# ทัศนคติและปัจจัยด้านจิตวิทยาที่ส่งผลกระทบต่อความตั้งใจของผู้เดินทางในการใช้การขนส่งทางรางในเขตเมืองในอนาคต

นายบอริท ลอง



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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ปีการศึกษา 2553

# ATTITUDES AND PSYCHOLOGICAL FACTORS AFFECTING COMMUTER'S INTENTION TOWARDS FUTURE URBAN RAIL TRANSPORT

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Civil Engineering
Department of Civil Engineering
Faculty of Engineering
Chulalongkorn University
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| Thesis Advisor | Assistant Professor Kasem Choocharukul, Ph.D. |
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บอริท ลอง :ทัศนคติและปัจจัยด้านจิตวิทยาที่ส่งผลกระทบต่อความตั้งใจของผู้เดินทางในการใช้การขนส่งทางรางในเขตเมืองในอนาคต. (ATTITUDES AND PSYCHOLOGICAL FACTORS AFFECTING COMMUTER'S INTENTION TOWARDS FUTURE URBAN RAIL TRANSPORT) อ. ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ.ดร.เกษม ชูจารุกุล, อ. ที่ปรึกษาวิทยานิพนธ์ร่วม: ศ.ดร. ทาคาชิ นาคัตซูจิ, 106 หน้า.

การศึกษานี้นำเสนอการประยุกต์ใช้ทฤษฎีพฤติกรรมตามแผน (TPB) เพื่อศึกษาถึงความตั้งใจของผู้เดินทางในการใช้รถไฟฟ้าในอนาคตในกรุงพนมเปญ เมืองหลวง ของประเทศกัมพูชา ผู้วิจัยวัดปัจจัยทางด้านจิตวิทยาและตัวแปรทางเศรษฐกิจและสังคมหลาย ตัวแปรซึ่งอาจช่วยอธิบายความเป็นไปได้ของการใช้รถไฟฟ้าในอนาคตโดยอาศัยการสำรวจด้วยแบบสอบถามโดยรวบรวมจากผู้ใช้รถจักรยานยนต์ 398 คนที่เดินทางระหว่างถนน Kampuchea Krom และ Russian Boulevards ซึ่งอยู่ในแนวรถไฟฟ้าเชื่อมโยงจากจุดศูนย์กลางทางธุรกิจในกลางเมืองไปยังท่าอากาศยานตัวแปรที่ใช้ในการสำรวจประกอบด้วยตัวแปรด้านจิตวิทยาต่างๆซึ่งรวมถึงทัศนคติบรรทัดฐานของบุคคลการรับรู้การควบคุมพฤติกรรมพันธะทางศีลธรรมและการตระหนักถึงผลกระทบผลการวิเคราะห์จากแบบจำลองสมการเชิงโครงสร้างพบว่าตัวแปรหลักของทฤษฎีพฤติกรรมตามแผน อันได้แก่ ทัศนคติ บรรทัดฐานของบุคคล และการรับรู้การควบคุมพฤติกรรมล้วนมีอิทธิพลต่อความตั้งใจของผู้เดินทางในการใช้รถไฟฟ้าในอนาคตนอกจากนี้ตัวแปรพันธะทางศีลธรรมและการตระหนักถึงผลกระทบยังเป็นปัจจัยสำคัญต่อความตั้งใจในการเดินทางเช่นเดียวกันกับตัวแปรด้านเศรษฐกิจและสังคมบางตัวแปรผลลัพธ์จากการศึกษานี้สามารถช่วยให้เข้าใจความตั้งใจของผู้เดินทางและช่วยบ่งชี้ถึงความเป็นไปได้ของการลงทุนดังกล่าวในมุมมองจากอุปสงค์ในการเดินทาง



ภาควิชา.....วิศวกรรมโยธา.....ลายมือชื่อนิสิต.....
สาขาวิชา.....วิศวกรรมโยธา.....ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....
ปีการศึกษา.....2553.....ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม.....

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KEYWORDS : PSYCHOLOGICAL FACTORS / FUTURE SKY TRAIN / THEORY OF PLANNED BEHAVIOR

BORITH LONG: ATTITUDES AND PSYCHOLOGICAL FACTORS AFFECTING COMMUTER'S INTENTION TOWARDS FUTURE URBAN RAIL TRANSPORT. THESIS ADVISOR: ASST. PROF. KASEM CHOOCHARUKUL, Ph.D., THESIS CO-ADVISOR: PROF. TAKASHI NAKATSUJI, Dr. ENG.,106pp.

This study presents an application of the Theory of Planned Behavior (TPB) to investigate the commuter's behavioral intention towards future sky train usage in Phnom Penh, the capital city of Cambodia. Several psychological factors and socio-economic variables that can potentially help explaining the likelihood of future sky train usage are measured by means of questionnaire survey. Responses are collected from 398 motorcyclists who travel along the Kampuchea Krom and Russian Boulevards, a planned sky train line linking the Central Market in CBD to the airport. The survey is conducted based on psychological constructs, including attitude, subjective norm, perceived behavioral control, moral obligation, and awareness of consequence. Applying structural equation modeling, it is found that main TPB constructs, i.e. attitude, subjective norm, and perceived behavioral control, significantly influence the behavioral intention of using future sky train. A further investigation reveals that moral obligation and the awareness of consequences are also found to be significant determinants for the behavioral intention. In addition, to some degrees, socioeconomic variables can also be used to explain the intention. The outcome of the study can help understanding commuter's current behavioral intention and shed some light on the feasibility of such an investment in terms of potential demand.

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| Academic Year : 2010 | Co-Advisor's Signature |

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# CHAPTER I

# INTRODUCTION

## 1.1 General Background

Phnom Penh is the capital and one of the best-known cities in Cambodia. It is the political, economic, commercial, industrial, cultural, tourist and historical center city of the Kingdom of Cambodia and is home to more than 2 million of Cambodia's population of over 14 million (Wikipedia, 2009). The traffic condition in Phnom Penh has been gradually worsening in recent years due to the rapid increase of vehicles caused by the concentration of population in the Capital. The number of registered vehicles has been increasing at a rate of about 15% each year and approximately 77% of all registered vehicles are motorcycles (IRITWG, 2009). Urban traffic congestion has grown to critical proportions in some areas, where the absence of traffic control devices (i.e. signals, signs and road marking) at several critical intersections and the poor condition of road surfaces and drainage on secondary roads and local streets exacerbate operational inefficiencies. Lack of road user discipline, inadequate regulations, poor use of traffic management measures, and low levels of enforcement are particular problems that greatly reduce the effective capacity of the road systems and contribute to safety concerns for all road users. The serious traffic congestion mostly occurs at the morning and evening peak hours. Traffic congestion and traffic accidents, especially by motorcycles, are one of the most serious social issues in Phnom Penh. The major reason of increasing number of motorcycles is because of improper public transportation in the city. Today, most of the public transport in the city relies on the motor-taxis, tricycles and some car-taxis, which are the only available modes. Bus service is only available for inter-city travel.

To increase the mobility in the city, the urban rail transportation system has been planned and proposed as a high priority project. Based on the feasibility study conducted by JETRO, the Municipality of Phnom Penh is working hard on the above problems with assistance of the Government of Japan for the ongoing traffic

improvement project and with assistance of Paris in France, for the ongoing city planning project (JETRO, 2008). There are very few studies of public transportation system, such as urban rail transportation system in Phnom Penh. Commuters may not be familiar with this new mode of transportation system. Therefore, the investigation of several aspects including socioeconomic variables and psychological factors that can help explain the likelihood of using future urban rail transport will be revealed in this research study. Results will be useful for understanding the commuter's current behavior which can give some ideas on the feasibility of such an investment.

## 1.2 Problem Statement

Many developing cities, including Phnom Penh, are now facing motorization problem, which leads to detrimental effects such as vehicular delays, traffic accidents, air and noise pollution. The JETRO study reported that 80 percent of the total traffic in Phnom Penh City is made up of motorcycles (JETRO, 2008). It is found that traffic congestion always happens on radial and ring roads with the large number of traffic volume especially at the morning and evening peak hours. To cope with these issues, one of the travel demand management (TDM) techniques is used to induce commuters to use more public transportation. Currently, Phnom Penh City has a plan to build an urban rail transportation system in order to increase mobility within the city. However, to what extent the existing commuters would patronize such a system is unknown. In addition, the underlying psychological factors that could induce more public transportation are not well understood.

## 1.3 Research Objectives

The objective of this research is to investigate several aspects, including socioeconomic variables and psychological factors that can potentially help to explain the likelihood of future sky train usage. The outcome of the project will help not only understanding commuter's current behavior but also give some ideas on the feasibility of such an investment in terms of potential demand.

