
X	The manifest variables for the latent exogenous variables
η	(eta), endogenous latent variables
ξ	(ksi), exogenous latent variables

ε	(epsilon), measurement error (error) associated with Y
δ	(delta), measurement error (error) associated with X
ζ	(zeta), measurement error (errors) in the structural equation
Γ	(gamma), the coefficient matrix band to the relationship of endogenous latent variables and exogenous latent variables
β	(beta), the coefficient matrix band to the relationship between the endogenous latent variables

CHAPTER 1

INTRODUCTION

1.1. Background

Bicycle is one of a sustainable mode of transportation with benefits, such as, no fuel consumption, no air pollution, good for health, and reduction in traffic congestion. (Gatersleben et al. 2007; Gatersleben and Haddad, 2010). Gatersleben et al. (2007) and Garrard et al. (2008) also said that as a mode of transportation, the bicycle is environmentally friendly and cycling has the social and community benefits. Gatersleben et al. (2007) argued that bicycle is suitable for short distance and the bicycle offers a reliable and affordable transportation mode for people. The bicycle is also associated to benefit as access costs and high efficiency in the use of road space (Ortuzar et al. 2000).

Unfortunately bicycle is recognized as one of the least safe mode for travelling (Parkin et al. 2007). Cycling is not safe and more facilities are needed to make it safe for user (Gatersleben et al. 2007). Cycling is widely considered to be among the riskiest modes of travel (Krizek and Roland, 2005). Barriers for cycling is the lack of adequate and safe cycling infrastructure, Lack of cycling facilities and unfriendly environment for cycling. (Moudon et al. 2005). Moreover the regular cyclist has the constraint in some weather conditions, namely rain, wind, temperature. The necessity to carry something and other people, the needs to arrive well-groomed, age, health and gender/cultural mores also do not encourage people to cycle (Nankervis, 1999). Cycling is also recognized as physical activities; because of that cycling sometimes depends on gender, health condition and age. Moudon et al. (2005) and Gatersleben et al. (2007), in their

research they argued that male and younger adults are the people who more fit is more common for cycling.

The puspose of this research is to determine the potential of cycling as an urban mode in specific Malysian contexts. To gain that purpose, all of those constraints as mentioned above must be considered.

1.2. Research problem statement

The problem statement is a concise description of the issues that need to be addressed in the research. In this research, there were three studies, namely; the studies of the potential for cycling as the transportation mode for activity around campus, the potential for cycling in accessing public transport facility and the potential of the children for cycling to school based on parents perception. The studies as mentioned above were selected due to the trips in the study are short distance. Mean while the cycling is potential for short distance.

Regarding the potential of cycling as the transportation mode for activity around campus, the preliminary study was conducted to investigate the origin-destination place of activities in campus. The destinations of the trip are the most frequently visited places among students, namely; the Sports Center, the Students Union building, Postgraduate Institute, Students Clinic, Main Library, mosque and Chancellery. The origin is taken from selected faculties in University of Malaya campus which are Faculties of Engineering, Faculty of Medicine, Faculty of Science, Faculty of Business and Account and Faculty of Islamic Studies.

Table 1.1. Travel distance matrix (m)

Origin (Faculty)	Sport center	Complex Perdana Siswa	IPS	Student's Clinic (College 12)	UM Main Library	Mosque	DTC & Chancellery
Academic of Malay Studies	1800	475	1390	1630	400	1460	592
Academy of Islamic Studies	677	2260	1070	1380	2320	2040	1950
Economics	2040	742	1650	1870	403	1370	800
Education	1790	491	1430	1620	271	1260	612
Engineering	1880	502	1450	1690	204	959	617
Computer Science and Information Technology	1800	490	1400	1640	426	1470	606
Medicine	3090	1770	2720	2920	1440	1440	1890
Languages and linguistics	1960	631	1610	1770	569	1730	778
Law	1470	1250	971	1200	925	337	950
Science	1340	400	988	1190	460	1030	292

The trip distance from origin to destination place is obtained based on the path traversed by car or motorcycle. As can be seen in **Table 1.1, t**he shortest distance from origin to destination is 292 meters (from Faculty of Science to DTC & Chancellery. The furthest distance is 3,090 meters, from Faculty of Medicine to sport center. Based on the trips distances, all the Origin-Destination pairs have the reasonable distance for cycling. Nilsson (1995) and Dickinson (2003) stated most people consider that the distance which is less than 5 km is not difficult for cycling and there is likely a potential for transferring some of these car trips to cycling. Cycling is fast and flexible for short distances. Cycling has many benefits, do not cause air and noise pollution, no oil consumption, cheap and suitable for the students which have the budget restricted (Tolley, 1996). Students are generally more concerned about the environment and welcome to new ideas. They are physically fit, have a limited budget and live close to campus. Staff and faculty members shared some characteristics and many influential members of the local community, as potential bike advocates, they can help persuade city officials and campus administrators to implement the cycling policies (Tolley, 1996 and Balsas, 2003).

In the study of cycling in accessing transit facilities and cycling to school, the study area is in Taman Medan, within Petaling Jaya Municipal Area Selangor, Malaysia. Petaling Jaya is a satellite township for Kuala Lumpur. This area consists of mostly residential. This area was selected due to the transit stop facilities and schools are inside or not far from the residential area, the area that have the high potential to implement the traffic calming policy. Parkin et al. (2007) and Ehrgott et al. (2012) stated that cycling is recognized as one of the least safe modes of travel for the user. The availability of adequate and environmental friendly cycling route will be a consideration to increase the safety. Timperio et al. (2006) and Isler et al. (2008) argued that physical neighborhood environment and social aspects are among aspects could influence the children to commute to school by cycling and walking. They also stated that the many children in the neighborhood environment would give the higher opportunities for cycling and walking together with other children to school. One of the approached that can be implement to create the adequate and environmental friendly cycling route is traffic calming policy.

Neverthenless, to promote bicycle as means of transportation is not an easy task. According to Ehrgott et al. (2012), they argued that Cycling is suitable and efficient options as alternative means of transportation for commuting trips due to cycling is the most less energy consumption and very healthy modes of transportation and have the low impact other traffic. Bicycle is also one of the appropriate modes for short travel distance. But it needs some hard effort to make the bike become to be the mode of transportation due to Malaysia as a developing country and the tropical country which has the low rates of cyclist, high users of private car and the large of gender differences on cycling. One of the constraint for cycling is the safety issue. Garrard et al. (2008) stated that in the countries which have the low rates of cyclist, high users of private car and the large of gender differences, the major constraint is traffic safety concerns. As

the result in their research McClintock and Cleary (1996) and Nankervis (1999) argued that the constraints for cycling are traffic safety on the road, heavy volume of traffic, inconsiderate drivers, exposure of pollution and the weather, while David et al. (2001) stated that the impediment for cycling is social pressure in the community.

1.3. Research questions

As mentioned before, there were three studies, namely; the study of the potential for cycling as the transportation mode for activity around campus, the potential for cycling in accessing public transport facility and the potential of the children for cycling to school based on parents perception. To provide the clear direction of the research and to establish the best methodology approach in this research, the research problem is divided into several question as mentioned below:

Study I : Potential for cycling as a transportation mode for activities on campus

1. How potential is the preference of cycling for activity around campus? How the socio demographic characteristic, the trip distance, travel cost influemce the willingness for cycling?
2. What are the impediment and the encouraging factors for cycling for activity around campus?
3. What are the cycling facilities suggested in order to encourage staff and students cycle for activity around campus?

Study II : The potential of cycling as feeder mode in public transportation system.

1. Does the accessibility influence the mode share for the commuting?
2. How potential is the cycling preference in accessing the public transit facility?
3. What is the impediment factor and And what factors must be considered?

Study III : the potential of cycling as a transport mode for going to school

1. How potential of cycling can decrease the dependence of private for the trip from home to school?
2. what factors must be considered for encouraging the parent to allow the children cycling to school?
3. What facility should be suggested in order the parent can allow their children cycling to school?

1.4. Research Objective

The main purpose of this research is to determine the potential of cycling as an urban mode in specific Malysian contexts. As mentioned above, there were three studies, namely; the study of the potential for cycling as the transportation mode for activity around campus, the potential for cycling in accessing public transport facility and the potential of the children for cycling to school based on parents perception. To gain the purpose there are objectives in research as mentioned below :

1. To investigate the willingness to cycle as an urban mode.
2. To find out the obstacles for cycling.
3. To investigate and establish the model regarding the adequate bike facility that can encourage people to cycle**.**

1.5. Brief of Research Methodology

Based on the research objectives above there were two of the areas are covered in this research. With regard to the potential of cycling for traveling around campus, the study covers the whole area of the University of Malaya campus in Kuala Lumpur, Malaysia. There are 12 residential colleges within the campus area of 922 acres. These colleges can accommodate more than 10,000 students out of a total of 25,000 students studying

in the university. Students are allowed to use motorcycles and cars in the campus. There are two (2) types of bus services available in the campus i.e. The public bus service which is operated by RapidKL and the university bus service which circulates within the campus area. The public bus fare is MYR1/trip (USD$ 0.30/trip) with an average frequency of one bus in every 30 minutes. Students who wish to use the campus bus service would only need to pay MYR30 (USD$10) for each semester. However, the campus bus service is lower in frequency and thus it is unable to attract more students to use this type of transportation provided (Kidwai et al. 2005). There is also a small number of students who cycle and walk to get around the campus area.

Regarding the potential for cycling as a transportation mode for activities on campus, field survey and on-line survey were conducted in this research, the respondents of surveys were student and staff in the University of Malaya. The data analysis were divided based on the area of respondent's residence, namely the respondents who live outside the university and reside in a residential college, in the university. The data analysis is also divided based on three socioeconomic data, namely; respondent's gender, age and income. The results of the analysis for this study were presented as the descriptive and inference statistic. The influence of the socioeconomic characteristic on those parameters is explored. The methodological approach for this analysis is based on z-test (Critical Z = ±1. 96 for α = .05) and Multivariate test at the 0.05 level of significance. The model of willingness for cycling corresponding to the socio-demography characteristic, transportation mode usage, cycling experience, type of residence and the impediment factor for cycling was designed. The model was designed by using the structural equation model (SEM) approached. This approached was also used to design the model of cycling facility suggested corresponding to the selected socio demographic characteristic, cycling acceptable distance and safety concerned. Logistic models has been also designed to analyze bicycle route choice in this study.

The objective of the study of potential for cycling as feeder mode in public transportation system was to obtain the environment that is suitable for cycling as a part of the public transport system. The study covers one area in Petaling Jaya (PJ). The data highlighted the behavior of travelling for daily activities in that area, Petaling is a satellite township for Kuala Lumpur, consist of mostly residential and some industrial areas. It is located in the Petaling district of Selangor with an area of approximately 97.2 km². The respondents who live around the public transport facilities. Field survey was conducted. In this research, Taman Medan Area in PJS 2 was considered due to there are KTM station, Rapid KL Bus and Metro Bus Stop in this area. The analysis highlighted the people's travel behaviour for daily commuting, the accessibility to the transit facilities and the potential of cycling in accessing the transit facilities**.** The results of the analysis were presented as the descriptive and inference statistic. Multivariate tests at the 0.05 level of significance were conducted as the inference statistic.

Regarding the study of the potential for children to go to school, the respondents were the parents who have the children in primary and secondary school in Petaling Jaya. The objective of this survey was to obtain the perception of the parent about bicycle as mode of transportation and the willingness to allow their children to cycle to school.

The analysis data in this study cover the parents' perception on the potential for their children cycling to school. The data analysis is also divided based on three socio-economic data, namely; the position in the family, income level and children ownership. The result of the analysis is presented as the descriptive and inference statistic. With regards to inference statistic, multivariate tests at 0.05 level of significance were conducted.

Structural equation model was designed to determine the correlation among the importance of physical activity perception and the perception of safety of neighbourhood surroundings toward the permission for doing physical activity alone outside home, the correlation between the cycling acceptable distance for cycling to school with the facilities suggested and the correlation among the importance of Physical activity perception, the perception of safety of the neighbourhood surrounding, parent's permission for doing physical activity alone outside home and bicycle ownership corresponding to the permission to cycle to school.

1.6. Thesis Structure

This thesis is structured into seven chapters, namely; **Chapter 1**, describes the overview of the introduction of the research, basic idea and the frame of research work was discussed in this chapter. In the **Chapter 2** discuss about the review of some previous studies related to the research. The points of the research were described in this chapter. **Chapter 3** explains the research methodologies and the conceptual framework. It provides the methodology of data collection, data analysis and how to present the findings. A conceptual framework aims to explain the main concepts of the research**.** **Chapter 4** reports the data finding results, data analysis and discussion of the potential of cycling in university environment. **Chapter 5** reports the data finding results, data analysis and discussion of the potential of cycling as the feedering mode of public transport. **Chapter 6** reports the data finding results, data analysis and discussion of the parent perception regarding the potential of cycling as a transport mode for going to school. **Chapter 7** consists the summary of the analusis in this research. **Chapter 8** consists the conclusion of this research.

CHAPTER 2

LITERATURE RIVIEW

2.1. Sustainable Development

The origin word of sustainability is from the Latin, namely *sustinere* (*tenere*, to hold; *Sus*, up). In In Oxford dictionary, *sustain* is to “endure ", "support", or “maintain” (Onions, Charles, T. (Ed), (1964). Sustainability is the ability to maintain or the ability to endure. Sustainability is the long-term enduring of responsibility. At World Summit, (2005) stated the "three pillars" of sustainability (the 3 E's). Namely the environmental, social equity and economic demands reconciliation.

Sustainability as the part of the sustainable development concept has been deeper used since the 1980s . On 20th of March, 1987, the Brundtland Report had been released by the United Nations, which included what is now one of the most well known definitions of **Sustainable development.** The definition of sustainable development in the Brundtland Report is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In the report also stated that the definition of **Sustainable development** conceives in two key concepts; first, the concept of 'needs', in particular the world's poor essential needs, to which should be given in high priority; second, the environment's capacity to supply present and future needs.

2.2 Cities and sustainable transport

A **sustainable city is** a city that was designed which the consideration of environmental impact, inhabited by people dedicated to maintain the balance of supplies such as

energy, water and food, and waste output such as air pollution - CO_2, methane, and water pollution.

Generally, a sustainable city should supply the needs of the present without sacrifice the capacity generations in the future to meet their own needs. The sustainable city must be able to meet their own needs which minimize the dependence on the countryside in the surroundings, and by using with renewable sources of energy to power it.

Transportation services have a significant impact on the environment and energy consumption in the city. Automobile as part of transportation mode have the significant impact to climate change, air pollution, pedestrian injuries and deaths, declines in physical activity and obesity, Maibach et al. (2009). In order to reduce the environmental impact and energy consumption in the last decade, the major focus is on sustainable transport.

The reason why the development expert were focussed to create the policy to promote the sustainable transport were well documented, such as traffic congestion and the increasing of travel time (Ory et al. 2004; Turcotte. 2005) and the increasing and uncertain price of oil (Almeida and Silva. 2009).

Sustainable transport (or **green transport**) refers to transportation system which have the environment low impact. Sustainable transport systems could serve well in the communities in the city and have the positive contribution to the sustainability of the environmental, social and economic.

Unmotorised transport such as walking and cycling, transit oriented development, car sharing are included in s**ustainable transport**. Rietveld and Daniel (2004) stated that due to lower emissions of pollutants, noise pollution and lower energy consumption, unmotorised transportation modes are often considered as the important elements of

sustainable transport. A high share of unmotorised transportation modes would certainly contribute to the urban environment more attractive.

2.3. Bicycle As Means of Transportation

Transportation mode or the means of transportation or the form of transportation is the term there is used to distinguish substantially the way to do transportation. Car, motorcycle, walking, bus, train, aero plane, walking and walking are widely recognized as the means of the transportation.

A **bicycle** or bike is a human-powered, pedal-driven, single-track vehicle, having two wheels attached to a frame, one behind the other. A person who rides a bicycle is called a cyclist, or bicyclist.

Due to it uses human-powered means of travel; the bicycle is recognized as one of actives transports. According to Litman (2003) and Cole et al. (2010) walking and cycling are among of active transport. Ehrgott et al. (2012) argued that Cycling is suitable and efficient options as alternative means of transportation for commuting trips due to cycling is the most less energy consumption and very healthy modes of transportation and have the low impact other traffic. Many research attempted has been devoted to seek how to promote active transport modes as part of the transportation system, e.g. Dill and Carr (2003), Gatersleben and Appleton (2007), Wardman et al. (2007), Pucher and Buehler (2008) and Akar and Clifton (2009).

The reason why cycling is suitable as means of transportation is well documented. Daley and Rissel (2011) sated in their research that the viewed of the people who ride bicycle regularly, cycling as an efficient transportation mode. It is also cheap and environmentally friendly. They also stated the image of cycling as the green mode of

transportation due to cycling is environmental friendly, cycling have lot of evironmental benefits.

2.4. The impediments for cycling

Garrard et al (2008) stated that in the countries which have the low rates of cyclist, high users of private car and the large of gender differences, the major constraint is traffic safety concerns. As the result in their research McClintock and Cleary (1996) and Nankervis (1999) argued that the constraints for cycling are traffic safety on the road, heavy volume of traffic, inconsiderate drivers, exposure of pollution and the weather, while David et al. (2001) stated that the impediment for cycling is social pressure in the community.

Kingham et al. (2001) and Dickinson et al. (2003) stated that the major barrier to cycle for working trip purpose is the travel distance. Garrard et al. (2006); Cavill and Watkins (2007) in their research suggested that the travel time, the distance, level of organization, family responsibilities, weather condition, the safety, drivers bad attitude, the pollution; inadequate of cycling infrastructure and facilities, lack of secure parking, end facility in the destination, cultural norms, physical violence are well recognised as the impediment for cycling. Hilliness is recognized as one of the reasons for the low rates of cycling in Bradford (Hopkinson and Wardman 1999). In line with Newby (1993) and Bannister (1988), they stated that the impediment for cycling is the gradient.

The public view point of the cycling may also gives the opinion as an impediment or encouraging for the cycling. The image of the cyclist as ‘‘courageous’’, ‘‘fit’’, ‘‘the green’’, or ‘‘foolish’’, ‘‘inconsiderate’’ or ‘‘dangerous’’ can influence a non-cyclist’s make the decision whether to cycle or not in different contexts (Skinner and Rosen 2007). Rissel et al. (2002) states that the bad view of cycling due to they have never

tried. The changes of view were often occurred happened after they have the experience of cycling. Many non-cyclists report the safety concerns as the significant reason for why they do not cycle, yet these concerns diminish as they have the cycling experience.

The other concerned of cycling is the fear of being 'on appearance' and feeling vulnerable when being active in public spaces, afraid of appearing inept or ashamed when cycling (Horton 2007). Parkin et al. (2007) and Ehrgott et al. (2012) stated that cycling is recognized as one of the least safe modes of travel for the user. More detail Ehrgott suggested the safety concerned namely, the high volumes of traffic and insufficient of bike paths and the narrow road. And that was emphasized by Plaut (2005), he stated that safety concerned is the dominant topic in the discussion on encouraging bicycling.

According to Bonham and Koth (2010), distance, travel time, weather, high volume and fast traffic, driver attitude, lack of continuous cycling path, secure parking and cultural norm are among of impediments for cycling. They stated that although some students suggested as a transportation mode, cycling is cheaper than car, there was still in debate comparing the cost of cycling and driving a car. Moreover the others still argued that if once equipment cost were included riding and driving were equally expensive.

In four season countries, the number of bicycle riders will be decreased during winter season due to its extremely low temperature (Nankervis 1998; Bergstrom et al. 2003). Nankervis (1999) argued that wind, rain and temperature are among the three important elements of weather to be considered.

Hilly cycling routes, bad weather and lack of bike way facilities were among the contents for people who have the willing to cycle but they have not even tried

(Gatersleben et al. 2001). In bad weather, especially in the day which is snowing or raining, the number of cyclists decreased (Nankervis 1999).

2.5. The motivators for cycling

Bonham and Koth (2010) stated that, for cyclists, commuter and non-commuter, they have the equal perception regarding the motivator for cycling. Cycling is healthy was the main motivation for cycling, while affordability, concern about environmental, travel time and cycling for fun were also key factors.

The expenditure for traveling and the impact of socioeconomic status as the reason cycling preference were still in debates (Bonham and Suh 2008). Furthermore Davies et al. (2001), Dickinson et al. (2003) stated that the main reason encouraging people for cycling is pleasure, health concerned, the flexibility, the speed and the less cost of cycling.

Regarding the cycling in university, Garrard et al. (2006) and Bonham and Koth (2010) suggested that students and staff were encouraged to cycle as the compensation of their daily activity working in front of a computer.

2.6. Bicycle facilities

Garrard et al. (2008) determined that bicycle facilities are categorized based on the level of the separation between cyclist and other traffic (the motorised modes), namely, 'Off-road facility' (bicycle-only or shared pedestrian/bicycle paths); 'lanes on the road' (marked and signed bicycle lanes adjacent to motor vehicle traffic); and 'No bicycle facility' (no bicycle facility or unmarked wide curbside lanes).

As mentioned in Tilahun et al. (2007), it provides five categories of cycling facilities, namely: Off-road path; bike facilities in the traffic with bike-lane and no on street

parking; bike facilities in the traffic with a bike-lane and on-street parking; bike facilities in the traffic with no bike-lane and no on-street parking, and bike facilities in the traffic with no bike-lane but with on-street parking,

Dickinson et al. (2003) stated that the addition of cycling path and the better of cycling have the low impact regarding the willingness to switch from the car used to cycling. The adequate of bicycle facilities, the type of the facility and the quality of the facility have the significant influence to the cyclist number. Dill and Carr (2003), Nelson and Allen (1997) have shown the percentage of cycling for commuting purpose were significantly affected by providing the adequate of cycling facilities. Beside of that the cycling facility must be well connected between origins to destination in order for encouraging cycling as the alternative mode for commuting. Gatersleben and Appleton (2007) argued that the non cyclist had already realized the benefits of cycling; they were not willing to cycle due to lack of adequate lane for cycling.

McClintock and Cleary (1996) shown that the cycling is well recognized as the riskiest of transportation modes, but the planning should not be based on safety consideration. The safer and pleasant route had already built but the cycling route became indirect to the destination. Because they were willing to arrive to work quickly, the commuter cyclist prefers riding the bike along the main road rather than the safer and pleasant route.

The cycling trips would increase due to the improvement of cycling facilities, moreover to avoid the unsafe cycling route, the cyclist was willing to cycle longer (Gatersleben studies 2007; Martens 2007; Wardman et al. 2007). To improve the cycling safety and encouraging cycling trips, demarcating on-street facility is often recommended as the strategy. (Krizek and Roland 2005). They also stated that the improvement of bicycle facilities could improve the safety on cycling. Bonham and Koth 2010 stated that, for

both commuter and non commuter student who cycle, they concerned about safety and the availability of the adequate facility

2.7. Dependence on private vehicles

Hagman (2003) argued that the important advantage of private car use is the flexibility of accessibility and time, that means that if they use a private vehicle people can go anywhere they want, will go at any time without waiting for public transport at the bus stop. Safety and comfort are also one of the advantages of using private vehicles. In line with Nilsson and Kuller (2000), time saving, comfort and free to go everywhere are among the reasons for driving car. The other advantage that people choose private car is user can carry everything (Cullinane et al. 2003). Private car used as a transportation mode in urban city is widely used, the majority travelling which is work trip purpose is car used (Dickinson et al. 2003).

Bergstrom and Magnusson (2003) stated that there were the wide negative effects of car as a transportation mode, traffic congestion, pollution, road accidents, and the lack of space for road and parking facilities. They also argued that to decrease the car in the traffic, especially in urban regions, could be reached by the promoting cycling as means of transportation.

Car owners usually have the habitual use their vehicle for both short and long trips (Bergstrom and Magnusson 2003). Dickinson (2003) stated that the potential for cycling is in the distance within 3 miles (5 km). Bergstrom and Magnusson (2003) stated that, based on Statistics Sweden in 1998, more than fifty percent of cyclist made the traveling shorter than 5 km, the distance that most the people is consider for cycling

However, car has to be reduced in order to reduce its negative impacts and for better land use in future. For example, reduction in car use means a decrease in demand for

parking area, so that the area can be planned for other more useful facilities (Shannon et al. 2006). There should be efforts to reduce car use in road network within campus through university pro-active educational milieu. College campuses are privileged places to communicate sustainability and to help reshape society's transportation patterns (Balsas 2003). Balsas also argue that university campuses can constitute the place for testing and implementation the various alternatives of transportation strategies, decrease the infrastructure expenditure and reducing the bad effect on the surrounding areas.

2.8. The Gender Influence for cycling

Garrard et al. (2008) stated the most of woman in Australia is not interesting for cycling. As expected, males were found to be more likely to cycle than females, the probability of cycling to work decreased as age increases. In the average female's travel distance is shorter than male and they have more resistance to cycle than male, more attention needs to go into attracting women to cycle (Dickinson et al. 2003).

Bull et al. (2000) stated that cycling was not independent toward gender and age. Cycling is most widely popular for youth and male and people have the capacity to do physical activity. This result was similar with Moudon et al. (2010), cycling have highly dependent with gender, male is more cycling than female and youths is the higher number of cyclists.

Several studies, for example, Bell et al. (2003) found that on average, female bicycle commuters were less than one third of male bicycle commuters in Australia. Studies by Sisson et al. (2008) also found that females were less likely to use a bicycle as their transportation mode.

Additionally, Garrard et al. (2008) found that female cyclists only amounted to one fourth of male cyclists on the road and Pucher et al. (2011) in their study found that in the Melbourne Metropolitan Area, the highest percentage of female bicycle commuters were recorded at only 37%. However, Garrard et al. (2008) stated that this is not the case in several Western European countries, where utilitarian cycling rates are high and men cycle less frequently than women.

By and large, traffic safety has been identified as a main constraint for cycling in countries with low rates of cyclist, high rates of private car used and a high difference of the gender in cycling (Garrard et al. 2008). He also stated that, females reported the concerned about traffic and bad attitude of the motorist as the constraints for cycling more than males. Females also preferred cycled on the off road cycling paths rather than on the roads with no bicycle facility.

The differences in travel behavior due to gender must be taken into consideration when formulating a transportation policy. Dickinson et al. (2003) stated that gender has been identified as one of the important parameters in travel patterns. In their study in Austria, Titze et al. (2008) found that 23% of the respondents were cyclists, where in 51.6% of them are female and the number of cyclists decreased as the travel distance increases.

2.9. Cycling for doing activities on campus

Actually, there are bicyclists in University of Malaya, but the number is very small. Several factors affect why a student does not use a bicycle, such as, aggressive car driver, bicycle availability, land topography and lack of cycling facilities. The answered by the people regarding the bicycle used, they do not ride the bicycle due to road safety, high volume of traffic, driver attitudes, air pollution, weather condition, the travel distance and travel time, hilliness, the problem with health and social norms. (Bannister

1988; Davies et al. 2001; Gatersleben & Appleton 2007; Kingham et al. 2001; McClintock & Clearly 1996; Newby 1993; Wardman et al. 1997).

In the other hand, student potential for cycling is very high, a lot of factors can encourage them to cycle. Students are usually more concern about the environment and more receptive to new ideas. They are young and physically more fit, have limited budgets, they already have their own bike and live around campus (Balsas 2003). Shannon et al (2006) argues that is not taking a long time to encourage student for cycling. A lot of factors could accelerate the process, such as, forbidding using car for undergraduate students or limited parking permission for student during the first year. Garrard et al. (2006) argues that motivators for cycling have included physical and mental health, fitness, sustainability and affordability, in line with cavil et al. (2007).

Weerts (1992) suggested that less considering about cycling as a part of the transportation policy due to cycling is still not considered as an alternative means of transportation. Besides that walking and cycling instead is an image of the high quality of life (Wilkinson 1997 and Clarke 2000). Walking and cycling can be used as a complement of transportation mode. In many universities, many students and staff who live in the campus. They are at the reasonable distance for walking and cycling. Cycling is fast and flexible for short distances. Cycling has many benefits, do not cause air and noise pollution, no oil consumption, cheap and suitable for the students which have the budget restricted (Tolley 1996). Staff and faculty members shared some characteristics and many influential members of the local community, as potential bike advocates, they can help persuade city officials and campus administrators to implement the cycling policies (Tolley 1996 and Balsas 2003).

2.10. Cycling as part of the public transport system

In recent years, the attentions of urban transport planners have focused on the policies for promoting bicycles used as an alternative to intensive car use (Palomares et al. 2012). One of the systems to promote bicycle used is bike-and-ride, or the combination of bicycle used and public transport in one trip travelling. This is the alternative of multimodal alternative to replace the car used. The different forms can be taken as a combination: bicycle as the path of the system can be used in access trips (at the home-end of a trip), or egress trips (at the activity-end of a trip), or the combination.

As mentioned in the Martens research (2004), comparing the car, bike-and-ride system is more environmentally friendly, lower noise and air pollution and lower energy used and offer social benefit. Moreover, bike-and-ride may improve the overall competitiveness of public transport, cycling, walking as the 'green' transportation modes toward the private car (Martens 2007).

Regarding the overall travel times, the private car is faster than public transport, even compared to the type of public transport which has fast speed, like the train (Rietveld 2000). Martens (2007) stated that the use of bike-and-ride can accomplish one of the public transport weaknesses, the accessibility of the public transport stops. The bicycle is also faster than walking and more flexible than public transport.

In addition, as the environmental benefits, the switching the car trips by bike and ride system could reduce congestion in the specific road corridor or on the access road to the public transport station/terminal. This system can limit the need of park and rides are in locations adjacent to public transport stations/terminals.

Martens (2004) stated that climate and weather condition have a significant influence on cycling and it may be expected that they also influence the bike-and-ride level. Nankervis (1999); Bergstrom and Magnusson (2003) and Bickelbacher (2004) suggested that the decreasing of bike and ride used in bad heater.

The bike-and-ride facilities in public transport station were recognized influence on the users. In the Netherland cycling to Train station is higher than the cycling to bus, tram and metro stops due to it has fairly well-equipped of cycling facilities. While as result of Wardman et al. (2006) research, the improvement of bike parking facility caused the small shifting from car to cycling. Fukuda and Morichi (2006) stated that the improvement of the parking area for cyclist have impacts on the increasing of public transport passenger, especially in station area within 4 km.

2.11. Bike Share System

Public bicycle systems are also well known as the bike share system. The systems were introduced as a part of public transportation system. It serves as the access mode in the beginning of traveling of egress mode at the end of travelling of the overall public transport system. As the bicycle sharing system uses bicycles as one form of public transportation in urban areas.

Bicycle sharing focuses on the first mile and/or last mile of the user's commute. It also provides a connection to other modes of transit (Lin et al. 2011). She also stated that, since the first introduction of a bicycle sharing system in Amsterdam in the Netherlands in the 1960s, bicycle sharing systems has received increased attention in recent years around the world, such as in Paris; Barcelona; Berlin; Washington, DC and Montreal.

One of the most prominent actions taken by transportation planners is the introduction of bike-sharing programs, also called “rental bike”, “public-use bicycles” (PUBs), “bicycle transit” or “smart bikes” (Midgley 2011).

Bike-sharing programs are the bicycle networks for public use. It is distributed around a city which is low cost for used. The programs consist of the short-term the rent of bike system in urban areas which available bicycles can be picked up at one self-serve bike station and returned to any other bike station. This scheme makes bicycle-sharing equipped for short-term point-to-point trips (New York City Department of City Planning 2009). The principle of bicycle sharing is simple: people can use bicycles as their needed, do not the buy or have the own bike (Shaheen et al. 2010).

2.12. Cycling for going to school

The willingness of the children to cycle to go to school is quite high. But unfortunately only a few children can do it, most because parents do not allow their children to cycle to school. Gatersleben et al. (2001) conducted a survey among parents of primary school children, the result of willingness to cycle to school is 30% but only 1% of them can make this a realization.

Parents have an influencing role in lowering the chances of bicycles used as a means of transportation for children to go to school. They are really concerned of their child's safety along the travelling routes to school. In addition to that they are also concerned on the safety from other traffic users and crime. The availability of adequate and environmental friendly cycling route will also be a consideration. Parents are also concerned on the availability of an officer at intersections to help children cross the road safely. If the requirement mentioned above is not met, then they would rather let their

children use other transportation, such as; school buses, public transport or the parents themselves drop and pick up their children from school by car and motorcycle.

Timperio et al. (2004) stated that by giving the children for cycling to school give them the opportunity to learn how to walk and cycling safety in traffic. It could not happen for 'chauffeuring' children to destinations. The parents, schools and the authorities should create a friendly environment for their children to cycle to school. But unfortunately due to the presumption of less safety for cycling to school, the parents do not even allow their children to cycle to school, they prefer to choose other transportation for their children, especially they drooped and pick up their children to school.

Actually as one of the active transport, cycling has many benefits for children, Cooper et al. (2008) found there is the relationship between the fitness with cycling to school for the children. In line with Tudor-Locke et al. (2002); Sirard et al. (2005); Mackett et al. (2005); Cooper et al. (2006), and Isler et al. (2008), they stated that cycling to school make the children and adolescent increase their daily cardiovascular fitness and energy expenditure, comparing the traveling by car. Doing physical activity regularly for children and youth is very important for their health (Buliung et al. 2009). According Chriqui et al. (2012), ideally, 60 minutes of physical activity should be spent every day. Tudor-Locke et al, 2001; Cooper et al. 2003; Timperio et al. 2004; Boarnet et al, 2005 ;Timperio et al. 2006; Faulkner et al, 2009. Buliung et al. 2009 stated for youth, cycling as one of active transport to school could increase the physical activity for the children.

It had been reported the active transport decreased in several countries. In the USA, Austria and United Kingdom has been reported the decreasing of active travel to school (ATS), (National Center for Safe Routes to School and Safe Routes to School National Partnership 2010, Van der Ploeg et al. 2008, Metcalf et al. 2004 and Chriqui et al.

2012). In line with Cole et al. (2010), they said that in the majority countries in the late 20th century have observed the active transports were significant decreased, in the other hand

Goodman and Tolley (2003); Institution of Highways and Transportation (2000); Owen et al. (2004); Tolley and Lumsdon (2003); Mokhtarian et al., (2001); Saelens et al, (2003), Carver et al. (2008), Cole et al. (2010) stated that the cycling to school decrease because the 'chauffeuring' children to the school were increased. They also have found that environmental factors and demographic to be associated with the decreasing of walking and cycling.

Timperio et al. (200) and Isler et al. (2008) argued that physical neighborhood environment and social aspects are among aspects could influence the children to commute to school by cycling and walking. They also stated that the many children in the neighborhood environment would give the higher opportunities for cycling and walking together with other children to school.

As stated in Carver et al. (2008) research, safety is identified as a potential influence for active transport. Timperio et al. (2006) suggested that the attention on the school location related to areas of the residence and the traffic routes. This is an important factor in planning for new communities and when the policy of school zone is made.

Children who have shorter distance are likely having more opportunity to commute by active transport to school (McDonald 2007; Merom et al. 2006; Nelson et al. 2008; Børrestad et al. 2011). The Netherlands have a tradition of cycling for a long time; they have a better built environment for cycling, which has the result the good infrastructure which is more safe and comfortable for cycling than in other countries (Bere et al. 2008).

As stated in Boarnet el al. (2005) research, the improvement of pedestrian and bicycle facilities such as the improvement of sidewalks and traffic control system can impact the preference of children for active transport to school. Isler et al. 2008 stated in Payerne urban area, the concerned about safety, there are more student to be accompanied by their parents.

2.13. The barrier for active travel to school

The distances, road traffic, the weather conditions, hilliness routes, the safety, busy intersections for crossing, bad access to pedestrian crossings, and many thing to carry are among of commonly cited barriers for children for active transport to school (National Public Health Partnership 2001; Dellinger 2002; DiGuiseppi et al. 1998; Timperio et al. 2006; Cole et al. 2010 Ahlport et al. 2008; Di Guiseppi et al. 1998; Faulkner et al. 2010; Greves et al. 2007; Kerr et al. 2006; Timperio et al. 2006; Martin and Carlson 2005; Timperio et al. 2006; Chriquí et al. 2012).

As stated in Muller (2005) research, respectively, the weather condition or season have the strong impact on students transport mode preference for students for travelling to school. Furthermore, linked with costs, the distance is recognised as the most important factor for discrimination between transport modes (public transport and car/motorcycle) and those with lower travel costs (walking and cycling).

As presented in Bringolf-Isler et al. (2008); Carver et al. (2008); Kerr et al. (2006); McDonald,(2007); Nelson (2008); Sjolie and Thuen (2002); Timperio et al. (2006); Bere et al. (2008) research, the different reasons have been suggested for the low and decreasing levels of active commuting such as safety concerns, traffic, road crossing, crime, convenience to drop children off on the way to work and environmental factors such as walk ability and distance to school .

From the school authorities, the road traffic, the distance from the residence to school, lack of sidewalks and cycling paths, lack of guards for crossing, bad weather and the crime were reported as the barrier for active transport to school (Chriqui et al. 2012). Children's physical activity can be impacted by road safety, Petch and Henson (2000); Carver et al. (2008) state that it is now realized that road accidents involving the children could be happened due to the various factors including the driver attitude and/or the children and the physical/social environment condition. Based on the result above in the recent research has shifted emphasis to the road/neighborhood environments modification to improve pedestrians and cyclists safety (Carver et al. 2008).

Road intervention should be conducted to improve the children safety from cycling to school. The type of intervention is traffic calming, which involves the reduction of speed and/or volume of traffic. The idea was created from "street for living design which promoted the coexistence of pedestrians, cyclists and motor cars. Being placed speed humps; vegetation and narrow section of road are among the methods to redesign the residential streetscape (Petch and Henson 1999; Harvey 1992; Carver et al. 2008).

In other way, Boarnet et al. (2005) and Carver et al. (2008) suggested that by constructing and maintenance of sidewalks and cycling road; the installation of traffic lights along the way to school would increase children's active transport. In addition, the several social interventions have aimed to promote active transport to school. These include designated days on which walking to school is encouraged, as well as walking- and cycling-school buses (Carver et al. 2008).

The finding confirms those of Staunton et al. (2001) and Boarnet et al. (2005), as the research in their study of the SR2S program in Marin County, and expands the results to

more schools and to more various settings, showing an relation between the improvement of SR2S toward the increasing increased active transportation among students from the schools with the demographic and the settings of built environment and the varied improvements of engineering.

2.14. The gender and active travel to school

In their research, Børrestad et al. (2011) suggested that boys were more likely to be cyclists and less likely to be walkers than girls. In Australia, regarding their active transport the adolescent girls' perception of safety on local road was positive (Carver et al. 2005 and Carver et al. 2008).

Cooper et al. (2003) stated that the girls were less physically active than the boys. However, since there was no difference between the travel groups for girls, this may also describe the various types of the physical activity that boys and girls pursue, with the boys are more active play than girls, or may arise through girls having less permitted to be active.

In the research of Boarnet et al. (2005) found that male youths who walking and cycling to school were significantly more physically active all the day than the male youths who did not walk and cycling to school.

2.15. Active travel to school related to social-economic status (SES)

In several countries, there were the social-economic status influence on active travel to school for the children. In Rotterdam the adolescent with at least one parent without pay job were more likely to be non-active commuters while traveling by walking and cycling seems most commonly to be a prominent transportation mode among adolescents of two working parents (Bere et al. 2008). There was also the difference in

the parental employment status measure on having bikes at home; the bicycle ownership of “two working parents” was higher than “at least one parent not working” groups. Higher SES groups have previously been reported to cycle more often to school in Australia; living in a high SES area increased the active transport to school (Timperio et al. 2006; Bere et al. 2008).

There was contrary phenomenon happened in the USA and Portugal, adolescents from higher socioeconomic status were not more likely walking or cycling to school (McDonald 2007; Mota et al. 2007; Bere et al. 2008). In the areas of low SES, the neighborhood provides the opportunities for inexpensive forms of physical activity, such as walking and cycling (Humbert et al. 2006; Carver et al. 2008).

As mentioned in research before, the supporting or impediments on transportation options by household are also often denoted have the significant influence the behavior of travelling to school (Bricker et al. (2002); Dellinger and Staunton (2002); Sjolie and Thuen (2002) and Ziviani et al. (2004). McMilan 2012 stated that the preference for travelling to school is walking and cycling if the travel distance from home and school as less than one mile. However, the number of car ownership in the household had no significant influence on the travel mode preference to school. McMilan in her research stated that both socio-demographic variables showed the significant influence the active transport probability to school: as the household income increased the probability of the active transport to school increased, the likelihood of the decreasing of non motorized school travel as the increasing of the children number in the household (KIDS), so did the likelihood of active transport to school.

2.16. The parent's perception on the active travel to school among the children

The decline of the active travel to school for the children were well documented, McDonald (2007) reported the decreasing of the active transport especially for the children to commute to school. He also stated active transport decreased 24 % in thirty one years since 1969. In the UK, the percentage of the child aged 7 year olds travelling alone to school and by active transport modes decreased to 7% from 72%, in 19 years since 1971(Hillman et al. 1991; Cole et al. 2010).

Parents often preferred to drop and pick up their children to school rather than encouraging their children walking, cycling or use public transport (Tranter and Pawson 2001; Carver et al. 2008). Due to concerned about road safety and the crime, many children are dropped and pick up of their activities at the school in order to protect them (Isler et al. 2008). Moreover, 'chauffeuring' of children to school were the attempted by parent to avoid their children from risk and injury (Timperio et al. 2004). In line with the findings of Timperio et al. (2004); Hillman et al. (1990) and Carver et al. (2008), they stated that the parental give the restriction on their children physical activity due to the concerned of the possibility their child injury.