## 1.4 Scope of the Study

The scope of the study will be limited to potential commuters in Phnom Penh, the capital city of Cambodia. The commuters who travel along the Russian Federation Boulevard and Kampuchea Krom Boulevard, a planned sky train line linking the Central market in CBD to Phnom Penh International Airport will be asked to complete the questionnaires. It is our intention to limit our subject target to only motorists and motor-taxis users due to the fact that this group of roads users represents the highest proportion in the traffic stream, and they are more likely to change their travel mode to the proposed rail line, compared with other road users such as private car users. A set of Theory of Planned Behavior model questionnaires will be used in this research study.

## 1.5 Expected Benefits

This study is designed to investigate the commuter's intention toward future urban rail transport usage in Phnom Penh. Upon the completion of the study, the following benefits are expected:

- ❖ Improved traffic situation in Phnom Penh City, focusing on the public transportation, plus a review of urban rail transport planning and related studies.
- ❖ The commuter's intention toward future urban rail transport and the likelihood of sky train usage.
- ❖ Research results will shed light on urban rail transport, sky train.
- ❖ The analysis results can be additionally useful for future research and study on urban rail transport in Phnom Penh.

## 1.6 Research Framework

To accomplish the objectives of this thesis, the research framework is designed and arranged as shown in Figure 1.1. First of all, the review of the current traffic situation in Phnom Penh city and its transportation future plan are expressed. It was found that traffic congestion and accident in the city were mostly caused by the motorists and also the lack of the public transportation in urban area. To solve this problem, Sky train, one of the more efficient modes of public transportation has been proposed by JETRO. The commuters may not be familiar with this new mode of transport. Therefore, the

investigation of several aspects including socioeconomic variables and psychological factors that can help explain the likelihood of sky train usage will be revealed in this research study. There is a very limited study of public transportation system, such as urban rail transportation system in Phnom Penh city.

Then, the background of theory of planned behavior and its application in transportation was reviewed. The theory of planned behavior (TPB) states that the attitude, subjective norm and perceived behavioral control are indirectly linked to behavior via intention. The theory has previously been successful in predicting such diverse behavior as choosing a career, deciding to donate blood, or deciding to use helmets, among many others (Ajzen, 2001). The theory has also been used in traffic safety research such as drinking and driving (Aberg, 1993), dangerous overtaking (Parker et al., 1992), close following (Parker et al., 1992) and land discipline (Parker, Manstead, and Stradling, 1995).

The pilot survey will be conducted to test the feasibility of the study, the readability and understandability of the questionnaires, and the efficiency of the developed survey forms. Following the pilot survey, a verification of the questionnaires and the whole structure of the survey was considered. The real data collection was collected with a larger sample size to assure the level of statistical significance. After the real survey, a database was created by cleaning and coding the raw data. These data were analyzed using SPSS and AMOS for descriptive statistics, reliabilities of TPB construct, estimated coefficients and further analysis. Finally, the estimation results were described and discussed.

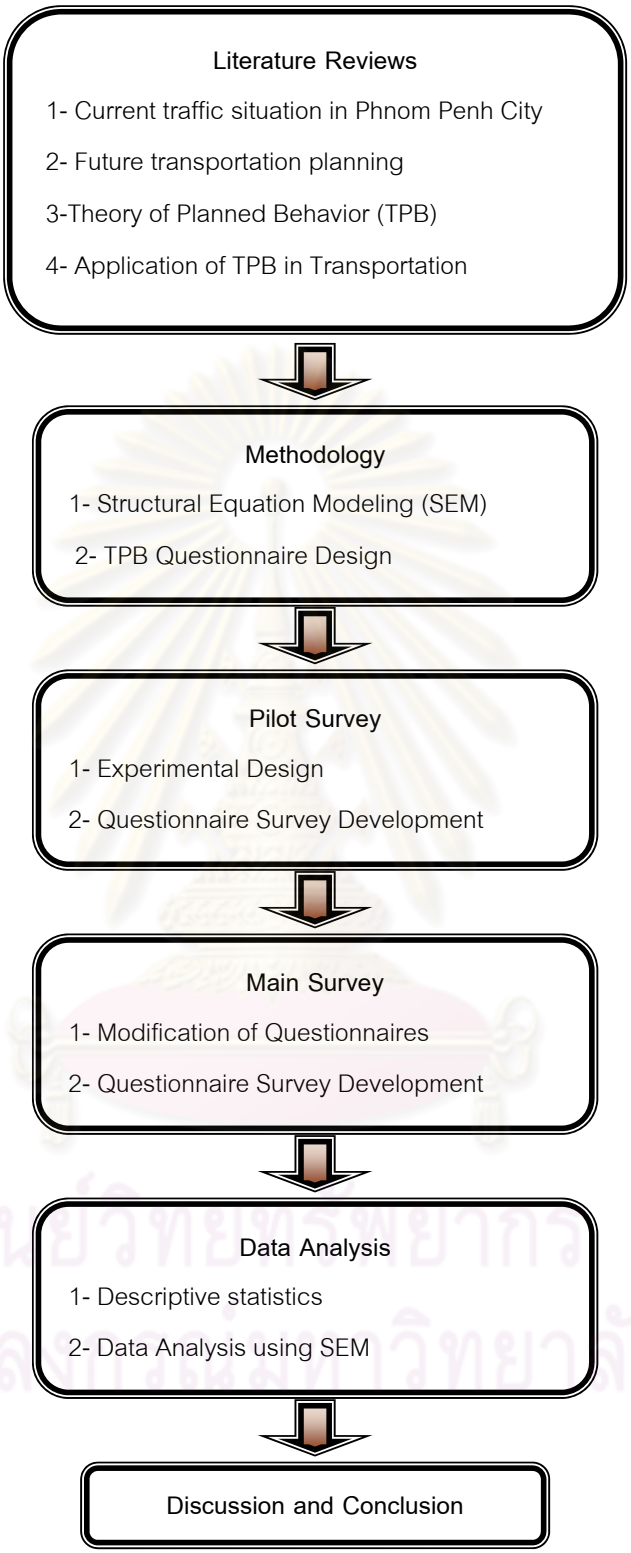



**Figure 1.1** Research Framework

## 1.7 Report Organization

The report of this study is organized into six chapters. Chapter one presents the introduction, problem statement, research objective, scope of study, expected results, research framework and report organization. Chapter two, literature reviews, gives the general background of Phnom Penh city, current traffic situation in Phnom Penh city, transportation planning in Phnom Penh, theory of planned behavior (TPB), application of TPB in transportation field, and summary of TPB applications. Chapter three, methodology, describes the structural equation modeling (SEM), TPB questionnaire design, pilot survey and main survey. Chapter four, descriptive statistics, represents the socio economic characteristics, trip characteristics and summarizes the result from the main survey. Chapter five, modeling results, describes model test and the results of SEM analysis models, which present the influence of the psychological factors and other additional variables on the behavioral intention towards future sky train usage and discussion. The last Chapter provides the conclusions and the future study.

# CHAPTER II

# LITERATURE REVIEW

## 2.1 Current Traffic Situation in Phnom Penh City

### 2.1.1 General Background of Phnom Penh City

Situated on the bank of the Tonlé Sap, Mekong and Bassac River, Phnom Penh City was established in 1434. A home to 1.37 million of the 14 million people or 14.3 percent of the total population in Cambodia, Phnom Penh City is noted for a place of great historical beauty and cultural attraction. Phnom Penh has been the main capital since France colonized Cambodia; it has become the center for the country's economic system and has grown to be the source of renowned industrial, commercial, cultural, tourist and historical centers, after 1979. Municipality of Phnom Penh consists of 7 districts, 76 communes and 637 villages. The population in Phnom Penh city consists of 2 communities: suburban community and urban community, covering 375 square kilometers, with density 4571.3 persons per square kilometer (MPP, 2005). From the Figure 2.1, it is found that ninety percent of land use in urban areas is made up of developments and amenities found in an urban setting and 70 percent of land use in suburban areas is occupied by natural and agricultural land use (JETRO, 2008).

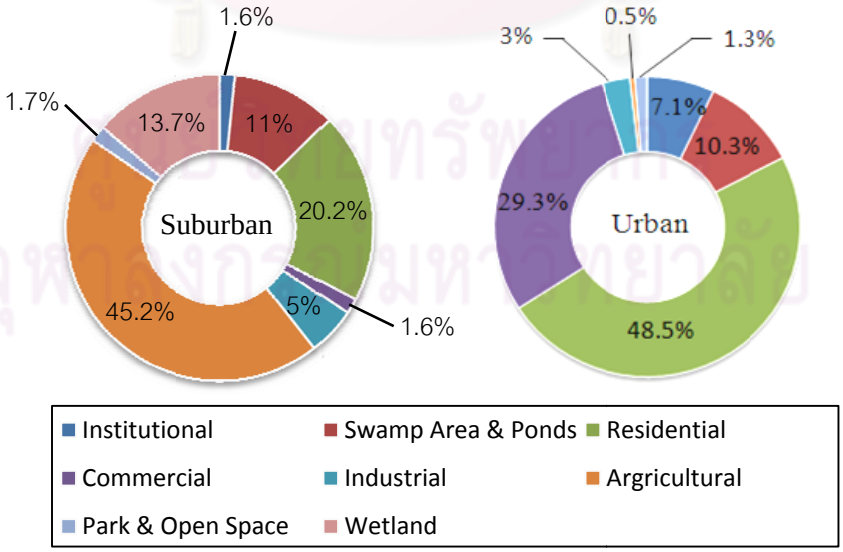



**Figure 2.1** Land Use of Phnom Penh City (JETRO, 2008)

The major institutional facilities such as government offices and tourist spots are concentrated in the eastern part of Monivong Boulevard. It has been observed that recently the urban development was done by the private sector in the city and surrounding area of the airport. From Table 2.1, among seven districts in Phnom Penh, 7 Makara is the smallest districts area (see Figure 2.2), which has the highest density of 50,767 persons/$Km^2$.

**Table 2.1** Population in Phnom Penh City by District (JETRO, 2008)

| No | District | Population | | | Area ($Km^2$) | | Density |
|---|---|---|---|---|---|---|---|
| | | 1998 | 2008 | AAGR | Total | Land | (Persons/$Km^2$) |
| 1 | Chamkar Mon | 187,082 | 190,075 | 1.002 | 9.60 | 9.30 | 20,526 |
| 2 | Daun Penh | 131,913 | 124,064 | 0.994 | 7.30 | 5.40 | 23,017 |
| 3 | 7 Makara | 96,192 | 108,640 | 1.012 | 2.20 | 2.10 | 50,767 |
| 4 | Toul Kok | 154,968 | 172,461 | 1.011 | 8.00 | 7.80 | 22,054 |
| 5 | Dangkor | 92,461 | 185,389 | 1.072 | 187.90 | 181.70 | 1,020 |
| 6 | Mean Chey | 157,112 | 264,836 | 1.054 | 50.90 | 40.20 | 6,591 |
| 7 | Russey Keo | 180,076 | 280,216 | 1.045 | 107.90 | 88.30 | 3,172 |
| Total | | 999,804 | 1,325,681 | 1.029 | 373.80 | 334.80 | 3,960 |

The total population in Phnom Penh is estimated to be 2.2 million people in 2020 with 1,260 US Dollars of GDP (see Table.2.2). The number of registered vehicles in 2010 is approximately 911,324 vehicles and this number has been increasing annually and is estimated to be 1,180,505 vehicles in 2020 (JETRO, 2008).

**Table 2.2** Summary of Future Socio-economic Characteristics (JETRO, 2008)

| Year | | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| Population (1,000) | | 1,065 | 1,228 | 1,391 | 1,554 | 2,200 |
| GDP per Capita (US$) | | 288 | 455 | 822 | 1,152 | 1,260 |
| Registered No. of Vehicles | Total | 328,504 | 485,827 | 911,324 | 1,085,568 | 1,180,505 |
| | 4-wheel | 61,357 | 105,862 | 206,792 | 250,940 | 274,994 |
| | 2-wheel | 267,147 | 379,965 | 704,532 | 834,628 | 905,511 |

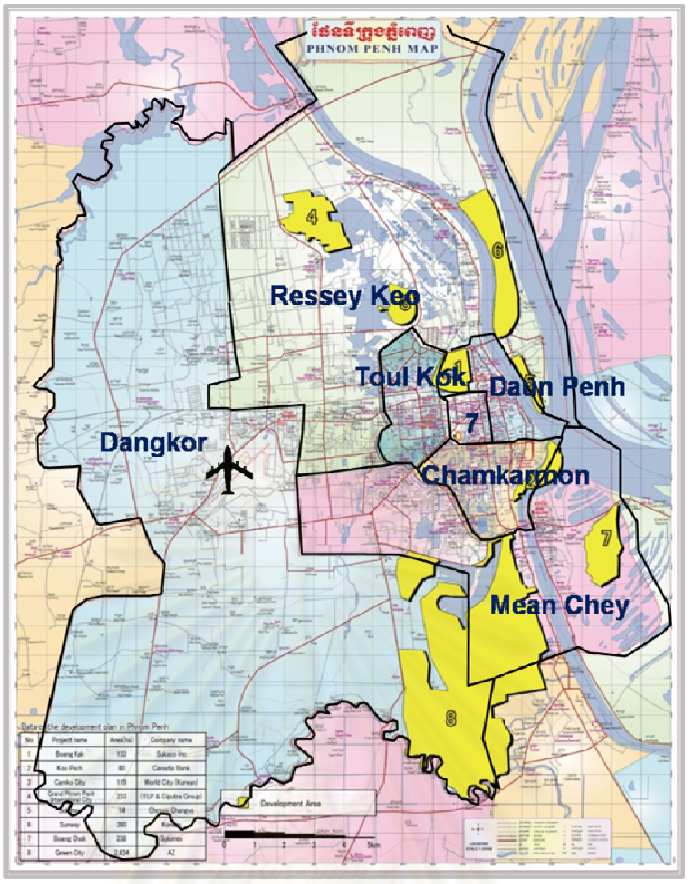



**Figure 2.2** Map of Phnom Penh City by District (JETRO, 2008)

### 2.1.2 Road Network

Roads in Phnom Penh city are well-connected but the roads in suburban areas have many missing links and the network is incomplete (see Figure 2.3). Some road sections are inundated and become impassable in the rainy season. Some geometric forms of road intersection, especially arterial roads, are not favorable to the existing number of vehicles passing through and also the existing ring roads have become inner ring roads due to city development and expansion. Whereas the paved condition of major roads is not always good and traffic congestion sometimes can occur not only because of the increased traffic volume but also because of flooded roads especially during the rainy season (JICA, 2001).

Eighty percent of total traffic is made up of motorcycles. Radial and ring roads with large number of traffic volume was observed as having serious traffic congestion especially at morning and evening peak hours (JETRO, 2008).

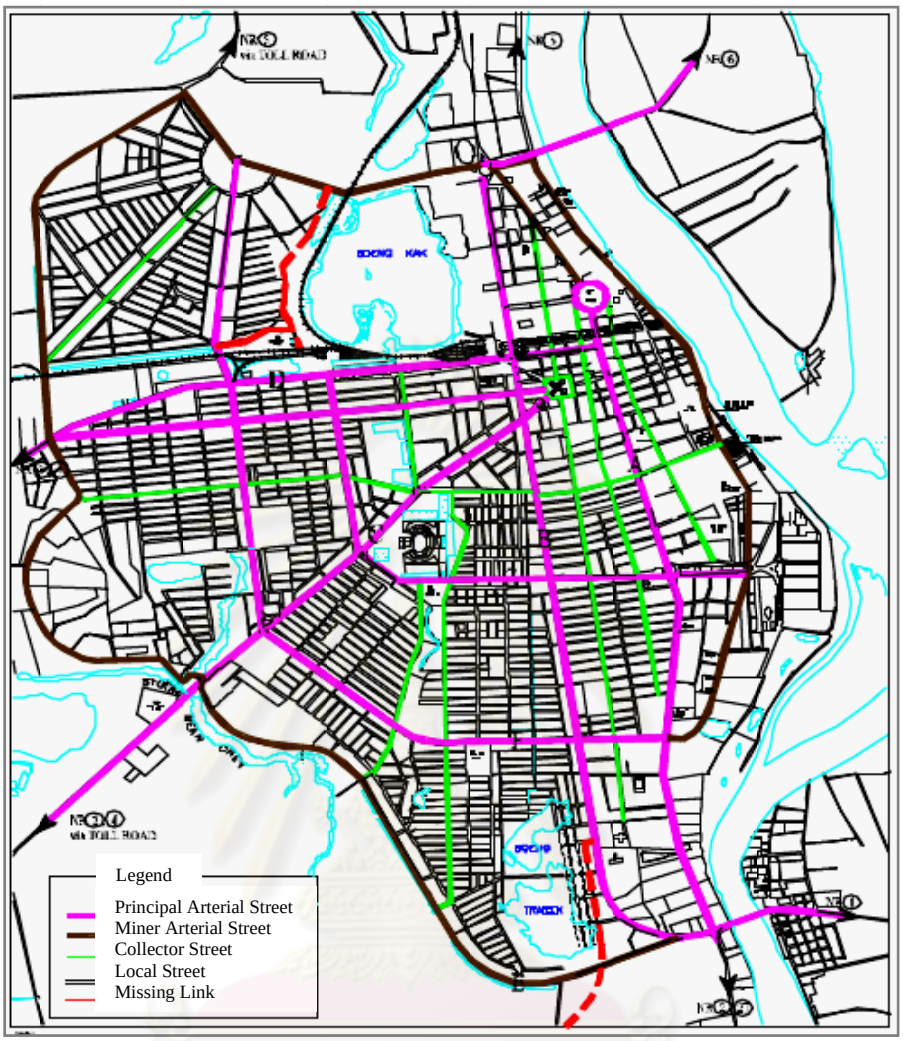



**Figure 2.3** Road Network in Urban Area (JICA, 2001)

Sambath et al. (2005) reported that the traffic condition in Phnom Penh city has been becoming worse because of the population growth and non improvement of transport system. In this sense, the urban area has sprawled and travel demand has already exceeded the supplies causing the traffic congestion. The traffic congestion has caused the reduction of economic activities and the augmentation of transport cost, which strongly affect the metropolitan economy. At the same time, air and noise pollution has also occurred (see Figure 2.4). Moreover, traffic congestion has a significant impact on the communities' livability. It hinders the ability to attract residents and business and degrades the quality of local's lives.