2.17. The preference of cycling as means of transportation

Bergstrom and Magnusson (2003) argued that the personal attitude, demographic, social and economic aspect affect the mode transportation choice, including the weather, distance and travel time. Regarding the preference cycling as means of transportation mode, the personal attitude is related to lifestyle, life situation, and social norms (Forward 1998). The concerned about traffic safety was widely recognized as the major impediment for cycling (Garrard et al. 2006; Goldsmith 1992), moreover, these concerns appear to have a differential impact on female, perhaps due to they are more

risk averse than men and The female cycling distance is shorter than males. (Byrnes et al. 1999 and Dickinson et al. 2003).

Ehrgott et al. 2012 stated that the first modeling of route choice for cyclists is applied by Bovy and Bradley 1985, they applied discrete choice models for that purpose. For modeling the cyclists' route choice for commuting, a stated preference approach was applied. There were three attributes, namely, time, the level of traffic level, and surface quality of road surface. Until today, a discrete choice model is recognised as the mainstream technique in the travel behavior modeling for cyclists (Ehrgott et al. 2012). In the area of Phoenix metropolitan, Howard and Burns (2001) optimized the cycling route based on distance, travel time and safety in a geographic information system.

In Edmonton, Canada, Hunt and Abraham (2007) applied the stated preference approach examining the factors influencing on cycling. In their research, more detail of route attributes were considered, namely, the travel time of cycling in various types of bike facilities. The other attributes were the cycling experience; the equipped parking area and the end trips facility are also considered. Study by Hopkinson and Wardman (1996) explored the demand for cycling facilities using stated preference in a route choice approach. The finding is the cyclists were willing to use the safer routes, the improvement of safety is more important rather than reducing the travel time. Moreover Abraham et al. (2004) also found that cyclists prefer off-street cycling facilities and low traffic residential streets.

Aultman-Hall et al. (1997), Stinson and Bhat (2003) and Ehrgott et al. (2012) stated that the shortest-distance routes resembled most closely the observed routes. While Antonakos (1994) also found that the traffic volume and road surface quality have the influence on cycling preference.

Shaafizadeh and Niemeier (1997) suggest that the separate bike paths were the important part of the overall cycling network and more recently. Moreover Tilahun et al. (2007) suggested that due to the safety concerned, the bike user is willing to cycle longer to switch their route from the unmarked bike facility on the street with side parking to an off-road cycle path. Regarding the cycling route preferences, the cyclists were not choice the route solely based on shortness, directness or safety, but rather based on the combination of both (Howard and Burns 2001).

The Vancouver cycling trip has options for cycling routes namely the shortest, the least traffic pollution, less elevation, the route which fully vegetation and allows restrictions on the slopes. It lets users choose their cycling route (Ehrgott et al. 2012). According Ehrgott et al. (2012), travel time and travel cost were importance for cycling route preference, however safety concerned must be considered. It is easy to imagine the shortest route follows a major road which unsafe for cyclist, while the perfectly safe of cycle paths but the path is longer.

2.18. The summaries of Literature Review

The summaries of literature review can be seen in Table below :

Table 2.1. The sumarized of literature liview

No.	Findings	Variabel	Authors
1.	The depedency on private car.	The depency is very high	Hagman (2003).
2.	The important advantage of private car used namely.	1. The flexibility of accessibility and time and people can carry everything. 2. Time saving, comfort and free to go everywhere are among the reasons for driving car.	Hagman (2003); Nilsson and Kuller (2000); (Cullinane et al. (2003). Nilsson and Kuller (2000),
3.	The wide negative effects of car as a transportation mode.	1. Air pollution. 2. Traffic congestion, pollution, road accidents, and the lack of space for road and parking facilities.	Maibach et al. (2009). Bergstrom and Magnusson (2003)
4.	The important advantage of private car used	The flexibility of accessibility and time; People choose private car is user can carry everything,	Hagman (2003); Nilsson and Kuller (2000); (Cullinane et al. (2003).
5.	The impediments for cycling..	1. Traffic safety concerns	Garrard et al. (2008); McClintock and Cleary (1996); Nankervis (1999); Garrard et al. (2006); Cavill and Watkins

			(2007); Skinner and Rosen (2007); Rissel et al. (2002), Parkin et al. (2007);
		2. The pollution and the weather.	Ehrgott et al .(2012); Plaut (2005) and Bonham and Koth (2010). McClintock and Cleary (1996); Nankervis (1999); Garrard et al. (2006); Cavill and Watkins (2007); Nankervis (1998) and Bergstrom et al. (2003),
		3. Social Norms.	David et al. (2001); Horton (2007).
		4. Inadequate of cycling infrastructure and facilities.	Garrard et al. (2006); Cavill and Watkins (2007); Bonham and Koth (2010) and Gatersleben et al. (2001).
		5. Hilliness	Hopkinson and Wardman (1999); Newby (1993) and Bannister (1988),
		6. The travel distance.	Kingham et al. (2001); Dickinson et al. (2003); Garrard et al. (2006); Cavill and Watkins (2007); Bonham and Koth (2010).
6.	The motivators for cycling.	1. Cycling is healthy.	Bonham and Koth (2010); Davies et al. (2001); Dickinson et al. (2003),
		2. Concern about environmental.	Bonham and Koth (2010),
		3. Travel time and the distance.	Bonham and Koth (2010), Davies et al. (2001), Dickinson et al. (2003).
		4. Cycling for fun.	Bonham and Koth (2010), Davies et al. (2001), Dickinson et al. (2003).

		5. Less cost of cycling, 6. Social interaction as the major motivation encouraging for cycling,	Davies et al. (2001), Dickinson et al. (2003). Garrard et al. (2006) and Bonham and Koth (2010).
7.	The constraint why student do not cycle.	Road safety, high volume of traffic, driver attitudes, air pollution, weather condition, the travel distance and travel time, hilliness, the problem with health and social norms.	Bannister (1988); Davies et al. (2001); Copsey (2001); McClintock & Clearly (1996); Newby (1993); Wardman et al, 1997), Gatersleben & Appleton (2007).
8.	The factors can encourage studentd to cycle.	1. Students are usually more concern about the environment. 2. Students are more receptive to new ideas, They are young and physically more fit. 3. They have limited budgets. 4. They already have their own bike and live around campus.	Timperio et al. (2006); Bere et al. (2008); Balsas (2003); Tolley (1996); Wilkinson (1997) and Clarke (2000).
9.	The factors could accelerate the cycling for activities around campus	1. Forbidding using car for undergraduate students. 2. Limited parking permission for student during the first year.	Shannon et al. (2006).
10.	The Gender Influence for cycling	1. The percentage of male were higher in cycling.	Garrard et al. (2008); Dickinson et al. (2003); Titze et al. (2008); Bull et al. (2000); Moudon et al. (2010); Bell et al.

		2. The average female's travel distance is shorter than male.	(2003); Sisson et al. (2008), and Pucher et al. (2011). In the average female's travel distance is shorter than male, Dickinson et al. (2003), and Titze et al. (2008).
11.	The willingness of the children to cycle to go to school.	The willingness is high	Gatersleben et al. (2001).
12.	The advanteges of cycling to school.	1. The opportunity to learn how to walk and cycling safety in traffic. 2. Increase their daily fitness,	Timperio et al. (2004). Cooper et al. (2008); Tudor-Locke et al. (2002); Sirard et al. (2005); Mackett et al. (2005); Cooper et al. (2006); Isler et al. (2008), Chriqui et al. (2012), Tudor-Locke et al. (2001); Cooper et al. (2003); Timperio et al. (2004); Boarnet et al. (2005) ;Timperio et al. (2006); Faulkner et al. (2009) and Buliung et al. (2009).
13.	The condition of cyclng to school	As one of active travel, cycling to school decreased.	National Center for Safe Routes to School and Safe Routes to School National Partnership (2010); Van der Ploeg et al. (2008); Metcalf et al. (2004); Chriqui et al. (2012); Goodman and Tolley. (2003); Institution of Highways and Transportation (2000); Owen et al. (2004); Tolley and Lumsdon (2003); Mokhtarian et al. (2001); Saelens et al. (2003), Carver et al. (2008); Cole et al. (2010); McDonald (2007) and Hillman et al. (1991).
14.	Parents concerned along the travelling routes to	The safety (traffic and crime)	Timperio et al. (2006); Bere et al. (2008); Tranter and Pawson, (2001); Carver et al. (2008), Isler et al. (2008);

	school.		Timperio et al. (2004); Timperio et al. (2004); Hillman et al. (1990) and Carver et al. (2008).
15.	The barriers for active travel to school	1. Distances, road traffic, the weather conditions, hilliness routes, the safety, busy intersections for crossing, bad access to pedestrian crossings, and many things to carry. 2. The safety	National Public Health Partnership (2001); Dellinger (2002); DiGuiseppi et al. (1998); Timperio et al. (2006); Cole et al. (2010) Ahlport et al. (2008); Di Guiseppi et al. (1998); Faulkner et al. (2010); Greves et al. (2007); Kerr et al. (2006); Timperio et al. (2006); Martin and Carlson (2005); Timperio et al. (2006); Chriquí et al. (2012). Bringolf-Isler et al. (2008); Carver et al. (2008); Kerr et al. (2006); McDonald (2007); Nelson (2008); Sjolie and Thuen (2002); Timperio et al. (2006); Bere et al. (2008). Carver et al. (2008) and Isler et al. (2008). The school location related to areas of the residence and the traffic routes were also influence for active transport, Timperio et al. (2006); McDonald (2007); Merom et al. (2006); Nelson et al. (2008); Børrestad et al. (2011) and Bere et al. (2008).
16.	The influence of gender on cycling to school	Boys were more likely to be cyclists and less likely to be walkers than girls. Male youths who walking and cycling to school were significantly more physically active all the day than the male youths who did not walk and cycling to school,. The adolescent girls' perception of safety on local road was positive,	Børrestad et al. (2011); Cooper et al. (2003). Boarnet et al. (2005). Carver et al. (2005) and Carver et al. (2008).

17.	The influence of Social-Economic Status (SES) on cycling to school.	Traveling by walking and cycling seems most commonly to be a prominent transportation mode among adolescents of two working parents, Higher SES groups have previously been reported to cycle more often to school in Australia; living in a high SES area increased the active transport to school. There was contrary phenomenon happened in the USA and Portugal, adolescents from higher socioeconomic status were not more likely walking or cycling to school.	Bere et al. (2008). Timperio et al. (2006); Bere et al. (2008). McDonald (2007); Mota et al. (2007); Bere et al. (2008); Humbert et al. (2006); Carver et al. (2008).
18.	The barrier for active transport to school base on the school authorities,	The road traffic, the distance from the residence to school, lack of sidewalks and cycling paths, lack of guards for crossing, bad weather and the crime were reported as	Chriqui et al. (2012), Henson (2000) andCarver et al. (2008).
19.	The policy that can encourage student to cycle to school.	The improvement of pedestrian and bicycle facilities such as the improvement of sidewalks and traffic control system can impact the preference of children for active transport to school.	Boarnet el al. (2005).

		Road intervention (traffic calming). Constructing and maintenance of sidewalks and cycling road and the installation of traffic lights along the way to school . Social interventions	Petch and Henson (1999); Harvey (1992) and Carver et al. (2008). Boarnet et al. (2005) and Carver et al. (2008). Boarnet et al. (2005) and Carver et al. (2008).
20.	Bicycle facilities	The categories of bicycle facilities, namely; Off-road path; bike facilities in the traffic with bike-lane and no on street parking; bike facilities in the traffic with a bike-lane and on-street parking; bike facilities in the traffic with no bike-lane and no on-street parking, and bike facilities in the traffic with no bike-lane but with on-street parking. The adequate of bicycle facilities have the significant influence to the cyclist number, To improve the cycling safety and encouraging cycling trips, demarcating on-street facility is often recommended as the strategy	Garrard et al. (2008), Tilahun et al. (2007). Dickinson et al. (2003) , Dill and Carr (2003), Nelson and Allen (1997), Gatersleben and Appleton (2007), Bonham and Koth (2010). Krizek and Roland (2005).

CHAPTER 3

RESEARCH METHODOLOGY

This chapter presents the methodological process of this study. The methodological process are islustrated in figure 3.1 below. The research started from the Initial description or the idea of bicycle as transporation mode. Base on the Initial description of bicycle as the transporation mode, a conceptual framework was developed. In the developing a conceptual framework, literuture review were needed. Literature review is 'a description of the literature relevant to a particular field or topic' (Emerald, 2012). As suggests by Hart (1999), the literature review can provide the researcher with the key theories and concepts, key writers, major issues and debates, the main questions and problems previously discussed, and research methodologies adopted.

Regarding the conceptual framework, it was needed due to according to a conceptual framework aims to explain the main concepts of the research, the key factors, its variables in narrative form, Miles and Huberman (1994). Maxwell (2005) expands this terminology to include the actual ideas and beliefs about the research topic. He stresses that the most important aspect of developing the conceptual framework is that it is a model of what is out there, and what is going on and why, hence it is a tentative theory of the investigated phenomenon. Moreover, Yin (2009) adds that by conceptualising the investigated phenomenon, the researcher can illustrate the main concepts of the study, the ways they are interrelated, and the boundaries within which the concepts and interrelationships are applicable. As a result, the development of a conceptual framework is an essential part of research process.

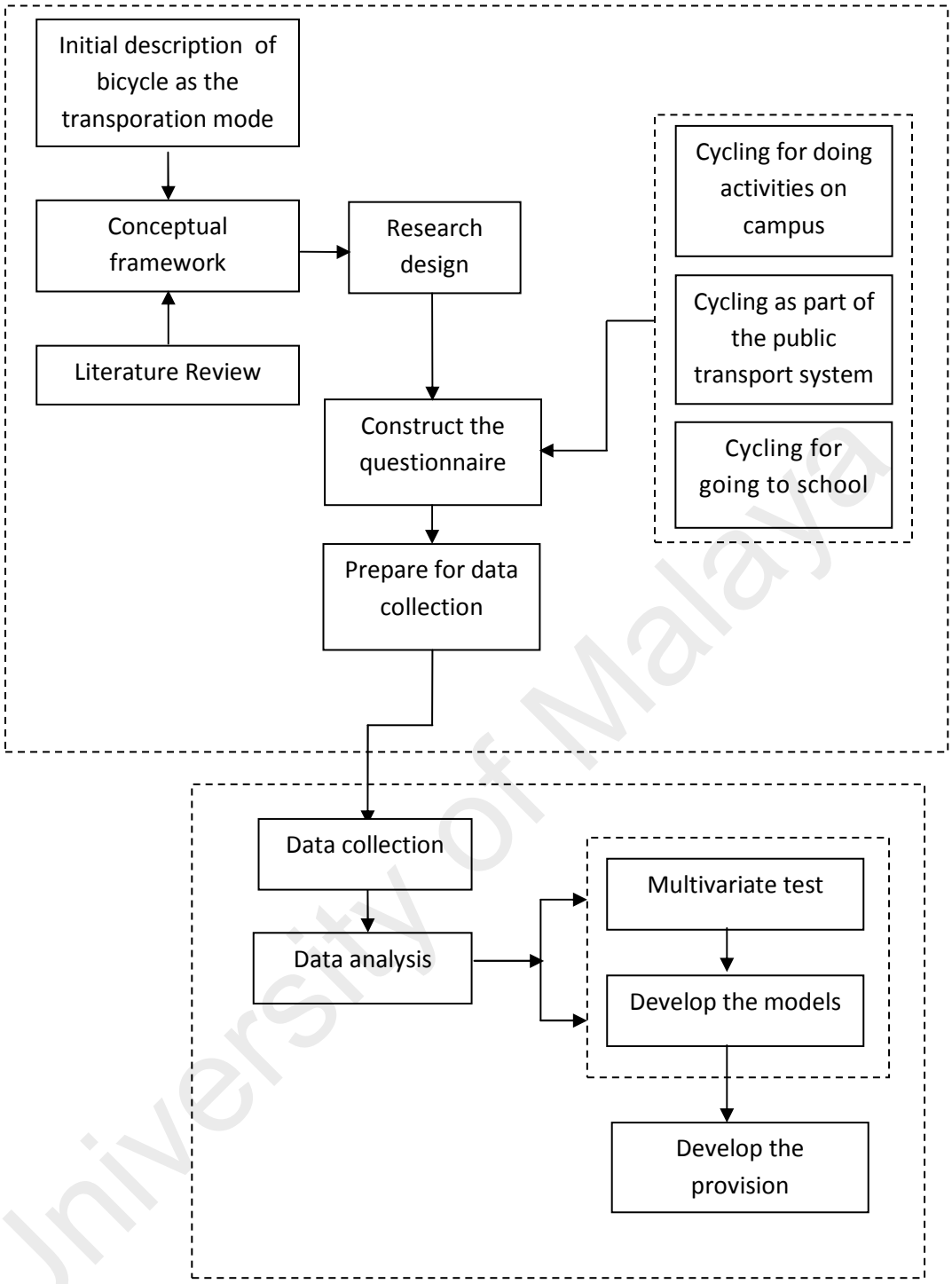


Figure 3.1. The reseach methodology

The key areas of the research that were identified through a literature review (Chapter 2) were used to generate the conceptual framework. As figured in Figure 3.2., some of the key areas are: the constraints for cycling (section 2.4), the motivators for (section 2.5), the influence of socio-demography (section 2.8, 2.14 and 2.15), the preference of

cycling as means of transportation (section 2.17), dependence on private vehicles (section 2.7), cycling for doing activities on campus (section 2.9), **c**ycling as part of the public transport system (section 2.10), and cycling for going to school (section 2.12).

The main concept of this research is the preference of cycling as means of transportation. As mentioned above, there are some key issues concerned in this study. Its key issues will give the contribution to develop the main concept. Regarding the previous studies, in Chapter 2 can be seen the influence of the key issues on the preference of cycling as means of transportation.

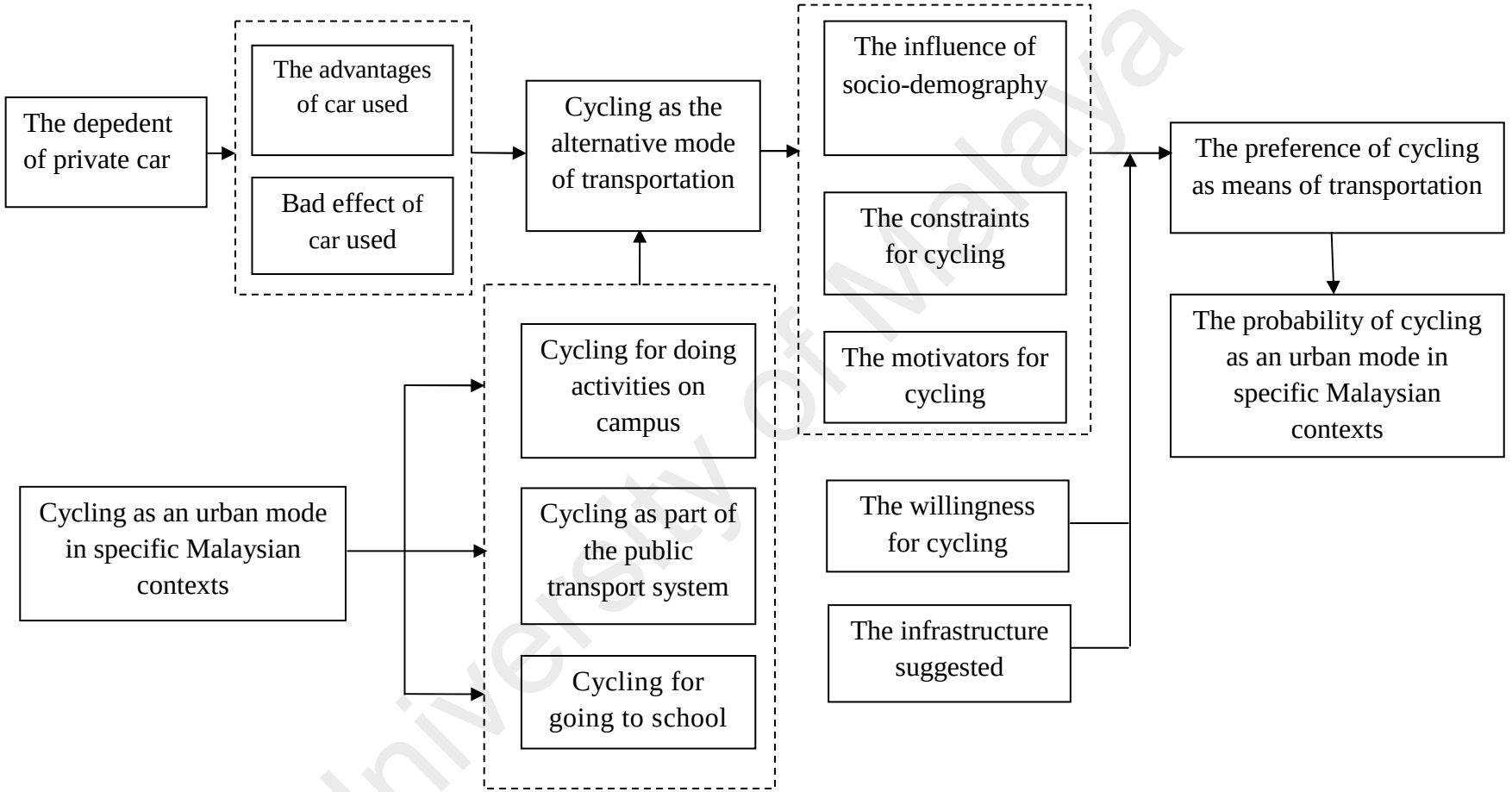


Figure 3.2. Conceptual Framework

3.1. The research design

The research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring you will effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data.

The quality of the research depends on the research design and the well understanding on the research design. The length and complexity of the research designs can vary considerably, but any sound design will do the following things:

1. Identify the research problem clearly and justify its selection,
2. Review previously published literature associated with the problem area,
3. Clearly and explicitly specify hypotheses i.e., research questions central to the problem selected,
4. Effectively describe the data which will be necessary for an adequate test of the hypotheses and explain how such data will be obtained, and
5. Describe the methods of analysis which will be applied to the data in determining whether or not the hypotheses are true or false.

3.2. Questionnaire Development

The research problem, research question and research hypotheses had been already mentioned in the first chapter. Some set of questionnaire were designed to accommodate both of them. As mentioned above there are three scopes of this research, namely; the potential of cycling as transportation mode for activities around campus, the potential of cycling for the children to go to school and the potential of cycling as a feeder mode in the public transportation system.

The common problem in the research that used the questionnaire form is how to make

respondent could understand clearly. The questionnaire must be simple and clear. Respondent can understand quickly and fill in the answer correctly. The purpose is respondents can give the information easily. Adams and Brace, 2006 stated that the success of the survey depends on the willingness of the respondents to provide the information

All the questionnaire consists of the socioeconomic character of the respondent, travel behavior characteristic, bicycle as a transportation mode, the factor that motivate and impede to cycle and preference for cycling. All the item of the `question in questionnaire form can be seen below:

Study I : Potential for cycling as a transportation mode for activities on campus

The study area of this part covers the whole campus of the University of Malaya in Kuala Lumpur, Malaysia. There are 12 residential colleges inside University of Malaya campus. Students use motorcycles, cars, and buses (campus buses and public buses) to move around campus while some prefer to walk and a much smaller number use bicycles.

The nearest distance from the residential college to faculty is 2.62 km (from 6nd residential college to Faculty of Medicine) and furthest distance is 3.120 km (from 10th residential college to faculty of Engineering). Two types of buses are available in campus, one is the public bus operated by Rapid KL which goes to the city and another is the university's bus which goes around within the campus. The public bus fare is RM 1 (about USD$ 0.30/trip) with the average frequency of one bus in every 30 minutes. The university bus is free but has a very low frequency, thus not very attractive to the students.

The respondents in this survey are the staffs and students on campus. The questionnaire

consists of several questions related to the socioeconomic data, travel behavior and the potential for cycling as mentioned below (**Appendix A1**) :

1. **Socioeconomic data** consist of the gender, occupation, marriage status, age, the area of the residence and income per month.

2. **Travel pattern characteristic** consist of the transportation mode used from residence outside university to classes/office, the travel distance from residence outside university to classes/office, transportation mode used from residential college to office/classes and transportation mode for travelling around campus.

   Regarding the traveling for activity around campus, a survey was conducted to explore the origin-destination activities in campus. The destination of the trip is the most frequently visited places among students which are the Sports Center, the Students Union building, Postgraduate Institute, Students Clinic, Main Library, mosque and Chancellery. The origin is taken from selected faculties in University of Malaya campus which are Faculties of Engineering, Faculty of Medicine, Faculty of Science, Faculty of Business and Account and Faculty of Islamic Studies.

3. **Cycling as transportation mode.** With regard to the cycling as transportation mode, questions consist of the willingness to cycle in relation to bicycle facility availability, the willingness to cycle in relation to distance, the reason for cycling, impediment factors for cycling, cycling preference for activity around campus and the cycling facilities suggested

   Regarding the reason for cycling, there are 8 factors to be involved, namely; cheaper, environmentally concerned, faster, fun, good for health, parking provision and too far and hot for walking.

And for the impediment for cycling, 8 factors to be involved, namely; rainy days, the distance, safety (aggressive drivers), concerned about personal appearance, hot weather, terrain, comfortable, lack of bicycle facilities.

4. **The cycling preference for activity around campus**. In this path the respondents were asked about the cycling preference for activity around campus, there are 5 scenarios of cost decreasing and the travel time increasing. .

Study II : The potential of cycling as feeder mode in public transportation system.

The data in this part highlighted the people's behavior in Petaling Jaya (PJ) on their travelling for daily activities, **Petaling is** a satellite township for Kuala Lumpur, consist of mostly residential and some industrial areas. It is located in the Petaling district of Selangor with an area of approximately 97.2 km². The study covered the area in South Petaling Jaya (PJS), namely Taman Medan .

There are two (2) types of public transport services available in study area i.e. the public public transport service and commuter train are operated by RapidKL while the public public transport service is operated by RapidKL and some private company.

The study focuses on public transport and private car user within Taman Medan area and seeks to explore their travel behavior characteristics, public transport issue, the probability to take a public transport for the private car user, the accessibility from the residence to public transport station and the potential of the bicycle as the alternative mode for the feeder of public transport.

The questionnaire consists of several questions related to the socioeconomic data, travel behavior and the potential for cycling as mentioned below (**Appendix A2**) :

1. **Socioeconomic data** : gender , occupation, marriage status, age, the area of residence and income per month, household number, car ownership, driving license ownership,

2. **Commuting travel pattern characteristic** : trip purpose for commuting, mode share, The reason for choosing transportation modes for commuting, public transportation services, the safety issue on the public transportation, the willingness to take the public transport and the improvement requirement of public transport service.

   Regarding the public transportation services, there are 8 factors to be involved, namely; the travel time, the access to the public transport station, driver attitude, the safety, the public transportation and its station condition, waiting time, passenger attitude, the capacity and comfortable.

   While for the safety issue is pickpockets, driver attitude, the passenger attitude, sexual arrestment, inadequate public transport stop facilities and vandalism. The improvement requirement of public transport service is travel time, accessibility, safety, the system, fare and comfortable.

3. **Accessibility to public transport facility** : the distance from residence to the nearest public transport terminal, transportation mode used from home to public transport facilities, the necessary of the alternative mode from residence to public transport facility, the reason respondents need of the alternative mode to public transport facility, the willingness to cycle as the alternative mode to public transport facility, the reason why respondent are not willingness to cycle as the alternative mode to public transport facility, the acceptance distance for cycling and the cycling facilities suggested to cycle public transport facility.

Study III The potential of cycling as a transport mode for going to school.

In this part, the study focuses on the potential of cycling as a transport mode for going to school within Taman Medan areas based on parents perception.

The questionnaire consists of several questions related to the socioeconomic data, travel behavior and the potential for cycling as mentioned below (**Appendix A3**) :

1. **Socioeconomic data** : gender , occupation, marriage status, age, the area of residence and income per month, the number of children,

2. **Bicycle as the active transport**: the importance of Physical activity and the perception of neighborhood environment safety.

3. **The transportation mode usage to school**

4. **The potential cycling to school** : the parent **permission** to cycle to school, the factor concerned regarding the **permission** to cycle to school, the encouraging factors for cycling to school, the cycling facilities suggested to cycle to school and the encouraging factor for cycling permitted to school.

3.3. Data Collecting

To obtain the objectives in chapter 1, some survey was conducted in this research. There were two types of survey; field survey and on-line survey, the respondents of surveys depend on the study. In the study of potential for cycling as transportation mode for activities in campus, the respondents were student and staff in the University of Malaya.

The objective of the study of potential for cycling as feeder mode in public transportation system were to obtain the environment that is suitable for cycling as a part of the public transport system. The respondents of this study is community in Malaysia who live around the public transport facilities. In this research author

considered Taman Medan Area in PJS 2, because there are KTM station, Rapid KL Bus and Metro Bus Stop.

For the study of the potential for children to go to school, the respondents were the parents who have the children in primary and secondary school in Malaysia. The objective of this survey was to obtain the perception of the parent about bicycle as mode of transportation and the willingness to allow their children to cycle to school.

To determine the sample size, the methods approach is based on Krejcie et. al study in 1970. In their study, the sample size was determined based on the female as mentioned below :

$$s = .\frac{\boldsymbol{\chi^2 NP(1-P)}}{d\hat{}2(N-1)+P(1-P)} \quad \text{..... (1)}$$

Whereas :

s = required sample size.

$\boldsymbol{\chi^2}$ = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

3.4. Data Analysis

Study I : Potential for cycling as a transportation mode for activities on campus

Regarding the p**otential for cycling as a transportation mode for activities on campus, the data** analysis were divided based on the area of respondent's residence, namely the respondents who live outside the university and reside in a residential

college, in the university. The data analysis is also divided based on three socioeconomic data, namely; respondent's gender, age and income.

1. Travel Pattern

Regarding the travel pattern in this sub topic, the study were addressed to analysis 2 scope of travel pattern, namely; t**ravel pattern for travelling from home to university and for travelling the trips around campus**

2. **Cycling as transportation modes**

In this part the data analysis were conducted on the parameter as mentioned bellow:

The willingness to cycle in relation to bicycle facility availability, the willingness to cycle in relation to distance, the reason for Cycling, impediment factors for cycling and cycling preference for activity around campus.

The results of the analysis for this study were presented as the descriptive and inference statistic. The influence of the socioeconomic characteristic on those parameters is explored. The methodological approach for this analysis is based on z-test (Critical Z = ±1. 96 for $\alpha = .05$) and Multivariate test at the 0.05 level of significance.

The model of willingness for cycling corresponding to the socio-demography characteristic, transportation mode usage, cycling experience, type of residence and the impediment factor for cycling was designed. The model was conducted by using the structural equation model approached. This approached was also used the design the model of cycling facility suggested corresponding to the selected socio demographic characteristic, cycling acceptable distance and safety concerned. Stated Preference has been conducted to analyze bicycle route choice in this study. Logistic models were designed.

Study II : The potential of cycling as feeder mode in public transportation system.

The analysis highlighted the people's travel behaviour for daily commuting, the accessibility to the transit facilities and the potential of cycling in accessing the transit facilities**.**

1. Commuting travel pattern characteristic

Regarding the c**ommuting travel pattern characteristic,** data analysis is on the parameter as mentioned bellow:

Mode share for commuting, the factor that influence on transportation mode preference for commuting, the satisfaction of the public transportation services, the willingness to take the public transport, the improvement of public transport services. The results of the analysis were presented as the descriptive and inference statistic. Multivariate test at the 0.05 level of significance were conducted as the inference statistic.

2. **The potential of cycling as the alternative mode to public transport facility**

Regarding t**he potential of cycling as the alternative mode to public transport facility, this analysis were conducted on the scope of study as mentioned below;**

a. Mode preference in accessing the public transit facilities.
b. The distance from residence to the nearest public transit terminal.
c. Transportation mode usage from home to public transport facilities based on access distance.
d. The satisfaction about the existing transit accessibility.
e. The willingness to cycle as the alternative mode to public transport facility.
f. The relationship of the willingness to cycle in accessing public transit towards the socio demography characteristic, car ownership, access distance, access mode and the obstacles for cycling.
g. The reason why respondent are not willing to cycle in accessing transit
h. Willingness to cycle related to distance

i. The cycling facilities suggested to cycle public transport facility

j. The correlation of the cycling facility suggested towards selected socio-demography characteristic, the safety concerned as obstacles for cycling, the acceptable distance for cycling and means of transportation used

Multivariate test at the 0.05 level of significance were conducted as the inference statistic. Structural equation model was designed to explore the relationship of the willingness to cycle in accessing public transit towards the socio demography characteristic, car ownership, access distance, access mode and the obstacle for cycling. The same approached also conducted to determine the correlation of the cycling facility suggested towards selected socio-demography characteristic, the safety concerned as obstacles for cycling, the acceptable distance for cycling and means of transportation used.

Study III The parent perception regarding the potential of cycling as a transport mode for going to school.

The analysis data in this study cover the parents perception on the potential for their children cycling to school. The data analysis is also divided based on three socio-economic data, namely; the position in the family, income level and children ownership.

1. **Bicycle as the active transport**

In this phase the data analysis is on the parameter as mentioned bellow:

a. The importance of physical activity for their children's health.

b. Parents' perception of neighbourhood surroundings safety.

c. In this study are also explored the parent’s permission for doing physical activity alone outside home.

d. This study also analysed the correlation among the importance of physical activity perception and the perception of safety of neighbourhood surroundings toward the permission for doing physical activity alone outside home.

2. The transportation mode to school

With regards to the means of transportation for travelling from home to school, the transportation modes were categories into 5 modes, namely ; private car and motorcycle (by dropping and picking the children up at school), school bus, public transport and walking.

3. **The potential for cycling to school**.

Regarding the potential for cycling to school this research explored parameter as mention below:

a. Parents permission for the children to have their own bike, the main reason why parents not to allow their children to own their own bicycle.
b. The parent permission to cycle to school, the factor concerned regarding the permission to cycle to school and the encouraging factor for cycling permission to school
c. The encouraging factors for cycling to school, the cycling facilities suggested to cycle to school.
d. Correlation between the cycling acceptable distance for cycling to school with the facilities suggested
e. The correlation among the importance of Physical activity perception, the perception of safety of the neighbourhood surrounding, parent's permission for doing physical activity alone outside home and bicycle ownership corresponding to the permission to cycle to school.

The result of the analysis is presented as the descriptive and inference statistic. With regards to inference statistic, multivariate tests at 0.05 level of significance were conducted.

Structural equation model was used to design the models as mention below;

a. The correlation among the importance of physical activity perception and the perception of safety of neighbourhood surroundings toward the permission for doing physical activity alone outside home.
b. Correlation between the cycling acceptable distance for cycling to school with the facilities suggested
c. The correlation among the importance of Physical activity perception, the perception of safety of the neighbourhood surrounding, parent's permission for doing physical activity alone outside home and bicycle ownership corresponding to the permission to cycle to school.

3.5. Mode Choice Preference

In transportation planning, mode choice is one of the essential element that has been deeply studied in recent four decades. Koppelman and Pas (1980); Benjamin and Sen (1982) described the process of decision making in mode choice. The desicion considers attitudes, perceptions, preferences. Ben-Akiva et al. (1996) expanded this approach by considering the latent and manifest variables. It also includes multiple decision variables.

Mode choice model aims to determine the proportion of people who would use the trasnsportation mode. Bruton (1985) defined the distribution of mode choice as a proportion of the people who travel by using the existing transportation infrastructure. The proportion was expressed in the form of fractions, ratio, or percentage of people using their own mode of transportation, such as private cars, buses, trains, motorcycles, bicycle and other public transportation.

Stopher (1978) argued that the realistic mode choice model is disaggregate, behavioral, and probabilistic. The model is disaggregate if the basic unit for the model calibration is

individual travelers (individuals). The model is behavioral due to it involves the user economic behavior and psychological behavior in determining the decision-making. The model is probabilistic because it shows the probability results (likelihood) of the potential decision.

The transportation mode choice between origin to destination is based on the comparison of various characteristics of transportation mode service, such as travel time, fare, waiting time, and others. Based on Ben-Akiva and Lerman (1985) and Tamin (2003), factors influencing the person choose the transport mode can be divided into 2 categories. First, traveler characteristic. It is influenced by: socioeconomic characteristics, vehicle ownership, driving license ownership, household number, and other factors. Second, travel characteristic. There were three parameters related to travel characteristics, namely; *trip purpose*, *travel time* and *travel distance*. Different trip purpose usually has different mode choice. In developed countries, it is usually easy to travel using (mass) public transportation. The trips are commonly for working purpose. In mode choice, the traveler usually consider the punctuality of schedule, cheaper cost, fastest travel time, reliability, high level of service.

3.5.1. Transportation Mode Choice Approach

As a selection among the alternatives, formulating the mode choice model is closely related to individual behavior as decision makers. Each individual makes decision which is considered to provide maximum satisfaction.

In decision making, the users are actually emphasis more on the value of a set of attributes offered. The value of each attribute is usually recognized as the utility. In such models of transportation mode choice, a traveler is usually assumed to derive the utility from the attributes of transportation mode alternatives (Gang Liu, 2007).

In transportation mode choice, the concept of rationality is utilized in order to described the consistent and transitive attitude. Consistent means that in the same condition, the decision by each of the individual must be equal. Transitive attitude occurs when the individual preferred the first mode rather than the second mode, and preferred the second mode than the third mode, which also means that the first mode would be preferred than the third mode. Key issue in transportation mode choice behavior approach is how to measure the utility value of each alternative mode. Utility value is a function of several attributes of service that may be perceived / interpreted differently for each individual. The interpretation is based on the amount of information received and individuals socioeconomic background. Several approaches can be used to formulate individual behavior to choose the transport mode are disaggregate approach and aggregate approaches.

3.5.2. Disaggregate approach

There were two approaches of disaggregate approach in analyzing traveler behavior based on individual behavior, namely;

1. Deterministic disaggregate approaches

   The Disaggregate deterministic assumption is the basic assumption of most travel modeling. By this assumption, the choice of mode will not change if traveler faced a set of same and repetitive alternatives.

   This approach has requirements, as follows:

   a. Users are able to identify all the alternatives.
   b. Users are able to identify all the attributes in every alternative
   c. Users are able to formulate their perceptions and preferences of the explicit attributes
   d. Users are able to use all of the above information to make decisions.

2. Stochastic Disaggregate Approaches

   This assumption is stochastic if the selection process is not always be deterministic. This is because there is an inability to obtain a complete information for both of alternative modes and its attributes. Mode preference of the traveler can be changed by certain influences. To fix this condition, it is necessary to give 'error' element or 'residual' elements that are stochastic (random).

3.5.3. Aggregate Approach

Aggregate approach analyzes traveler behavior in groups (a group of individuals, house hold, or company). Henry (1994) suggested that the aggregation can be carried out in two ways:

1. Divided the object to several groups /segments /zones that have elements that are relatively homogeneous.
2. Perform aggregation of the disaggregate data, where the aggregate function for particular groups can be derived from individual utility functions as a member of that group.

3.5.4. Discrete Choice Model

According to Tamin (1997), discrete choice model is expressed as individual opportunities to choose an option; which is a function of socioeconomic characteristics and attractiveness of these options. To declare an alternative attractiveness, the concept of utility is used. The alternative does not produce utility, but utility is obtained from the characteristics and of every individual (Lancaster, 1996). The discrete choice model is derived from one underlying utility function (Guilin Li, 2004).

A discrete choice is the choice of exactly one alternative from a finite set of alternatives. In this approach, behavioral theory is added including utility to measure the 'worth' of alternatives. This extends the choice situation to be the choice of the best alternative measured on an arbitrary scale of utility (Sorensen, 2003).

3.5.5. Stated Preference Technique

Stated Preference method is a crucial tool widely used in travel behavior research (Hensher, 1994; Zhang et.al, 2009). Stated Preference is defined as the individual expression regarding the choice towards other choice (Permain and Swanson, 1999). Stated-preference is the preferred means of assessing the potential demand for a new service or one that is vastly different from those that are currently being offered (Shiftan et al. 2006).

The basic principle of stated preference is its ability to deliver a choice scenario situation, and then leads the respondent to choose as respondent desirability. In a stated preference study, the results are the potential results (Hensher, 1994)

Stated preference techniques are characterized by the use of experimental design to build an alternative hypothesis to the situation (hypothetical situation). Furthermore, respondents were asked about what options they want to do or how they make the rankings / ratings or selection in one or several alleged situation.

Stated preference has less constrained than revealed preference studies. Its allow us to look at potential changes (Swait et al, 1994). Stated preference studies allow us to examine own decision-making varies as different types of attribute profiles and levels are considered (Hensher, 1994).

Stated preference approaches provide the variety of technique analysis based on how the respondents express their choice. The main characteristic of this approach are mentioned below:

1. The stated preference technique design is based on respondents expression on how they respond to some alternative hypotheses.
2. Each choice is represented as a 'package of the description' from the various attributes such as time, cost, headway and others.
3. Hypothesize alternatives were designed in orderto measure individuals influence of each attribute. This purpose can be obtained by using the experimental design techniques.
4. The questionnaire must provide alternative hypotheses which can be understood clearly by the respondents.
5. The respondents express the opinion on each of the options. The respondents rank and rate the best decision from the groups of alternative.
6. The response given by the individuals is analyzed to obtain a quantitative measurement of the information of each the decision .