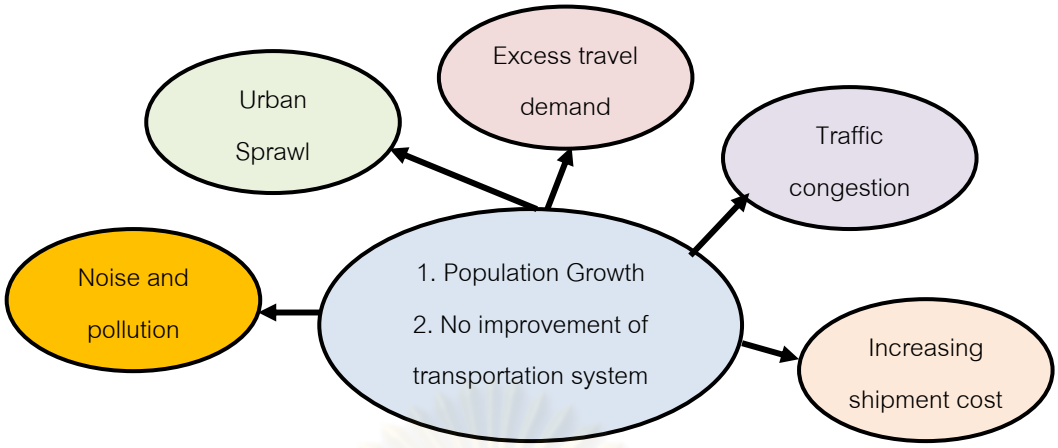



**Figure 2.4** Traffic Problems in Phnom Penh (Sambath et al., 2005)

### 2.1.3 Traffic Management

In 2001, JICA conducted a study on Urban Transport Master Plan in Phnom Penh metropolitan area to solve transport problems and to maintain and sustain the urban development in the city (JICA, 2001). JICA study pointed out the following problems of the traffic management:

1. Deteriorated road conditions and inappropriate road facilities, which lead to the traffic concentration on the major roads and finally cause traffic congestion, especially at major intersections.

2. Inefficient traffic control typically exemplified by insufficient number of traffic signals and inefficient out-dated existing traffic signals, insufficient and inappropriate traffic signs and pavement markings, inadequate configurations of intersections and roundabouts, and inadequate traffic enforcement.

3. Illegal usage of sidewalks by vendors and owners of roadside shops force the pedestrians to walk on the carriageway and put them in a dangerous situation.

4. Lack of discipline of drivers and pedestrians also causes traffic congestion and increases the traffic accident cases.

5. Lack of public transport services, which results in domination of inefficient private transportation means and para-transit, especially motorcycles and motorcycle taxi (Motodup) which cause traffic congestion, high traffic accident and air pollution.

In 2007, the Municipality of Phnom Penh (MPP) and Japan International Cooperation Agency (JICA) conducted a “Project for Traffic Improvement in Phnom

Penh City" (PTIPP) to improve urban traffic condition by reducing traffic congestion and traffic accident through the implementation of appropriate traffic management by 3Es: Intersection improvement (E1: Engineering), traffic safety education to drivers (E2: Education), and traffic enforcement by traffic police (E3: Enforcement) as shown in Figure 2.5. These concepts were tested at 2 intersections in Phnom Penh city in 2007 and were applied to other intersections in the city in 2008 (PTIPP, 2009).

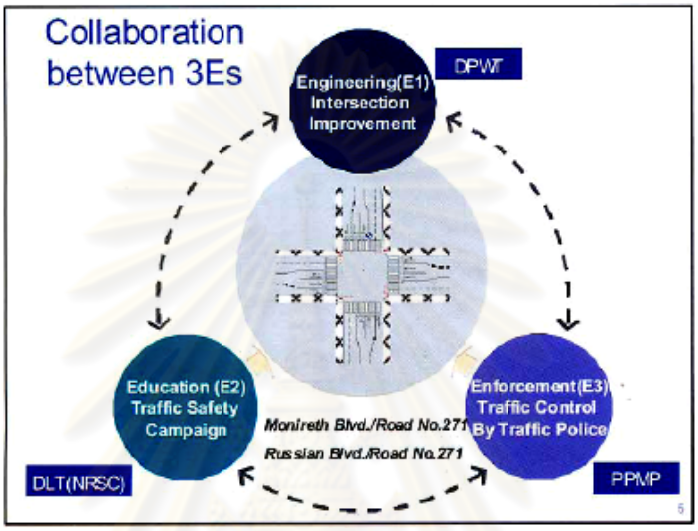



**Figure 2.5** PTIPP Concepts (PTIPP, 2009)

### 2.1.4 Public Transportation in Phnom Penh

Various modes of public transport are currently operated in Phnom Penh city. There are mainly eight modes of public transport operating in Phnom Penh. Mostly, transport system is dominated by private transport modes, which result in higher risk of accidents and less reliability (JICA, 2001).

- Buses and taxi-buses are mainly operated for the inter-city service. Van, pick up and sedan are used for taxi-bus. Taxi-bus has special routes but sometimes they assume the function of hired taxis according to the request of passengers. Bus terminals are mostly located near the market, where the traffic congestion often occurs because of merging of large number of buses and taxi-buses.
- Taxi-Car mostly stands by at the airport waiting for the passengers. There are insufficient taxi-cars running in the city center.

Taxi-car

Motorcycle taxi (Motodup)

Tricycle (cyclos)

Three wheels motor-taxi (Tuk-tuk)

Inter-city Van

Inter-city bus

Para-transit: Motorumoks

**Figure 2.6** Major Public Transport Modes in Phnom Penh City

- Motorcycle-taxi and three-wheel motor-taxi are a kind of para-transit. They are the major public transport mode in the city area. However, they are also a primary contributor of the traffic problems on the roads (dangerous and uncomfortable for passengers).
- Tricycle (cyclos) is also a common public transport mode, which mostly operate for short-distance transport. Today, it is used for goods transportation. Recently, the number of cyclos has drastically decreased due to the slow speed and the friction with other vehicles on roads.
- Another Para-transit is Motorumoks, which are operated in the suburban area and mainly used by factory workers to commute and by farmers to transport their product to the market.
- Railways are operated by Royal Railways of Cambodia. Railway network consists of 2 routes in the country, but is not used for urban transport.
- River transport is operated on 7 routes: 3 intra-city and 4 inter-city services.
- Air transport is operated on international routes and domestic routes within 2 international airports: Phnom Penh International Airport and Siem Reap International Airport (JICA, 2001).

## 2.2 Transportation Planning in Phnom Penh

The fast growing population and urban development of Phnom Penh has recently caused several traffic problems. Firstly, the numbers of vehicles circulating through the city and daily trips have been increasing due to an increase in urban population. Secondly, the capacity of road network in both urban and suburban areas, including national roads, cannot support the growing traffic demand, and the pavement status is generally in poor conditions; the traffic issues have become worse and are contributing to the social problems of Phnom Penh metropolitan area. Municipality of Phnom Penh is working hard on traffic improvement project. Based on the Phnom Penh metropolitan traffic master plan done by JICA in 2001, it was found that the Municipality of Phnom Penh has to undertake road improvement projects for 55 lines of road network with a total length of 73 km (JICA, 2001).

Based on the future master plan in 2020 reported by JETRO, road transport and the development of public transport system in Phnom Penh city was planned to support the decentralized urban structure (4 inner cities) with 2.2 million population (see Figure 2.7). Based on the radial ring-road network for the future public transport system, rail transit and bus transport system will be introduced inside the urban area not only inner city but also sub-cores.

It was found that western transport corridor has high priority for introduction of public transport system (See Figure 2.7). Among 3 corridors (Figure 2.7), the western transport corridor has the largest public transport demand of 480,000 person trips in 2020 (JETRO, 2008). The current development conditions and the location of major urban vital facilities corridor development are ongoing along western transport corridor where Phnom Penh International Airport, the largest mode interchange area is located.

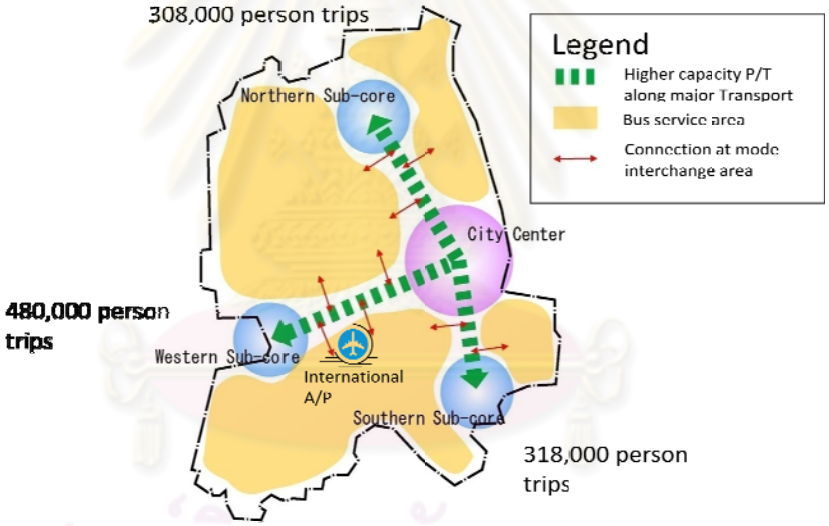



**Figure 2.7** Public Transport Systems (JETRO, 2008)

In order to resolve the increasingly serious traffic problems in the metropolitan area, a feasibility study on public transportation systems of Phnom Penh Sky Rail (airport line) was conducted by JETRO. It is necessary to construct a new rail system which will provide a smooth, reliable, environmentally friendly and safe transit system along the selected corridor with adequate passenger capacity. This rail system will improve the convenience of Phnom Penh citizens, the business community and tourists from other countries. It also will prevent economic loss and discouragement of workers, shoppers and students due to chronic traffic congestion (JETRO, 2008).

From Figure 2.8, the future public transportation system in Phnom Penh City has been well planned. There will be 3 main lines of urban rail transports system and public bus system running in Phnom Penh city. The urban rail systems are designed to link traffic from the suburban-cores to downtown. Roads will be improved to have a specific lane for cars, motorcycles, and pedestrians.

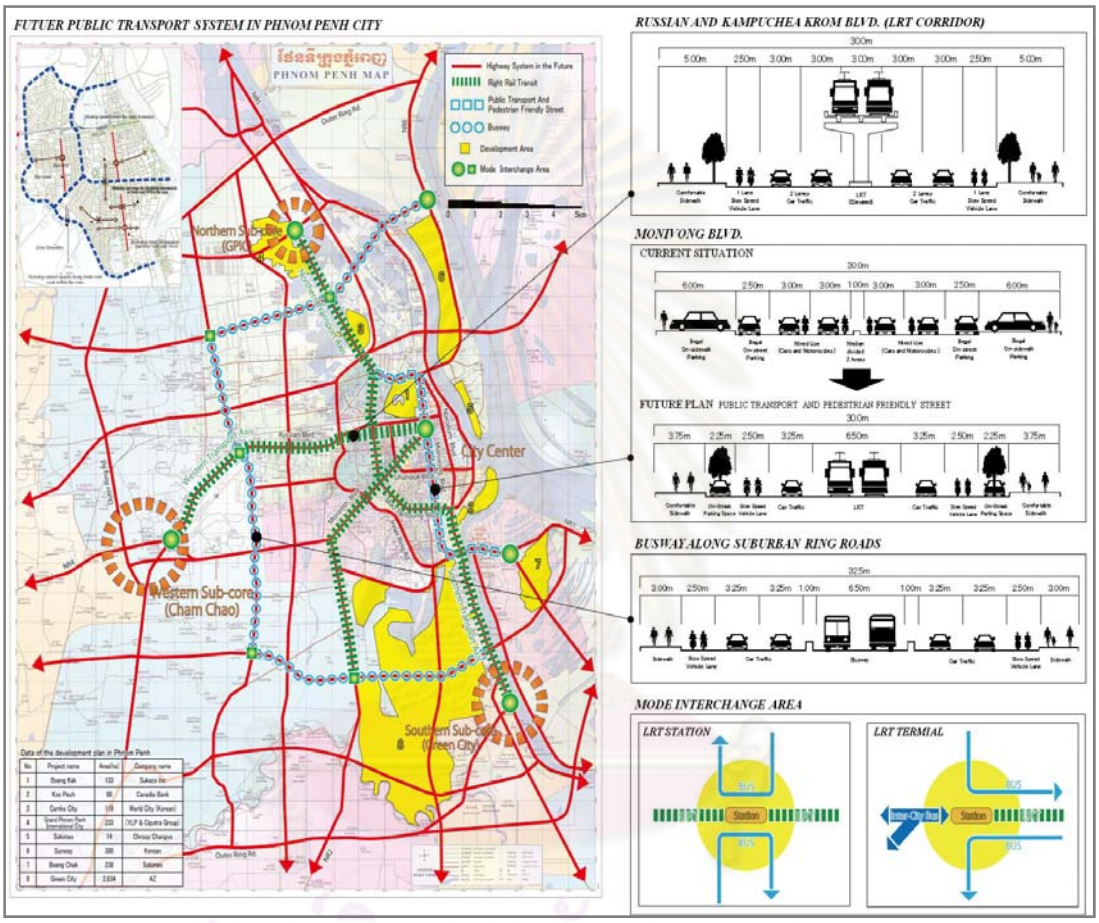



**Figure 2.8** Future Public Transport Systems in Phnom Penh (JETRO, 2008)

### 2.2.1 Sky Rail Airport Line Project

The total length of the sky rail airport line is approximately 10 Km including the depot. This proposed route corridor starts from New Central Market to Phnom Penh International Airport along Kampuchea Krom and Russian Boulevard. It is an elevated viaduct structure that uses precast segmental system for the guide-way superstructure and piers which are located in the median of the main roads (see Figure 2.9). This sky rail airport line totally has 7 stations, 3 substations and 1 depot (see Figure 2.10). Terminal stations and intermediate stations are constructed with island platforms and

separate platforms given the ease of construction work, the good visibility and the line alignment. The effective length of each platform is about 60m except for station 1, the city terminal, which should be extended to 65m to accommodate a buffer stop. There will be a concourse floor at station 7, the airport terminal, considering access to the airport building, and the future line extension plan. The other stations are constructed without a concourse floor to reduce the construction cost (JETRO, 2008).

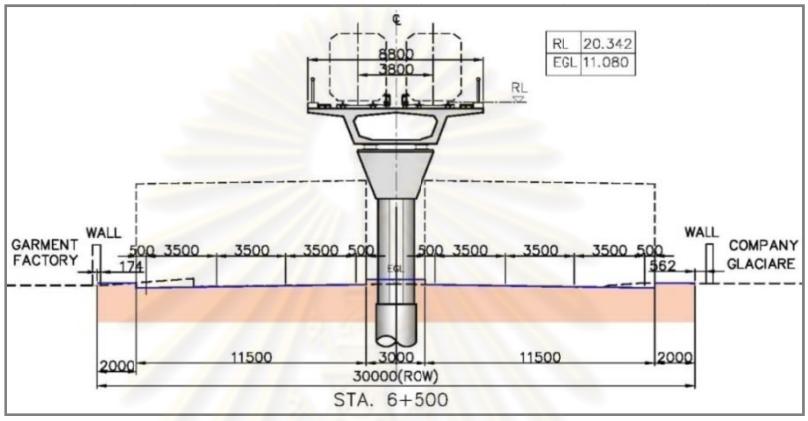



**Figure 2.9** Sky Rail Cross Section on Russian Boulevard (JETRO, 2008)

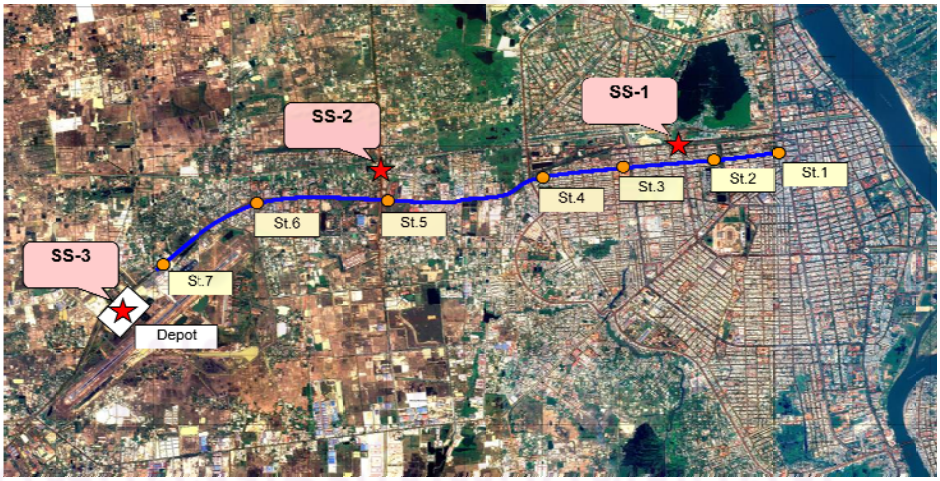



**Figure 2.10** Sky Rail Overall Plan including Stations and Substations (JETRO, 2008)

The construction cost of this project is about US$ 309.3 million and land acquisition cost for depot and stations is approximately US$ 55.3 million (2008 year's cost). Based on the feasibility study, project implementation schedule, the construction of civil work of this project will start in 2014.