Stated preference questionnaire form should provides the service characteristics. The questionnaire should ensure that it consists of variety of attributes combination. The design of choice options presented should contain three things, namely: the attribute level and the combination of each alternative; presentation of alternative and specification of the responses.

To find out the choice information of the alternative option offered can be described as following below :

1. Ranking Responses (Conjoint Measurement)

This approach is carried out by offering all of the choice options to the respondents. The respondents were asked to rank the choice options, which indirectly represents a hierarchy of utility value. In this approach, all the options were presented, but the number of alternative options should be limited so as not exhausting.

2. Ratting Responses (Functional Measurement)

In the rating technique, respondents declare the level of the choice by using the semantic scale. The scale is defined from the sentence such as surely choose A, maybe choose A, maybe choose B, and surely choose B. Certain score must be determined to express each of the choice. The next stage is finding out the quantitative correlation of the level of choice with the response that is stated in semantic scale (Ortuzar and Willumsen, 1994). For the set of choice as mentioned above, the semantic scale is from 1 to 4. Semantic scale must be transform to numeric scale to find out the best probability model. In this context, the symmetric scale can be used for the semantic scale from 1 to 4. The symmetric scales are -1.3863, -0.4055, 0.4055 and 1.3863. The symmetric scale is obtained based on the Berkson – Theil transformation from the probability 0.2 for 1; 0.4 for 2; 0.6 for 3 and 0.8 for 4 (Parkin et.al, 2008).

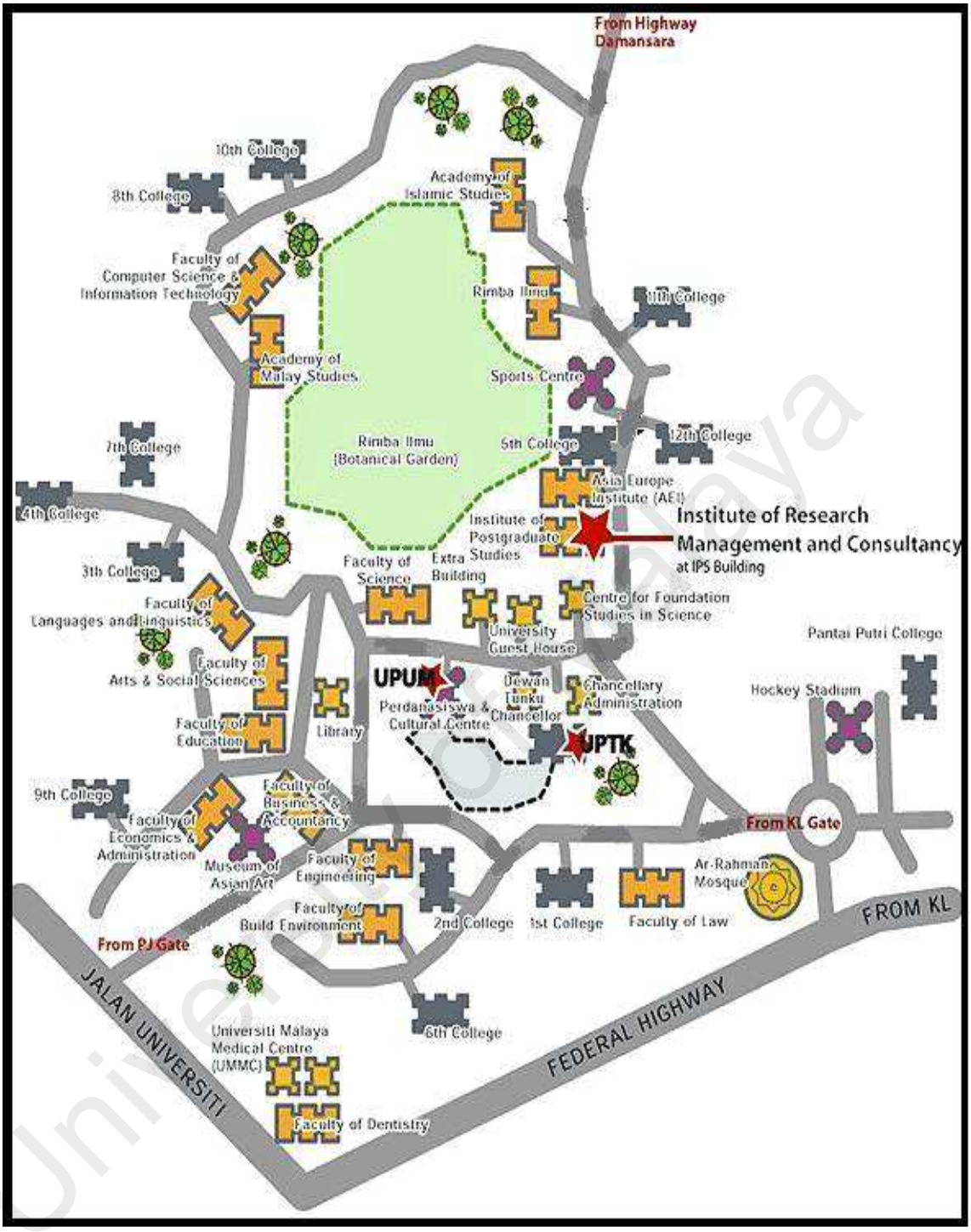
CHAPTER 4

THE POTENTIAL OF CYCLING IN UNIVERSITY ENVIRONMENT

In this part, the study area covers the whole campus of the University of Malaya in Kuala Lumpur, Malaysia. As presented in **Figure 4.1**, the university has 12 residential colleges on campus. The main loop of the campus road network is a 2 km, two-lanes, one-way street system (Karim, 1992). As transportation mode, respondents use motorcycles, cars, and buses (campus buses and public buses) to move around campus while some prefer to walk and a much smaller number use bicycles.

There are two types of buses available on campus, one is the public bus operated by Rapid KL which goes to the city and another is the university's bus which goes around within the campus. The public bus fare is RM 1 (about USD$ 0.30/trip) with an average frequency of one bus in every 30 minutes. The university bus is free but has a very low frequency, thus not very attractive to the users.

Field survey and web-based survey were undertaken in this study. The surveys were conducted in four months; February – May 2011. To determine the sample size, the method approached is based on Krejcie et. al (1970). In this study the population is 25,000. Based on Krejcie et Al. method the minimum sample size is 376. In this study sample size is 406 respondents. As presented in **Table 4.1,** respondents are slightly more females than males (51.5% compared to 48.5%). They live within and outside the campus (60.1 % and 39.9 %).



Source: http://ippp.um.edu.my/

Figure 4.1. University of Malaya Map

Table 4.1 shows the large majority of respondent age is between 20 and 30 years old, followed by more than 30 years old and less than 20 years old. The majority of respondents are undergraduate student (78.6%), followed by post graduate student (14.0%) and 7.4 % of the respondents are staff. Most of them earn less than RM 1000

(65.0%), 25.4% respondent earn between RM 1000 and RM 3000 and 9.6 % earn more than RM 3000 as a monthly income.

Table 4.1. Characteristic data of respondents

Characteristic	Statistics (%)
The area of residence	**Outside campus** (60.1), **Residential college inside campus** (39.9)
Gender	**Female** (51.6), **Male** (48.4)
Occupation	**Under graduate students** (78.6), **Graduate students** (14.0), **Staff** (7.4)
Age	**< 20 years old** (11.8), **20 – 30 years old** (77.1), > **30 years old** (11.1)
Income	**< RM 1000** (65.0), **RM 1000 - 3000** (20.7), **> RM 3000** (14.3%)

4.1. Travel Pattern for travelling from home to university

There were 243 respondents come from outside university and 163 respondents come from residential college inside the university. They use motorcycles, cars, and buses (campus buses and public buses), walking and bicycle. As a mode of transportation from home to university, cycling and walking are a minority. As presented in **Table 4.2**, there were only 2.2% and 0.4% of respondents preferred to walk and cycle (from outside university). A total of 18.4 % of them walked and only 1.2% cycled for travelling from inside university to classes.

Table 4.2. The transportation mode used from home to classes/office

From residence outside university to offices/classes (%)						From residential college to offices/classes (%)				
Characteristic	Motorcycle	Car	Public transport	Walking	Cycling	Motorcycle	Car	Public transport	Walking	Cycling
All respondents	17.8	50.9	28.6	2.2	0.5	33.80	26.40	20.20	18.40	1.20
Gender										
Female	7.8	54.9	35.3	2.0	-	28.4	30.5	26.3	13.7	1.1
Male	30.1	45.8	20.5	2.4	1.2	41.2	20.6	11.7	25.0	1.5
Income level										
< RM 1,000	20.20	39.50	35.70	3.10	1.60	36.3	23.6	19.3	19.3	1.5
RM 1,000 - 3,000	22.60	57.10	17.90	2.40	-	26.3	31.6	26.3	15.8	-
> RM 3,000	10.30	72.50	17.20	-	-	20.0	50.0	20.0	10.0	-
Age										
<20 years old	14.9	48.9	34.1	2.1	-	40.3	25.8	16.2	17.7	-
20-30 years old	20.9	47.2	27.6	3.1	1.2	31.2	25.8	21.4	19.4	2.2
>30 years old	21.9	62.5	15.6	-	-	22.2	33.3	33.2	11.1	-

High dependency on for private vehicle occurred for respondents who come from outside the campus. As can be seen in **Table 4.2,** 68.6% of respondents prefer to use private vehicle. The most widely usage of transportation modes by respondents from outside university to campus is car (50.8%), followed by public transport (28.6%) and motorcycle (17.8%).

The results also show high dependency on private vehicle for the respondents who come from inside campus. Most of them preferred to use motorcycle (33.7 %) and private car (26.4%), followed by public transport (20.2%). Most faculties act as the center of activities in University Malaya, and regarding the public transport usage, the mobility is covered by public bus and university bus. However, the route from residential colleges as the origin is only covered by university bus which serves long time headway. This explains the high dependency on motorcycle and car among students who live in residential colleges compared to public transport. It is quite encouraging though to note that 18.4 % of students prefer to walk when the distance to the destinations is not very far (**Table 4.2**).

Regarding the high usage of private car, it is argued that the benefits of car are in transporting large amount of goods, reducing waiting times and comfort are the main factors that contribute to the large number of respondents driving their cars into the campus. The other advantage of car is flexibility and the dependency on car is clearly not a habit that is easy to change. Polk (2003) supported the statement that other transportation modes simply cannot replace the great flexibility of car.

More attention must be given to that phenomenon above. The high dependency on motorcycle and private car will cause a few bad consequences, such as traffic congestion, air pollution and parking availability. Other than traffic congestion effects, parking availability become one of the current main problems in University of Malaya.

Shoup (1997) and Dober (2000) argued that the major problem with automobile is the amount of parking space it requires. In college campuses parking is a common problem with different slants (Balsas, 2003). Keniry (1995) also stated that a university is a group of administrators, faculty and students held together by a common grievance over parking.

Most of female and male respondents preferred to use private car (54.9% and 45.8%) for travelling from the residence outside university to offices/classes. Females preferred to use public transport for the second choice (35.3%) while males choose the motorcycle (30.1%). Female car users are higher than males but at the 0.05 level of significance, the different was not significant (Z-value = 1.724, P-value=0.129). This result is in line with Polk (2003). He showed the example case in Beijing for example, car has the highest number of users amongst men as compared to other modes of transportation. In their research Pooley and Turnbull (1999) suggested that males and females were dependent on the car regarding their commuting; the different number of males and females who used the car was close.

The influence of gender on motorcycle and public transport preference as mode of transportation for the trips from outside university to offices/classes was significant. The percentages of female respondents who use motorcycle are lower than males (Z-value = -4.161, P-value=0.000) while female public transport users are higher than males (Z value = 2.323, P-value=0.035). For both males and females, walking and cycling were the minority, only 2.4% of males walked and 1.2% of them cycled. 2.0% of females walked and none of females cycled. Males preferred to walk than females but the different was not significant (z value = -0.675, P-value= 0.470).

For the trips from residential college inside university to offices/classes, female respondents are dominantly car users (30.5 %), followed by motorcycle users (28.4 %),

public transport users (26.3 %), walking (13.7 %) and cycling (1.1 %). Male respondents were dominant motorcycle users (41.2 %), followed by walking (25.0%), car users (26.6 %), public transport users (11.8 %) and cycling (1.5 %).

As presented in **Table 4.2**, there were only the respondents earned an income less than RM 1000 cycled. The consistent pattern occurs among income levels towards walking, car and public transport usage for the trips from home outside university to offices classes. The car usage increased as the income level increased.In addition as the income levels increased, walking and public transport usage decreased (**Table 4.2**).

Table 4.2 also presents the transportation mode usage for traveling from residential college to office/classes corresponds to the income level. Most of the respondents earned an income less than RM 1000 preferred to use motorcycle (36.3%). The respondents earned income RM 1000 – RM 3000 and more than RM 3000 (31.6% and 50.0%). None of the respondents earned income RM 1000 – RM 3000 and more than RM 3000 cycled.

At the 0.05 level of significance, there is a significant influence of income level towards car and public transport usage as transportation mode from home outside university to offices/classes (P-value = 0.010; P-value = 0.010) while there is no significant influence of the income level towards walking (P-value=0.684) and motorcycle (P-value=.0.975). The influence of income level on private car usage for the trips from residential college to offices/classes was significant (P-value = 0.035) while there is no significant influence of income level towards walking, car, motorcycle, public transport usage for the trips from residential college inside university to offices/classes (P-value=0.383; P-value=0.320; P-value=0.887).

As can be seen in **Table 4.2,** both of origin places, these results suggest that the car usage is closely related to the higher income level. On the other hand, motorcycle users, walking and cycling were related to low income level.

Table 4.2 also shows that, the reliance of private vehicles for the trips from outside university was explored. Among groups of age, the dependence on private car is high. The percentage of car usage for the respondents aged less than 20 years old is 48.9 %, the respondents aged between 20-30 years old is 47.2% and the respondents aged more than 30 years old is 62.5%.

Based on the respondents age, walking and cycling are also the minority. Only the respondents in group 20 – 30 years old cycled. A total of 2.1% respondents aged less than 20 years old walked and 3.1% of age group 20 – 30 years old walked. None of the respondents in group more than 30 years old walked

As shown in **Table 4.2**, the consistent pattern occurred among the age group towards the percentage of motorcycle and public transport usage. The motorcycle usage increased as the age group increased, otherwise public transport users decreased as the age group decreased. There is no consistent pattern among the age groups toward the percentage of car usage. At the 0.05 level of significance, there is no significant influence of income level towards walking, car, motorcycle, public transport usage as transportation mode from residential college inside university to offices/classes (P-value=0.799; P-value = 0.267; P-value=.0.400; P-value=.058), (P-value=.341; P-value = 0.249; P-value=1.000; P-value=.665.

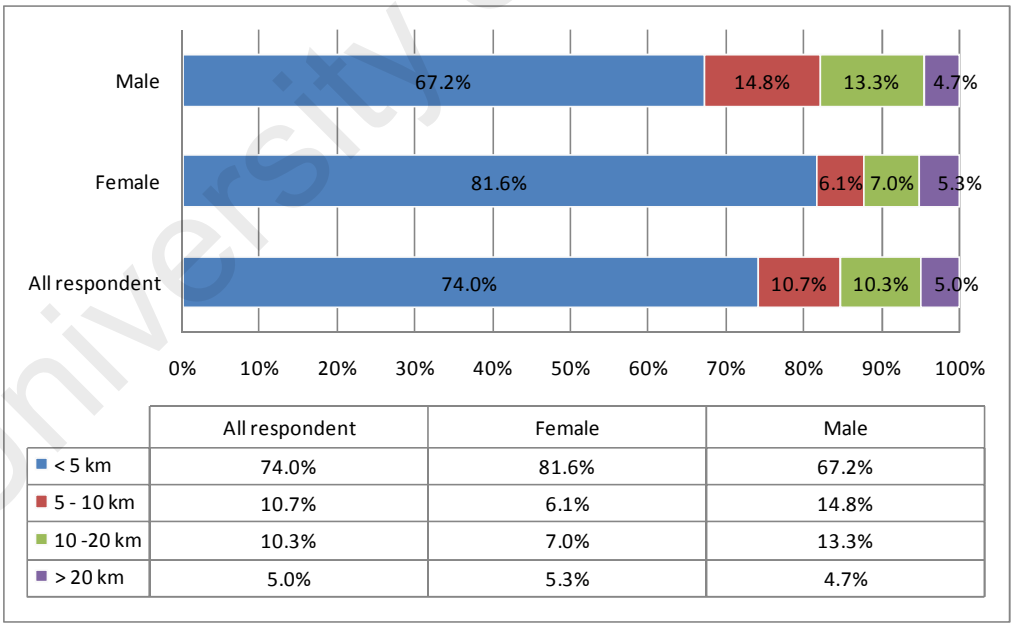
The study identified 40 km as the farthest distance travelled to the campus, (average distance is 6.42 km, Std Dev 7.24). As shown in **Table 4.3,** regarding the influence of the gender to the distance from home to university, males distance is further than

females. The phenomenon occurred for car users, motorcycle users and public transport users.

Table 4.3. The average distance from residence outside university to offices/classes

Transportation mode	Average distance (km)	
	Female	Male
All respondents	5.646	7.061
Motorcycle	7.000	7.855
Car	5.189	7.073
Public transport	5.892	6.026

As can be seen in **Figure 4.2,** the majority respondents reside within 5 km from the university. Nilsson in 1995 stated most people consider that the distance less than 5 km is not difficult for cycling and there is likely a potential for transferring some of these car trips to cycling. Nevertheless, distance is not the only factor that determines the preference of bicycles as a mode of transportation.



	All respondent	Female	Male
< 5 km	74.0%	81.6%	67.2%
5 - 10 km	10.7%	6.1%	14.8%
10 -20 km	10.3%	7.0%	13.3%
> 20 km	5.0%	5.3%	4.7%

Figure 4.2. The distance from residence outside university to campus

For respondents who reside within 5 km to the university, the average trips distance is 2.99 km, Std Dev 1.29, for males, average trips distance is 3.08 km, Std Dev 1.27, while females is 2.89 km, Std Dev 1.30. This range of trips distance has a potential for

cycling. Based on ANOVAs single factor analysis, there is a significant difference between the distances from the residence to the university in both genders (P-value > 0.05).

The study found the average distance travelled for females who use car are shorther than males. This finding is consistent with other researched by Krizek et al., 2005 and Garrard et al., 2008. Data obtained indicated that female car users prefer to choose places which are closer to their activities as compared to male users. This is also in line with a statement from Krantz (2000) who stated that men travelled significantly longer distances than women.

4.2. Transportation mode usage for the trips around campus

For both respondents who reside outside university and in the residential college, the private car is not the most widely used for activities around campus. As shown in the **Table 4.4**, most respondents preferred to walk (50.0%). Private car usage is in the second place (19.0%), followed by motorcycle (16.7%), and public transport (13.8%). Only 0.5% of respondents cycled.

Table 4.4. Transportation mode usage for the trips from home to university

Characteristic	Motorcycle (%)	Car(%)	Public transport(%)	Walking(%)	Cycling(%)
All respondents	25.6	40.1	24.6	8.9	0.7
Gender					
Female	18.1	43.8	30.5	7.1	0.5
Male	33.7	36.2	18.4	10.7	1.0
Income level					
< RM 1,000	28.4	31.4	27.7	11.4	1.1
RM 1,000 - 3,000	17.9	59.5	19.0	3.6	0.0
> RM 3,000	24.1	51.7	19.0	5.2	0.0
Age					
<20 years old	20.8	33.3	31.3	14.6	0.0
20-30 years old	26.8	39.0	24.6	8.6	1.0
>30 years old	22.2	55.6	17.8	4.4	0.0

The mode shifts analysis were conducted in this study. The analysis were conducted for the trips from home to classes and for the trips around campus. As shown in **Table 4.5**, the highest decrease was in private car usage (53%); for the trips from home to offices/classes private car usage was 40.1% (**Table 4.4**) while for the trips around campus, private car usage was only 19.1% (**Table 4.5**). At the 0.05 level, the decrease was significant at the 0.05 level of significance (P-value = 0.000); Motorcycle and public transport usage also decreased (35%; 44%), at the 0.05 level of significance, the decrease was significant (P-value = 0.002; P-value = 0.000). Walking increased (464%), at the 0.05 level of significance, the decrease was significant (P-value = 0.000).

Table 4.5. Transportation mode usage for activities around campus

Characteristic	Motorcycle (%)	Car(%)	Public transport(%)	Walking(%)	Cycling(%)
All respondents	16.7 (0.35) ↓	19.0 (0.53) ↓	13.8 (0.44) ↓	50.0 (4.64) ↑	0.5 (0.33) ↓
Gender					
Female	18.1 (-)	16.7 (0.62) ↓	12.4 (0.59) ↓	52.4 (6.33) ↑	0.5 (-)
Male	15.3 (0.55) ↓	21.4 (0.41) ↓	15.3 (0.17) ↓	47.4 (3.43) ↑	0.5 (0.33) ↓
Income level					
< RM 1,000	16.3 (0.43) ↓	17.4 (0.45) ↓	15.9 (0.42) ↓	49.6 (3.37) ↑	0.8 (0.33)
RM 1,000 - 3,000	15.5 (0.13) ↓	25.0 (0.58) ↓	8.3 (0.56) ↓	51.2 (13.33) ↑	-
> RM 3,000	20.7 (0.14) ↓	17.2 (0.67) ↓	12.1 (0.36) ↓	50.0 (8.67) ↑	-
Age					
<20 years old	14.6% (0.30) ↓	16.7% (0.50)↓	14.6% (0.53) ↓	54.2% (2.71) ↑	-
20-30 years old	16.3% (0.39) ↓	18.2% (0.53)↓	15.0% (0.39) ↓	49.8% (4.78) ↑	0.6% (0.33) ↓
>30 years old	22.2% (-)	26.7% (0.52)↓	4.4% (0.75) ↓	46.7% (9.50) ↑	-

As presented in **Table 4.5,** both females and males preferred to walk (52.4% and 47.4%) **f**or the trips around campus,. Females preferred to use motorcycle (16.7%) in the second choice while male preferred to use private cars (21.4%). The percentage of females who walk and use motorcycle for the trips around campus is higher than males. Male who use private car and public transport are higher than females. Except walking, compared to the trips from home to offices/classes, motorcycle, private car and public transport usage decreased for the trips around campus. For females, the highest decrease was private car usage; there was 43.8% car usage for the trips from home to offices/classes (**Table 4.4**), while for the trips around campus was only 16.7%, it decreased 62% (**Table 4.5**). For males the highest decrease was motorcycle usage (55%). A multivariate test was conducted to explore the influence of the gender on the mode shift for travelling around campus, the result is at the 0.05 level of significance, there was significantly influence (P-value =0. 018).

There were no consistent patterns occurred among the mode shift of motorcycle, public transport usage and walking toward income level and groups of age. There were

consistent patterns for car usage. The mode shift increased as income level and groups of age increased. At the 0.05 level of significance there were no significant influences of income level and groups of age towards the mode shift (P-value =0.410; P-value = 0.254).

4.3. Willingness to cycle

Currently, there are existing bicyclists in University of Malaya, but the number is very small. Several factors influence why students are reluctant to use bicycles, such as, aggressive car driver, bicycle availability, land topography and lack of cycling facilities. Generally, the obstacles for cycling often referred to traffic safety, heavy traffic, inconsiderate drivers, pollution, bad weather, distance and travel time, gradient, not being fit enough and social pressure (Davies et al, 2001; Gatersleben and Appleton, 2007; Kingham et al, 2001; McClintock and Clearly, 1996; Newby, 1993; Wardman et al, 1997).

The potential of cycling in University of Malaya is obviously high. As can be seen from the survey results in **Table 4.6,** a total of 85.5% said they would use the bicycle if cycling facilities are provided within the campus area. **Table 4.6** also shows the influence of gender on willingness to cycle. If cycling facilities were provided, a total of 82.1% of male respondents were willing to cycle while their female counterparts recorded 81.4% of them were willing to cycle.

There were consistent patterns among groups of respondents' age towards the willingness to cycle for activities around campus. As respondent's age increased, the willingness to cycle would decreased (**Table 4.6).** Similarly with the level of income, there were consistent pattern among groups of respondents' income towards the

willingness to cycle for activities around campus. As the respondent income level increased, the willingness to cycle would decrease (**Table 4.6).**

Table 4.6. The potential for cycling if the facilities are provided inside campus.

Characteristics	**Yes (%)**	**No(%)**
All respondents	85.5	14.5
Gender		
Male	82.1	17.9
Female	81.4	18.6
Income		
< RM 1000	88.3	11.7
RM 1000 - 3000	84.1	15.9
> RM 3000	76.2	23.8
Age		
< 20 years old	95.8	4.2
20 – 30 years old	83.0	17.0
> 30 years old	56.1	43.9

A multivariate test was conducted to investigate the influence of the gender, income level and group of age corresponding to the willingness for cycling. At the 0.05 level of significance, there was no significant influence of the gender (P-value = 0.853) while there were significantly influence of income level and groups of age towards the willingness to cycle (P-value =0.000; P-value = 0.000).

Figure 4.3 shows the respondents' willingness to cycle in relation to travel distance. Generally, both female and male students are willing to cycle for distance below 1km. Willingness to cycle for both female and male respondents is more than 50%. It is interesting to note that for distance between 1km and 2km, the percentage of female respondents who are willing to cycle was higher than male while for distances above 2km, the percentage of males who are willing to cycle was higher than females.

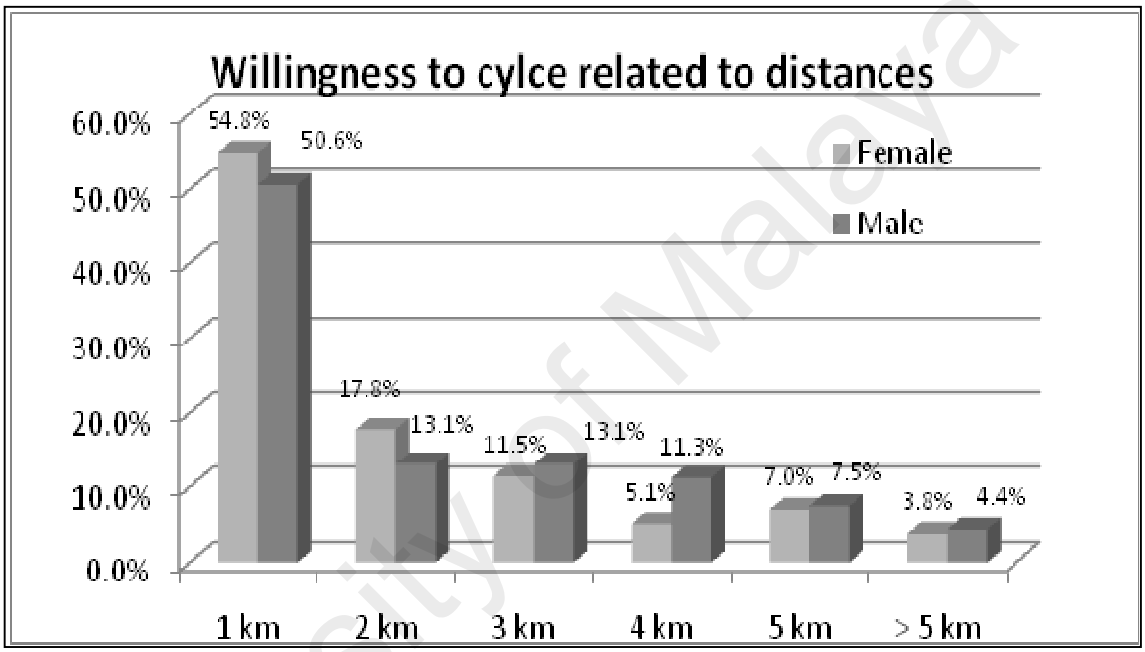


Figure 4.3. Willingness to cycle in relation to distance

In comparison, as mentioned in Chapter 1, the furthest trip distance of The O-D place is approximately 3 km in distance), it shows that the potential for cycling activity around the campus is very high. If cycling facilities were provided within the campus area, total of 84.1% of females were willing to cycling for the distance within 3 km, furthermore 76.9% of males would cycle.

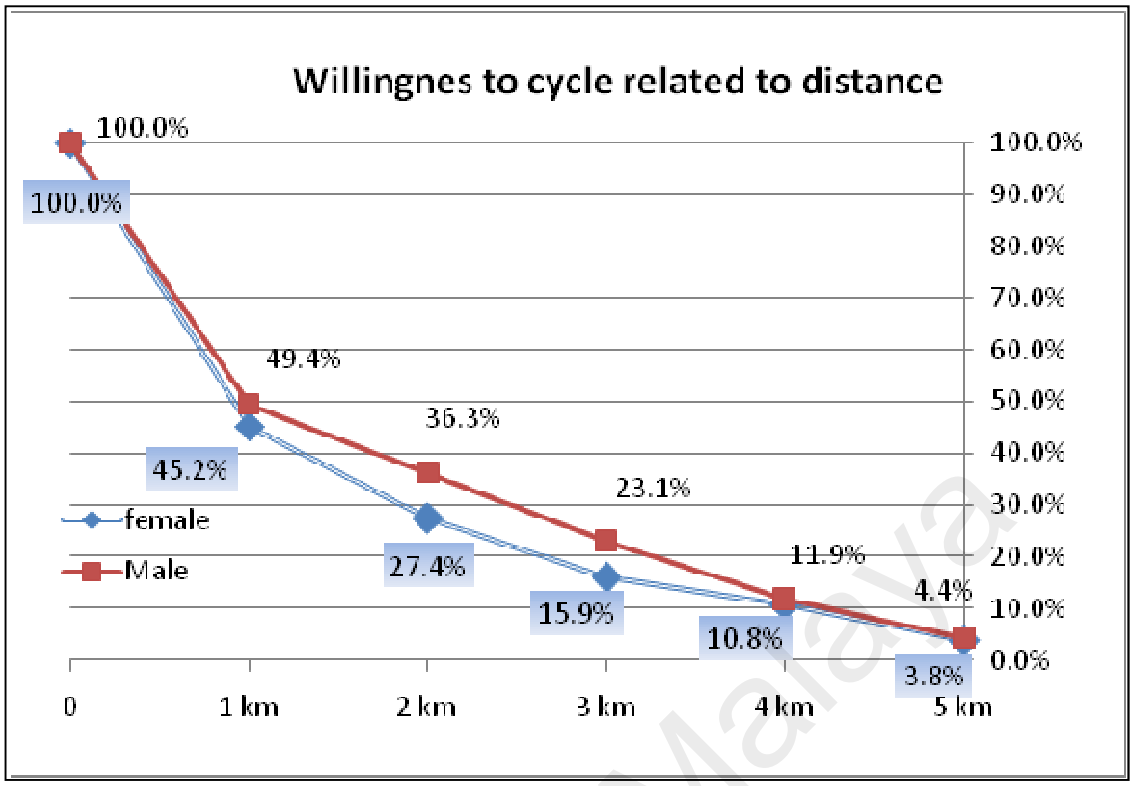


Figure 4.4. The cumulative of willingness to cycle respondents' percentage in relation to distance

A total of 84.1% female respondents and 77.9% of male respondents are willing to cycle if bicycle facilities were available within the campus. Additionally, **Figure 4.4** shows that 4.4% and 3.8% of male and female respondents respectively are willing to cycle for distances more than 5km.

4.4. The Reason for Cycling

Accordingly, a study by Bonham and Koth in 2010 (2) stated that among the motivations for cycling are health, affordability, environmental concern, time and pleasure. However, affordability is still in debates due to the comparative cost between driving and cycling.

Table 4.7. The reason of willingness for cycling

Mode of transportation usage		Percentage	The reason	Percentage
Motorcycle	No	20.6	Cheaper	14.8
	Yes	79.4	Environmentally concerned	24.1
			Faster	3.7
			Fun	16.7
			Good for Health	20.4
			Parking provision	13.0
			Too far and hot for walking	7.4
Car	No	18	Cheaper	14.3
	Yes	82	Environmentally concerned	17.5
			Faster	6.3
			Fun	3.2
			Good for Health	14.3
			Parking provision	36.5
			Too far and hot for walking	7.9
Public transport	No	7.1	Cheaper	19.2
	Yes	92.9	Environmentally concerned	15.4
			Faster	19.2
			Fun	7.7
			Good for Health	26.9
			Too far and hot for walking	11.5
Walking	No	20.7	Environmentally concerned	16.1
	Yes	79.3	Faster	29.8
			Fun	8.7
			Good for Health	19.9
			Too far and hot for walking	25.5
Cycling	Yes	100.0	Faster	50.0
			Good for Health	50.0

As far as the reason for the willingness to cycle is concerned, a total of 19.6% of respondents considered health and environment concern (**Table 4.7**) as the main reason

for cycling, followed by parking provision (14.8%), faster (14.5%) cheaper (11.2%) and fun (10.3%). The last is too hot for walking (10.0%),

As shown in **Table 4.7**, it seems that parking provision successfully encouraged car user to cycle if the facilities were available. Most of them stated that the reason why they would cycle due to the parking provision (36.5%)

4.5. The willingness to cycle for activity around campus

In this research, regression models were developed to investigate the correlation of the willingness to cycle for activities around campus towards gender, occupation, level of income, age, type of residence, means of transportation usage, the distance from home to university, the willingness to shift the mode usage for activities around campus, and the obstacles for cycling around campus (**Figure 4.5**).

In the model, gender was categories data, whereas “male was equal into 0” and “female was equal into 1”. Occupation was also categories data, whereas “student was equal into 0” and “staff was equal to 1”. Income was grouped in 5 categories, “< $ 330.9 was equal into 1”, “$ 330.9 - $ 992.8 was equal into 2”, “$ 992.8 - $ 1,654.7 was equal into 3”. Age variables were divided into three categories, namely “<20 years old” was categorized into “1”, “20 - 30 years old” was categorized into “2”, and “> 30 years old” was categorized into “4”. Type of residence consists of two categories, namely “live outside university” was categorized into “1”, “reside in residential college” was categorized into “2”. The means of transportation usage were grouped into 2 categories, namely, private vehicle (motorcycle and private car user) was categorized into “1”, public transport users and walking was categorized into “2.

The willingness to switch means of transportation used for activities around campus consists of 2 categories, namely the respondents who are not willing to switch was

categorized as “0” and the respondents whom are willing to switch was categorized as “1”.

This study also investigate, the correlation between the willingness for cycling toward the obstacles for cycling (**Figure 4.5**). There were 7 obstacles for cycling around campus, namely rainy days, safety concerned, hot weather, concerned about the distance, terrain, convenience, lack of bicycle facility and the personal appearance concern. The obstacles for cycling were scale data, it shows the scale of level of important those obstacles toward the willingness for cycling around campus. There were 1 until 5 scales of the each obstacles for cycling namely, “1” denoted the obstacle was extremely not important, “2” denoted the obstacle was not important, “3” denoted the obstacle was moderately important, “4” denoted the obstacle was important, “5” denoted the obstacle was extremely important.

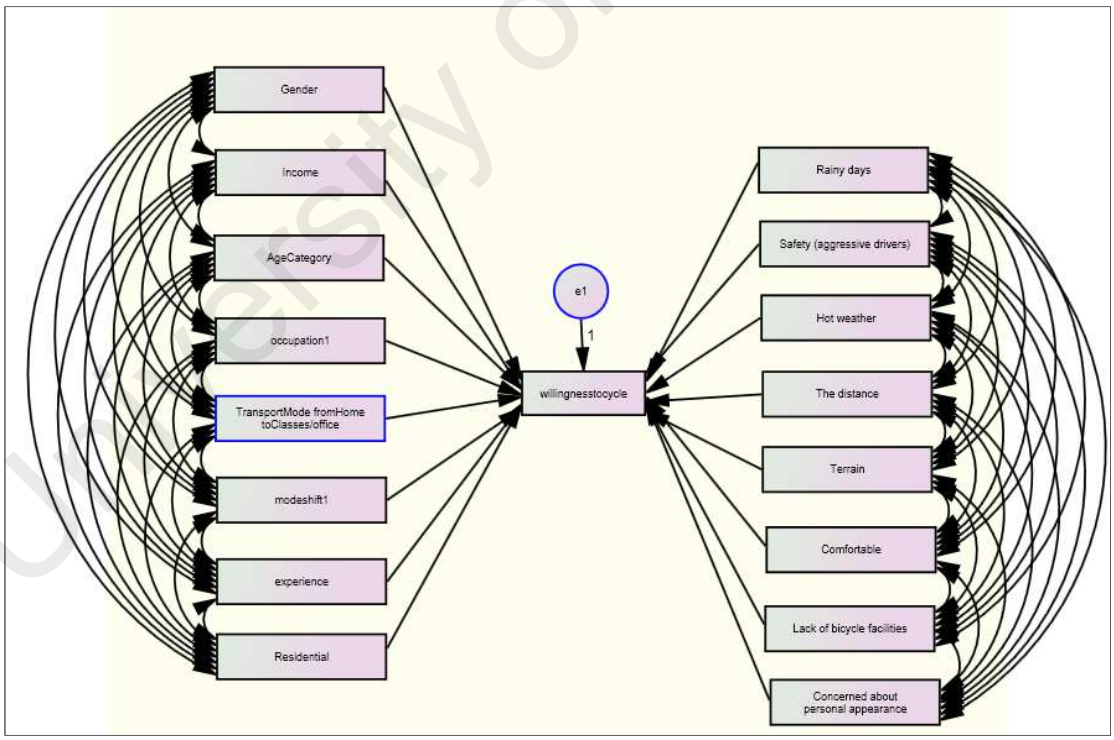


Figure 4.5. The structure of the willingness for cycling models

The result of the model was presented in **Table 4.8.** As presented in T**able 4.8**, coefficients for gender are negative. The result implied if the gender is male; the answer

for the question regarding the willingness for cycling around campus is yes. Furthermore if the occupation is staff, the answer for the question regarding the willingness for cycling around campus is also yes. There were no significant correlation between willingness to cycle around campus toward gender and occupation (P-value = 0.402; P –value = 0.145). There were also no significant correlations between willingness to cycle around campus toward transport mode usage for the trips from home to offices and the willingness to switch transportation mode usage (P-value = 0.697; P –value = 0.459).

Table 4.8. The willingness for cycling model for activities around campus

			Estimate	S.E.	C.R.	P
Willingness to cycle	<---	Gender	-.023	.027	-.839	.402
Willingness to cycle	<---	Age	-.077	.032	-2.388	.017
Willingness to cycle	<---	occupation	.087	.060	1.457	.145
Willingness to cycle	<---	Income	-.068	.023	-2.931	.003
Willingness to cycle	<---	The type of residential	-.066	.028	-2.314	.021
Willingness to cycle	<---	Transport mode usage from home to offices	.011	.027	.389	.697
Willingness to cycle	<---	The willingness to shift mode usage	-.040	.054	-.741	.459
Willingness to cycle	<---	Cycling experience	.128	.029	4.355	0.00
Willingness to cycle	<---	Rainy days	.173	.044	3.909	0.00
Willingness to cycle	<---	Safety	.104	.029	3.593	0.00
Willingness to cycle	<---	Hot weather	.154	.021	7.180	0.00
Willingness to cycle	<---	Concerned about the distance	.130	.030	4.282	0.00
Willingness to cycle	<---	Terrain	.045	.019	2.356	.018
Willingness to cycle	<---	Lack of bicycle facility	.044	.014	3.082	.002
Willingness to cycle	<---	Concerned about personal appearance	.118	.015	7.930	0.00
Willingness to cycle	<---	Convenient	-.002	.011	-.184	.854

As presented in **Table 4.8**, the coefficients for age, income level, type of residents and cycling experience are negative. The result implied as the income level and age increase; the answer for the question regarding the willingness for cycling around

campus is no. Furthermore if the respondents reside outside university, the answer for the question regarding the willingness for cycling around campus is yes. If the respondents have the cycling experience in the past, the answer for the question regarding the willingness for cycling around campus is also yes. There were the significant correlations between willingness to cycle around campus toward age, income level, cycling experience and type of residents (P-value = .017; P –value = .003; P-value = 0.000, P-value = .021).

Malaysia is a country with high rainy days. This can be the obstacles for cycling for activities around campus due to automatically none of respondents are willing to cycle in the rain. Therefore it can be seen in **Table 4.8**, the main obstacle for cycling is the rainy day (0.173).

Hot weather in tropical countries also could reduce the number of bicycle users. Nevertheless, in an area that lacks public transport services, respondents may be more encouraged to cycle because of the hot weather rather than walking. It can be seen in **Table 4.8**, hot weather was in the second place as the obstacle for cycling (0.154).

The respondents also concerned the distance and safety as the obstacles for cycling around campus since those parameters were in the third and fourth place as the obstacle (0.130; 0.104). In the their research, Bonham and Koth (2010) stated that safety is an important factor to consider for cycling.

Several reseaches on cycling preference were well documented. Abraham et al. (2004) investigated cyclist preferences for different attributes using a SP survey in the context of route choice. Respondents were given three alternate routes and their attributes and were then asked to rank the alternatives. The responses were analyzed using a logit choice model. Among other variables that were of interest to their study, they found

that cyclists prefer off-street cycling facilities and low traffic residential streets. But they also claim that, this may be due to an incorrect perception of safety on the part of the respondents, and education about the safety of off-road facilities may change the stated choice. Tilahun et al, 2007

Stated Preference has been conducted to analyze bicycle route choice in the city of Delft. The route surface quality, traffic levels and travel time in route choice were amongst the factors considered in their study. Bovy and Bradley's (1985) work found that travel time was the most important factor in route choice followed by surface type.