### 2.2.2 Train Operation Plan

Based on the project implementation schedule, the operation of the sky train will start in 2017. From the Table 2.4, the prediction of the number of passengers in starting year, 2017, is approximately 5500 people per hour per direction and this number is predicted to be 8600 people per hour per direction. The train will operate 17 hours per day starting from 5 a.m. to 10 p.m. with the speed of 30 km per hour. The required number of trains to operate in an hour is 8 trains.

**Table 2.3** Sky Rail Operation Plan at Starting Year (JETRO, 2008)

| Items | Year 2017 |
|---|---|
| Transportation volume | 5,500 p/ph/direction<br>(8,600 p/ph/direction in 2020) |
| Train operation hours | 17 hours (5am to 10pm) |
| Scheduled train speed | 30 Km/h |
| Station dwelling time | 30secs (way stations)<br>1min. (terminals) |
| Turn back time at terminals | 5 mins. |
| Train controls system | CS-ATC, ATO with driver |
| Normal train capacity | 384 passengers |
| Max load factor in peak hour (approx.) | 180% |
| Max train capacity in peak hour | 690 passengers |
| Required number of trains operating per hour (min. headway) | 8 trains (every 7.5mins) |
| Time required for one round trip train operation | 45 minutes |
| Required number of trains (spare trains) | 21 (3) |

### 2.2.3 Traffic Demand Forecasting

JETRO conducted some surveys to measure the traffic demand and road user's attitudes for sky rail system. They are the manual traffic count survey, travel speed survey, vehicle occupancy survey, and social survey.

#### 1. Manual Traffic Count Survey

Manual traffic count has been conducted and counted by vehicle types and directed by using hand tally counter. Manual traffic count has been carried out from 6

a.m. to 10 p.m. in principal. The surveys were done in 6 selected locations along the Kampuchea Krom Boulevard and Russian Boulevard (see Figure 2.11). There were 7 types of vehicles counted: passenger car or pick up, mini bus or van, standard bus or large bus, medium or large truck, motorumok or tuk-tuk, motorcycle or motordop, and bicycle (JETRO's report, 2008).

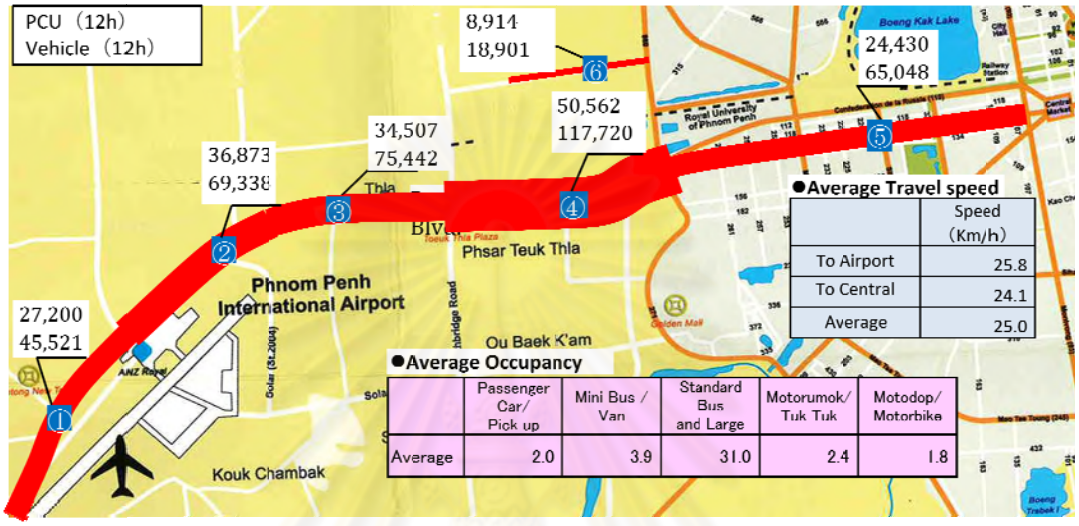



Figure 2.11 Location of Traffic Survey (JETRO, 2008)

2. Travel Speed Survey

Travel speed survey was done by floating car method. Two cars were arranged at two locations: start and end point. Travel speed have been conducted only during peak hour and started every one hour. There were nine check points along this corridor. Travel distance, travel time, stopping time was noted at each check point (JETRO's report, 2008). It was found that the minimum travel speed is 21.23 Km per hour whereas the maximum travel speed is 32.30 km per hour. The average travel speed along this corridor is 25 Km per hour. It can be observed that the traffic along this corridor runs smoothly in morning around 6 am and starts to get congested from 5 p.m. to 6 p.m. for the direction of Central market to suburban area (JETRO, 2008).

3. Vehicle Occupancy Survey

JETRO also did the vehicle occupancy survey which was conducted by manually observation of the number of passengers per vehicle by vehicle type. The numbers of passengers per vehicle in both directions of corridor were counted. It was found that the number of passengers per vehicle by vehicle type in both directions was

quite similar. In conclusion, the occupancy of bus, car, van and motorcycle along this study line was respectively 31, 2.0, 3.9 and 1.8 (JETRO, 2008).

4. Social Survey

The social survey was carried out in order to grasp the transportation user's attitude for sky rail system. This survey was done at two locations: Russian Boulevard near Pet lork Sang intersection and Phnom Penh international airport (JETRO, 2008). The survey form was divided into 3 sections asking about the general information, trip information and personal information. The survey form is shown in Appendix A.

It was found that the average of the modal share is 73% of motorcycle, 15% of cars and 4% of minibuses and vans (see Figure 2.12). From Figure 2.13, almost 100 percent of the respondents intend to use sky rail airport line. In terms of the fare, 80 percent of the respondents were willing to use sky rail if the fare is less than 3,000 Riels (see Figure 2.14).