Another study by Hopkinson and Wardman (1996) and Tilahun et al. (2007), the demand for cycling facilities was investigated by using stated preference in a route choice context. They found that individuals were willing to pay more to use the facility for safer consideration. According to them, the increasing of the safety for cycling is likely more important than reducing travel time.

Concerning mobility for activities around campus, the probability to switch their transportation mode to cycle was investigated. In order to conduct the analysis, five scenarios were designed for each travel time increase and travel cost decrease, the objective of scenario design is to explore the effects of travel time increase and travel cost decrease on the cycling preference. All of those models were summarized in **Table 4.9** and **Table 4.10.**

Table 4.9. Logistic models of the cycling preference as transportation mode for activities around campus (car user)

Car users	**Logistic Models**
1. Female	$\boldsymbol{Y} = \frac{-0.344 * \text{TRAVEL TIME} + 2.294 * \text{COST} + 1.293}{1 + (\boldsymbol{e}^{-0.344 * \text{TRAVEL TIME} + 2.294 * \text{COST} + 1.293})}$
2. Male	$\boldsymbol{Y} = \frac{-0.398 * \text{TRAVEL TIME} + 2.342 * \text{COST} + 1.143}{1 + (\boldsymbol{e}^{-0.398 * \text{TRAVEL TIME} + 2.342 * \text{COST} + 1.143})}$
1. Age groups < 20 years old	$\boldsymbol{Y} = \frac{-0.344 * \text{TRAVEL TIME} + 2.249 * \text{COST} + 1.142}{1 + (\boldsymbol{e}^{-0.344 * \text{TRAVEL TIME} + 2.249 * \text{COST} + 1.142})}$
2. Age groups 20 – 30 years old	$\boldsymbol{Y} = \frac{-0.368 * \text{TRAVEL TIME} + 2.306 * \text{COST} + 1.191}{1 + (\boldsymbol{e}^{-0.368 * \text{TRAVEL TIME} + 2.306 * \text{COST} + 1.191})}$
3. Age groups > 30 years old	$\boldsymbol{Y} = \frac{-0.384 * \text{TRAVEL TIME} + 2.245 * \text{COST} + 1.102}{1 + (\boldsymbol{e}^{-0.384 * \text{TRAVEL TIME} + 2.245 * \text{COST} + 1.102})}$
1. Income level < RM 1000	$\boldsymbol{Y} = \frac{-0.362 * \text{TRAVEL TIME} + 2.247 * \text{COST} + 0.955}{1 + (\boldsymbol{e}^{0.362 * \text{TRAVEL TIME} + 2.247 * \text{COST} + 0.955})}$
2. Income level RM 1000 - 3000	$\boldsymbol{Y} = \frac{-0.403 * \text{TRAVEL TIME} + 2.480 * \text{COST} + 1.685}{1 + (\boldsymbol{e}^{-0.403 * \text{TRAVEL TIME} + 2.480 * \text{COST} + 1.685})}$
3. Income level > RM 3000	$\boldsymbol{Y} = \frac{-0.358 * \text{TRAVEL TIME} + 2.378 * \text{COST} + 0.835}{1 + (\boldsymbol{e}^{-0.358 * \text{TRAVEL TIME} + 2.378 * \text{COST} + 0.835})}$

Table 4.10. Logistic models of the cycling preference as transportation mode for activities around campus (Motorcycle users)

Motorcycle users	**Logistic Models**
1. Female	$\boldsymbol{Y} = \frac{-0.363 * \text{TRAVEL TIME} + 2.580 * \text{COST} + 1.177}{1 + (\boldsymbol{e}^{-0.363 * \text{TRAVEL TIME} + 2.580 * \text{COST} + 1.177})}$
2. Male	$\boldsymbol{Y} = \frac{-0.425 * \text{TRAVEL TIME} + 2.647 * \text{COST} + 1.655}{1 + (\boldsymbol{e}^{-0.425 * \text{TRAVEL TIME} + 2.647 * \text{COST} + 1.655})}$
1. Age groups < 20 years old	$\boldsymbol{Y} = \frac{-0.416 * \text{TRAVEL TIME} + 2.787 * \text{COST} + 1.532}{1 + (\boldsymbol{e}^{-0.416 * \text{TRAVEL TIME} + 2.787 * \text{COST} + 1.532})}$
2. Age groups 20 – 30 years old	$\boldsymbol{Y} = \frac{-0.400 * \text{TRAVEL TIME} + 2.627 * \text{COST} + 1.400}{1 + (\boldsymbol{e}^{-0.400 * \text{TRAVEL TIME} + 2.627 * \text{COST} + 1.400})}$
3. Age groups > 30 years old	$\boldsymbol{Y} = \frac{-0.354 * \text{TRAVEL TIME} + 2.344 * \text{COST} + 0.783}{1 + (\boldsymbol{e}^{-0.354 * \text{TRAVEL TIME} + 2.344 * \text{COST} + 0.783})}$
1. Income level < RM 1000	$\boldsymbol{Y} = \frac{-0.410 * \text{TRAVEL TIME} + 2.708 * \text{COST} + 1.667}{1 + (\boldsymbol{e}^{-0.410 * \text{TRAVEL TIME} + 2.708 * \text{COST} + 1.667})}$
2. Income level RM 1000 - 3000	$\boldsymbol{Y} = \frac{-0.377 * \text{TRAVEL TIME} + 2.413 * \text{COST} + 1.217}{1 + (\boldsymbol{e}^{-0.377 * \text{TRAVEL TIME} + 2.413 * \text{COST} + 1.217})}$
3. Income level > RM 3000	$\boldsymbol{Y} = \frac{-0.355 * \text{TRAVEL TIME} + 2.466 * \text{COST} + 1.223}{1 + (\boldsymbol{e}^{-0.355 * \text{TRAVEL TIME} + 2.466 * \text{COST} + 1.223})}$

In **Figure 4.6 - Figure 4.11, it** can be seen the summarized of the bicycle preference sensitivity analysis corresponding to travel time and travel cost for car users.

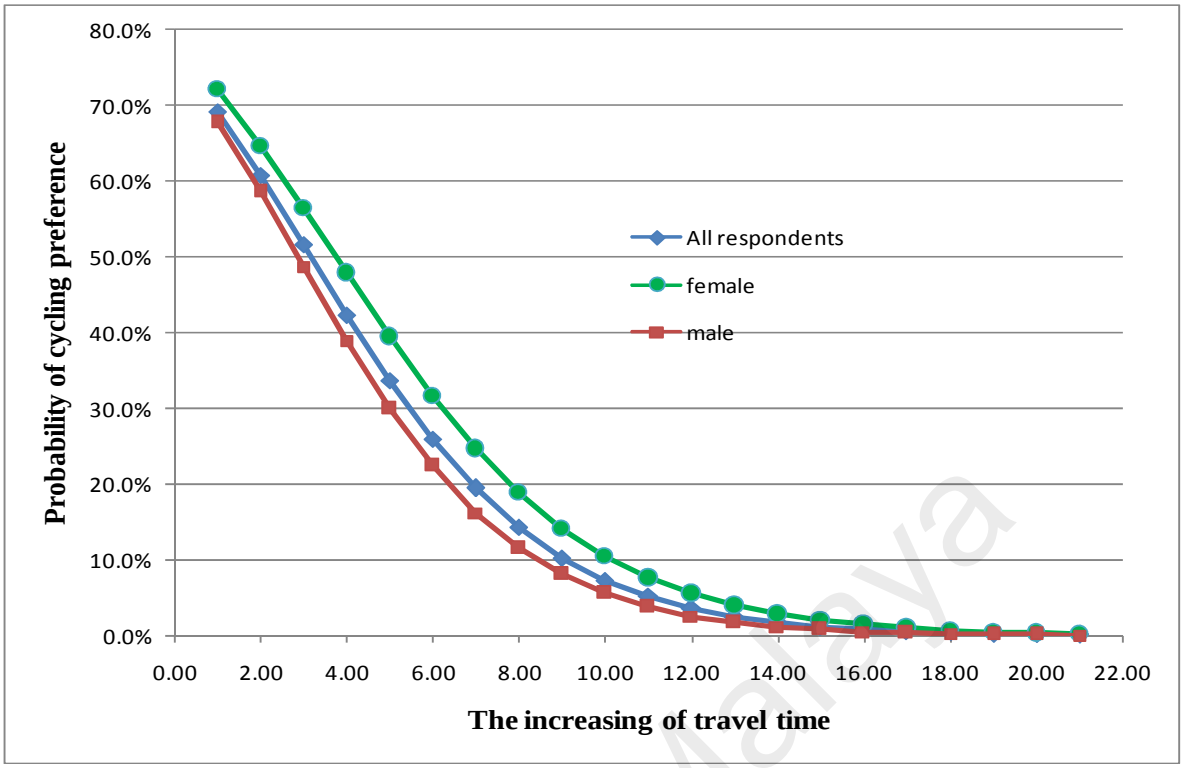


Figure 4.6. The sensitivity of bicycle preference corresponds to travel time (car users)

In **Figure 4.6,** the ordinate is the probability of bicycle preference while the axis is the multiple of the decrease travel time design. For example, if the travel time design is 3 minutes and increase to 6 minutes, the value in the axis is 2.

As presented in the Figure above, if the travel time increases, the probability of cycling preference decreases. At one point of the travel time increases, females probability for cycling is higher than males. If the axis is equal to 2, females probability of cycling preference is 64.7 % while males probability is 58.6%

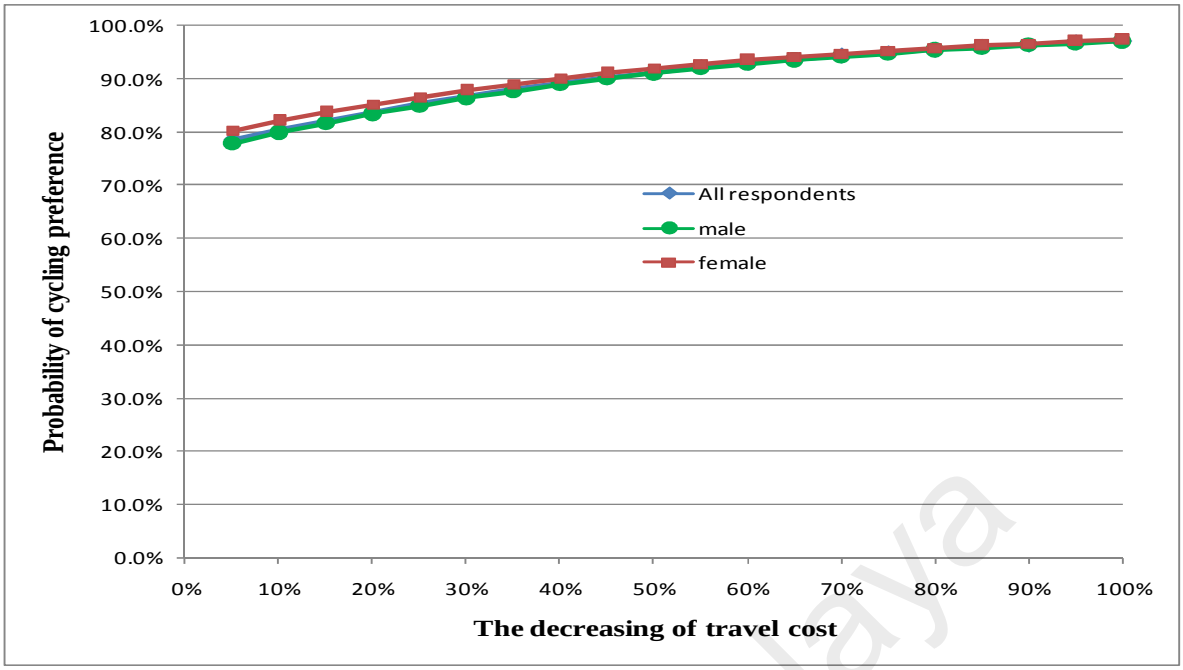


Figure 4.7. The sensitivity of bicycle preference corresponds to travel cost (car users)

Furthermore **Figure 4.7** shows the sensitivity of bicycle preference toward the travel cost (car users). The ordinate is the probability of bicycle preference (%) while the axis is the percentage of travel cost decrease.

As presented in the Figure above, if the travel cost decreases, the probability of cycling preference increases. At one point of the travel cost decreases, females probability for cycling is higher than males. For example if travel cost decreases 20%, the females probability switching for cycling is 85.2 % while and males probability is 83.4%. If the decrease is 100 %, it means that there is bike free policy in University of Malaya. If there is bike free policy in campus, the probability for cycling preference is 97.1%.

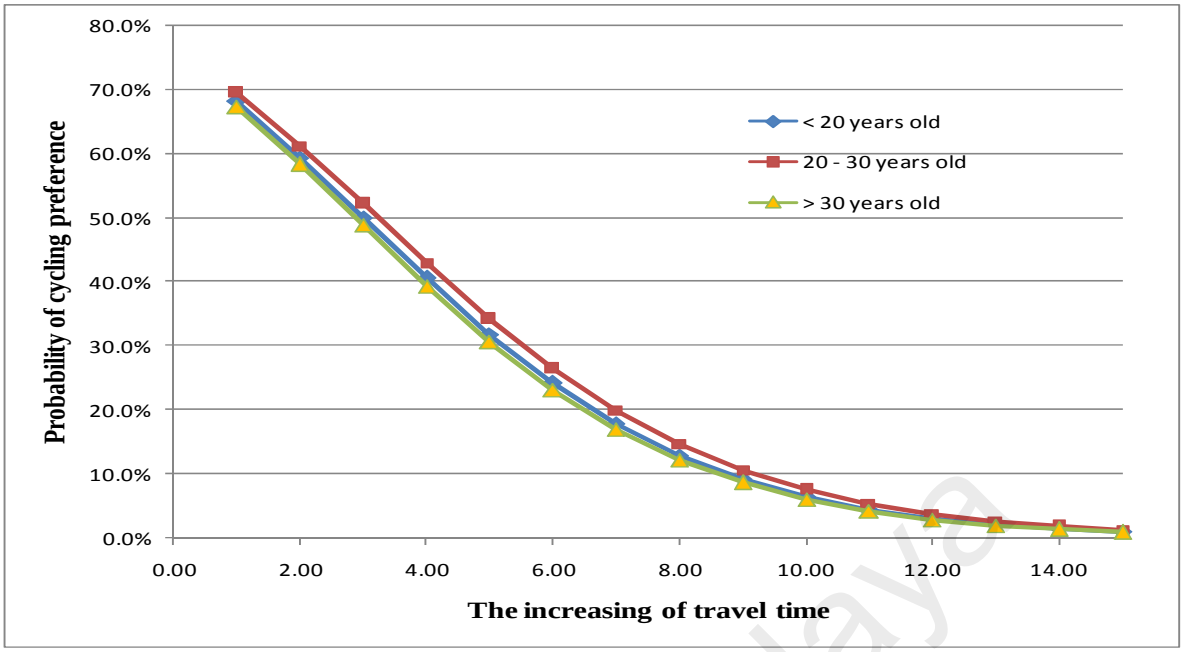


Figure 4.8. The sensitivity of bicycle preference corresponds to travel time (car users based on age)

Figure 4.8 shows the sensitivity of bicycle preference toward travel time (car users based on level of age). There is no consistent pattern between respondents age toward the cycling preference probability for car users. As can be seen in **Figure 4.17,** the cycling preference probability for respondents aged more than 30 years old is lower than respondents aged below 30 years old.

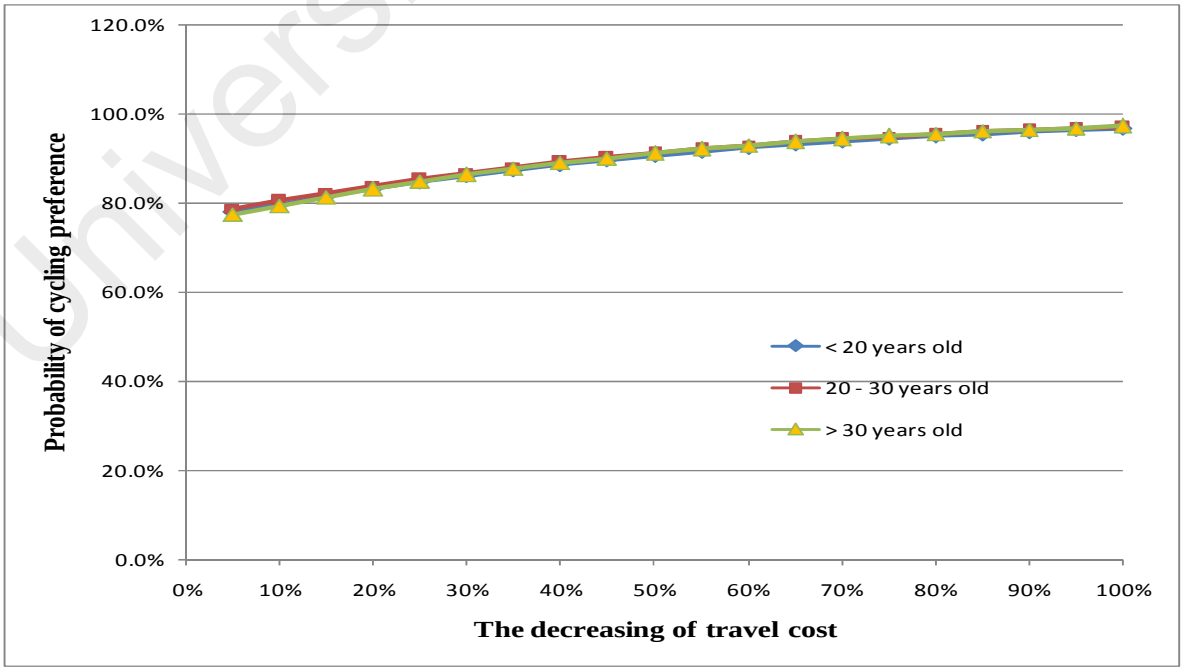


Figure 4.9. The sensitivity of bicycle preference corresponds to the travel cost (car users based on age)

Figure 4.9 shows the sensitivity of bicycle preference toward the travel cost (car users based on level of age), it also shows that the cycling preference probability for both groups of age is almost similar in one line but actually the highest cycling preference probability is the respondents aged 20 – 30 years old. There is no consistent pattern of respondents age toward the probability of cycling preference.

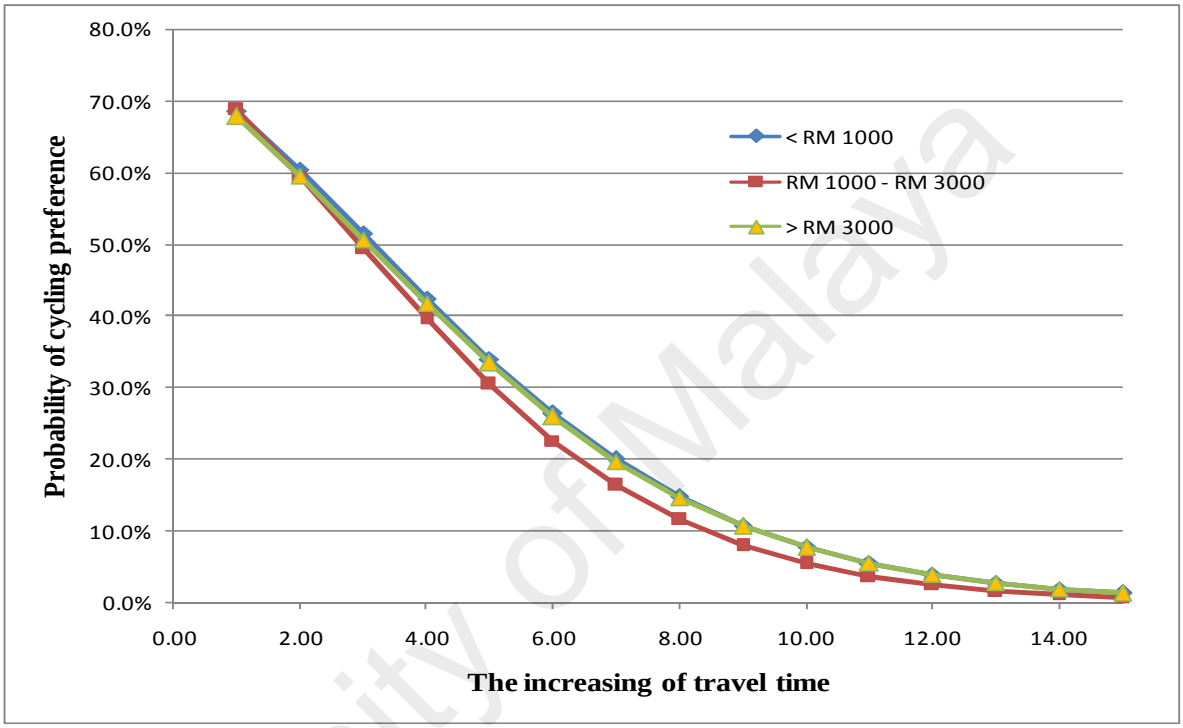


Figure 4.10. The sensitivity of bicycle preference corresponds to travel time (car users based on level of income

Figure 4.10 shows the sensitivity of bicycle preference toward travel time (car users based on level of income). There is no consistent pattern between income level toward the cycling preference probability of car users.

Figure 4.11 shows the sensitivity of bicycle preference toward the travel cost (car users based on level of income). The cycling preference probability for both groups of income level is almost similar in one line but actually the highest cycling preference probability is the respondents who earn the income less than RM 1000 .

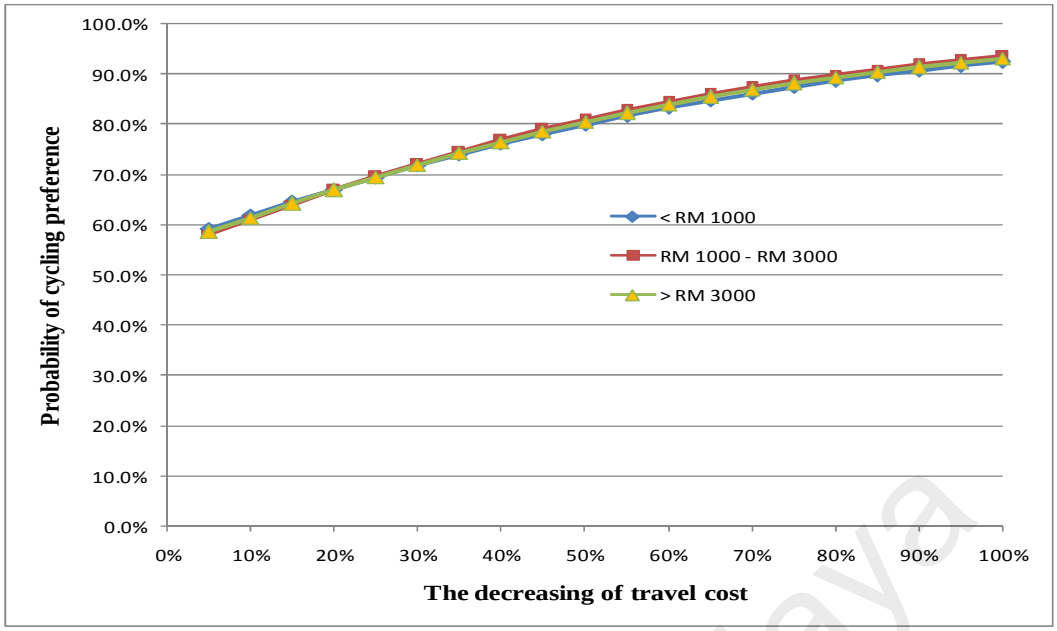


Figure 4.11. The sensitivity of bicycle preference corresponds to the travel cost (car users based on level of income

Figure 4.12 shows the sensitivity of bicycle preference toward travel time (motorcycle users). Equal to car user, if travel time increases, the probability of cycling preference decrease. As presented in Figure below, in one point of the travel time increases, females probability for cycling is lower than males. If the axis is equal to 2, females probability of cycling preference is 61.1 % while and males probability is 69.1%

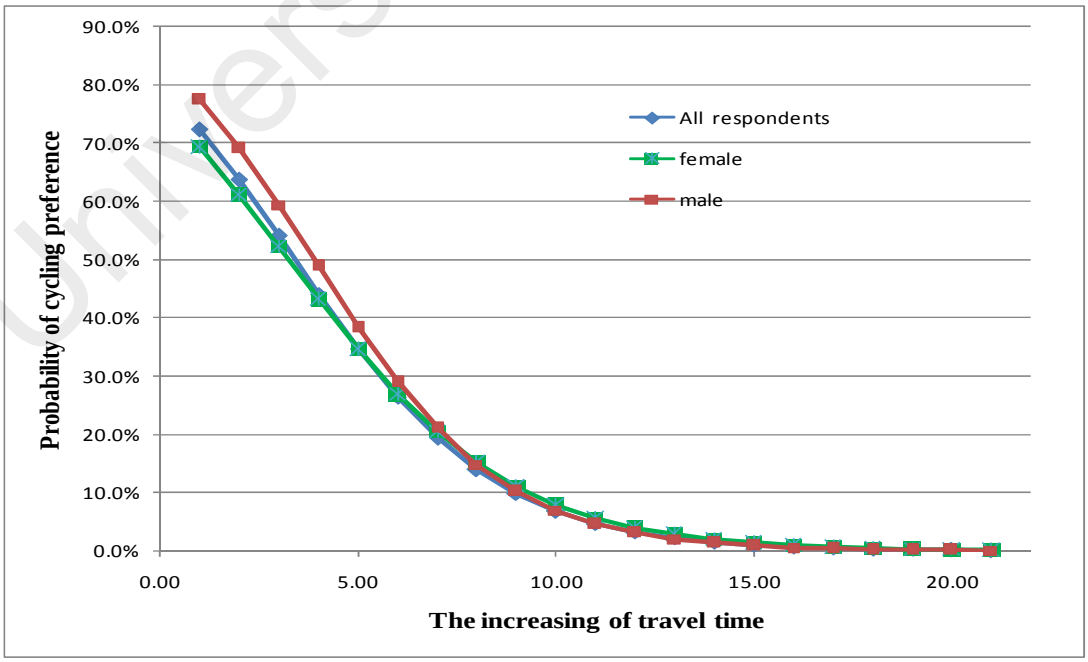


Figure 4.12. The sensitivity of bicycle preference corresponds to travel time (motorcycle users)

Furthermore, **Figure 4.13** shows the sensitivity of bicycle preference toward the travel cost (car users). If the travel cost decreases, the probability of cycling preference increases. The same phenomenon occurred in the sensitivity analysis of bicycle preference toward travel cost, as presented in **Figure 4.13**, at one point of the travel cost decreases, females probability for cycling is lower than males. In the point of travel cost decreases 20 %, females probability of cycling preference is 84.5 % while males is 89.9%. If the decreases is 100 %, the probability for cycling preference is 98.1%.

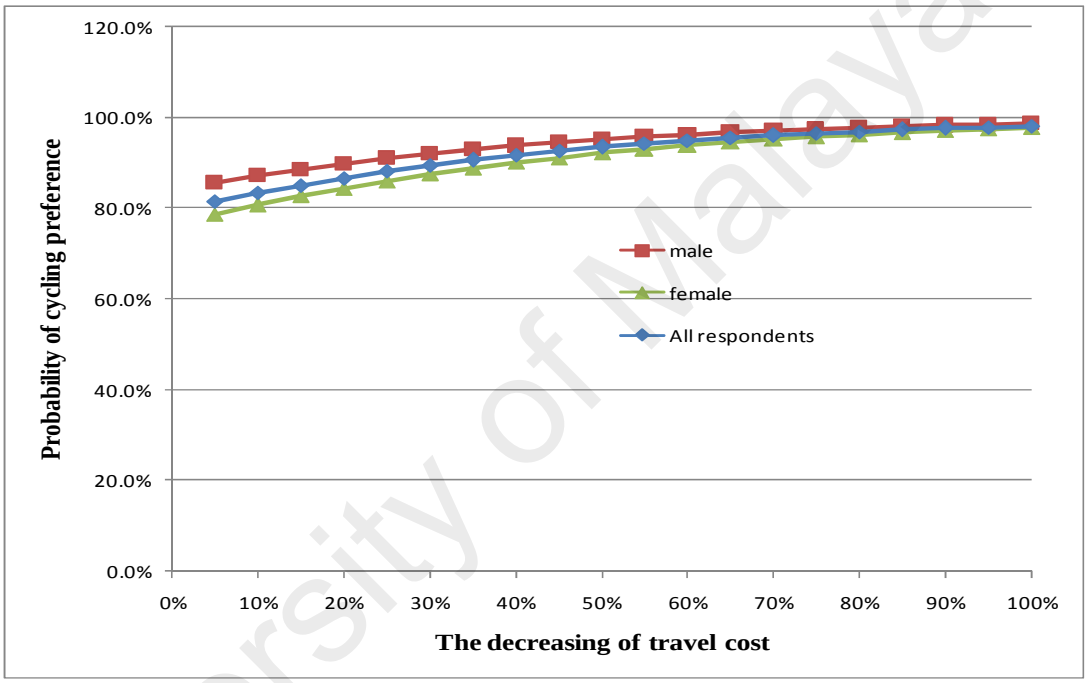


Figure 4.13. The sensitivity of bicycle preference corresponds to travel cost (motorcycle users)

Figure 4.14 shows the sensitivity of bicycle preference toward travel time (motorcycle users based on level of income). There is a consistent pattern between income level toward the cycling preference probability for motorcycle users. As can be seen in **Figure 4.14**, as the higher of motorcycle users' income, the higher the probability of cycling preference.

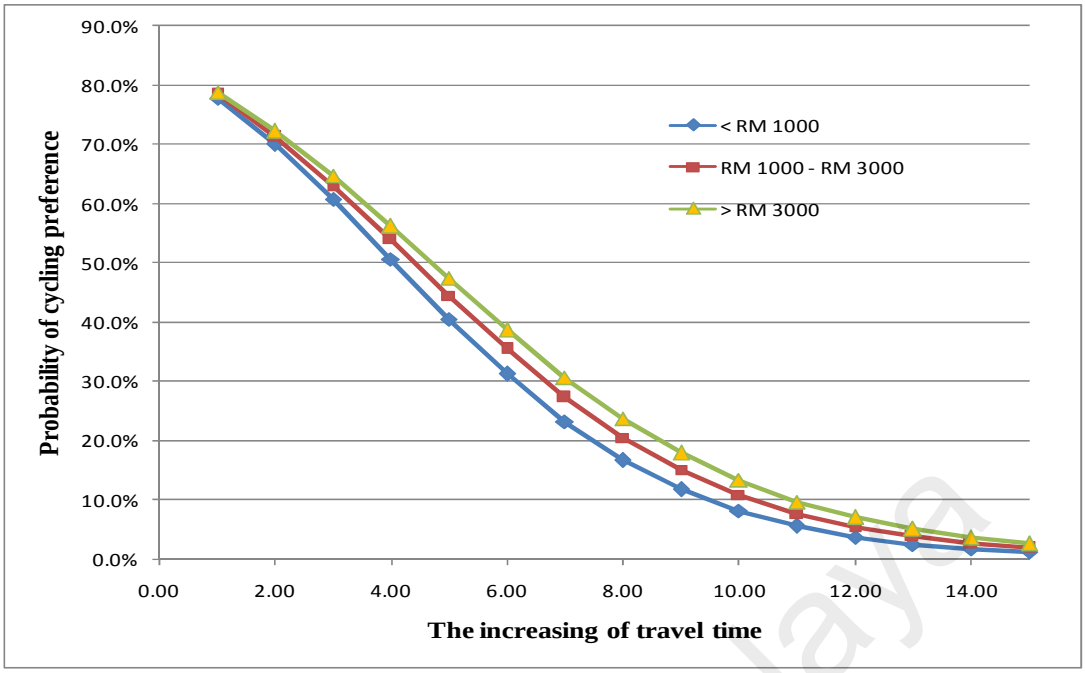


Figure 4.14. The sensitivity of bicycle preference corresponds to travel time (motorcycle users based on level of income)

Moreover **Figure 4.15** presents the sensitivity of bicycle preference toward the travel cost (motorcycle users based on level of income), there is no consistent pattern between income level toward the cycling preference probability of motorcycle users. But as can be seen in **Figure 4.15**, the probability of cycling preference for respondent who earn less than RM 1000 is higher than RM 1000 above.

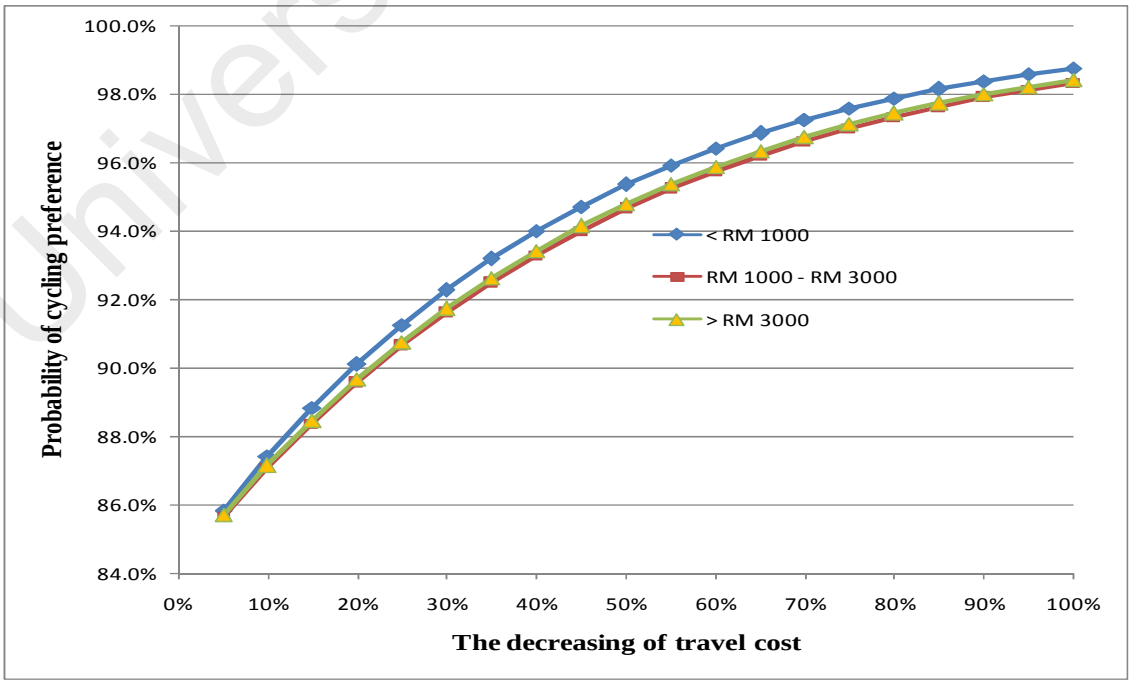


Figure 4.15. The sensitivity of bicycle preference corresponds to the travel cost (motorcycle users based on level of income)

Figure 4.16 shows the sensitivity of bicycle preference toward travel time (motorcycle users based on level of age). There is a consistent pattern of respondents age toward the cycling preference probability for motorcycle users. As can be seen in **Figure 4.16**, if motorcycle users age increases, the probability of cycling preference increases too.

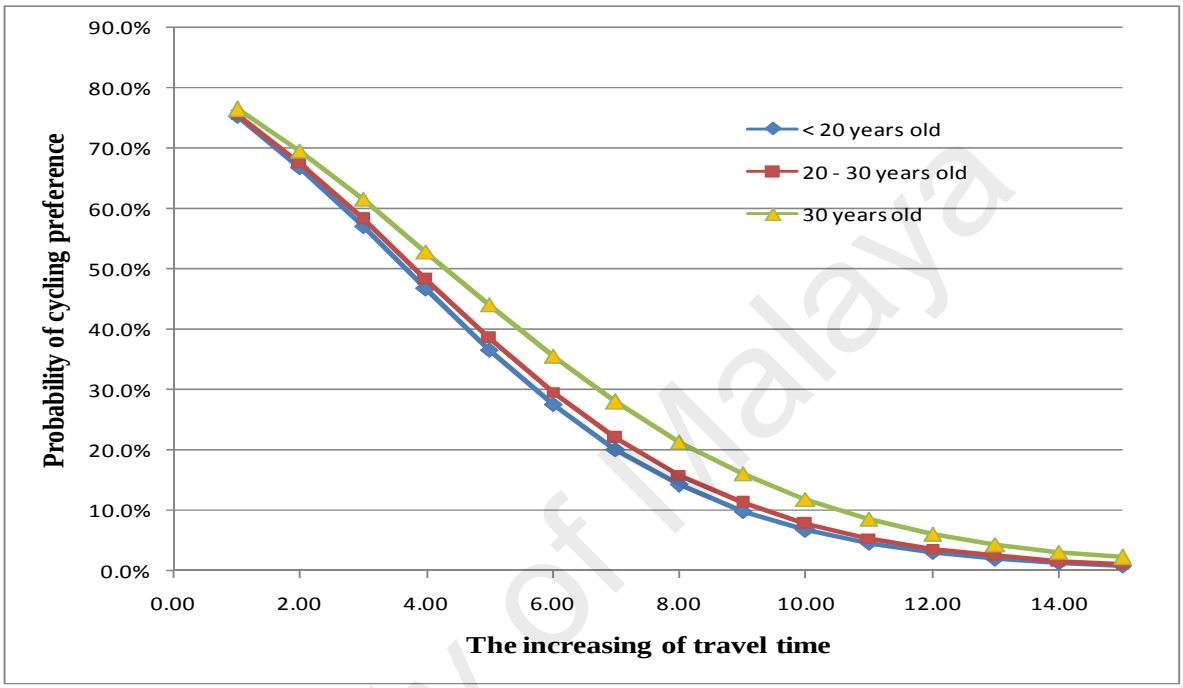


Figure 4.16. The sensitivity of bicycle preference corresponds to travel time (motorcycle users based on respondents age)

Figure 4.17 shows the sensitivity of bicycle preference toward the travel cost (motorcycle users based on level of age). There is the consistent pattern of respondents age toward the cycling preference probability for motorcycle users. As can be seen in **Figure 4.17**, if users age incrases, the probability of cycling preference decreases.

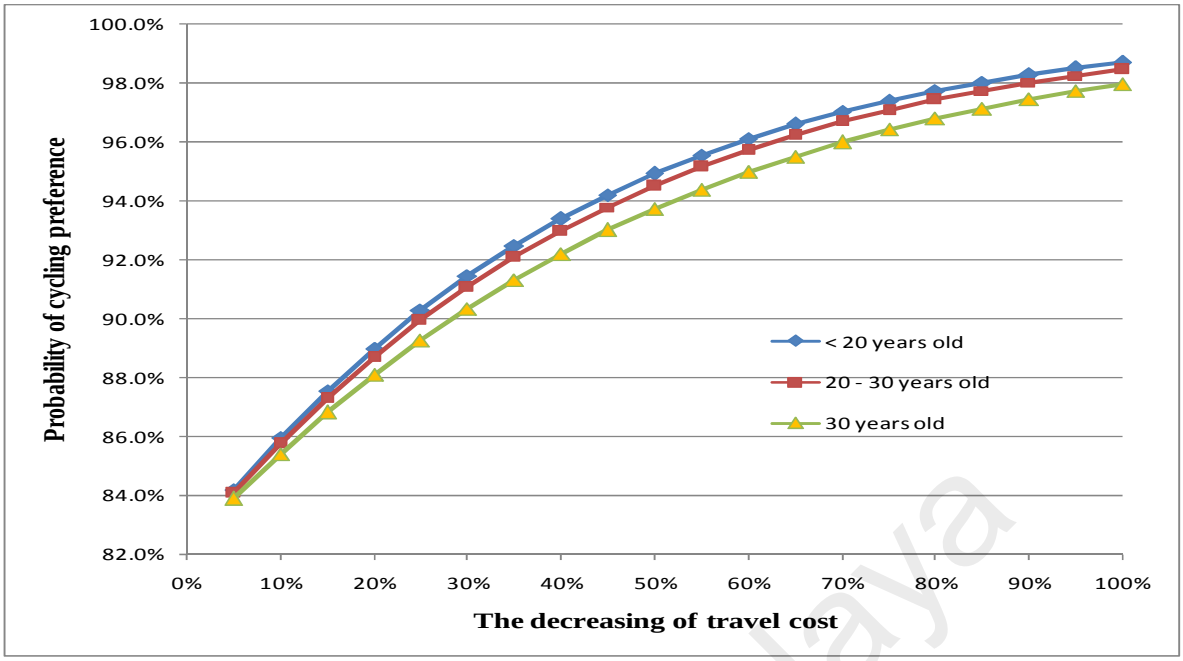


Figure 4.17. The sensitivity of bicycle preference corresponds to the travel cost (motorcycle users based on respondent's age)

The travel time scenarios as mentioned above can be considered to determine the type of bicycle path and the length of bicycle route. Proximity to an off-road bicycle trail plays an important role in route choice decisions. Using intercept surveys along the Burke-Gilman trail in Seattle, Shafizadeh and Niemeier (1997) found that among people reported thir origins near the off-road facility, travel time gradually increases as they are further from trail to a point and then decreases, leading them to speculate that there may be a 0.5–0.75 mile ''bike shed'' around an off-road bike path, within which individuals will be willing to increase their travel time to access that facility and outside of which a more direct route seems to be preferred. Tilahun et al, 2007

In the study area , there is no off road bicycle path or bicycle lane available inside the campus. Cyclist rides their bike on the road mix with other traffic. **Figure 4.18 - Figure 4.21** shows the sample scenarios for cycling routes inside campus.