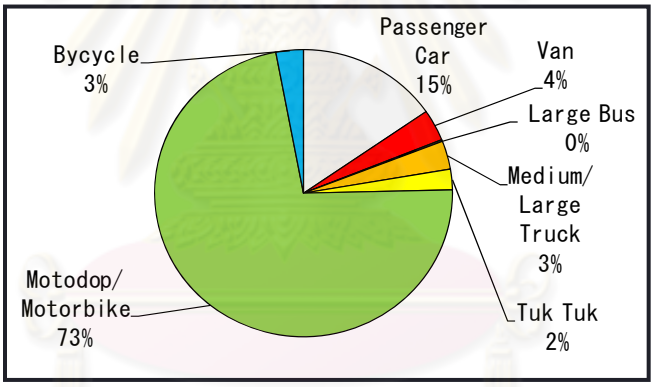



**Figure 2.12** Modal Shares (JETRO, 2008)

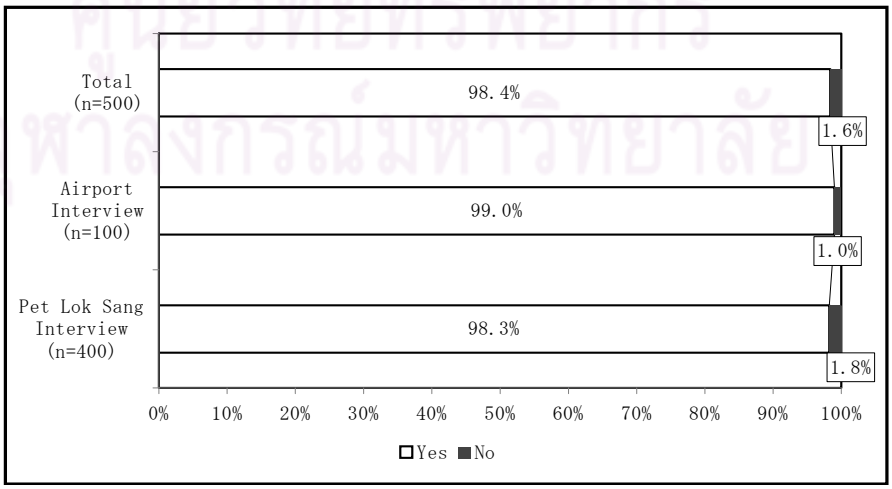



**Figure 2.13** Willingness of Sky Rail Use (JETRO, 2008)

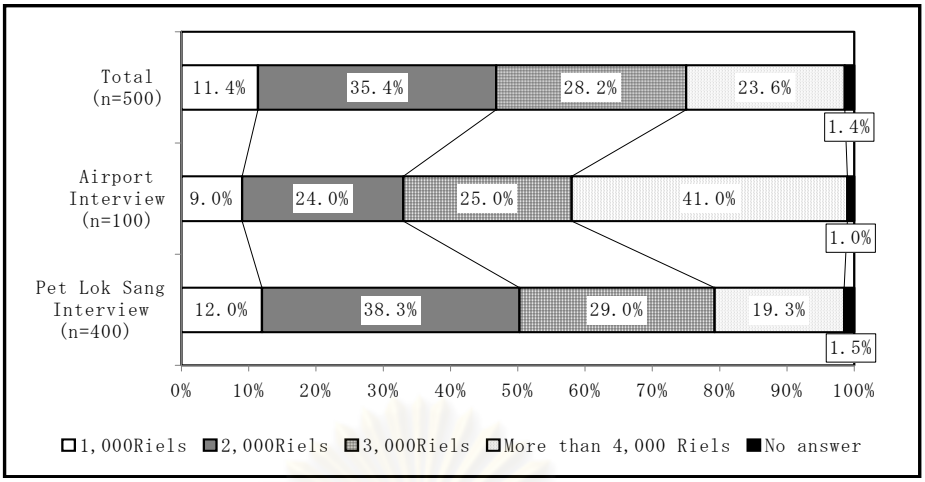



**Figure 2.14** Fare Level of Sky Rail Airport Line (JETRO, 2008)

## 2.3 Theory of Planned Behavior (TPB)

Given aforementioned traffic issues, the main traffic management issues are the number of motorcycles and an insufficient urban public transportation system, which is why a new public transportation system, sky rail, has been planned in order to provide high mobility services between the urban core and suburban core, to minimize social impact and to minimize the traffic congestion by reducing the conflicting traffic. The travel demand management (TDM) or mobility management (MM) can be used to induce commuter to use more public transportation. However, the commuters along this corridor may not be familiar this new system. It is necessary to understand the psychological factors and commuter's intention of using future urban rail transport. Therefore, the investigation of psychological factors including socioeconomic variable and other variables will be revealed in this study. Theory of Planned Behavior (TPB) will be used as a methodology in this research study in order to know the factors affecting the commuters' intention and behavior.

The Theory of Planned Behavior (TPB) was proposed by Icek Ajzen in 1985 through his article "From intentions to actions: A theory of planned behavior" (Wikipedia, 2009). The theory was an extension of the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1975, 1980). The theory is grounded in various theories of attitude such as learning theories, expectancy-value theories, consistency theories and attribution theory. The TPB is a well-researched model which was widely used in explaining in predicting human behavior across a variety of disciplines (Ajzen, 1991).

Theory of Reasoned Action (TRA) suggests that a person's behavior is determined by intention to perform the behavior and that intention is a function of attitude toward the behavior and subjective norm (Ajzen, 1985). However, an additional construct of perceived behavioral control (PBC) which was an antecedent variable affecting both intention and behavior has been added to the TRA model. TRA could adequately predict behaviors under volitional control but under circumstances where there are constraints on action, the mere formation of an intention is insufficient to predict behavior (Yang and Hsiao, 2010). The best predictor of behavior is intention. Intention is the cognitive representation of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior. This intention is determined by three things: their attitude toward the specific behavior, their subjective norms and their perceived behavioral control. According to the theory of planned behavior, people's attitude towards the behavior, their subjective norm, and their perceived behavioral control determine their behavior indirectly via their intentions (see Figure 2.15). People's attitude towards a behavior is determined by their beliefs about the likely consequences of the behavior, their subjective norm is determined by their beliefs about the normative expectations of important others and their perceived behavior control is determined by their beliefs about the presence of factors that may facilitate or obstruct the performance of the behavior. The intention is defined as a willingness to try to perform the behavior and the behavior refers to a defined action. The more positive a person's attitude and subjective norm is, and greater their perceived control, the stronger is their intention to perform the behavior (Ajzen, 1991). As a general rule, the more favorable the attitude, the subjective norm and the greater the perceived control, the stronger the person's intention to perform the behavior in question. The TPB is regarded as one of the psychological theories that have been applied in the travel behavior research in predicting travel behavior.

***Attitude toward the behavior*** is defined as the individual's positive or negative feelings about performing a behavior. It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences (Eagly et al., 1993). Jillian et al. (2004) defined that attitude is a person's overall evaluation of the behavior. It is assumed to have two

components which work together: beliefs about consequences of the behavior (behavioral beliefs) and the corresponding positive or negative judgments about each these features of the behavior (outcome evaluations). Attitude toward behavior is a function of the product of one's important belief (B) that performing the behavior will lead to certain outcomes, and an evaluation of the outcomes (E) (Chang, 1998). Attitude thus is defined as: $AT = \sum B_i E_i$

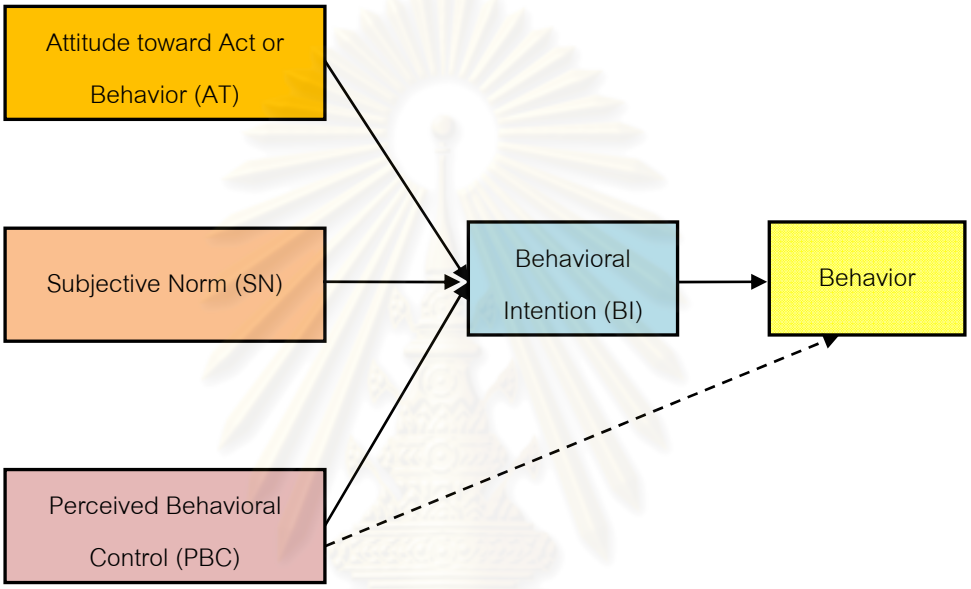



**Figure 2.15** Theory of Planned Behavior (TPB)

***Subjective norm*** is defined as an individual's perception of whether people important to the individual think the behavior should be performed (Eagly et al., 1993). Jillian et al. (2004) defined that subjective norms are a person's own estimate of the social pressure to perform or not perform the target behavior. Subjective norms are assumed to have two components which work in interaction: beliefs about how other people, who may be in some way important to the person, would like them to behave (normative beliefs or descriptive) and the positive or negative judgments about each belief (injunctive). Subjective Norm is a function of the product of one's normative belief (NB) which is the "person's belief that the important referent thinks he should (or should not) perform the behavior" (Ajzen and Fishbein, 1980), and his or her motivation to comply (MC) to that referent (Chang, 1998). Thus Subjective Norm can be defined as: $SN = \sum NB_i MC_i$

***Perceived behavioral control*** is defined as one's perception of the difficulty of performing a behavior. The PBC views the control that people have over their behavior as lying on a continuum from behaviors that are easily performed to those requiring considerable effort, resources, etc (Eagly et al., 1993). Jillian et al. (2004) defined that perceived behavioral control is the extent to which a person feels able to enact the behavior. It has two aspects: how much a person has control over the behavior (controllability); and how confident a person feels about being able to perform or not perform the behavior (capability). Perceived Behavioral Control is a function of control beliefs (CB) and perceived facilitation (PF). Control belief is the perception of the presence or absence of requisite resources and opportunities needed to carry out the behavior. Perceived facilitation is one's assessment of the importance of those resources to the achievement of outcomes (Ajzen and Madden, 1986). PBC can be defined as $PBC = \sum CB_i \, PF_i$

## 2.4 Application of TPB in Transportation

The theory of planned behavior has previously been successful in predicting such diverse behaviors as choosing a career, deciding to donate blood, or deciding to use helmet, among many others. The theory has also been used in transportation research to predict behavior. For example, in Taiwan Yang and Hsiao (2010) applied the TPB to understand travelers' intention to take high speed rail among college students. High speed rail system was launched in 2007. The study added two constructs, namely, novelty seeking and trust to the model of theory of planned behavior. The sample size was collected from 300 Taiwanese students. Results indicated that attitude, subjective norm and perceived behavioral control are found to have positive effects on the behavioral intention of taking high speed rail. Novelty seeking and trust also found positively influence on attitude and three antecedents of the intention in taking high speed rail.