Figure 4.18 shows the cycling routes scenario for the origin – destination from Faculty of Engineering to Mosque. As presented in **Figure 4.18, t**here are three scenarios to design the bicycle path.

Figure 4.18 (a) presents the cycling route on the existing road. There is one way traffic flow. As presented in this figure the travel distance is 1.53 km. If respondents would like to go to mosque by car, the travel time is 1.56 minutes. There is no cycling facility in this route. The cyclist must ride the bike carefully due to the traveling is mixed with other traffic.

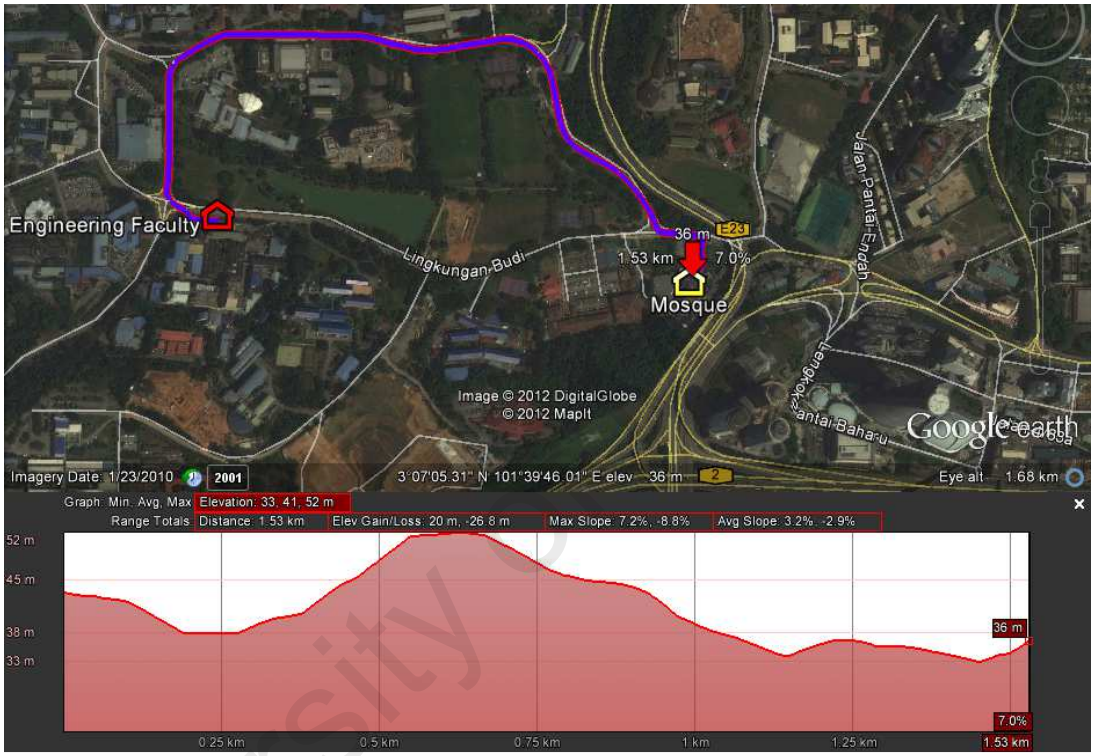


Figure 4.18a. Cycling route from Faculty of Engineering to Mosque (on the existing road)

Referring to **Figure 4.6,** if the cycling facility is available**,** for the first scenarios the probability of switching from car to bicycle for activities around campus is 29.7%.

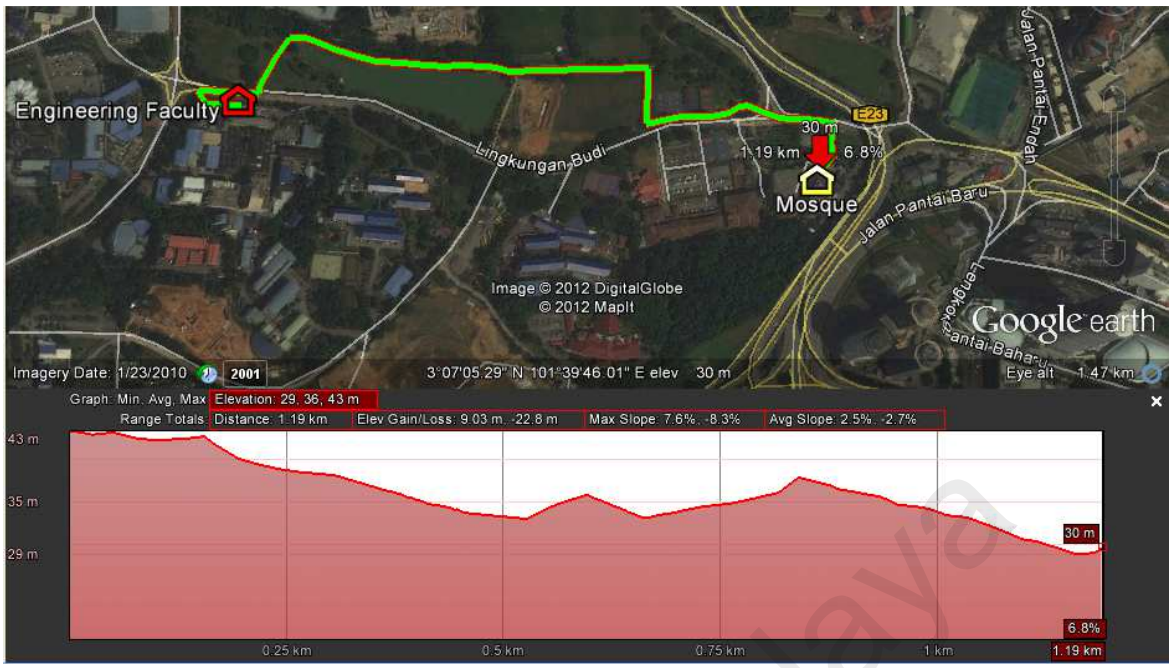


Figure 4.18b. Cycling route from Faculty of Engineering to Mosque (on the existing road)

In **Figure 4.18b,** the cycling route follows the jogging track, the distance is 1.19 km, most of the route is off road, this route is shortert than the existing road. It is argued that the route is safer than the first route due to most of the path is not mixed with other traffic. Referring to **Figure 4.6,** if the cycling facility is available**,** for the second scenarios the probability switching from car to bicycle for activities around campus is 39.9%.

Figure 4.18 (c) shows the cycling routes against the traffic flow, the distance is 0.957 km. This scenario is faster than the two previous scenarios, but this scenarios is more dangerous because the travel would against the traffic flow.

Referring to **Figure 4.6,** for the third scenarios the probability of switching from car to bicycle for activities around campus is 47.5%.

Figure 4.18c. Cycling route from Faculty of Engineering to Mosque (against traffic flow)

Figure 4.19 shows the cycling routes scenarios for the origin – destination from Faculty of Engineering to DTC.

Figure 4. 19a. Cycling route from Faculty of Engineering to DTC (on the existing road)

Figure 4. 19a presents the cycling route on the existing road, where cyclist ride their bike follow the one way traffic flow. The travel distance is 0.618 km.

Figure 4. 19b shows the cycling routes from DTC to Faculty of Engineering. The distance is farther than from Faculty of Engineering to DTC due to there is one way traffic flow, the distance is 1.56 km.

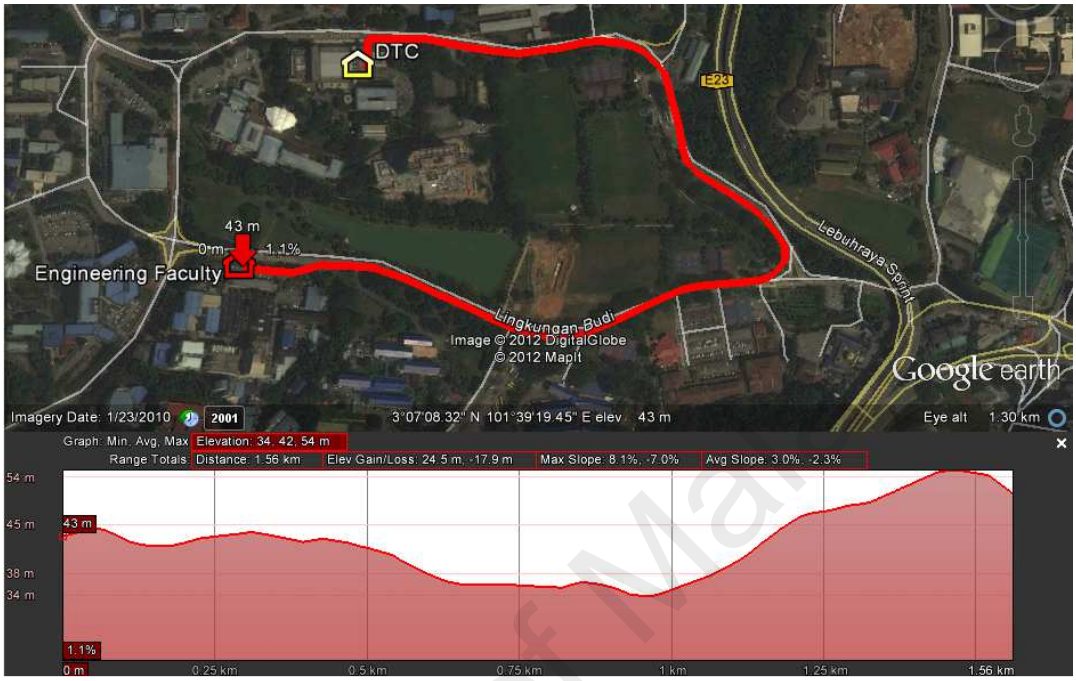


Figure 4. 19b. Cycling route from Faculty of Engineering to DTC (on the existing road)

Figure 4. 19c. Cycling route from Faculty of Engineering to DTC (on the existing road)

Figure 4. 19c shows the cycling route which is following the jogging track, the distance is 0.585 km. Referring to **Figure 4.6** the probability to switch from car to

bicycle for activities around campus is 29.7% if first scenario is used, 1.8% if second scenarios and 32.0% if third scenario is used.

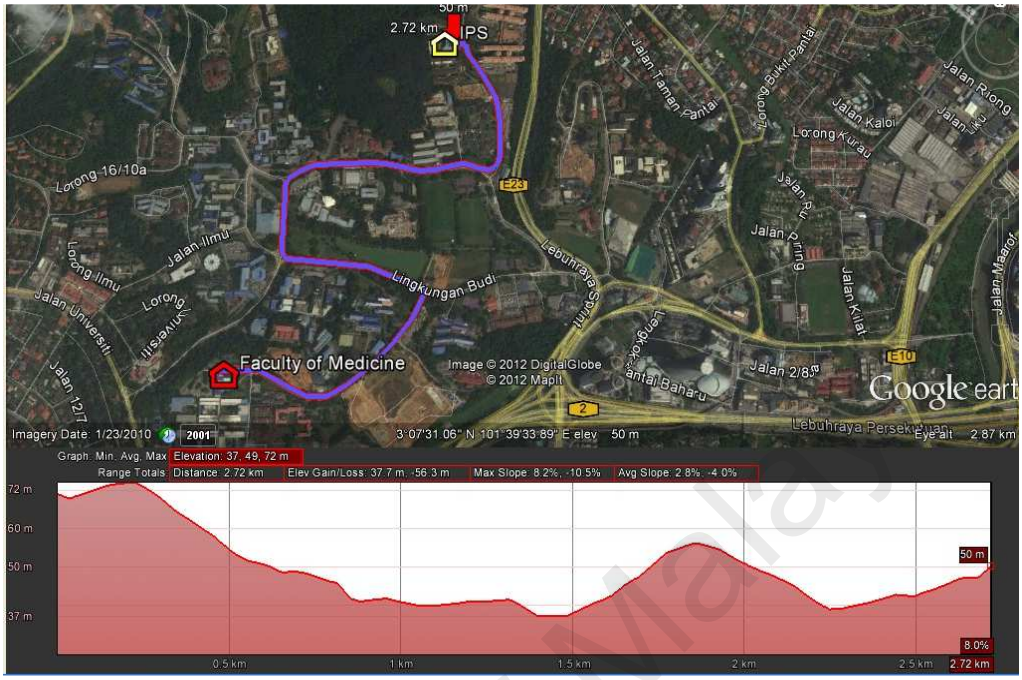


Figure 4.20a. Cycling route from Faculty of Medicine to IPS (on the existing road)

Figure 4.20 shows the cycling routes scenarios for the origin – destination from Faculty of Medicine to IPS. **Figure 4.20a** presents the cycling route on the existing road. The travel distance is 2.72 km.

Figure 4.20b shows the cycling route which is following the jogging track, the distance is 2.07 km.

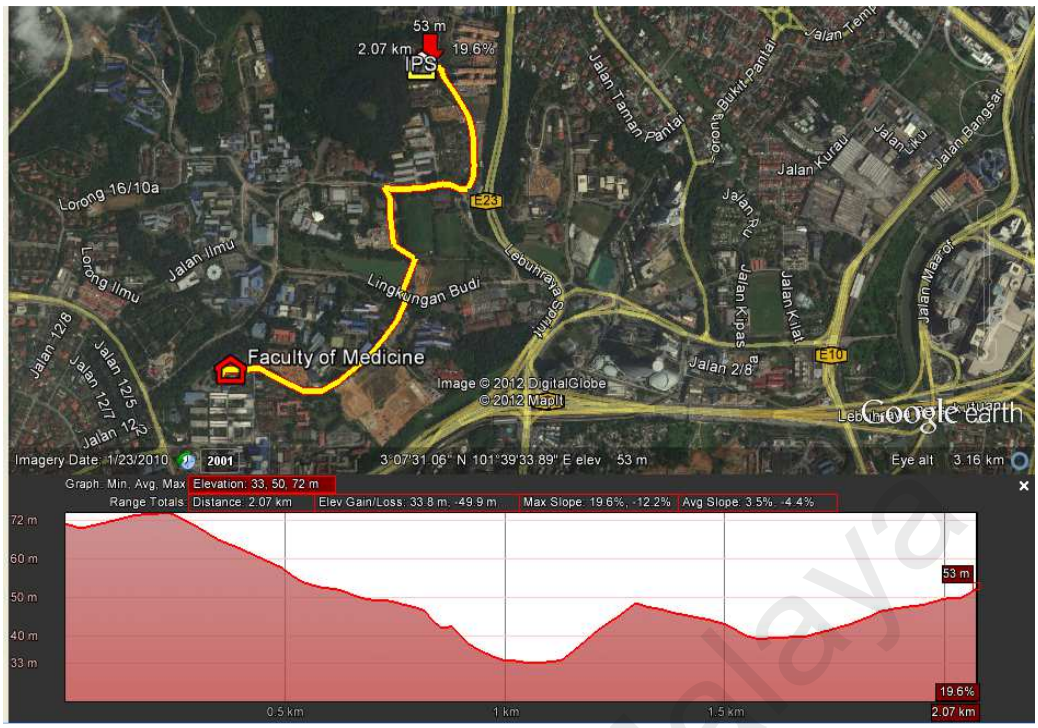


Figure 4.20b. Cycling route from Faculty of Medicine to IPS (on the existing road)

Referring to **Figure 4.6** the probability to switch from car to bicycle for activities around campus is 29.7% if first scenario is used, 40.7% if second scenarios.

Figure 4.21 shows the cycling routes proposed for the origin – destination from Academic of Islamic Study to Mosque. **Figure 4.21a** presents the cycling route on the existing road, where the travel distance is 2.03 km. **Figure 4.21b** shows the cycling routes from the Mosque to Academic of Islamic Study. The distance is farther due to there is one way traffic flow. The distance is 3.45 km.

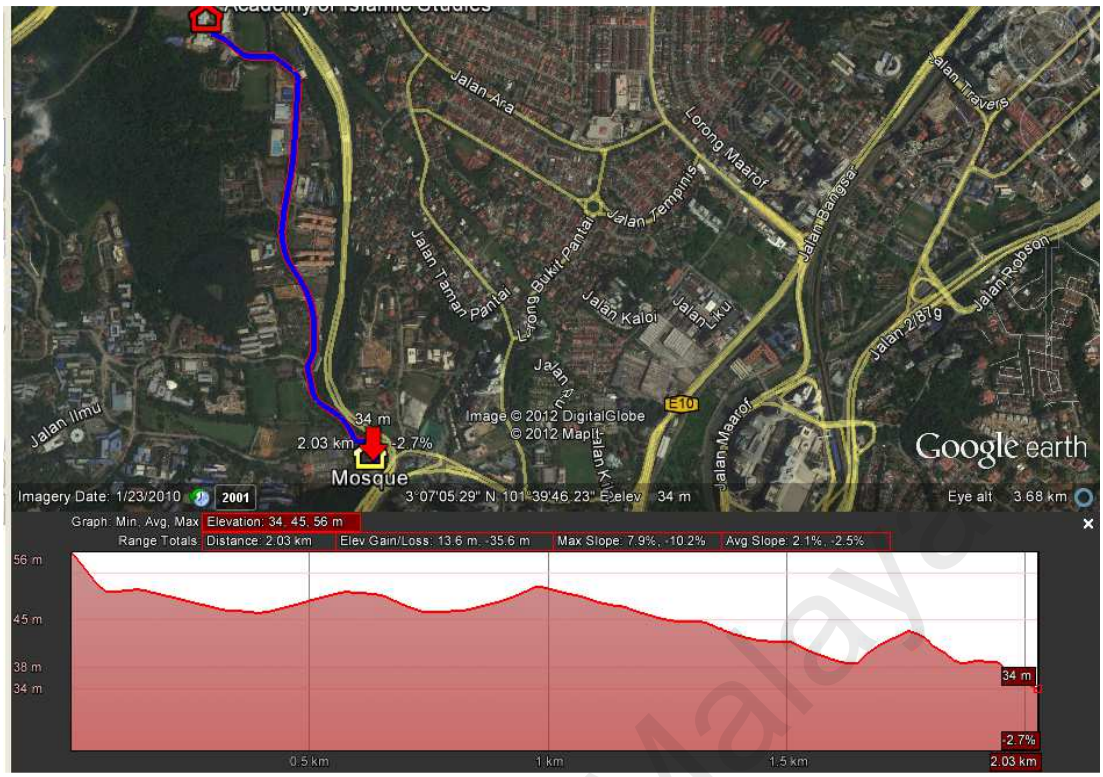


Figure 4.21a. Cycling route from Academy of Islamic Studies to Mosque (on the existing road)

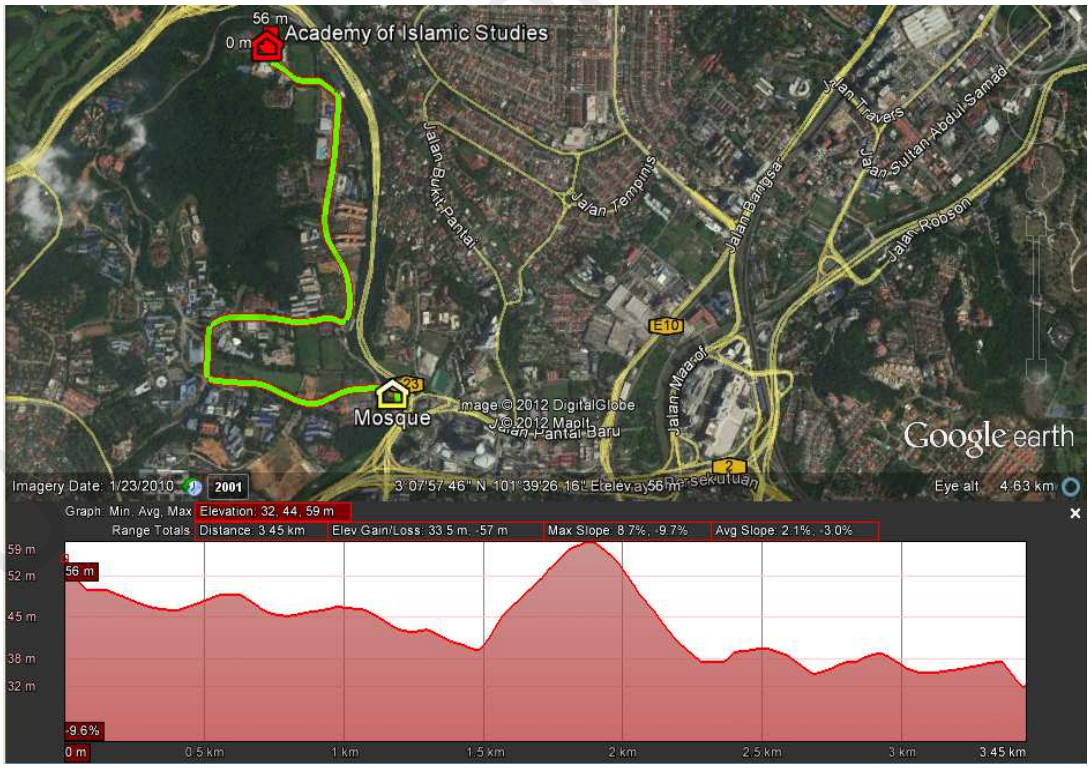


Figure 4.21b. Cycling route from Academy of Islamic Studies to Mosque (on the existing road)

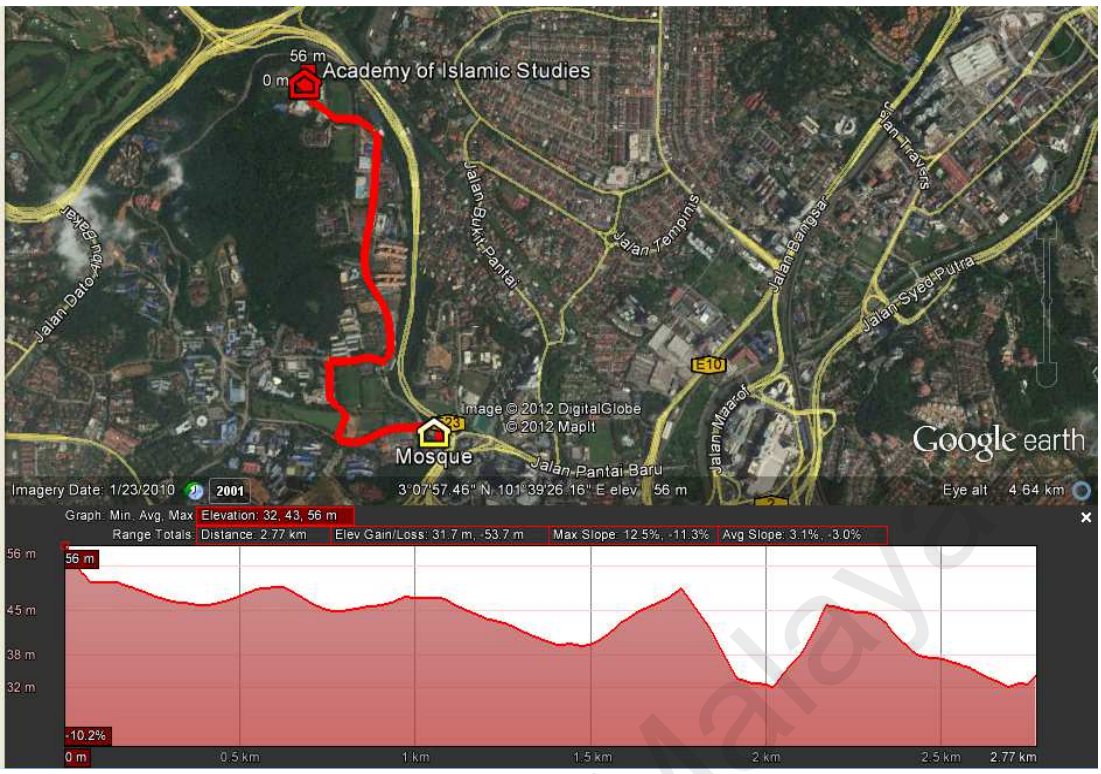


Figure 4.21c. Cycling route from Academy of Islamic Studies to Mosque (on the existing road)

Figure 4.21c shows the cycling route which is following the jogging track, the distance is 2.77 km. Referring to **Figure 4.6** the probability to switch from car to bicycle for activities around campus are 29.7% if first scenario is used, 9.2%if second scenarios and 16.7% if third scenario is used.

4.6. The cycling facilities for cycling around campus

The road safety concerned was shown by the respondents in the cycling facilities suggested. The respondents concerned about the dangers from other traffic. As the result, in **Figure 4.22**, the majority of respondents suggested the exclusive bike path for cycling around campus (77.1%). It is only 22.9% of the respondents are willing to cycle on the existing road. Moreover, 0.2 % would let cycle on the road mix with other traffic.

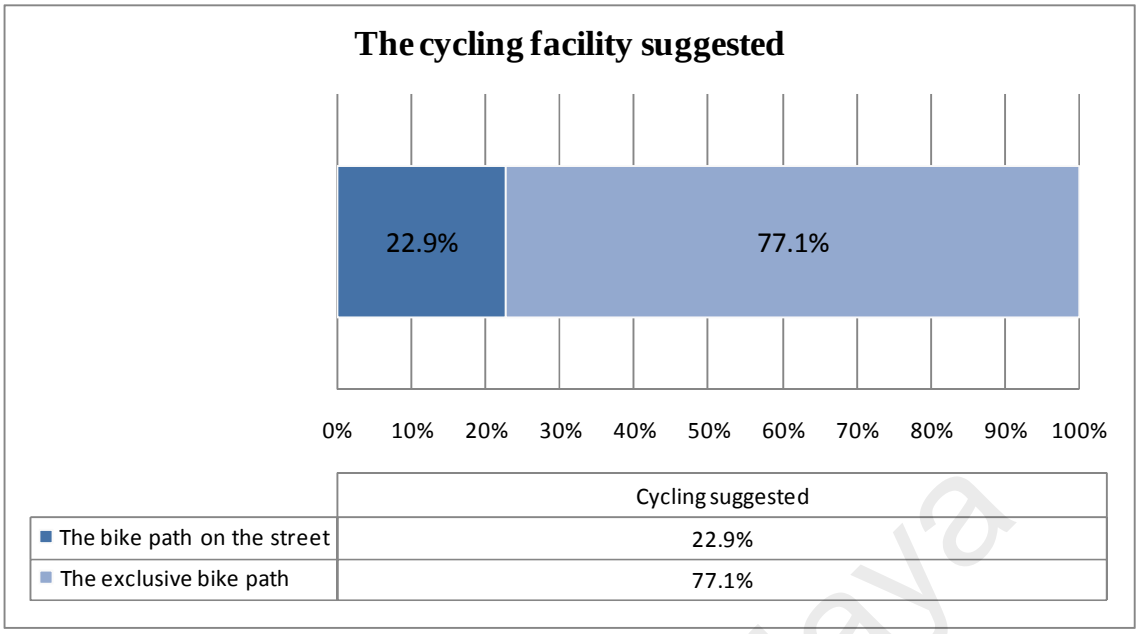


Figure 4.22. Cycling facilities suggested

In order to explore the correlation of the cycling facility suggested towards gender, level of income, age, the safety concerned, obstacles for cycling around campus and the acceptable distance, a regression model was designed. The structure of the model was shown in **Figure 4.23**.

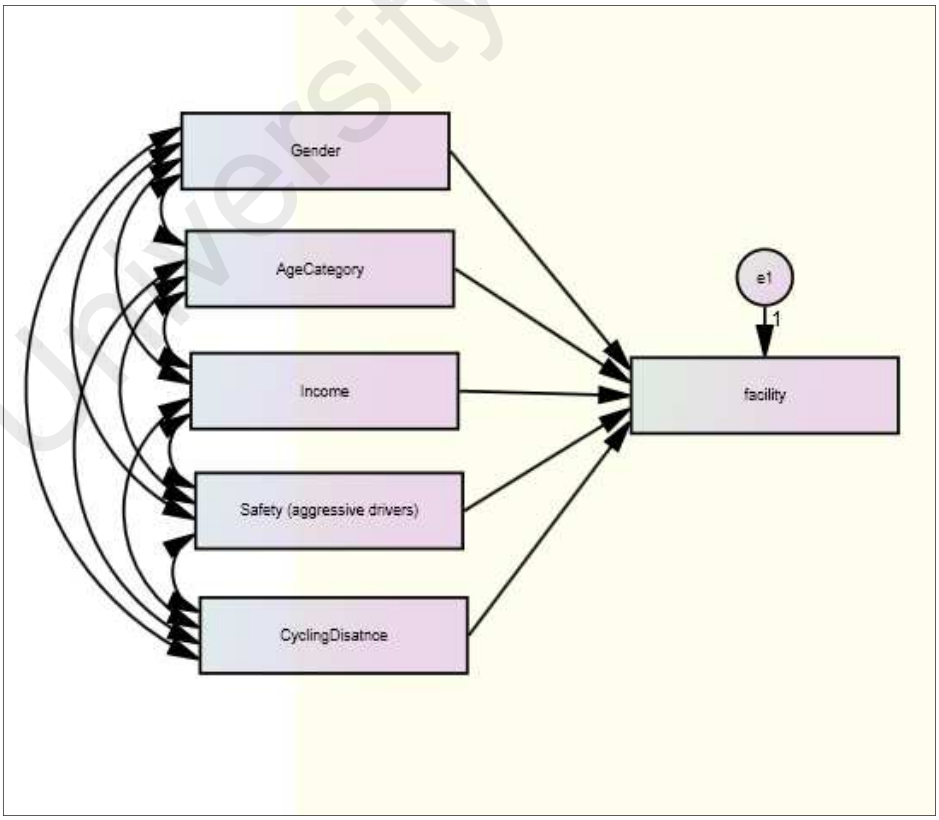


Figure 4.23. The structure of facility suggested model

As presented in **Table 4.11**, coefficients for age and income level do not significantly influence the cycling facility suggested (P-value = 0.372; P –value = .465; P-value = 0.803). Moreover, concerned about safety and acceptable cycling distance have significant influences toward the cycling facility suggested (P-value = 0.034; P –value = .004). The coefficient of safety concerned was negative, this result implied that as the safety concerned level of importance increases, the cycling facility suggested was the bike path on the street. When the distance coefficient was positive, it means that as the acceptable distance increases, the cycling facility suggested was the exclusive bike path.

Table 4.11. Cycling facility suggested model

			Estimate	S.E.	C.R.	P
Facility suggested	<---	Gender	.037	.041	.893	.372
Facility suggested	<---	Age Category	.036	.049	.731	.465
Facility suggested	<---	Income	.008	.032	.249	.803
Facility suggested	<---	Safety concerned	-.087	.042	-2.073	.038
Facility suggested	<---	Acceptable cycling distance	.040	.014	2.894	.004

Regarding the facility for cycling, the cycling preference for daily activity around campus, it has the difference result with Aultman-Hall et al. (1997), in his research, GIS were used to investigate bicycle routes in Guelph, Canada. While comparing the shortest path to the path actually taken, they found that people diverted very little from the shortest path and that most bicyclist used major road routes. They found little use of off-road trails. While this may be due to the location of the trails and the O–D pair they connect, even in five corridors where comparably parallel off-road facilities do exist to in-traffic alternatives, they found that bicyclist used the in traffic facilities much more often. Only the direct highest quality off-road facility (one that is ‘‘wide with a good quality surface and extends long distance with easy access points’’) seemed to be used relatively more.

4.7. The summary

In this study, there were 243 respondents come from outside university and 163 respondents come from residential college inside university traveled do travelling from home to university. They use motorcycles, cars, and buses (campus buses and public buses), walking and cycling. As a mode of transportation from home to university, cycling and walking are a minority. There were only 2.2% and 0.4% of respondents preferred to walk and cycle (from outside university). For the respondents who reside in residential college, 18.4 % of them walked and only 1.2% cycled.

High dependency on private vehicle occurred for respondents who come from outside the campus. A total of 68.6% of respondents prefer to use private vehicle. The most widely usage of transportation modes by respondents from outside university to campus is car (50.8%), followed by public transport (28.6%) and motorcycle (17.8%). The results also show the high dependency on private vehicle for the respondents who come from inside campus. Most of them preferred to use motorcycle (33.7 %) and private car (26.4%), followed by public transport (20.2%). Most faculties act as the center of activities in University Malaya, and regarding the public transport usage, the mobility is covered by public bus and university bus. However, the route from residential colleges as the origin is only covered by university bus that serves long time headway. This explains the high dependence of motorcycle and car among students who live in residential colleges compared to using public transport. It is quite encouraging though to note that 18.4 % of students prefer to walk when the distance to the destinations is not very far.

In the mode shifts analysis, the highest decreases was private car usage (53%). Motorcycle and public transport usage also decreases (35%; 44%), walking increases (46.4%).

The potential of cycling in University of Malaya is obviously high. A total of 85.5% said they would use the bicycle if cycling facilities are provided within the campus area. Regarding the trips distance, both female and male students are willing to cycle for distance below 1km. Willingness to cycle for both female and male respondents were more than 50%. It is interesting to note that for distance between 1km and 2km, the percentage of females who are willing to cycle were higher than male while for distances above 2km, the percentage of males who are willing to cycle were higher than females.

The furthest trips distance of The O-D place is approximately 3 km in distance. It shows that the potential for cycling activity around the campus is very high. If cycling facilities were provided within the campus area, a total of 84.1% of females were willing to cycling for the trips distance within 3 km, while 76.9% of males would cycle. A total of 84.1% female respondents and 77.9% of male respondents are willing to cycle if bicycle facilities were available within the campus. A total of 4.4% and 3.8% of male and female respondents respectively are willing to cycle for distances more than 5km.

Accordingly, a study by Bonham and Koth (2010) stated that among the motivators for cycling are health, affordability, environmental concern, time and pleasure. However, affordability is still in debates due to the comparative cost between driving and cycling. It seems that parking provision was successfully encouraged car user to cycle if the facilities were available since most of them stated that the reason why they would cycle due to the parking provision (36.5%). Overall, as far as the reason for the willingness to cycle is concerned, a total of 19.6% of respondents considered health and environment concerned as the main reason for cycling, followed by parking provision (14.8%), faster (14.5%) cheaper (11.2%) and fun (10.3%). The last reason is too hot for walking (10.0%),

As result in the model, coefficients for age, income level, type of residents and cycling experience are negative, the result implied that as the income level and age increases; the answere for the question regarding the willingness for cycling around campus is no. Furthermore if the respondents reside outside university, the answer for the question regarding the willingness for cycling around campus is yes. If the respondents have the cycling experience in the past, the answer for the question regarding the willingness for cycling around campus is yes.

Malaysia is a country with high rainy days. This can be the obstacles for cycling for activities around campus due to automatically no one of respondents are willing to cycle in the rain. It can be seen in the result, the main obstacle for cycling is the rainy day. The respondents also concerned the distance and safety as the obstacles for cycling around campus since those parameters were in the third and fourth place as the obstacle. In their research, Bonham and Koth (2010) which stated that safety is an important factor to consider for cycling.

Concerning mobility for activities around campus, the probability of respondents' to switch their transportation mode to cycling was investigated. In the model that were designed, as the travel time and travel cost decreased the preference for cycling increased. In designing the cycling path facilities the authorities must consider the safety due to the respondents concern about safety. As the result in this study, regarding the cycling facilities, the majority of respondents suggested the exclusive bike path for cycling around campus (77.1%). It is only 22.9% of the respondents suggest on the existing road. Moreover, 0.2 % would let would cycle on the road mixed with other traffic. The reason why the respondent choose the inclusive path due to the safety concern, as figured in the regression model, coefficient of safety concerned was

negative, this result implied that as the increase of the safety concerned level of importance the cycling facility suggested was the bike path on the street.

This study also analyzed the correlation among the parameters that were investigated corresponding to gender, age and income level, the result were presented in Table 4.12.

Table 4.12 : The correlation of gender, age and income level toward the parameter that invertigated (the potential for cycling in accessing public transit facilitiesl)

Parameters	Correlation		
	Gender	Age	Invome Level
Mode preference from residence to campus Car Motorcycle Public Transport Walking Cycling	 **Not Significant** **Significant** **Significant** **Not Significant** -	 **Not Significant** **Not Significant** **Not Significant** **Not Significant** -	 **Significant** **Not Significant** **Significant** **Not Significant** -
The distances from the residence to the university	**Significant** Females' distance were shorter than males	-	-
Mode shift	**Significant**	**Significant** The mode shift increased as groups of age increased	**Significant** The mode shift increased as income level increased
The willingness for cycling	**Not Significant**	**Significant** As respondent's age increased, the willingness to cycle would decrease.	**Significant** As the respondent income level increased, the willingness to cycle would decrease.
The cycling facility suggested	-	**Not Significant**	**Not Significant**

CHAPTER 5

THE POTENTIAL OF CYCLING AS THE FEEDERING MODE OF PUBLIC TRANSPORT

5.1. The influence of Socio-Demographic Characteristic on Mode Share

In this part, the data highlighted the people's travel behaviour for daily commuting, the accessibility to the transit facilities and the potential of cycling in accessing the transit facilities. The study area is in Taman Medan, within Petaling Jaya Municipal Area Selangor, Malaysia. Petaling Jaya is a satellite township (**Figure 5.1**) for Kuala Lumpur. The area consists of mostly residential and some industrial areas. The area is approximately 97.2 km². There are two types of public transit services available in study area i.e. the public bus service and commuter train which are operated by RapidKL while the public bus service are operated by RapidKL and other private companies.

The field survey was undertaken in this study. A set of questionnaire was prepared and distributed to the respondents in those areas. The questionnaire covers public transit and private car users, consist of socio-economic data, travel behaviours for daily commuting, potential for taking public transits, the satisfaction on public transits and its accessibility and the potential of cycling in accessing public transit. The surveys were conducted in seven months; May – December 2011.

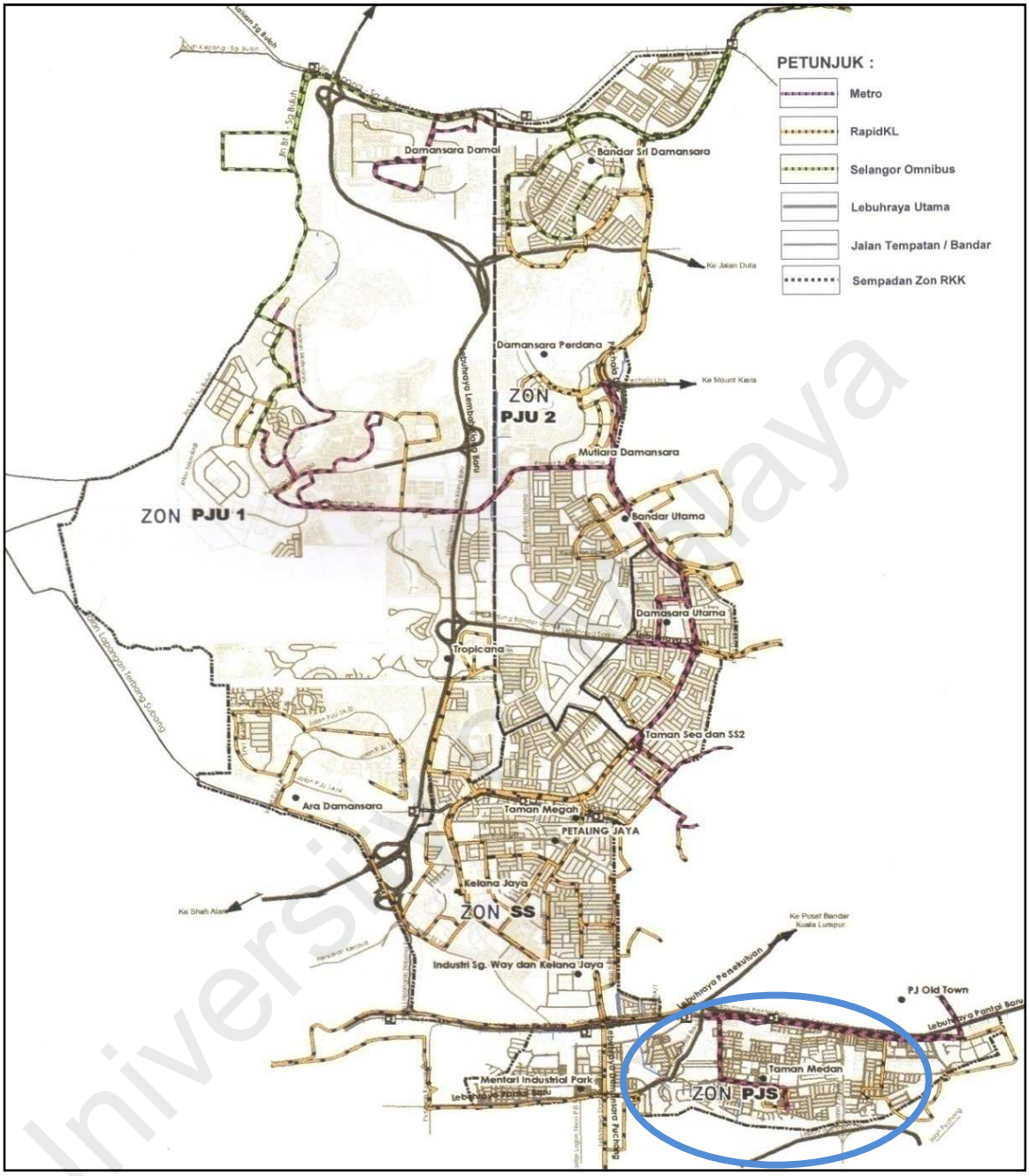


Figure 5.1. The map of study area

The population in the study area is 140,000. Based on Krejcie et.al in 1970, for this number of population, the minimum sample sizes is 376. In this study, the sample size is three hundred and eighty two respondents (n=382). The respondents consist of 70.2% public transit users and 29.8% private car users.

Table 5.1. Socio-demographic data of respondents

Demographic characteristic	All respondents (%)	Transit users (%)			Car users (%)	[a] % of Transit users
		All Transit users	Captive user	Choice users		
All respondents		70.2	29.2	70.8	29.8	70.2
Gender						
Female	62.3	70.9	73.1	69.8	42.1	79.8
Male	37.7	29.1	26.9	30.2	57.9	54.2
Marriage status						
Single	36.9	41.0	44.9	39.2	27.2	78.0
Married	47.1	43.3	41.0	44.4	56.1	64.4
Others	16.0	15.7	14.1	16.4	16.7	68.9
Age						
< 18	2.6	3.4	14.1	2.1	1.8	90.0
18 - 40	50.0	63.8	73.1	77.8	72.8	89.5
40 - 55	45.3	32.5	11.5	20.1	19.3	50.3
>55	2.1	0.4	1.3	0.0	6.1	12.5
Occupation						
Employee	59.2	57.8	41.0	65.1	62.3	68.6
Students	31.9	34.3	51.3	27.5	26.3	68.8
Housewife	7.6	6.7	7.7	6.3	9.6	62.1
Unemployed	1.3	1.1	-	1.1	1.8	94.1
Income (MYR)						
< 1000	16.5	22.0	46.2	12.7	3.5	94.0
1000 – 3000	60.7	69.8	52.6	77.2	39.5	83.8
3000 – 1,630	17.0	5.6	1.3	6.9	43.9	56.5
> 1,630	5.8	2.6	-	3.2	13.2	59.5
Household number						
<3	6.8	5.6	6.4	5.3	9.6	57.7
3-4	56.8	63.4	57.7	66.1	41.2	78.3
5-6	25.9	22.4	24.4	21.2	34.2	60.6
>6	10.5	8.6	11.5	7.4	14.9	57.5

[a] % of public transport users = public transport users/(public transport users+ car users)

Table 5.1 summarizes the socio-demographic data of respondents. The data consists of public transit and car users. The public transit users consist of choice users and captive users. Refer to Deng and Nelson study in 2012; the captive users are defined as public transit users who do not have the alternative mode for commuting while the choice users do. In this study, most public transit users were choice users (70.8%) while captive users are 29.2%.

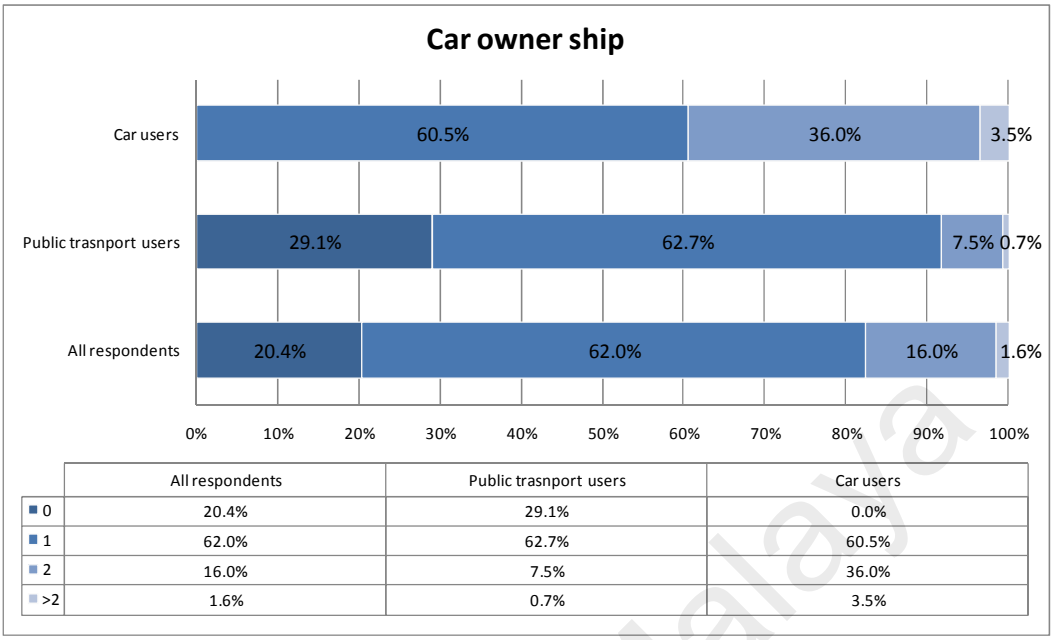
As presented in **Table 5.1**, the percentages of females are higher than males. The survey recorded 62.3% of the respondents were female while male respondents were 37.7%. Based on gender, the number of females is the highest for both 'captive' and 'choice' users (73.1% and 69.8%). For female choice users, this result was in accordance with Deng and Nelson in 2012, while the contradicted result was explored for males. The result also shows male respondents were the highest number among car users (57.9%). There is a significant difference between females and males in data corresponding to the public transit and private car preference at the 0.05 level of significance (F = 30.319, P-value = 0.000), while there is no significant difference between a captive and choice users (F = 1.431, P-value = 0.234).

There are four categories of respondent's age in this study, namely under 18 years old, 18 – 40 years old, 40 - 55 years old and above 55 years old. The highest car users and public transport users are the respondents aged between 18 - 40 years old (most of whom are employed). As shown in **Table 5.1**, the highest number of car and public transit users are respondents aged between 18 - 40 years old (most of whom are employed). The consistent pattern does not occur between respondent's age towards mode share for commuting. At the 0.05 level. A significant difference occurs among the categories of respondent's age corresponding to the mode share for commuting, (F = 19.537, P-value = 0.00). While there was no influence of respondent age towards the captive and choice users of public transit, (F = 2.827, P-value = 0.095).

The highest number of public transit and private car users are working individuals (59.2%), followed by students (31.9%). There is no significant difference between respondent's occupation corresponding to public transit and private car preference, at the 0.05 level (F =

0.001, P-value = 0.975), The interesting result was observed for public transit captive users, that contradicted with other results in which the highest number of captive users is students. Author disputed that results associated with limitations of students accessing a car, was due to the fact that some of them were less than 18 years old. They were not allowed to have driving licenses and lack of car ownership.

The view that public transit users is from low income group was explored in this research. Based on income level, the highest public transit user respondent earned an income of 1000 –3000 MYR (60.7%), while the highest number of car user respondents earned an income of 3000 - 5000 MYR (17.0%). Moreover, 69.8% of public transit users earned an income below 3000 MYR. The percentage of respondents earned an income more than 3000 MYR and uses car are higher than the respondents earned an income below 3000 MYR. Multivariate test were conducted to explore the difference between the income less than 3000 MYR and more than 3000 MYR with regards to the mode preference for commuting. As the result, the significant difference occurs at the 0.05 level of significance, (F = 102.198, P-value = 0.000). Moreover, there is a significant difference between the income level towards the mode share, (F = 102.198, P-value = 0.000). This result is in accordance with Sanchez in 2002; his research also stated the relevance of low income and public transit users. He also indicated that this phenomenon can be considered for land public transit authority in the decision-making of public transit system and policy, such as travel cost expenses subsidies for the public transit users.



	All respondents	Public trasnport users	Car users
0	20.4%	29.1%	0.0%
1	62.0%	62.7%	60.5%
2	16.0%	7.5%	36.0%
>2	1.6%	0.7%	3.5%

Figure 5.2. Car ownership

As can be seen in **Figure 5.2**, most respondents only have one car (62.0 %), followed by having no car (20.4%) and two cars (16.0%). The majority of the respondents who use car for daily commuting have one car (60.5%), equal to the respondents who use public transport (62.7%). Based on Multivariate test at the 0.05 level of significance, there is a significant influence of car ownership towards the public transport and private car preference for daily commuting ($F = 92.425$, P-value = 0.000).

The majority of the respondents have a car driving license (64.7%). As presented in **Figure 5.3,** there are 88.6% of car users having driving license while 11.4% do not. Interesting result is presented in **Figure 5.3**, among respondents who do not have driving license, 11.4% used car as a transportation mode for daily activities. The authors argue that for this condition in daily commuting they joined with another car as the passenger, because it is impossible for them to drive their own car without driving license. The results also show that they even use public transport, although 54.5% of them have a car driving license.

There is a significant influence of car driving license ownership correspondent to the public transport and private car preference (F = 45.370, P-value = 0.000).

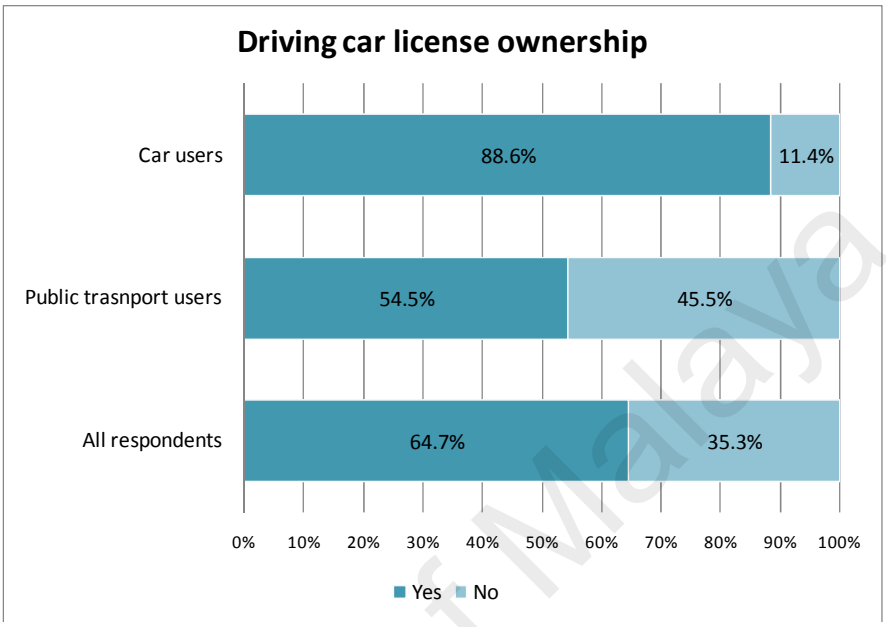
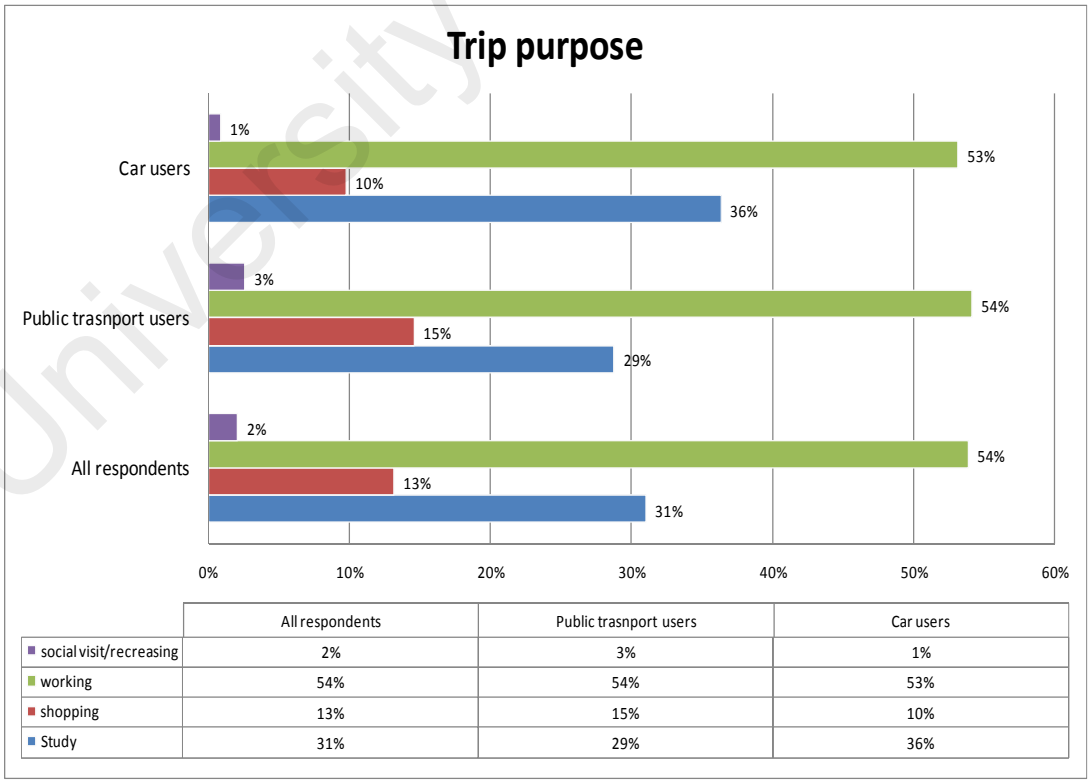


Figure 5.3. Driving car license ownership



	All respondents	Public trasnport users	Car users
social visit/recreasing	2%	3%	1%
working	54%	54%	53%
shopping	13%	15%	10%
Study	31%	29%	36%

Figure 5.4. Mode share based on trip purpose

Then, as presented in **Figure 5.5**, the highest trip purposes for main daily activities are for working (54.0%) followed by studying (31.%) and shopping (13.%), in the three highest of trip purpose for car users are working (53.0%), followed by studying (36%) and shopping (10%). Equal to the public transport user, the highest was working (54%), followed by studying (29%) and shopping (15%). There is no significant difference between trip purpose toward the public transport and private car preference (F = 0.908, P-value = 2.281).

5.2. The factor that influence transportation mode preference for commuting

Considering the impoetant ofcar users behaviour in decision-making for the public transit system and policy is commonly agreed by researcher and land transport authorities, Button et al. (1980) also stated the importance of car user travel pattern involvement on the public transit system and policy. Moreover the improvement of the public transit service and accessibility would increase the mode shift from car to public transit (Cooper et al. 2001). Regarding the accessing of distance to the public transit facility, Scheme (1996) suggested that, commuters who reside near transit stations used private car less than who reside farther from transit stations.

This study clearly indicates the reason why respondents prefer to use private cars for daily commuting. Existing public transit routes are limited and its accessibility must be a significant concern by the land transport authority in Malaysia as the main reason why commuters who use a private car for daily activities due to ‘flexibility’ and ‘easy to access’ (51.8%). This result is in line with Hagman (2003) and; Nilsson and Kuller (2000), who suggested that the advantages of private car are its flexibility and easy to access. Regarding the accessibility of transit stations, Hongkong is one of the citis with the highest number of public transit users. The most plausible explanation of this statement is that Hongkong is

not only well known to have the most comprehensive transit network, but also has a well developed system feeder of the transit system (Shyr et al. 2013).

Table 5.2. The reason for choosing private car and public transit for commuting

The reason to take a private car for commuting	All respondents (%)	**Gender (%)**		**Income (%)**	
		Female	Male	≤ 3000	> 3000
Need to carry something	6.1	6.3	6.1	7.7	4.1
Comfortable	2.6	4.2	1.5	4.6	12.2
Private car is faster then public transit	18.4	12.5	22.7	23.1	59.2
Easy to access and flexibility	51.8	43.8	57.6	46.2	20.4
Safety	18.4	31.3	9.1	16.9	4.1
Car ownership	2.6	2.1	3.0	1.5	4.1
The reason to take public transit for commuting					
No need to park the car	2.6	1.1	6.4	1.6	14.3
Don't have driving license	7.1	8.9	2.6	7.3	4.8
Easy to access	35.1	36.8	30.8	33.2	57.1
Cheaper	44.0	41.1	51.3	46.2	19.0
Physical problem	0.7	0.5	1.3	0.4	4.8
No car ownership	10.4	11.6	7.7	11.3	0.0

Male and Females who use car also concerned about 'flexibility' and 'easy to access' (57.6%; 41.1%) as the reason they used private car for daily commuting. They concerned about safety (18.4%; 31.3%) in the second place. Regarding the safety concerned, Lynch and Atkins (1988); Walsh (1999) suggested that safety concerns are the reason why commuters do not use public transit. Lynch and Atkins in 1988 also stated that the unsafe feeling that female respondents feels is not only on public transit but also in accessing the

public transit station. That is why female respondents prefer to choose the other alternatives for travelling (Hamilton and Jenkins, 2000). This phenomenon must be a crucial concern taken into account by the land transport authorities in decision-making for supporting the crime prevention in the transit system and policy, as suggested in Hurwitz and Smithey in 1998, or more protection from crime for women than men as mentioned in Hamilton and Jenkins (2000); Reed et al. (2000); Wallace et al. (1999).

As presented in **Table 5.2.**, most respondents who earned incomes below 3000 MYR concerned on travel time, since the reason they choose private car due to they need the faster means of transportation for daily activities (59.2%) while the respondents who earned income more than 3000 MYR indicated that they prefer to use the car due to its'flexibility' and 'easy to access' (46.2%). Based on Multivariate test at the 0.05 level, there was no significant difference between female and male as the reason for choosing to use a private car, (F = 2.675, P-value = 0.105). Moreover, there is no significant difference between the income below 3000 MYR and more than 3000 MYR toward the reason for choosing a car, (F = 2.559, P-value = 0.113).

The reasons why people choose public transit for commuting are presented in **Table 5.2**. In the second place are accessibility as the reason why respondents choose public transit for commuting (35.1%). The majority of public transit users said that they preferred to choose public transit because public transit was cheaper than private car usage (44.0%). In their study, Hine and Scott (2000) revealed that costs had an actual or potential impact on the respondents use of public transport. Furthermore, based on **Table 5.2**, it can be seen that both females and males respondents were mostly concerned about cheaper public transit cost expenditure as the reason why public transit was chosen for their daily activity. There

is also a significant influence in gender on the reason for choosing public transit at the 0.05 level (F = 11.583, P-value = 0.001).

Likewise, the respondents also earned below 3000 MYR considered cost expenditure as the main reason while respondents who earned an income more than 3000 MYR stated that they choose public transit due to easy to access. Based on Multivariate test at the 0.05 level, there is a significant difference between respondents whom earned an income below 3000 MYR and more than 3000 MYR that influences the reason for choosing public transport, (F = 1.2340, P-value = 0.246).

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5.3. The satisfaction of the public transportation services

There is a set of questions formulated in the form aiming to explore the satisfaction of public transportation services. As shown in **Figure 5.5**, public transport user stated that travel time (23.9%) as the most recognized factor concerned regarding the public transportation services, followed by access to public transport station (20.9%), capacity (15.3%), safety concerned (10.4%), waiting time (9.0%), driver attitude (6.3%), and traffic congestion (4.9%). The rest of them stated that passenger attitude, public transportation and station condition and convenience as the factors concerned of the public transport services.

Moreover, the majority of car users mentioned that travel time (19.3%) and access to public transport station (17.5%) in the top rank as the factors concerned, followed by safety concerned (15.8%), drivers attitude (12.3%), convenience (11.4%), waiting time (8.8%), transit infrastructures condition (7.0%), capacity (4.4%) and passenger attitude (3.5%).

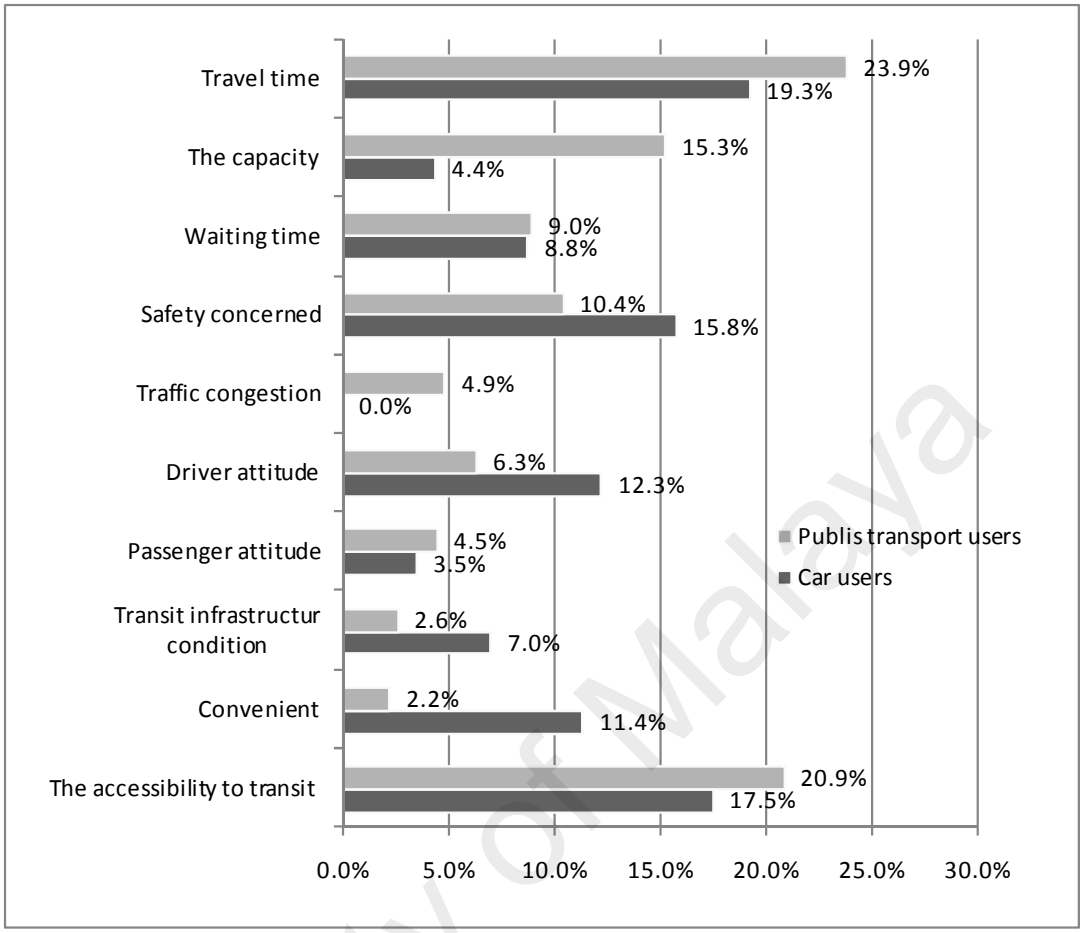


Figure 5.5. The public transportation satisfaction with regards to the public transport services

Based on ANOVAs single factor analysis, there is no significant difference between the acceptance distances for cycling as access mode for both genders (P-value < 0.05).

5.4. The willingness to take the public transport

In order to explore the willingness of car users to take a public transport and to identify necessary improvement for that purpose, relevant questions were formulated in the questionnaire form.

The results reported in **Table 5.3**, 48.2 % of car users are willing to take public transport. Most female car users stated that they are not willing to take public transport (60.4%) while most male car users are willing to take public transport (54.5%). Based on Multivariate test at the 0.05 level, there is a significant influence of gender towards the willingness to take the public transport, (F = 52.124, P-value = 0.000). Based on income level, both income level groups below ≤3000 MYR and more than >3000 MYR, most of them are not willing to take the public transport (46.9%; 49.2%). Based on Multivariate test at the 0.05 level, there is a significant influence of income level towards the willingness to take the public transport, (F = 5.181, P-value = 0.023).

Table 5.3. Willingness to take a public transport

The willingness to take public transport	**Yes (%)**	**No (%)**
All respondents	48.2	51.8
Gender		
Female	39.6	60.4
Male	54.5	45.5
Income level		
≤RM 3000	46.9	53.1
> RM 3000	49.2	50.8

From **Table 5.4**, about 29.1 % of respondent agreed that they are willing to take a public transport if its travel time is shorter than the existing condition. The others stated that they are willing to take a public transport if there are improvements of accessibility to public transit stop (25.5%), 18.2% of car users want cheaper fare, improvement on safety issues (14.5%) and concerned on the convenient (9.1%). The rest of them demanded improvements of the system (3.6%). This result is quite similar with Kingham et al. (2001),

they suggested that the changes that would switch from private car to public transport were frequency, reliability, convenient drop off sites, better connections and discount tickets.

Most female respondents concerned about the refinement of safety in encouraging their willingness to take public transport (31.6%). The accessibility to public transit stop (26.3%) is in the second place, followed by the travel time (21.1%), cheaper fare (15.8%) and good system (5.3%). While most male car users concerned about travel time (33.3%), followed by accessibility (25.0%), fare (19.4%), comfort (13.9%), safety (5.6%) and good system (2.8%) to be improved in encouraging their willingness to use public transport.

Table 5.4. The improvement of public transport services

The improvement of public transport service	All respondents (%)	Female (%)	Male (%)	≤ RM 3000 (%)	> RM 3000 (%)
Travel time	29.1	21.1	33.3	26.1	31.3
The accessibility	25.5	26.3	25.0	30.4	18.8
Safety	14.5	31.6	5.6	21.7	9.4
Good system	3.6	5.3	2.8	0.0	6.2
Fare	18.2	15.8	19.4	17.4	21.9
Convenient	9.1	0.0	13.9	4.3	12.5

A Multivariate test was conducted to influence of the females and males toward the improvement of public transport service, while at the 0.05 level significance, the different is not significant (F = 2.2722, P-value = 0.053).

As can be seen in **Table 5.4**, most the income level group ≤ 3000 MYR stated that improvement in accessibility (30.4%) as their considerations to be willing to take public transport. While for the income level group which is more than 3000 MYR, the travel time must be shorter (31.3%). At the 0.05 level significance, there is no significant influence of

income level toward the improvement of public transport service (F = 1.567, P-value = 0.176).

5.5. The accessibility to transit facility

In transport systems, accessibility is an essential element. In 2000, Rietveld stated that accessibility can be one of the reasons in determining rail transit as the alternative mode. Krygsman et al. (2004) suggested that poor accessibility can be one of the reasons why commuters do not use public transport. Wardman and Tyler (2000); Givoni and Rietveld (2007) revealed high elasticity of demand for rail transport with respect to the distance from the station. In addition, improving accessibility to transit station would increase transit users.

Table 5.5 shows that most males walked to public transport facility (51.3%). In **Table 5.5** also can be seen that the high dependence on the private car usage for females, most of whom use car for traveling from home to a public transport facility (40.05). Based on a Multivariate test, at 0.05 level significance, there is a significant influence of respondent's gender toward the transportation used from residence to the public transport terminal, (F = 5.098, P-value = 0.007).

Moreover as presented in **Table 5.5**, it can be seen that most respondents walked from their residence to public transport facilities. The percentage of students who used car is less than other occupation while most employees and housewife used car (38.1%; 711.4%). At 0.05 level significance, there is no significant influence of respondents occupation toward the transportation used from residence to public transport terminal, (F = 0.077, P-value = 0.926).

Table 5.5. Mode preference in accessing the public transit facilities

Socio-demographic data	Car (%)	Motorcycle(%)	Walking(%)
Gender			
Female	40.0	24.7	35.3
Male	20.5	28.2	51.3
Occupation			
Employee	38.1	26.5	35.4
Student	54.3	26.1	19.6
housewife	77.8	11.1	11.1
Unemployed	33.3	66.7	0.0
Age			
< 18 years old	25.0	6.2	68.8
18-40 years old	34.3	27.0	38.7
> 40 years old	37.5	27.1	35.4
Income level			
< 1000 MYR	14.1	12.5	73.4
1000-3000 MYR	38.3	32.2	29.5
> 3000 MYR	61.9	9.5	28.6

As can be seen in **Table 5.5**, the result implied that there are consistent pattern occurred between the respondent's ages toward the transportation usage from their resident to the public transport facilities. As the age increased, motorcycle used and pedestrian increased, while car usage decreased. Most respondents aged less than 18 years old and between 18-40 years old walked while most respondents aged more than 40 years old used car. At 0.05

level significance, there is no significant influence of respondents age toward the transportation used from residence to public transport terminal, (F = 0.226, P-value = 0.798).

The results also imply that there is a consistent pattern occurred between the respondent's level incomes toward the car usage and walking from the respondent resident to the public transport facilities. As the income level increasea, car usage increases, walking decreases. The highest percentage of motorcycle usage is the respondents earned income between RM 1000 - 3000 (32.2%). Likewise, the highest percentage of the respondents who walk is the respondents earned income less than RM 1000 (73.4 %). At 0.05 level significance, there is a significant influence of respondents income level toward the transportation used from residence to the public transit station (F = 14.149, P-value = 0.00).

Regarding the "accessibility to transit facility", **Table 3** presents the trip distances from the respondent's residence to the nearest transit facility. In this table, the data of bus users indicated that, the highest range of trip distance is 500 – 700 meters (32.8%), followed by between 750 m – 1 km (26.5%), 250 – 500 meter (25.0%), within 250 meters (8.6%) and more than 1 km (7.1%). In this research, the nearest transit facility for car users was additionally explored. This refers to the result in **Table 3** where the majority of them live in the distance more than 500 meters from the transit facility, 750-1000 meters (29.8%), more than 1 km (23.7%) and 500 – 700 meters (18.4%).

In this study, commuters prefer to walk to public transit station and stops. A total of 39.0% walked to access public transit, 35.2 % preferred to use cars and 25.8 % used motorcycles. This resulted in quite different outcome from the study by Givoni and Rietveld (2007) in Netherland, where it was revealed that the mode share in accessing public transit in

Netherland is cycling (38.3%), public transport (26.7%), walking (20.1%) and car usage (13.8%).

Table 5.6. The distance from residence to the nearest public transit terminal

The distance from residence to the public transit terminal	Public transit users (%)	Car users (%)
< 250m	8.6	11.4
250 - 500 m	25.0	16.7
500 - 750 m	32.8	18.4
750 m - 1km	26.5	29.8
> 1 km	7.1	23.7

Figure 5.6 shows the mode share from the residence to public transit facilities based on access distance. As shown in **Figure 5.6,** there were three types of access mode, namely cars, motorcycles and walking. The consistent pattern occurred among the transportation used towards the access distance. Walking would decrease once access distance increased. While motorcycle and car usage would increase once access distance increased. Overall, based on Multivariate test, there is a significant influence of access distance toward the transportation mode used from residence to the public transit terminal at the 0.05 level ($F = 101.740$, P-value = 0.000).

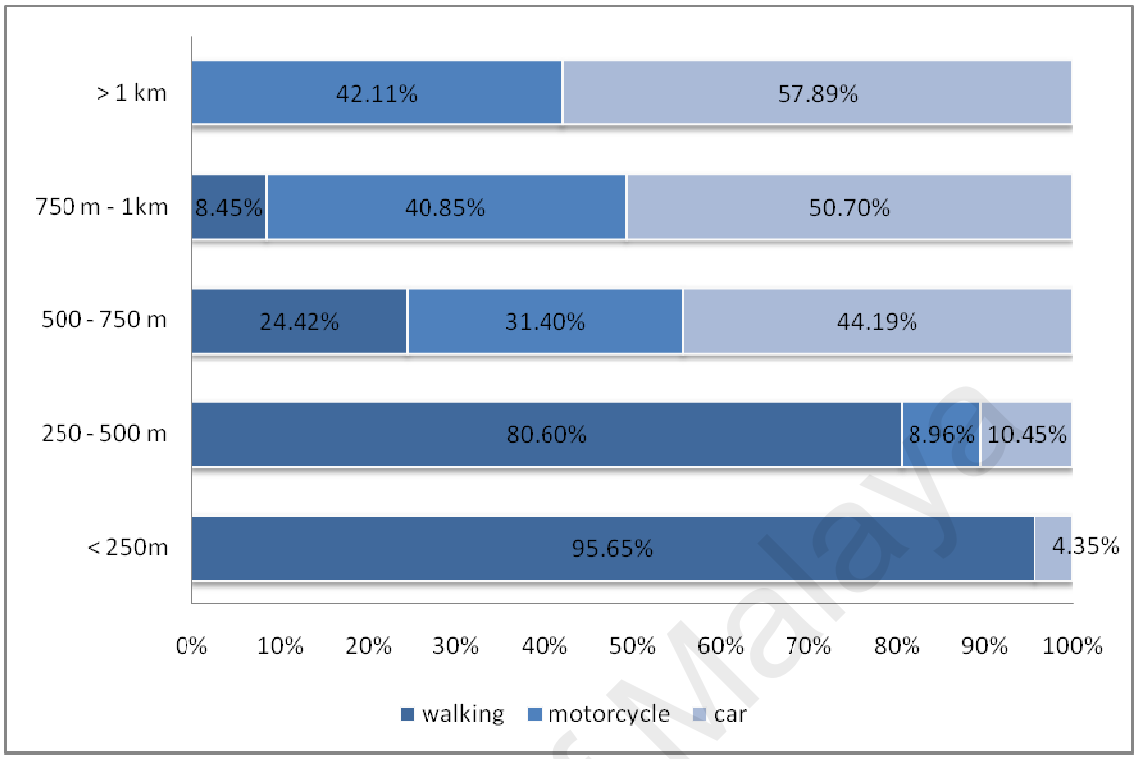


Figure 5.6. Transportation mode used from home to public transport facilities based on access distance

The results indicated that the acceptable distance for walking to public transit stations and stops is within 500 meters. As the findings, most respondents are willing to walk if the access distance is within 500 meters; 95.65 % if the distance is less than 250 meters and 80.60 % if the distance is between 250 - 500 meters. At the 0.05 level of significance, there is no significant difference of the percentage for walking in respondents who lived within 250 meters and between 250-500 meters from the public transit terminal, (Z value = 1.719, P value = 0.093), while there is a significant difference of percentage of walking to the public transit terminal for respondent lived within 500 meters and more than 500 meters, (Z value = 10.947, P value = 0.093).

For the distance more than 500 meters, it can be disputed that social economic status (SES) influence the commuter for taking the choice to walk to the public transit facility due to fact that the income earned was less than 1000 MYR (85.7% and 88.5%). Moreover 85.7% of

them were captive users of public transit. Based on Multivariate test at the 0.05 level, the influence of SES is significant (F = 9.766, P-value = 0.000).

5.6. The satisfaction about the existing transit accessibility

As the discussion before, transportation mode usage from respondent's residence to public transport facility are motorcycle, car and walking. In this research the respondents were asked regarding the satisfaction regarding the existing transit accessibility. The result is summarized in **Table 5.7**.

As can be seen in **Table 5.7**, most car users and motorcycle users are not satisfied (79.3%; 58.3%). Most of them stated they are not satisfied due to they need q cheaper access mode (49.3%; 52.5%). Furthermore 47.7% of public transit users whom walk in accessing public transit facilities suggested “not satisfied” and all of them stated that they are not satisfied due to they need a faster access mode. Based on Multivariate test at the 0.05 level of significance, there is a significant influence of access mode type in accessing public transit facility corresponding to the satisfaction about the existing transit accessibility and the reason why they are not satisfied, (F = 22.217, P-value = 0.000) and (F = 278.697, P-value = 0.000).

Table 5.7. The satisfaction about the existing transit accessibility

The satisfaction	Car (%)	Motorcycle (%)	Walking (%)
Not satisfied	79.3	58.0	47.7
Satisfied	20.7	42.0	52.7
The reason commuters need the alternative access mode			
Need faster access mode	6.8	5.0	100.0
Need cheaper access mode	49.3	52.5	-
Do not want to be dependent on anyone	26.0	27.5	-
Limited park and ride area	17.8	15.0	-

This study also explored the respondents who are not satisfied regarding the accessibility to public transit facility based on access distance and the reason why they are not satisfied for the respondents who reside in the distance more than 500 meters. The results are summarized in **Table 5.8** and **Table 5.9.**

Table 5.8. The respondents who are not satisfied regarding the accessibility based on access distance

The access distance	Car (%)	Motorcycle (%)	Walking (%)
Less than 250 meter	-	-	-
250 - 500 meter	5.5	7.5	**47.1**
500 - 750 meter	39.7	32.5	41.2
750 - 1000 meter	43.8	47.5	11.7
More than 1000 meter	11.0	12.5	-

It can be seen **in Table 5.8,** a total of 52.9% the public transit users whom walk and reside outside the acceptable distance are not satisfied with the accessibility. All of them are not satisfied due to the need the faster access mode (**Table 5.9)**

A total of 91.6% and 91.3% of car users and motorcycle users reside more than 500 meters from public transit facility. As can be seen in **Table 5.8**, 94.5 % of car users and 92.5 % of motorcycle users are not satisfied regarding the accessibility. **Table 5.**9 shows that most of them are not satisfied due to the cost expenditure in accessing the public transit facility. A total of 50.7% of car users and 56.8% of motorcycle users mentioned that reason.

Table 5.9. The reason why the public transits users are not satisfied with the existing transit accessibility for the distance more than 500 meters

The reason	Car (%)	Motorcycle (%)	Walking (%)
Need faster access mode	7.2	-	100.0
Need cheaper access mode	50.7	56.8	-
Don't want dependent on anyone	26.1	27.0	-
Park and ride area limited	15.9	16.2	-

Thus, it should be a concern for the local transport authority. For car and motorcycle users, there were no choices for them in accessing public transit system. They preferred to use private vehicles since there are no alternative mode choices and the distance is too far for walking. For the public transit users who walk in accessing public transit facility, the similar situation also occurs; there are no alternative mode choices, they preferred to walk even the distance is too far. Furthermore, as mentioned before, most of them are captive users and from the low income group.

In order to improve the accessibility, a cheaper and faster alternative mode must be provided in accessing public transit. Transit-oriented Development (TOD) can be approached to solve the problem. As mentioned above, Transit-oriented Development (TOD) planning techniques that aims to reduce automobile use and promote the use of public transit and human-powered transportation modes through high density, mixed use, environmentally-friendly development should be within areas of walking distance from transit centers. Moreover Lachapelle and Noland (2012) revealed that improving the accessibility to transit station has the potential to encourage commuters to walk. A policy to reduce motorized vehicles used to access transit facility through environmentally efficient and socially acceptable access modes to transit system promotion (Rastogi and Rao, 2003).

5.7. The willingness to cycle as the alternative mode to public transport facility

Nonmotorized transports such as walking and cycling and car pooling are included as sustainable transport. In line with Rietveld and Daniel (2004). In their research, it was stated that due to lower emissions of pollutants, noise pollution and lower energy consumption, nonmotorized transportation modes are often considered as the important elements of sustainable transport. A high share of nonmotorized transportation modes would certainly contribute to the more attractive urban environment.

In recent years, the urban transport planners have focused their attention on policies for promoting bicycles use as alternatives to intensive car use (Palomares et al. 2012). One of the systems used to promote bicycle used is bike-and-ride, or the combination of bicycle used and public transit in one trip travelling. This is an alternative of multimodal options to replace the car use. The different forms can be taken as a combination: bicycle as the path

of the system can be used in access trips (at the home-end of a trip), or egress trips (at the activity-end of a trip), or the combination.

As mentioned in the Martens research (2004), compared to the car, bike-and-ride system is more environmentally friendly, lower noise and air pollution and lower energy use and offer social benefits. Moreover, bike-and-ride may improve the overall competitiveness of public transport, cycling and walking as 'green' transportation modes compared to the private car (Martens, 2007).

Regarding overall travel times, private car is faster than public transport, even compared to the type of public transit which has faster speed, like the train (Rietveld, 2000). Martens (2007) stated that the use of bike-and-ride can accomplish one of the public transit weaknesses; the accessibility of the public transit stops. Furthermore the bicycle is also faster than walking and more flexible than public transport. In addition, as the environmental benefits, the switching of the car trips by bike and ride system could reduce congestion in specific road corridors or on the access roads to the public transit station/terminals. This system can limit the need of park and ride in locations adjacent to public transit stations/terminals. Martens (2004) stated that climate and weather condition have a significant influence on cycling and it may be expected that they also influence the bike-and-ride level. Nankervis (1999); Bergstrom and Magnusson (2003) and Bickelbacher (2004) suggested the act of decreasing bike and ride used in bad weather.

The bike-and-ride facilities in the public transit station were recognized as influence on the users. In Netherland cycling to Train station is higher than the cycling to bus, tram and metro stops due to it being fairly well-equipped of cycling facilities. While as result of Wardman et al (2006), the improvement of bike parking facilities caused the small shifting

from car to cycling. Fukuda and Morichi (2006) stated that the improvement of the parking area for cyclist have impacts on the increasing of public transit passenger, especially in station area within 4 km.

As shown in **Table 5.10**, most respondent mentioned that they do not want to cycle if the cycling facilities from their residence to public transit facilities are available (72.8%). Males were more likely to consider for cycling than females. Based on Multivariate test, there is no significant influence of respondent's gender toward the willingness to cycle as the alternative mode to public transit facility at the 0.05 level, (F = 0.279, P-value = 0.598).

As can be seen in **Table 5.10**, the highest potential of cycling in accessing public transport facilities is students. A total of 59.8% students are willing to cycle if the facilities are available. Most of the employees, housewife and unemployed would not like to cycle if cycling facilities are available. Based on Multivariate test at the 0.05 level, there is significant influence of respondent's occupation towards the willingness to cycle as the alternative mode to public transit facility, (F = 18.973, P-value = 0.000).

As described in **Table 5.10**, there is a consistent pattern between age and the willingness to cycle to public transit station. As the age factor increased, the willingness to cycle decreased. An interesting result is that most respondents aged less than 18 years old would like to cycle (87.5%). Based on Multivariate test at the 0.05 level, there is a significant influence of respondents age toward the willingness to cycle as the alternative mode to public transit facility at the 0.05 level, (F = 40.374, P-value = 0.000).

Table 5.10. The willingness to cycle in accessing transit

Socio-demographic data	Yes (%)	No (%)
All commuters	27.2	72.8
Female	26.3	73.7
Male	29.5	70.5
Captive users	37.7	62.3
Choice users	18.5	81.5
Employee	11.0	89.0
Student	59.8	40.2
Housewife	-	100
Unemployed	33.3	66.7
< 18 years old	87.5	12.5
18-40 years old	27.9	72.1
> 40 years old	4.2	95.8
< 1000 MYR	50.8	49.2
1000-3000 MYR	20.9	79.1
> 3000 MYR	22.7	77.3

Table 5.10 shows the willingness to cycle to public transit station based on income level. The majority of respondents who cycle to public transit station are the respondents who earned income less than 1000 MYR, while the respondents who earned income between 1000 – 987 MYR and more than 987 MYR would not like to cycle to public transit station Overall at the 0.05 level, there is significant influence of respondents' income level towards the willingness to cycle to public transit station, (F = 13.435, P-value = 0.002).

To explore the relationship of the willingness to cycle in accessing public transit towards the socio demography characteristic, car ownership, access distance, access mode and the obstacle for cycling, a mathematic model was developed. The structure of the model is shown in **Figure 5.7**.

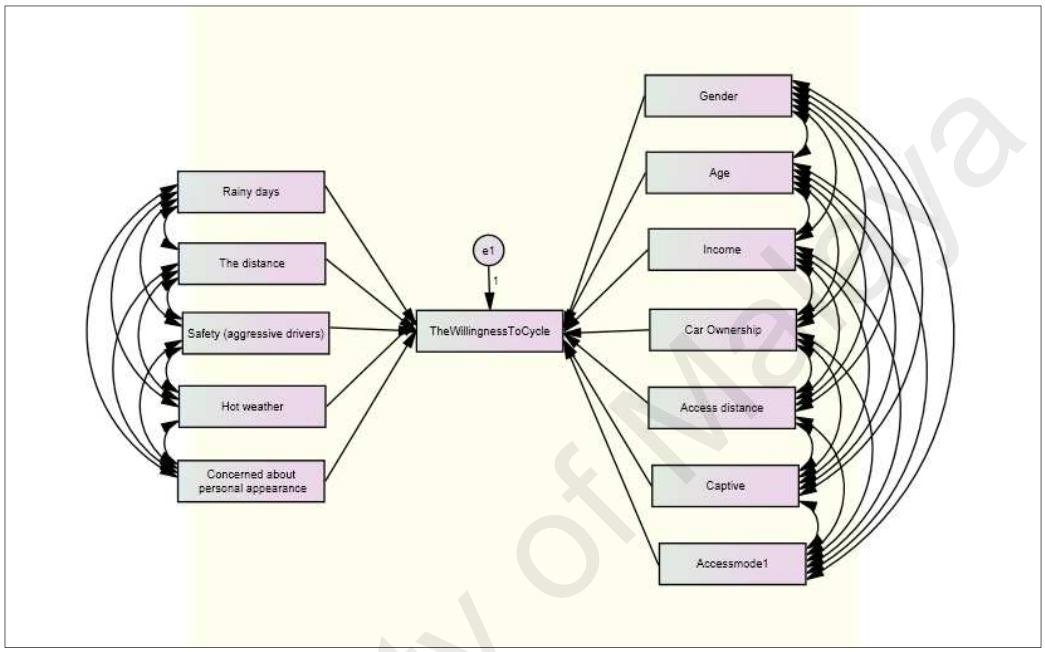


Figure 5.7. The structure of the willingness to cycle model

The model is presented in **Table 5.11.** As shown in **Table 5.11,** the coefficient gender and captive choice are negative. The result implied that males and captive users are willing to cycle more than females and choice users. The age, income level and car ownership are negative, and it is implied that as the respondents' age, income level and car ownership increased, the willingness to cycle decreased.

Table 5.11. The willingness to cycle in accessing public transit model

			Estimate	S.E.	C.R.	P
TheWillingnessToCycle	<---	Gender	.171	.053	3.201	.001
TheWillingnessToCycle	<---	Age	-.286	.061	-4.679	.000
TheWillingnessToCycle	<---	Income level	-.093	.050	-1.884	.060
TheWillingnessToCycle	<---	Car ownership	-.098	.043	-2.305	.021
TheWillingnessToCycle	<---	Captive user	.117	.049	2.377	.017
TheWillingnessToCycle	<---	Access mode	.031	.070	.450	.653
TheWillingnessToCycle	<---	AccessDistance	.025	.032	.774	.439
TheWillingnessToCycle	<---	Hot Weather	.066	.030	2.170	.030
TheWillingnessToCycle	<---	Personal appearance	.035	.037	.957	.339
TheWillingnessToCycle	<---	Raini days	.193	.048	3.977	.000
TheWillingnessToCycle	<---	The distance	.095	.050	1.899	.058
TheWillingnessToCycle	<---	Safety concerned	.089	.040	2.219	.026

Table 5.11 also shows that respondents are most concerned about the rainy days (0.193) as the obstacle for cycling, followed by, the distance (0.095), safety (0.089), hot Weather (0.066) and personal appearance (0.035).

5.8. The reason why respondent are not willing to cycle in accessing transit

As shown in **Table 4.12**, the majority of respondents suggested that, they would not cycle to public transit stations due to safety concerns (58.5%), followed by individual personal appearance concerns (28.4%), they do not how to ride (8.0%) and health or physical problem (5.1%). For both males and females, they also concern about safety as the reason why they do not cycle to public transit facility (58.0%; 58.7%). Based on Multivariate test at the 0.05 level, there is no. significant influence of respondent's gender toward the reason for not cycling to the public transit station, (F = 0.916, P-value = 0.434).

As can be seen in **Table 4.12,** based on respondent's age**,** the reasons why they do not cycle to public transit stations are also due to the safety concerned. Based on Multivariate test at

the 0.05 level of significance, there is a significant influence of respondents age towards the reason for not cycling to public transit station, (F = 9.751, P-value = 0.002).

Table 5.12. The reason why the respondents are not willing to cycle in accessing transit

Socio-demographic data	Health and physical problem (%)	Personal appearance concerned (%)	Safety concerned (%)	No experience with cycling (%)
All commuters	5.1	28.4	58.5	8.0
Female	6.3	28.6	58.7	6.3
Male	2.0	28.0	58.0	12.0
< 18 years old	-	50.0	50.0	-
18-40 years old	3.0	28.0	60.6	8.3
> 40 years old	11.9	28.6	52.4	7.1
< 1000 MYR	3.7	11.1	74.1	11.1
1000-3000 MYR	3.8	33.8	56.4	6.0
> 3000 MYR	18.8	12.5	50.0	18.8

Table 5.12 shows the reason why respondent do not cycle to public transit station based on income level. For both income level groups, they do not cycle to public transit stations due to safety concerns (68.6%; 62.3%; 70.0%). At 0.05 level of significance, there is a significant influence of respondents age towards the reason for not ~~to~~ cycling to public transit station, (F = 3.703, P-value = 0.006).

5.9. Willingness to cycle related to distance

The study identified 2.5 km as the farthest acceptable distance for cycling in accessing public transit. The average distance is 700 meters and the standard deviation is 280.8. Male

are willing to cycle farther than female, and the distance is 901.3 meters for male (standard deviation = 371.8) compared to 664.8 meters for female (standard deviation = 482.1). Based on ANOVAs single factor analysis, there is a significant difference between the acceptance distances for cycling as access mode for both genders (P-value > 0.05). This result is very low compared to the cycling distance in other countries such as in Netherland which is within 4 km, Fukuda and Morichi (2006); 3,300 m in Jakarta, Indonesia, Soegijoko and Horthy (1991); 6,000 m in Ningbo, China, Lin et al (1993); 5,100 m in Delhi, India, Gupta (1986); 5,200 meters in Tiruchirapalli, India, Arasan et al (1994); 2,724 m in Mumbai, India, Rastogi and Rao (2003).

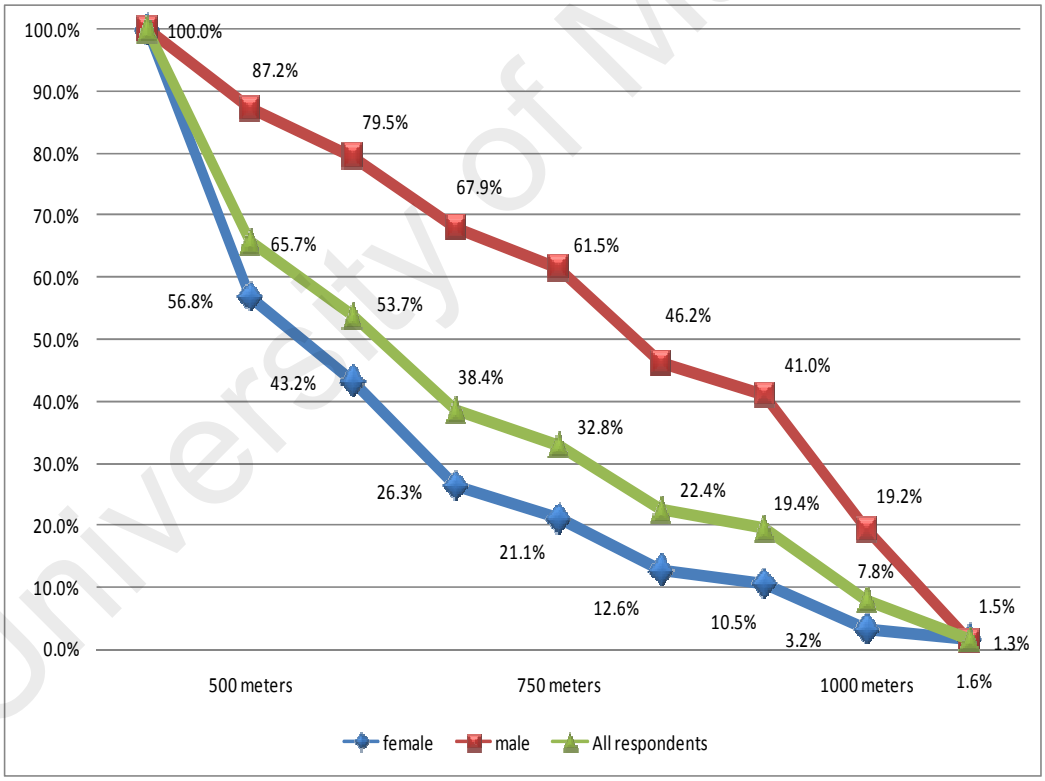


Figure 5.8. Willingness to cycle in relation to distance

Figure 5.8 shows the cumulative of the acceptable distance based on gender. As can be seen in the figure, female distance decrease is higher than male's.

5.10. The cycling facilities for cycling in accessing public transport facility

Tilahun et al (2007) mentioned there are five types of cycling facilities, namely: Off-road path; bike facilities in traffic with bike-lane and no street parking; bike facilities in traffic with a bike-lane and on-street parking; bike facilities in traffic with no bike-lane and no on-street parking, and bike facilities in traffic with no bike-lane but with on-street parking.

Table 5.13. Cycling facilities suggested

Socio-demographic data	The bike lane on the existing road (%)	The exclusive bike path (%)
All commuters	37.3	62.7
Female	26.3	73.7
Male	61.5	38.5
< 18 years old	18.8	81.2
18-40 years old	41.2	58.8
> 40 years old	27.1	72.9
< 1000 MYR	42.4	57.6
1000-3000 MYR	39.0	61.0
> 3000 MYR	-	100

The adequate of bicycle facilities, the type of the facility and the quality of the facility have significant influence on the cyclist's number. Dill and Carr (2003), Nelson and Allen (1997) have shown that percentage of cycling for commuting purpose significantly affected by how adequate cycling facilities were provided. Beside that, cycling facility must be well connected between the origin points of departure to destination in order to encourage cycling as an alternative mode for commuting. In Gatersleben and Appleton (2007), they

argued that the non cyclist had already realized the benefits of cycling. They were not willing to cycle due to lack of adequate lane for cycling.

Table 5.13 shows the cycling facility suggested. As presented in that table, most respondents' concerns are about the safety along the route from their residence to public transit facility, therefore they suggest the exclusive bike path (67.1%).

The interesting result is males prefer to choose the bike lane on the existing road (61.5%), while females prefer to suggest the exclusive bike path (72.6%). The significant difference occurs between female and male regarding the cycling facility suggested from the residence to the public transit station at the 0.05 level, (F = 32.998, P-value = 0.000).

In order to explore the correlation of the cycling facility suggested towards gender, level of income, age, the safety concerned as obstacles for cycling, the acceptable distance and means of transportation used, a regression model was designed. The structure of the model was shown in **Figure 5.9**.

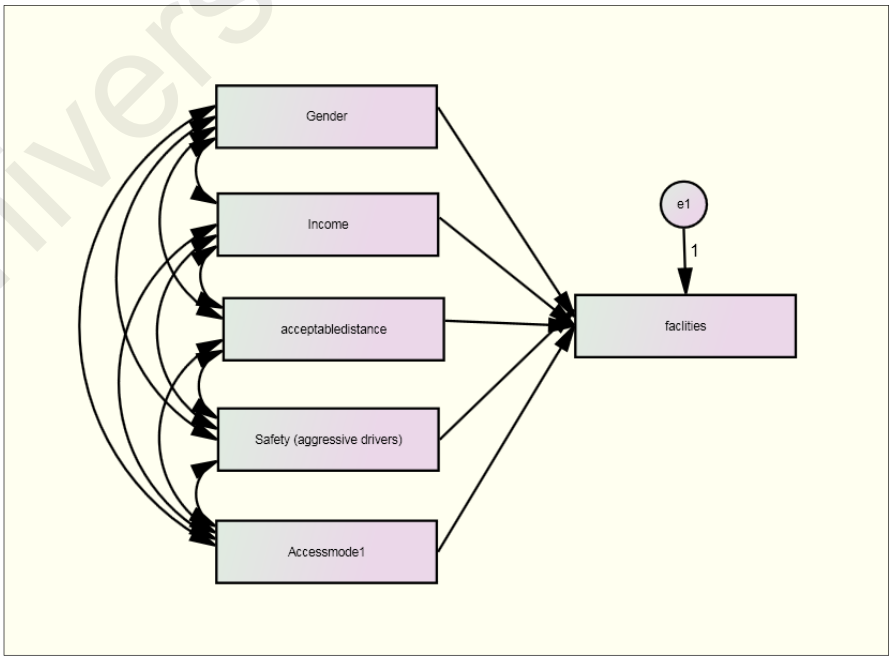


Figure 5.9 Structural equation of facility suggested

As presented in **Table 5.14**, coefficients for gender and income level significantly influenced the cycling facility suggested (P-value = 0.000). Moreover, concerns about safety and acceptable cycling trips distance have significant influences toward the cycling facility suggested (P-value = 0.04; P –value = .00).

Table 5.14. Cycling facilities suggested model

			Estimate	S.E.	C.R.	P
Facilities	<---	Safety	.078	.038	2.058	.040
Facilities	<---	Access mode	.045	.047	.961	.337
Facilities	<---	Gender	-.552	.050	-11.025	.000
Facilities	<---	Income level	.155	.043	3.588	.000
Facilities	<---	Acceptable distance	.005	.000	4.178	.000

Coefficient gender was negative and the result implied that if the respondent gender is female, the cycling facility suggested is the exclusive bike path. Income level is also positive, as income level increase, the cycling facility suggested is the exclusive bike path. The safety concerned and acceptable distance for cycling was positive, as the safety level of importance and acceptable distance for cycling increase, the cycling facility suggested is the exclusive bike path.

7.2. The summary

Regarding the means of transportation usage for commuting, beside travel cost, public transport users considered the accessibility as the reason why they choose the public transport. The improvement of accessibility to public transit facilities must be concerned due to most of car user concerned on the accessibility as the reason why they choose private car. They suggested that they prefer to use private car because private car is easy to access

and flexible. Moreover, besides concerning about travel time, they are willing to take public transport if there were improvements of the public transport accessibility. Wardman and Tyler (2000); Givoni and Rietveld (2007) revealed that high elasticity of demand for rail transport with respect to the distance from the station. In addition, improving accessibility to transit station would increase transit users.

In transport systems, accessibility is an essential element. Rietveld (2000) stated that accessibility can be one of the reasons in determining rail transit as the alternative mode. Krygsman et al (2004) suggested that poor accessibility can be the reason why commuters will not use public transport. Regarding the "accessibility to transit facility", commuters prefer to use private vehicle (35.2 % preferred to use cars and 25.8% used motorcycles) to public transit station and stops, a total of 39.0% of them walked to access public transit. This resulted in quite a different outcome with the study by Givoni and Rietveld (2007) in Netherland, where it was revealed that most of commuters used bicycle in accessing public transit. The consistent pattern occurs among the transportation usage towards the access distance. Walking would decrease once access distance increased. While motorcycle and car usage would increase once access distance increased

Regarding the access distance, the results indicated that the acceptable distance for walking to public transit stations and stops is within 500 meters due to most respondents who walk to public transit facilities reside within 500 meters. As the findings, most respondents are willing to walk if the access distance is within 500 meters; 95.65 % if the distance is less than 250 meters and 80.60 % if the distance is between 250 - 500 meters.

Regarding the satisfaction about the existing transit accessibility, most car users and motorcycle users are not satisfied. Most of them are not satisfied due to the cost

expenditure in accessing the public transit facility. Furthermore, a total of 47.7% of public transit users who walk in accessing public transit facilities suggested “not satisfied” and all of them stated that they are not satisfied due to they need the faster access mode.

In recent years, the urban transport planners have focused their attention on policies for promoting bicycles usage as alternatives to intensive car use (Palomares et al. 2012). One of the systems used to promote bicycle used is bike-and-ride, or the combination of bicycle used and public transit in one trip travelling. This is an alternative of multimodal options to replace the car usage. The different forms can be taken as a combination: bicycle as the path of the system can be used in access trips (at the home-end of a trip), or egress trips (at the activity-end of a trip), or the combination. In this study, most respondent mentioned that they do not want to cycle if the cycling facilities from their residence to public transit facilities are available. Males were more likely to consider for cycling than females, meanwhile the highest potential of cycling in accessing public transport facilities is students. Most of the employees, housewife and unemployed would not like to cycle if cycling facilities are not available. There is a consistent pattern between age and the willingness to cycle to public transit station. As the age factor increases, the willingness to cycle decreases. The interesting result is that most respondents aged less than 18 years old would like to cycle (87.5%).

The majority of respondents suggested that, they would not want to cycle to public transit stations due to safety concerns, followed by individual personal appearance concerns; they do not know how to ride and health or physical problem (5.1%). Both males and females also concern about safety as the reason why they do not cycle to public transit facility.

The study identified 2.5 km as the farthest acceptable distance for cycling in accessing public transit. The average distance is 700 meters and standard deviation is 280.8. Male are willing to cycle farther than female, and the distance is 901.3 meters for male (standard deviation = 371.8) compared to 664.8 meters for female (standard deviation = 482.1). This result is very low compared to the cycling distance in other countries such as in Netherland which is within 4 km, Fukuda and Morichi, 2006; 3,300 m in Jakarta, Indonesia, Soegijoko and Horthy in 1991; 6,000 m in Ningbo, China, Lin et al. In 1993; 5,100 m in Delhi, India, Gupta (1986); 5,200 meters in Tiruchirapalli, India, Arasan et al. (1994); 2,724 m in Mumbai, India, Rastogi and Rao (2003).

Regarding the cycling facility suggested, most respondents concerns are about safety along the route from their residence to public transit facility, so they suggest the exclusive bike path. The interesting result is that males more concern about travel time due to most of them prefer to choose the bike lane on the existing road.

The structure of the model shows that coefficient gender was negative; and the result implied that if the respondent gender is female, the cycling facility suggested is the exclusive bike path. Income level is positive, and it implied that, as income level increase, the cycling facility suggested is the exclusive bike path. The safety concerned and acceptable distance for cycling were positive, as the safety level of importance and acceptable distance for cycling increase, the cycling facility suggested is the exclusive bike path.

This study was also analyzed the correlation among the parameters that were investigated corresponding to gender and income level, and the result were presented in Table below:

Table 5.15. The correlation of the gender, age and income level toward the parameter that investigated (the potential for cycling in accessing public transit facilities)

Parameters	Correlation		
	Gender	Age	Invome Level
Mode preference for commuting	**Significant**	**Significant** There is no consistent pattern	**Significant** The percentage of respondents earned an income more than 3000 MYR and uses car are higher than the respondents whom earned an income below 3000 MYR
The willingness to take the public transport	**Significant** Most female car users stated that they are not willing to take public transport, while most male car users are willing to take public transport	-	**Significant** Both income level groups below ≤ 3000 MYR and more than > 3000 MYR, most of them are not willing to take the public transport
The transportation usage from residence to the public transit station	**Not significant** The high dependence on the private car usage for females, most of them use car for traveling from home to a public transport facility	**Not significant**	**Significant** As the income level increase, car used increase, walking decreases.
Access mode for the distance more than 500 meters	-	-	**Significant** Social economic status (SES) influence the commuter for taking the choice to walk to the public transit facility due to fact that the income earned was less than 1000 MYR
The willingness to cycle to public transit station	**Not significant** Males were more likely to consider for cycling than females	**Significant** (There were consistent pattern) As the age factor increases, the willingness to cycle decreases.	**Significant** The majority of the income level < 1000 MYR would like to cycle to public transit station, while the respondents whom earned income > 1000 MYR would not like to cycle to public transit station.
The reason why respondent do not cycle to public transit station	**Not significant** The reasons why they do not cycle to public transit stations are also due to the safety concerned.	**Significant** The reasons why they do not cycle to public transit stations are also due to the safety concerned.	**Significant** The reasons why they do not cycle to public transit stations are also due to the safety concerned.
The cycling facility suggested	**Significant** Most of males prefer to choose the bike lane on the existing road, while females prefer to suggest the exclusive bike path.	-	-

CHAPTER 6

THE PARENT PERCEPTION REGARDING THE POTENTIAL OF CYCLING AS A TRANSPORT MODE FOR GOING TO SCHOOL

In this part, the study focuses on the potential of cycling as a transport mode for going to school within Taman Medan areas based on parent's perception. (The map of the study area can be seen in **Figure 5.1**)

The field surveys were undertaken. A set of questionnaires was prepared and distributed to respondents in this area. The surveys were conducted in seven months; September 2011–February 2012. Socio-demographic data of respondents are summarized in **Table 6.1**, two hundred and fifty five (n = 256) parents participated in this study. There were 61.3% males and 38.7% females.

Respondent's ages are placed in 4 groups. As presented in **Table 6.1**, the majority age of respondents is between 30 and 40 years old (43.8%), followed by 40-50 years old (29.7%), more than 50 years old (21.9%) and under 30 years old (4.5%). Moreover the majority of respondents are married (90.2%).

Regarding the occupation of respondents, There are five categories of respondent's occupation in this study, namely under the trading (23.0%), private (31.9%), housewife (7.0%), government employee (27.7%) and retired (3.1%). As shown in **Table 6.1**, the highest of income level is between RM 1000 and RM 3000 (44.9%), followed by RM 3000-RM 5000 (22.3%), less than RM 1000 (12.9%), and more than RM 5000 (19.9%).

As can be seen from **Table 6.1**, most of the respondents only have a car (55.9%) followed by two cars (22.3%), do not do not have car (16.0%) and more than 3 cars (2.0%)

Table 6.1. Socio-demographic data of respondents

Demographic characteristic	N	Percentages
Gender		
Mother	156	61.30
Father	99	38.70
Marriage status		
Married	248	97.30
Divorced	8	3.10
Occupation		
Government employee	71	27.70
Trading	59	23.00
Private	100	39.10
Housewife	18	7.00
Retired	8	3.10
Age		
< 30 years old	12	4.70
30 – 40 years old	112	43.80
40 – 50 years old	76	29.70
> 50 years old	56	21.90
Income		
< 1000 MYR	33	12.90
1000 – 3000 MYR	114	44.90
3000 – 5000 MYR	57	22.30
> 5000 MYR	51	19.90
Car ownership		
None	41	16.00
1	143	55.90
2	57	22.30
3	10	3.90
> 3	5	2.00

The number of children ownership is summarized in **Table 6.1.** Most of respondents have two until four children (52.9%), followed by five until six children (32.3%), more than six (8.4%) and one child (6.5%).

6.1. The importance of Physical activity

Doing physical activity regularly for children and youth is very important for their health (Buliung et al. 2009). According to Chriqui et al. (2012), ideally 60 minutes of physical activity should be spent every day.

Table 6.2. The importance of Physical activity

Socio demographic	Important (%)	Not important (%)
All respondents	60.5	39.5
Gender		
Mother	61.0	39.0
Father	61.7	38.3
Single parent	37.5	39.5
Income level		
< 1000	60.6	39.4
1000 - 3000	66.1	33.9
3000 - 5000	57.9	43.1
>5000	51.0	49.0
Daughter ownership		
Have daughter aged < 13 years old	61.5	38.5
Do not have daughter aged < 13 years old	57.8	42.2
Have daughter aged > 13 years old	63.6	36.4
Do not have daughter aged > 13 years old	58.6	41.4
SonSon ownership		
Have Sonson aged < 13 years old	60.1	39.9
Do not have Sonson aged < 13 years old	61.2	38.8
Have Sonson aged > 13 years old	63.0	37.0
Do not have Sonson aged > 13 years old	59.1	40.9

In this research, the parents were asked regarding the importance of physical activity for their children's health, and the results are summarized in **Table 6.2.** As shown in the table, most parents agree that the physical activity regularly is important for their children health (60.5%). Most fathers (61.7%) agree that the physical activity regularly is important for health, while 61.0% of mothers agree. Most single parents disagree that the physical activity is important for their children's health (62.5%). Overall, there is no significant influence of the respondent's marriage status towards the answer about the importance of physical activity for their children at the 0.05 level, (F = 0.00, P-value = 0.988.).

Table 6.2 also shows the correlation of parent's level income towards the answer about the importance physical activity for their children. Based on income level, most of respondents agree that the physical activity regularly is important for their children's health. There is no consistent pattern among the income level toward the importance of physical activity perception. The interesting result is if the physical activity perception of the respondents earned more than 1000 MYR; the consistent pattern occurs. The parents whom agree the importance physical activity for their children decrease as the increasing of respondent income level. Based on Multivariate test at the 0.05 level, there is no significant influence of respondent income level towards the parents answered about the importance of physical activity for their children, (F = 0.947, P-value = 0.451).

6.2. Parents' perception on safety inf neighbourhood surroundings

Parents are actually aware that cycling as a physical activity is essential for the health of their children, it consequently can be the beginning of realization of willingness to allow their children to cycle to school. Tudor-Locke et al. (2001); Cooper et al. (2003); Timperio et al. (2004); Boarnet et al. (2005); Timperio et al. (2006); Faulkner et al. (2009) and

Buliung et al. (2009) stated that for youth, cycling as one of the active mode of transport to school could increase physical activity for the children, however it must be supported with some convincing factors such as a friendly neighborhood to carry out activities outside the residence, a safe and friendly environment away from potential accidents and crime when cycling to school.

Timperio et al. (2006) and Bringolf-Isler et al. (2008) argued that physical neighborhood environment and social aspects are among aspects that could influence the children to commute to school by cycling and walking. It was also stated that the many children in the neighborhood environment would give higher opportunities for cycling and walking together with other children to school. Regarding the safety of neighborhoods surrounding for physical activities alone, the parental concerns are on road safety and 'stranger danger'; Both of which are major causes that becomes parent's concern to restrict their children's outdoor play and active transport (Carver et al. 2008).

In **Table 6.3, it** can be seen that, most parents slightly suggested that the neighbourhood surroundings was not safe for doing physical activities, only 48.4% of parents stated that their neighbourhood surrounding is safe for their children. In this study, there is a different viewpoint among fathers, mothers and single parents regarding their neighborhood surroundings' safety for physical activities. Most fathers stated that their neighbourhood environment is safe (60.2%), while the majority of mothers and single parents stated that their neighbourhood environment is not safe (58.0% and 56.0%). The percentage of fathers who answered safe, was higher than mother. Based on Multivariate test at the 0.05 level, there is a significant influence of the position of the family corresponding to the perception of neighbourhood surroundings safety, ($F = 8.244$, P-value = 0.004).

Table 6.3. The perception of neighbourhood environment safety

Socio demographic	Safe (%)	Not safe (%)
Gender		
Mother	42.0	58.0
Father	60.2	39.8
Single parent	44.0	56.0
Income		
< 1000	69.7	30.3
1000 - 3000	50.4	49.6
3000 - 5000	49.1	50.9
>5000	29.4	70.6
Daughter ownership		
Have daughter aged < 13 years old	44.8	55.2
Do not have daughter aged < 13 years oldDo not	59.4	40.6
Have daughter aged > 13 years old	27.3	72.7
Do not have daughter aged > 13 years oldDo not	61.8	38.2
Son ownershipSon		
Have son aged < 13 years oldSon	46.4	53.6
Do not have son aged < 13 years oldDo notSon	59.2	40.8
Have son aged > 13 years oldSon	44.6	55.4
Do not have son aged > 13 years oldDo notSon	50.6	49.4

Table 6.3 also presents the correlation among group of parent's level of income towards the perception of the neighbourhood surroundings safety for their children to do physical activity outside. There is a consistent pattern of the respondents' income level corresponding to the perception of the neighbourhood surroundings safety perception for

doing activities outside their home. The parents who stated that the neighbourhood environment is"safe" decreased as the income level increased. Based on Multivariate test at the 0.05 level, there is a significant influence of the position in the income level towards the perception of the neighbourhood environment safety, (F = 10.605, P-value = 0.002).

As can be seen in **Table 6.3,** the percentage of the parents with income less than 3000 MYR who stated the neighbourhood surroundings are "safe" are higher than the percentage of parents with income more than 3000 MYR. The difference is significant. Moreover, the percentage of parents that earned an income less than 3000 MYR stated that the neighbourhood surroundings are 'safe" are higher than "not safe". While the parents who earned an income more than 3000 MYR who stated the neighborhood surroundings is "safe" are lower than "not safe". Multivariate test was also conducted to explore the difference between the parent's income less than 3000 MYR against the income 3000 MYR above. The result is, at the 0.05 level of significant, the difference is significant (F = 5.640, P-value = 0.018).

Regarding the correlation between child ownership corresponding to the neighborhood environment safety perception, as can be seen in **Table 6.3**, the parents who have the daughter less than and more than 13 years old more concerned regarding the neighborhood safety than the parents whom do not have. Most of them suggested the neighborhood environment is not safe (55.2% and 72.7%), while most parents whom do not have the daughter less than and more than 13 years old stated that the neighborhood environment is safe (59.4% and 61.8%). Based on Multivariate test at the 0.05 level, the different is significant, (F = 32.389, P-value = 0.000) and (F = 4.121, P-value = 0.043). Similarly with son ownership, the parents who have the son less than and more than 13 years old, they suggested that the neighborhood environment is not safe (53.6% and 55.4%), while most

parents who do not have the son stated that the neighborhood environment is safe (59.2% and 50.8%).%). Based on Multivariate test at the 0.05 level, for the parents who have the son less than 13 years old the different is significant, (F = 4.083, P-value = 0.044), while for the parents who have the son more than 13 years old, the different is not significant (F = 0.858, P-value = 0.355).

This study also explored the parent's permission for doing physical activity alone outside home. The results are summarized in **Table 6.4.** As shown in **Table 6.4**, Most fathers allow their children doing physical activity alone outside home (77.7%), while most mothers and single parents do not allow (4.0%, 11.3%). Based on Multivariate test at the 0.05 level, there is a significant influence of the position of the family corresponding to the permission for doing physical activity alone outside home, (F = 4.511, P-value = 0.035).

The consistent pattern occurs among parent's income level and the permission for doing physical activity alone outside home. The permission would decrease once income level increased. Based on Multivariate test at the 0.05 level, there is a significant influence of the income level towards the permission for doing physical activity alone outside home, (F = 20.020, P-value = 0.000).

Table 6.4. Parent's permission for doing physical activity alone outside home

Socio demographic	Allow (%)	Do not allow (%)
Gender		
Mother	4.0	96.0
Father	22.3	77.7
Single parent	11.30	88.7
Income		
< 1000	39.4	60.6
1000 - 3000	18.3	81.7
3000 - 5000	5.3	94.7
>5000	3.9	96.1
Daughter ownership		
Have daughter aged < 13 years old	18.3	81.7
Do not have daughter aged < 13 years old~~Do not~~	39.4	66.6
Have daughter aged > 13 years old	3.9	96.1
Do not have daughter aged > 13 years old~~Do not~~	5.3	94.7
SonSon ownership		
Have Son~~son~~ aged < 13 years old	15.0	85.0
Do not have Son~~son~~ aged < 13 years oldDo not	15.5	84.5
Have Son~~son~~ aged > 13 years old	8.7	91.3
Do not have Son aged > 13 years old	18.9	81.1

Based on children ownership, most parents do not allow their children doing physical activity alone outside home. Based on Multivariate test at the 0.05 level of significance, the

different is significant between the parents whom have the daughter less than 13 years old and the parents who do notdo not have with regards to the permission for doing physical activity alone outside home, (F = 16.554, P-value = 0.000), similarly with daughter ownership more than 13 years old, the different is significant, (F = 8.702, P-value = 0.003)..

Regarding the correlation between son ownership towards the permission for doing physical activity alone outside home, only son ownership more than 13 years old, the different is significant, (F = 4.807, P-value = 0.029)..

This study also analyzed the correlation among the importance of physical activity perception and the perception of safety of neighbourhood surroundings toward the permission for doing physical activity alone outside home. The results are summarized in **Table 6.5** below**.**

Table 6.5. The correlation among the importance of physical activity perception and the perception of safety of neighbourhood surroundings toward the permission for doing physical activity alone outside home

	Allow (%)	**Do not allow (%)**
The importance of physical activity perception		
Not importance	8.9	91.1
Importance	21.3	78.7
The perception of neighbourhood surroundings safety		
Not Safe	0.8	99.2
Safe	30.6	69.9

As can be seen in **Table 6.5**, the number of parents who suggested the physical activity is important for their children health allow their children doing physical activity alone outside home more than the parents who suggested the physical activity is not important (21.3%

compare to 8.9%). Based on Multivariate test at the 0.05 level, the difference is significant, (F = 5.231, P-value = 0.023). **Table 6.5** also shows the parent concerning the neighbourhood surroundings safety with regards to the permission for doing physical activity alone outside home. The number of parents whom suggested neighbourhood surroundings is "not safe" do not allow their children doing physical activity alone outside home more than the number of parents whom suggested the neighbourhood surroundings is "safe" (99.2% compare to 69.9%), at the 0.05 level the influence of neighbourhood surroundings safety towards the permission is significant (F = 53.047, P-value = 0.000).

6.3. The transportation mode usage to school

It was reported that there was a decrease of active transport in several countries. In USA, Germany, Austria and United Kingdom, it has been reported the decrease of active travel to school (ATS), (National Center for Safe Routes to School and Safe Routes to School National Partnership, 2010; Van der Ploeg et al. 2008; Metcalf et al. 2004; Scherer, 2006 and Chriqui, 2012). Cole et al. (2010), said that in a majority of countries in the late 20th century observed, active transport significant decreased.

Parents often preferred to drop and pick up their children to school rather than encouraging their children to walk, cycle or use public transport as the result of that knowing other families are no longer encouraging those active transport (Tranter and Pawson, 2001; Carver et al. 2008). Due to concern about road safety and crime, many children are dropped and picked up after their activities at the school in order to protect them. Moreover, 'chauffeuring' of children to school were an attempt by parents to avoid from risk and injury to their children (Timperio et al. 2004). In line with the findings of Timperio et al. (2004); Hillman et al. (1990) and Carver et al. (2008), it was stated that parents put the

restriction on their children's physical activity due to concerns about possibility of child injury. Tempera et al. (2004) stated regarding the issues of safe active transport conditions, the parental perceptions have had negative correlation with 10 - 12-year-old children's active transport to their destination. The parents' protections for their children safety along the journey to the school are likely contributing factors as to why active commuting is at low levels. The parents' safety concern was mostly related to dangers from traffic (Isler et al. 2008).

The study by Hillman et al. (1990) and Carver et al. (2008) suggested that parent' concerns about road safety resulted in the restriction of their children in travelling alone from school to their home. Parental concern on traffic and pedestrian safety may not be unfound, as the cause of pedestrian and cyclists injured, fatality and hospitalization in Australian children (Timperio et al. 2004). Further research is needed to objectively measure neighborhood road safety by analyzing road characteristics and traffic calming measures in detail, and to examine its influence on children's physical activity and active transport, Carver et al (2008).

As presented in **Table 6.6,** with regards to the means of transportation for their children travelling from home to school, most parents let their child take a school bus (36.9%); followed by dropping and picking them up at school (by motorcycle, 29.2% and by car, 26.6%). Only 4.2% of parents would allow them to take public transport and 3.6% allowed them to walk to and from school. Furthermore, most mothers let their child to take a bus school (40.4%) while fathers would prefer to use their car to pick them up or use a motorcycle to do so (31.0%). Based on Multivariate test at the 0.05 level, there is a significant influence of the position in household towards the transportation mode of choice for the children to use to go to school ($F = 2.652$, P-value = 0.026).

Based on Multivariate test at the 0.05 level, there is no significant influence of the income level towards the Transportation mode for the children to go to school, (F = 0.266, P-value = 0.931).

As presented in Table **6.6**, most parents earned income less than 1000 MYR use a motorcycle to drop and pick their children at the school (72.0%), while the parents who earned an income of 1000 – 3000 MYR (41.6%) and 3000 – 5000 MYR (45.2%) allow their children to take the school bus and parents who earned an income more than 5000 MYR would drop and take their children from school by car (58.3%).

The consistent pattern occurs among income levels towards car and motorcycle usage as transportation mode for travelling to and from the school. The car user increased as the income level increased. However as the income levels increased, motorcycle users decreased. No parents earned an income of 3000 – 5000 MYR and more than 5000 MYR let their child to school. In several countries, social-economic status (SES) influenced active travel to school for children. In Rotterdam, the adolescents with at least one parent without a paying job were more likely to be a non-active commuter while travelling by either walking or cycling seems to be the most commonly prominent transportation mode among adolescents of two working parents (Bere et al, 2008). In the areas of low SES, the neighborhood provides the opportunities for inexpensive forms of physical activity, such as walking and cycling (Humbert et al. 2006; Carver et al. 2008).

There was a contrary phenomenon seen happening in the USA and Portugal, adolescents from higher socioeconomic status were not more likely to walk or cycling to school (McDonald, 2007; Mota et al. 2007; Bere et al, 2008). McMilan (2012) in her research stated that both socio-demographic variables showed significant influence for active transport probability to school. As household income increased, the probability of the active

transport to school increased. The likelihood of the decreasing of non motorized school travel was seen as the increasing of number of children in the household (KIDS), so did the likelihood of active transport to school.

Table 6.6. Transportation mode used for the children to go to school

Socio-demographic characteristic	You take them by car (%)	You take them by motorcycle (%)	School bus (%)	Walking (%)	Public transport (%)
All respondents	26.6	29.2	36.5	3.6	4.2
Mother	26.3	29.8	40.4	1.8	1.8
Father	26.8	31.0	26.8	7.0	8.5
Single parent	28.6	-	71.4	-	-
≤ 1000 MYR	8.0	72.0	4.0	12.0	4.0
1000 – 3000 MYR	15.7	33.7	41.6	4.5	4.5
3000 – 5000 MYR	33.3	16.7	45.2	-	4.8
≥ 5000 MYR	58.3	2.8	36.1	-	2.8
Have daughter aged < 13 years old	26.9	30.8	34.1	3.3	4.9
Do not have daughter aged < 13 years oldDo not	22.4	29.3	31.0	1.7	15.5
Have daughter aged > 13 years old	26.3	25.3	36.8	-	11.6
Do not have daughter aged > 13 years oldDo not	25.5	33.8	31.0	4.8	4.8
Son ownership	23.4	31.7	33.1	3.4	8.3
Have Sonson aged < 13 years oldDo not	29.5	28.4	33.7	2.1	6.3
Do not have Sonson aged < 13 years old	34.4	24.4	32.2	-	8.9
Have Sonson aged > 13 years oldDo not	17.0	35.8	39.6	3.8	3.8

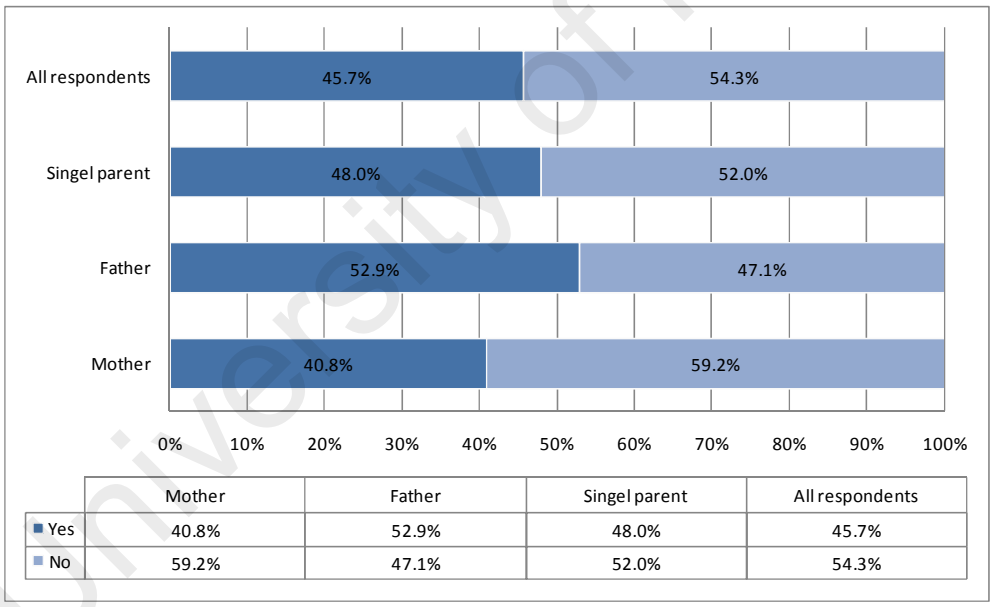
As presented in **Table 6.6,** regarding the means of transportation for their children for the trip from home to school, most parents let their children take a school bus, while the parents who do not have the daughter less than 13 years old drop and pick their children by motorcycle. The parents who have son more than 13 years old drop and pick their children by car. Based on Multivariate test at the 0.05 level, only the parents who have the son and daughter more than 13 years have the transportation mode usage for their children to go to school, (F = 2.275, P-value = 0.048) and (F = 2.743, P-value = 0.020).

6.4. The parent permission for cycling to school

The willingness of the children to cycle to go to school is quite high. But unfortunately only a few children can do it, because most of parents do not allow their children to cycle to school. Gatersleben et al. (2001) conducted a survey among parents of primary school children, as the result, almost one-third of the children were willing to cycle to school but only 1% of them can make this a realization.

Parents have an influencing role in lowering the chances of bicycles used as a means of transportation for children to go to school. They really concerned of their child's safety along the travelling routes to school. In addition to that they concerned on the safety from other traffic users and crime. The availability of adequate and environmental friendly cycling route will also be a consideration. Parents also concerned on the availability of an officer at intersections to help children cross the road safely. If the requirement mentioned above is not met, then they would rather let their children ~~to~~ use other transportation, such as; school buses, public transport or the parents themselves drop and pick up their children from school by car and motorcycle.

It is argued that parents doubted their children had the ability yet to anticipate the risk of cycling alone on the road with traffic. It is in accordance with Soole et al. study (2011), child-related risks, children's safety as pedestrians and cyclists was also compromised by the behaviour of drivers, especially those exceeding the speed limit in residential environments, and in addition, their research stated that young children are typically still developing their ability to make sound and accurate judgments when interacting with ~~the~~ road environments. The number of accidents involving children is also a consideration for their parents before allowing their children to cycle to school, María de Lourdes Martínez, (2010) suggested that more than 50 % of children less than < 15 years old are involved in transport-related injuries in Nicaragua.



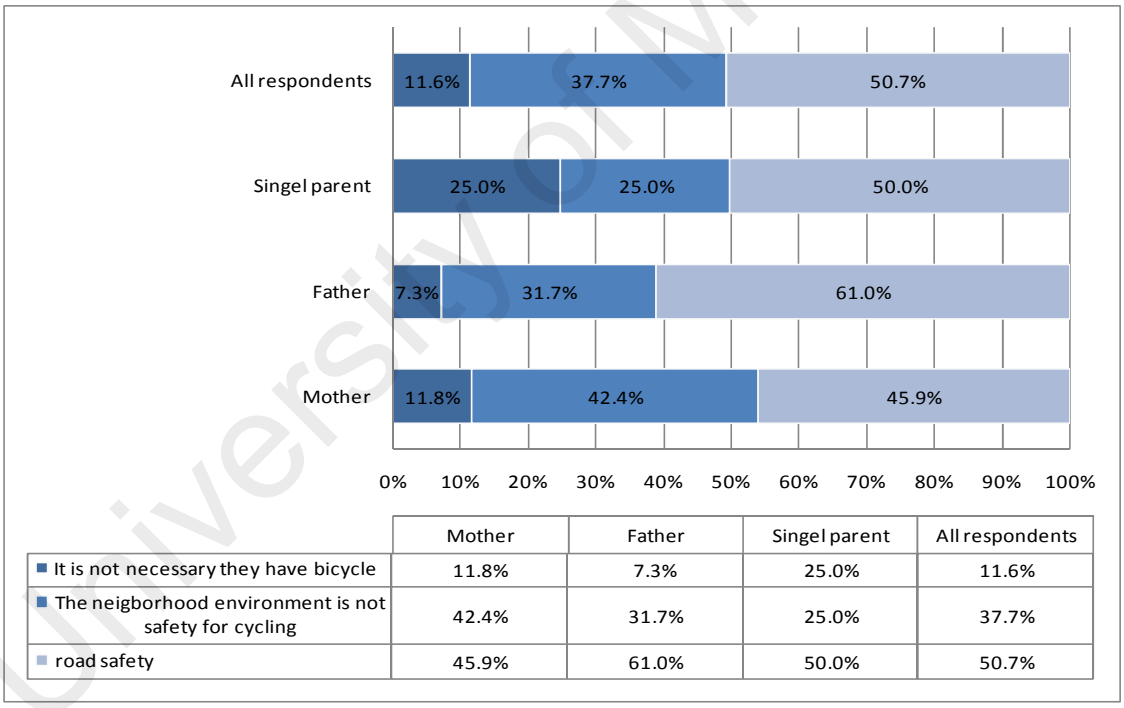
	Mother	Father	Singel parent	All respondents
Yes	40.8%	52.9%	48.0%	45.7%
No	59.2%	47.1%	52.0%	54.3%

Figure 6.1. Bicycle ownership

Figure 6.1 summarizes the bicycle ownership of children, the results in **Figure 6.1** reflect the parents slightly that more of them do not allow their children to own a bicycle (54.3% compared to 45.7%). Most of the mothers do not allow their children to have their own bike (40.8%), while the majority of fathers allow (52.9%). Based on Univariate test at the 0.05

level, there is a significant influence of the position in household towards the permission of having their own bike (F = 4.254, P-value = 0.04).

In **Figure 6.2, it** can be seen that, the main reason why parents do not allow their children to own their own bicycle was due to road safety (50.7%), followed by the fact that the neighborhood was not safe for cycling (37.7%) and while others argue that is not necessary for children to have their own bike (11.6%) **.** Most fathers' and mothers' concerns about road safety (61.0%; 45.9%). Based on Univariate test in the 0.05 level, there is no significant influence of the position in household towards the reason why parents do not allow their children to own a bike, (F = 1.281, P-value = 0.26).



	Mother	Father	Singel parent	All respondents
It is not necessary they have bicycle	11.8%	7.3%	25.0%	11.6%
The neigborhood environment is not safety for cycling	42.4%	31.7%	25.0%	37.7%
road safety	45.9%	61.0%	50.0%	50.7%

Figure 6.2. The reason why parents do not allow their children to have their own bicycle

Encourage cycling to school is not an easy task, because one needs to keep a steady rhythm and remain on the cycle track. One also needs to stop and cross the streets with care Kullman and Palludan (2011). Goodman and Tolley (2003); Institution of Highways and Transportation (2000); Owen et al .(2004); Tolley and Lumsdon (2003); Mokhtarian et al

(2001); Saelens et al. (2003); Carver et al. (2008); Cole et al. (2010) stated that the decreasing of cycling to school was because the 'chauffeuring' of children to school increased. They also have found that environmental factors and demographic factors are associated with the decreasing need of walking and cycling.

Table 6.7. The permission for cycling to school

Socio demographic	Allow (%)	Do not allow (%)
All respondents	26.2	73.8
Gender		
Mother	20.2	79.8
Father	30.5	69.5
Single parent	12.5	87.5
Income		
< 1000	21.2	78.8
1000 - 3000	32.2	67.8
3000 - 5000	24.6	75.4
>5000	17.6	82.4
Daughter ownership		
Have daughter aged < 13 years old	25.0	75.0
Do not have daughter aged < 13 years old	29.7	70.3
Have daughter aged > 13 years old	20.2	79.8
Do not have daughter aged > 13 years old	29.9	70.1
Son ownership		
Have Son aged < 13 years old	30.7	69.3
Do not have Son aged < 13 years old	19.4	80.6

Have Son aged > 13 years old	21.7	78.3
Do not have Son aged > 13 years old	28.7	71.3

As presented in **Table 6.7,** most parents do not allow their children cycle to school (73.8%). The percentage of fathers who allow cycling is higher than mothers (30.5% compares to 20.2%). Based on Multivariate test at the 0.05 level, there is a significant influence of the position in household towards the permission to cycle to school, (F = 49.276, P-value = 0.000).

Table 6.7 also shows the correlation of parent's level income towards the permission to cycle to school. There is no consistent pattern between the parent's income levels towards the permission for cycling to school. Based on Multivariate test at the 0.05 level, there is a significant influence of parent's income level corresponding to the cycling permission to school, (F = 29.957, P-value = 0.000).

This study also analyzed the correlation among the importance of physical activity perception, the perception of safety of neighbourhood surroundings, parent's permission for doing physical activity alone outside home and bicycle ownership. The results are summarized in **Table 6.8** below**.**

As can be seen in **Table 6.8**, the permission to cycle to school of the parents who suggested the physical activity is important for their children health is higher than the parents who suggested the physical activity is not important (38.5% compare to 15.8%). Based on multivariate test at the 0.05 level, the different is significant (F = 48.647, P-value = 0.000).

Furthermore, the permission for cycling to school of the parents who suggested the neighbourhood surroundings is safe, is higher than the parents who suggested the

neighbourhood surroundings is not safe (32.3% compare to 26.8%). At the 0.05 level, the different is significant (F = 7.699, P-value = 0.006).

Table 6.8. The correlation among the importance of Physical activity perception, the perception of safety of neighbourhood surroundings, parent's permission for doing physical activity alone outside home and bicycle ownership corresponding to the permission to cycle to school.

	Allow (%)	**Do not allow (%)**
The importance of physical activity perception		
Not importance	15.8	84.2
Importance	38.5	61.5
The perception of neighbourhood surroundings safety		
Not Safe	26.8	83.2
Safe	32.3	67.7
Parent's permission for doing physical activity alone outside home		
Do not allow	9.1	90.9
Allow	44.4	55.6
Bicycle ownership		
Do not have	27.6	72.3
Have	65.0	35.0

The parents who allow their children to do physical activity alone outside home, the permission for cycling to school is higher than the parents who do not allow (32.3%

compare to 26.8%). At the 0.05 level, the different is significant (F = 42.899, P-value = 0.000).

The parents who allow their children to own their own bicycle, the permission for cycling to school is higher than the parents who do not allow (65.0% compare to 27.6%). At the 0.05 level, the different is significant (F = 17.899, P-value = 0.000).

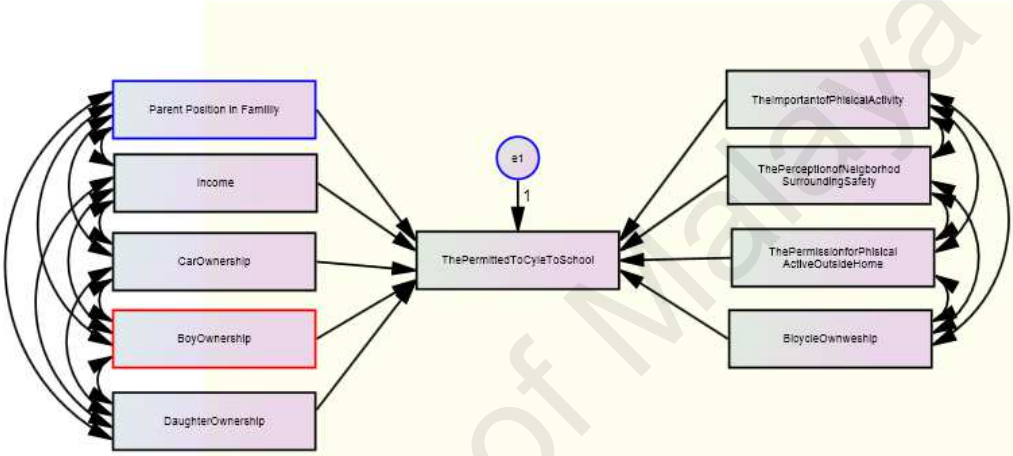


Figure 6.3. The structure of the permissiom for cycling to school model

In this research, there were develop the model of the correlation between The permission for cycling to school with parent position in family, income level, car ownership and children ownership. It also invertigated the correlation between the permission for cycling to school with the importance of Physical activity perception, the perception of safety of neighbourhood surroundings, parent's permission for doing physical activity alone outside home and bicycle ownership.

The model is summarized in **Table 6.9**., where coefficient of income level and car ownership were negative. The result implied that as income level and car ownership increases, the permission for cycling decreases. Fathers give the permission for cycling more than mother (coeffisent of position in family is positive). As the ownership of son and

daughter increases, the permission for cycling increases too. Moreover if the parents suggested that the physical activity is important, the neighbourhood surroundings is safe, and they allow their children to do physical activity alone outside home, to cycle to school.

Table 6.9. The permissiom for cycling to school mode**l**

			Estimate	S.E.	C.R.	P
ThePermittedToCyleToSchool	<---	Income	-.099	.033	-3.031	.002
ThePermittedToCyleToSchool	<---	CarOwnership	-.001	.037	-.018	.986
ThePermittedToCyleToSchool	<---	SonOwnership	.007	.019	.377	.706
ThePermittedToCyleToSchool	<---	PositioninFamily	.297	.041	7.161	***
ThePermittedToCyleToSchool	<---	TheImportantofPhisicalActivity	.119	.041	2.909	.004
ThePermittedToCyleToSchool	<---	ThePerceptionofNeigborhodSurroundingSafety	.269	.040	6.645	***
ThePermittedToCyleToSchool	<---	ThePermissionforPhisicalActiveOutsideHome	.333	.057	5.836	***
ThePermittedToCyleToSchool	<---	BicycleOwnweship	.085	.042	2.031	.042
ThePermittedToCyleToSchool	<---	DaughterOwnership	.053	.019	2.828	.005

6.5. The factor concerned regarding permissions to cycle to school

The trip distances, road traffic, the weather conditions, hilly routes, the safety, busy intersections for crossing, bad access to pedestrian crossings, and many things to carry are among commonly cited barriers for children when active transport to school is considered (National Public Health Partnership, 2001; Dellinger, 2002; DiGuiseppi et al. 1998; Timperio et al. 2006; Cole et al. 2010). Barriers for allowing children to cycle and walk to school is the fact that cycling and walking, parents and caregivers have common concerns about their child's safety and distance to school (Ahlport et al. 2008; Di Guiseppi et al.

1998; Faulkner et al. 2010; Greves et al. 2007; Kerr et al. 2006; Martin and Carlson, 2005; Timperio et al. 2006; Chriquí et al. 2012).

As stated in the Muller research (2005), respectively, the weather condition or seasons have a strong impact on student transport mode preference for students travelling to school. Furthermore, linked with costs, the distance is recognized as the most important factor for discrimination between transport modes (public transport and car/motorcycle) and those with lower travel costs (walking and cycling). In Timperio et al. (2006) it was suggested that the present study found that some factors, such as travel distance to school, hilly routes, the dangerous high traffic volume for crossing, and less accessibility and infrastructure for crossing were negatively associated with walking/cycling to school. Those all factors mentioned have an important influence for the improvement of safer active transport environments and child-friendly urban design.

In this research, the parents were asked regarding the factors concerned as the reason why they could not encourage them to allow their children to cycle to school. Structural equation model was developed. The purpose is to investigate whether the factors concerned for cycling to school such as neighborhood environment safety, the crossing guard, speed zones, bicycle facilities, need helmet, separate path, the distance, adequate and safe cycling facilities have any influence on the permission for cycling to school. The factors concerned for cycling to school was in a 5-point scale in which 1 denotes extremely not important and 5 extremely important. The permission for cycling to school is a categorical variable in which 0 is for “do not allow to cycle to school” and 1 is for “allow for cycling to school”.

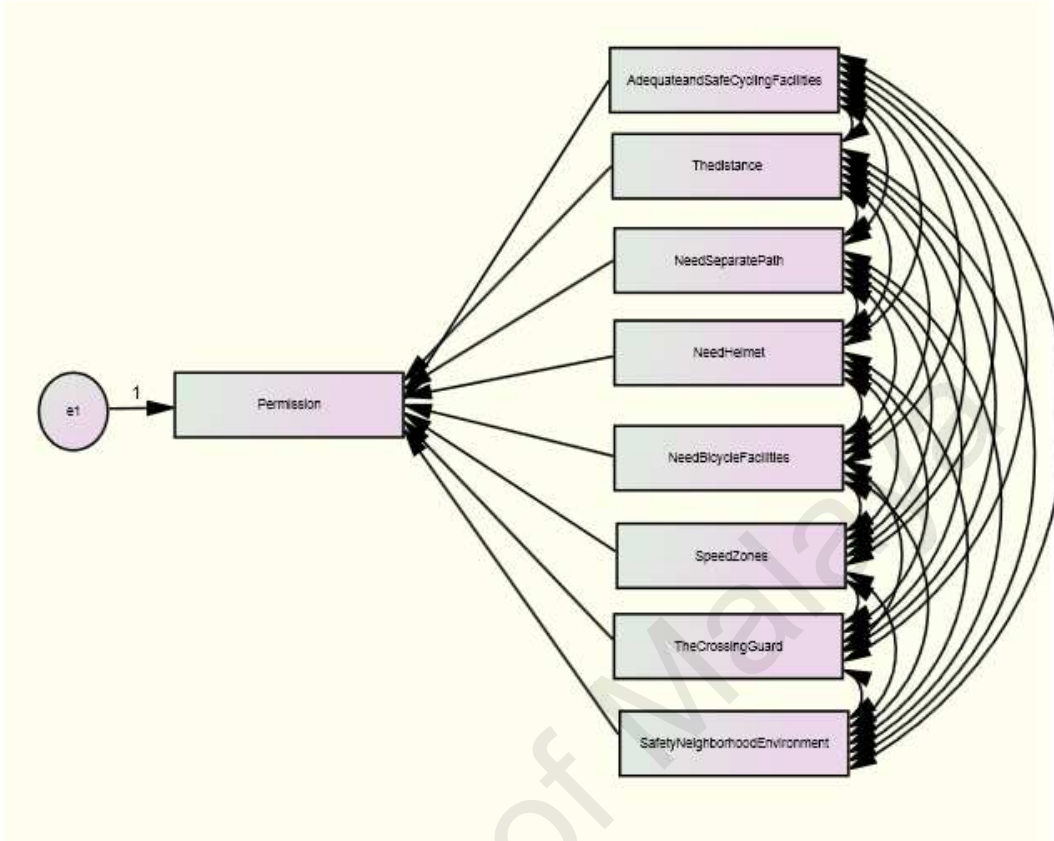


Figure 6.4. The structure model of the permission for cycling corresponding to the factor concerned for cycling to school.

The model is summarized in **Table 6.9**. "Adequate and Safe Cycling Facilities" have the highest influence on the permission for cycling to school (1.271), followed by "The distance" (.930), "Neighborhood Environment Safety" (.858), "The Crossing Guard" and " Need Separate Path" (.689), "Need Bicycle Facilities (Parking Area)" (.463), 'Speed Zones" (.278) and "Need Helmet" (.258). As shown in **Table 6.9**, only 'Speed Zones" and "Need Helmet" variables are not significant influences the permission for cycling to school.

Table 6.10. Model of the permission for cycling corresponding to the factor concerned for cycling to school.

			Estimate	S.E.	C.R.	P
ThePermittedToCyleToSchool	<---	AdequateandSafeCyclingFacilities	.164	.051	3.207	.001
ThePermittedToCyleToSchool	<---	Thedistance	.131	.054	2.412	.016
ThePermittedToCyleToSchool	<---	NeedSeparatePath	.101	.043	2.382	.017
ThePermittedToCyleToSchool	<---	NeedHelmet	.053	.039	1.345	.179
ThePermittedToCyleToSchool	<---	NeedBicycleFacilities	.077	.032	2.381	.017
ThePermittedToCyleToSchool	<---	SpeedZones	.038	.032	1.185	.236
ThePermittedToCyleToSchool	<---	TheCrossingGuard	.122	.037	3.261	.001
ThePermittedToCyleToSchool	<---	SafetyNeighborhoodEnvironment	.120	.044	2.707	.007

Beside the distance, parents ranked the adequacy and safety route in second place and the safety of the neighbourhood environment in two highest places. Children's physical activity can be impacted by road safety. Petch and Henson (2000); Carver et al (2008) stated that it is now realized that road accidents involving children could be happening due to the various factors including the driver's attitude and/or the children and the physical/social environment conditions. Based on the result above, in the recent research emphasis has shifted to the road/neighbourhood environments modification to improve pedestrians and cyclists safety (Carver et al. 2008). It argued that the children need to be introduced to the idea of taking part in preserving their environment, keeping themselves from accidents on the road and protect themselves from criminal threats. This can be done by giving them the opportunity to indulge in their surrounding neighbourhood. Timperio et al in 2004 stated that giving children an opportunity to cycle to school, gives them the opportunity to learn how to walk and cycle safely in traffic. It could not happen if we chauffeur children to their

destinations. Children should be encouraged to cycle or walk to school. The parents, schools and the authorities should create a friendly environment for children to cycle to school. Road intervention should be conducted to improve child safety when cycling to school. The type of intervention is traffic calming, which involves the reduction of speed and/or volume of traffic. The idea was created from "street for living design which promoted the coexistence of pedestrians, cyclists and motor cars. Placing speed humps; vegetation and narrow section of road are among the methods that could be taken in redesigning the residential streetscape (Petch and Henson, 1999; Harvey, 1992; Carver et al. 2008)

In another way, Burnett et al. (2005) and Carver et al. (2008) suggested that by constructing and executing maintenance of sidewalks and cycling roads; the installation of traffic lights along the way to school would increase children's active transport.

In addition, the several social interventions have taken place aimed to promote active transport to school. These include designated days on which walking to school is encouraged, as well as walking- and cycling-school buses (Carver et al. 2008).

One of the interventions for encouraging children to cycle to school is explored in The Stockholm Manifesto Creating a safe environment for children in Europe (2005). The manifesto was initiated by The European Child Safety Alliance. The Alliance, launched in 2001, focuses on strategies that assist in the reduction of injury related deaths and disability amongst children 0 to 18 years of age in the European Union Members States. Included was the development of child friendly communities that encourage and enable walking and cycling as major modes of safe transport and increase public play spaces that balance play value and acceptable risk.

Another intervention is Safe Route To School (SR2S). Staunton et al.(2001) and Boarnet et al. (2005) suggested in their study of the SR2S program in Marin County, and expands the results to more schools and to more various settings, showing an a relation between the improvement of SR2S toward the increasing the active transportation among students from the schools with the demographic and the settings of built environment and the varied improvements of engineering.

6.6. The bike facilities for cycling to school

The road safety concerned was shown by parents on the cycling facilities suggested. The parents concerned on dangers from very high other traffics on the road. As the result, regarding cycling facilities, the majority of parents suggested exclusive bike path for their children to go to school (64.1%) while 35.9% of the parents suggest bike lane on the existing road. No one would let their children ride their bicycle on a road mix with other traffics, therefore most of them proposed an exclusive bike path for their children.

Regarding the distance, as stated in Carver et al research (2008), safety is identified as a potential influence for active transport. Timperio et al. (2006) suggested that the attention on school location related to areas of residence and traffic routes. This is an important factor in planning for new communities and when the policy of school zone is made.

As can be seen in **Table 6.11,** most parents who allow their children to cycle within 500 meters suggest the exclusive bike path for cycling (80.7%), while for the parents who allow their children to cycle for the distance more 500 meters suggested the bike lane on the street (85.9%).

These results were in line with McDonald (2007); Merom et al. (2006); Nelson et al.(2008); Børrestad et al. (2011), they stated that children who have shorter distance are likely to have more opportunity to commute by active transport to school. The Netherlands have a tradition of cycling for a long time. They a better built environment for cycling, which has the result of good infrastructure which is more safe and comfortable for cycling than in other countries (Bere et al. 2008). In line with Dellinger (2005); Ewing et al. (2004); Timperio et al (2006); Merom et al. (2005); Isler et al. (2008) research, they suggested that travel distance to school and high volume of traffic were significantly associated with non-active transport commuting. While as stated in Buliung et al. (2009) research, the migration from elementary schools to larger secondary schools could change the type of transport.

Table 6.11. Correlation between the cycling acceptable distance with the facilities suggested

Cycling facilities suggested	Less than 500 m (%)	500 m above (%)
All respondents	75	25
Bike lane on the street	19.3	85.9
Exclusive bike path	80.7	14.1

In order to explore the correlation of the cycling facility towards parent position in familiy, level of income, car ownership, the perception of surrounding neighborhood safety, acceptable distance for cycling and encouraging factor for the cycling permission (adequate and safe cycling facility and surrounding neighborhood safety), a regression model was designed The structure of the model was shown in **Figure 6.5**.

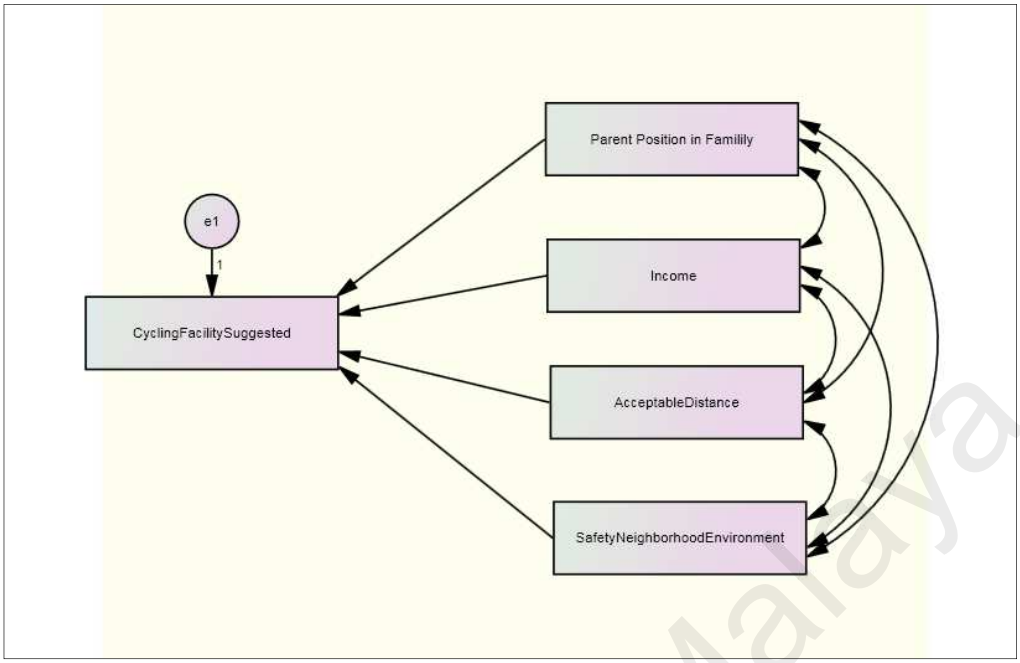


Figure 6.5. The structure of cycling facility

As presented in **Table 6.12**, coefficients for position in family and income level significantly influence the cycling facility suggested (P-value = 0.492; P-value = 0.382). Likewise, concerned about surrounding neighborhood safety and acceptable cycling distance have the significant influences toward the cycling facility suggested (P-value = 0.00; P –value = .007).

Table 6.12. Cycling facility model

			Estimate	S.E.	C.R.	P
CyclingFacilitySuggested	<---	Income	-.013	.015	-.874	.382
CyclingFacilitySuggested	<---	AcceptableDistance	.787	.043	18.238	0.00
CyclingFacilitySuggested	<---	PositioninFamily	.025	.037	.686	.492
CyclingFacilitySuggested	<---	SafetyNeighborhoodEnvironment	.091	.033	2.709	.007

Coefficients of the concerns about surrounding neighborhood safety and acceptable distance for cycling were positive. As the safety level of importance and acceptable distance for cycling increase, the cycling facility suggested is the exclusive bike path.

6.7. The Summary

Doing physical activity regularly for children and youth is very important for their health (Buliung et al. 2009). According to Chriqui et al. (2012), ideally 60 minutes of physical activity should be spent every day. Parents are actually aware that cycling as a physical activity is essential for the health of their children. As the result of this research, most parents agree that the physical activity regularly is important for their children health.

It can be the beginning of realization of willingness to allow their children to cycle to school. Boarnet et al. (2005); Timperio et al. (2006); Faulkner et al. (2009) and Buliung et al. (2009) stated that for youth, cycling as one of the active mode of transport to school could increase physical activity for the children. However it must be supported with a friendly neighborhood to carry out activities outside the residence, a safe and friendly environment away from potential accidents and crime when cycling to school. Most parents slightly suggested that the neighbourhood surroundings is not safe for doing physical activities. A total of 51.6 % of parents stated that their neighbourhood surrounding is not safe for their children. There were significant influence between the permission for doing activities outside home school corresponding to the parents' perception regarding the neighbourhood safety. The number of parents who suggested neighbourhood surroundings is not safe do not allow their children doing physical activity alone outside home more than the number of parents whom suggested the neighbourhood surroundings is safe.

There were also significant influence of the parents' perception regarding the important of the physical activity regularly for their children health. The number of parents whosuggested the physical activity is importance for their children health allow their children doing physical activity alone outside home more than the parents who suggested the physical activity is not important

With regards to the means of transportation for their children from home to school, most parents dropp and pick them up at school (by motorcycle, 29.2% and by car, 26.6%). The consistent pattern occurs among income levels towards car and motorcycle usage for the trip to the school. The car user increased as the income level increased. However as the income levels increased, motorcycle users decreased.

In several countries, social-economic status (SES) influenced active travel to school for children. In Rotterdam, the adolescent with at least one parent without a paying job were more likely to be a non-active commuter while travelling by either walking and cycling which seems to be a most commonly prominent transportation mode among adolescents of two working parents (Bere et al. 2008). In the areas of low SES, the neighborhood provides the opportunities for inexpensive forms of physical activity, such as walking and cycling (Humbert et al.., 2006; Carver et al. 2008).

There was a contrary phenomenon seen happening in the USA and Portugal, adolescents from higher socioeconomic status were not more likely to walk or cycling to school (McDonald, 2007; Mota et al. 2007; Bere et al. 2008). McMilan (2012) in her research stated that both socio-demographic variables showed significant influence for active transport probability to school. As household income increase the probability of the active transport to school increase, the likelihood of the decreasing of non motorized school travel

was seen as the increasing of number of children in the household (KIDS), so did the likelihood of active transport to school.

As the result of this research, most parents do not allow their children to cycle to school (73.8%). The percentage of mothers who do not allow cycling is higher than fathers. The different is significant. In line with Timperio et al. 2006 and Bringolf-Isler et al. 2008 who argued that physical neighborhood environment and social aspects are among aspects that could influence the children to commute to school by cycling, for most of the parents who suggested the neighbourhood surroundings is safe, the permission for cycling to school is higher than the parents who suggested the neighbourhood surroundings is not safe.

Regarding the factors concerned that could not encourage them to allow their children to cycle to school, most parents concerned about "Adequate and Safe Cycling Facilities", followed by "The distance", "The Crossing Guard" , "Neighborhood Environment Safety" , " Need Separate Path", "Need Bicycle Facilities (Parking Area)" , 'Speed Zones" and "Need Helmet". 'Speed Zones" and "Need Helmet" variables are not significant influence the permission for cycling to school.

The road safety concerned was shown by parents on the cycling facilities suggested. The parents concerned on dangers from very high traffic on the road. As the result, regarding cycling facilities, the majority of parents suggested exclusive bike path for their children to go to school. No one would let their children ride their bicycle on a road mix with other traffics, therefore most of them proposed an exclusive bike path for their children.

In this study also analyzed the correlation among the parameters investigated corresponding to position in family and income level. The result were presented in Table below :

Table 6.13 : The correlation of the position in family and income level toward the parameter that invertigated (the potential for cycling to school)

Parameters	Correlation	
	Position in family	Invome Level
The importance of physical activity for their children's health	**Not Significant** most parents agree that the physical activity regularly is important for their children health	**Significant** The parents who agree the importance physical activity for their children decrease as the increasing of respondent income level increase
The perception of the neighborhood environment safety	**Significant** **(**The percentage of fathers who answered safe, was higher than mother.)	**Significant** (There were consistent patern) As the income level increase the answer “not safe” increased
The permission for doing physical activity alone outside home	**Significant** Most fathers allow their children doing physical activity alone outside home, while most mothers do not allow.	**Significant** (There were consistent patern) The permission would decreases once income level increases.
Mode share	**Significant** Most parents would drop and pick them up at school (by motorcycle, 29.2% and by car, 26.6%)	**Not significant** (There were not any consistent patern)
Bicycle ownership	**Significant** Most of them do not allow their children to own a bicycle	-
The permission to cycle to school.	**Significant** Most parents do not allow their children to cycle to school	**Significant** There is no consistent pattern

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research is to find out the potential of cycling as an urban mode in Malaysia contexts. There were three studies in this research, namely; the study of the potential for cycling as the transportation mode for activity around campus, the potential for cycling in accessing public transport facility and the potential of the children for cycling to school based on parents perception. As the results of the study, it is gained the conclusions as mentioned below:

7.1. Objective 1 : To investigate the potential for cycling as mode of transportation

There were the contrary result occured between the potential of cycling for activity around campus with the potential for cycling in accesing public transit facilities and the potential cyling as transportation mode to go to school.

The potential of cycling for activity around campus is obviously high. A total of 85.5% said they are willing to cycle if the facilities are provided within the campus area. Regarding the trips distance, both female and male students are willing to cycle for distance below 1km.

While, most respondent mentioned that they do not want to cycle if the cycling facilities from their residence to public transit facilities are available (72.8%). Males were more likely to consider for cycling than females. The study identified 2.5 km as the farthest acceptable distance for cycling in accessing public transit. The average distance is 700 meters and the standard deviation is 280.8. Male are willing to cycle farther than female.

Them, most parents do not allow their children to cycle to school (73.8%). The percentage of mothers who do not allow their children to cycle to school is higher than fathers.

7.2. The objective 2 : The obstacles for cycling

The main obstacle for cyclingfor cycling for activity around campus is the rainy day. The respondents also concerned the distance and safety as the obstacles for cycling around campus since those parameters were in the third and fourth place as the obstacle.

As the reason why respondents suggested that, they would not cycle to public transit stations due to safety concerns (58.5%), followed by individual personal appearance concerns (28.4%), they do not how to ride (8.0%) and health or physical problem (5.1%). For both males and females, they also concern about safety as the reason why they do not cycle to public transit facility (58.0%; 58.7%). Based on Multivariate test at the 0.05 level, there is no. significant influence of respondent's gender toward the reason for not cycling to the public transit station, ($F = 0.916$, P-value = 0.434).

Regarding the factors concerned that could not encourage them to allow their children to cycle to school, most parents concerned about "Adequate and Safe Cycling Facilities", followed by "The distance", "The Crossing Guard" , "Neighborhood Environment Safety" , " Need Separate Path", "Need Bicycle Facilities (Parking Area)" , 'Speed Zones" and "Need Helmet". 'Speed Zones" and "Need Helmet" variables are not significant influence the permission for cycling to school.

7.3. Objective 3 : To find out the adequate bike facility that can encourage people to cycle

Regarding the cycling facilities suggested, the road safety concerned was shown for cycling around campus, cycling in accessing public transit facilities and cycling as tarnsportation mode to go to school. The respondents concerned about the dangers from other traffic.

For cycling for activity around campus, the majority of respondents suggested the exclusive bike path for cycling around campus (77.1%). It is only 22.9% of the respondents are willing to cycle on the existing road. Moreover, 0.2 % would let cycle on the road mix with other traffic. The road safety concerned was also shown by parents on the cycling facilities suggested. The parents concerned on dangers from very high other traffics on the road. As the result, regarding cycling facilities, the majority of parents suggested exclusive bike path for their children to go to school (64.1%) while 35.9% of the parents suggest bike lane on the existing road. No one would let their children ride their bicycle on a road mix with other traffics, therefore most of them proposed an exclusive bike path for their children. Regarding the cycling in accessing the public transit facility, most respondents' also concerns are about the safety along the route from their residence to public transit facility, therefore they suggest the exclusive bike path (67.1%).

By using Structural equation model, the correlation of the cycling facility suggested towards gender, level of income, age, the safety concerned, obstacles for cycling around campus and the acceptable distance, a regression model was find out for cycling around campus. As the result, coefficients for age and income level do not significantly influence the cycling facility suggested. Moreover, concerned about safety and acceptable cycling distance have significant influences toward the cycling facility. The coefficient of safety concerned was negative, this result implied that as the safety concerned level of importance

increases, the cycling facility suggested was the bike path on the street. When the distance coefficient was positive, it means that as the acceptable distance increases, the cycling facility suggested was the exclusive bike path.

Regarding the cycling in accessing public transit , structural equation model was also establish. As the result, coefficients for gender and income level significantly influenced the cycling facility suggested. Moreover, concerns about safety and acceptable cycling trips distance have significant influences toward the cycling facility suggested. Coefficient gender was negative and the result implied that if the respondent gender is female, the cycling facility suggested is the exclusive bike path. Income level is also positive, as income level increase, the cycling facility suggested is the exclusive bike path. The safety concerned and acceptable distance for cycling was positive, as the safety level of importance and acceptable distance for cycling increase, the cycling facility suggested is the exclusive bike path.

For the cycling for going to school, the parents were asked regarding the factors concerned as the reason why they could not encourage them to allow their children to cycle to school. Structural equation model was developed. The result are "Adequate and Safe Cycling Facilities" have the highest influence on the permission for cycling to school (1.271), followed by "The distance" (.930), "Neighborhood Environment Safety" (.858), "The Crossing Guard" and " Need Separate Path" (.689), "Need Bicycle Facilities (Parking Area)" (.463), 'Speed Zones" (.278) and "Need Helmet" (.258). Only 'Speed Zones" and "Need Helmet" variables are not significant influences the permission for cycling to school.

7.4. Policy recommendation

The authorities must concern about the safety in encouraging people to cycle as an urban mode in Malaysia. The exclusive bike lane must be considered to provide for the cyclist. The shorter route than the existing road are also considered due to, as the result of the study, there were cyclsit prefer to choose the main road than the exclusive bike lane because the main road shorter than the bike lane. Regarding the cycling for activity around campus, beside provide the adequate facilities for cycling, the limited parking permission and forbidding using car for undergraduate students can encourage student for cycling.
Create the safe environment surrounding and road intervention such as traffic calming can be used to encourage parents allow their children for cycling to school.

The traffic calming involves the reduction of speed and/or volume of traffic. The idea was created from "street for living design which promoted the coexistence of pedestrians, cyclists and motor cars. Being placed speed humps; vegetation and narrow section of road are among the methods to redesign the residential streetscape.

Constructing and maintenance of sidewalks and cycling road; the installation of traffic lights along the way to school would increase children's active transport. In addition, the several social interventions have aimed to promote active transport to school. These include designated days on which walking to school is encouraged, as well as walking- and cycling-school buses.

7.5. The recommendation for future research

In the study of the potential of cycling as a transport mode for going to school, the survey only conducted on the cycling potential based on the parents perception due to it is argued that the parents' permission have has the important influence on the potential for cycling to school. For next research the children perception must be considered to investigate the potential of cycling as a transport mode for going to school.

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APPENDIX D : List of Publication

Bayu Martanto Adji, Angelalia Roza , Raja Syahira Binti Raja Abdul Aziz and Mohamed Rehan Karim. 2011. **Potential Of Bicycle As Transportation Mode For Activities Around Campus**, Proceedings International Transport Research Conference.

Angelalia Roza, Bayu Martanto Adji, Raja Syahira Raja Abdul Aziz, Mohamed Rehan Karim, 2011. **Student Intercity Travel Characteristics By Stated Preference Method: A Case Study For Intercity Travel Between Parit Buntar, Penang And Kuala Lumpur**, Proceedings International Transport Research Conference.

Bayu Martanto Adji, Angelalia Roza, Raja Syahira Raja Abdul Aziz, Mohamed Rehan Karim, 2011. **Intercity Bus Transportation System And Its Competition In Malaysia,** Proceedings Of Eastern Asia Society For Transportation Studies, Vol.8.

Raja Syahira Raja Abdul Aziz, Bayu Martanto Adji, Angelalia Roza, Mohamed Rehan Karim, 2011. **Preference Of University Students Towards Cycling In Campus,** Proceedings Of Eastern Asia Society For Transportation Studies, Vol.8.

Angelalia Roza, Bayu Martanto Adji, Raja Syahira Raja Abdul Aziz, Mohamed Rehan Karim, 2011**mode Preference Of Intercity Travel By Stated Preference Method – A Case Study In Malaysia,** Proceedings Of Eastern Asia Society For Transportation Studies, Vol.8.

Nik Ibtishamiah Ibrahim**,** Bayu Martanto Adji, Mohamed Rehan Karim, 2011. **Preliminary Study On Parking Control System For Proposed Transit Oriented Development (TOD) Area: Implementation Potential In Petaling Jaya City Council (MBPJ), Malaysia**, Proceedings Of Eastern Asia Society For Transportation Studies, Vol.8.

Angelalia Roza, Nik Ibtishamiah Ibrahim, Bayu Martanto Adji, Mohamed Rehan Karim, 2013. **Study On Parking Characteristic: Case Study In Petaling Jaya City Council (MBPJ), Malaysia.** Journal of Society for Transportation and Traffic Studies (JSTS) Vol.4 No.1.

Bayu Martanto Adji,Suhana Koting, Nik Ibtishamiah Ibrahim, Angelalia Roza, Mohamed Rehan Karim, Ahmad Saifizul, 2013. **Parents' Perception on the Potential of Cycling as a Transport Mode to School.** Proceedings Of Eastern Asia Society For Transportation Studies, Vol.9.

Nik Ibtishamiah Ibrahim, Bayu Martanto Adji, Mohamed Rehan Karim, 2013. **Public Transport Passengers' Perception and Demand Satisfaction: A Case Study At Petaling Jaya Municipal District, Malaysia.** Proceedings Of Eastern Asia Society For Transportation Studies, Vol.9.