In Taiwan, Lam and Hsu (2006) investigated the behavioral intention of choosing a travel destination applying the theory of planned behavior (TPB) model as a research framework. The study was an extension of TPB by adding one more variable, past behavior, on the core constructs variable (attitude, subjective norm, and perceived

behavioral control). The study sample comprised 299 potential Taiwanese travelers to Hong Kong. This study has found that subjective norm, perceived behavioral control, and past behavior, but not attitude had direct impact on behavioral intention of choosing a travel destination among Taiwanese potential visitors to Hong Kong. Subjective norm had the greatest effect on behavioral intention of visiting Hong Kong. That is, the intention was associated with perceived social pressure from important referents of Taiwanese residents. Attitude did not play any significant role in affecting the behavioral intention of choosing Hong Kong as a travel destination when important referents and inhibiting factors existed.

Other application of the Theory of planned behavior (TPB) was conducted by Elliot et al. (2003). The theory of planned behavior was applied to driver's compliance with speed limits. In the study, data were collected from 598 drivers at 2 time points by using questionnaires including TPB variables, demographic information, self-reported prior behavior and self-reported subsequent behavior. Results showed that attitude, subjective norm and perceived behavioral control were positively associated with behavioral intention of compliance with speed limits. TPB variable mediated the effects of age and gender on behavior.

Warner and Aberg (2006) applied the TPB to investigate the driver's decision to speed. The study predicted the driver's everyday speeding behavior, using the structural equation modeling. It was found that the independent variables stipulated in the theory afforded a level of prediction of driver's self-reported speeding as well as of their logged speeding. Attitude towards speeding, subjective norm, and perceived behavioral control were significant determinants of self-reported speeding. Self-reported speeding and subjective norm contributed to the prediction of driver's logged speeding. Whereas perceived behavioral control did not directly contribute may be due to the possibility that drivers with several years of experience already take into account the actual control.

In Sweden, Forward (2009) extended the theory of planned behavior (TPB) to predict the intention to commit two different driving violations: speeding in an urban area and dangerous overtaking by adding descriptive norms, past behavior, perceived ease and perceived risk in the core structure of TPB. In this study, questionnaire was mailed

to 500 people drawn from the public driving license records. The questionnaires included two different driving scenarios: speeding in an urban area and dangerous overtaking. The outcome of this study found that all variables within TPB are significant relationship. Descriptive norms and past behavior presented the strongest relationship with intention to violate. It also found that the effect of descriptive norms is greater in a situation described as risky. The effect of age and annual mileage were significant with regard to speeding indicating that young drivers and those who use the car regularly are more likely to speed. Similar study in France done by Letirand and Delhomme (2005) applied the TRA and TPB to predict and understand the speed behavior focusing on exceeding and not on observing the speed limit. This study examines whether the evaluation of exceeding but also of observing the speed limit contributes to improving predictions of self-reported speed behavior and determining intentions to produce each of these two behavioral options.

Similarly in Belgium, Paris and Broucke (2008) applied the TPB to measure cognitive determinants of speeding. The study described the development and validation of a self-report questionnaire to measure the determinants of speeding behavior in road traffic based on the theory of planned behavior. The sample size were collected from 116 drivers with a provisional questionnaire measuring self-reported speeding behavior as well as its determinants as predicted by the TPB model, namely, attitudes towards speeding and towards respecting speed limits, social norms, perceived behavioral control, and intentions. Results showed that intentions were the most strongly predicted by explicit social norms and negative attitude towards respecting speed limits. Self-reported speeding was predicted by intention and perceived internal control. In contrast, actual speeding behavior was not significantly predicted by intentions and perceived control. The study demonstrates the validity of the theory of planned behavior to predict self-reported speeding behavior and provides a valid and reliable measure of the cognitive concepts featured in this model, but suggests that actual speeding behavior can only partially be predicted from these concepts.

In Chile, Díaz (2002) applied the TPB to investigate pedestrians' intentions to violate traffic regulations. In this study, pedestrians' attitudes towards traffic violations

and self-ratings of violations, errors and lapse were measured among a sample of 146 pedestrians. The reported violations, errors and lapses appear causally related to the intention to violate regulations and this in turn with positive attitudes, subjective norms and perceived behavioral control. It was found that young people have more positive attitude towards committing violations as pedestrians than adults; men are more frequent violations of the traffic rules than women.

In Canada, Abrahamse (2009) investigated the factors influencing the car use for commuting and the intention to reduce it in a sample of Canadian office workers. The results showed that car use for commuting was mostly explained by variables related to individual outcomes (perceived behavioral control and attitudes) whereas the intention to reduce car use was mostly explained by variables related to morality (personal norms). The study also found that perceived behavioral control moderated the relation between personal norms and behavioral intentions: stronger personal norms were associated with stronger behavioral intentions, but only when perceived behavioral control was low.

In Thailand, Choocharukul et al. (2007) extended the theory of planned behavior (TPB) to investigate the behavioral intention of using private car in the future work trips. The questionnaire survey was used to measure several psychological variables related to private car use for future work trips after graduation of undergraduate students. Besides, the 3 main variables of the behavioral intention: attitude, subjective norm, and perceived behavioral control, moral obligation was added as a variable to predict the behavioral intention of private car use. In the study, 156 undergraduate students who were in their senior year and were expected to graduate in the next few months were asked. Results from the structural equation models revealed that the behavioral intention of driving to work after graduation was significantly influenced by attitude, subjective norm and moral obligation. However, the perceived behavioral control did not significantly influence the behavioral intention of driving to work after graduation.

In Vietnam, Van and Fujii (2007) investigated attitudinal aspects of six travel modes currently used in Ho Chi Minh City, and examined the relationship among psychological constructs following Theory of Planned Behavior (TPB). The sample size were collected from 208 people in public place using measures on attitudes, perceived

behavioral control (PBC), subjective norm, moral obligation and intention for travel mode choices. The study applied three attitudinal factors into the TPB constructs, namely, symbolic affective, Instrumental and Social Orderliness. Results showed that all the constructs (attitude, subjective norm, PBC, and moral obligation) explained high significant proportions of the intentions' variances. Results found that TPB was potential for predicting the behavioral intention of mode choice in HCM City.

In England, Norman and Evans (1998) applied the TPB to predict pedestrians' road crossing intentions. The responses were collected from 210 of road users. The respondents were ask to complete the questionnaires which included scenarios of three potentially dangerous road crossing behaviors, namely, dual carriageway, pelican crossing and residential road, followed by measures of attitude, subjective norm, perceived behavioral control, self-identity and intention. Results from the study indicated that the social psychological variables under consideration were able to explain 39 and 52 percent of the variance in intention to across the road in the manner depicted in the scenario. The perceived behavioral control was found to be the strongest predictor of the pedestrians' road crossing intentions. Another study in England, Poulter et al. (2008) applied the TPB to truck driving behavior and compliance with regulations. The study was conducted with truck drivers to help understand driving and compliance behavior. Path analysis examined the ability of the TPB to explain the direct and indirect factors involved in self-reported driving behavior and regulation compliance. Law abiding driving behavior in trucks was related more to attitudes, subjective norms and intentions than perceived behavioral control. For compliance with UK truck regulations, perceived behavioral control had the largest direct effect.

In China, Zhou et al. (2009) investigated the effects of age, gender and conformity tendency on Chinese pedestrians' intention to cross the road in potentially dangerous situations. A sample of 426 respondents were asked to complete a demographic questionnaire, a scale measuring their tendency towards social conformity, and a questionnaire based on the theory of planned behavior (TPB). This questionnaire measured people's intentions to cross the road in two different road crossing situations, their attitude towards the behavior, subjective norms, perceived behavioral control, anticipated affect, moral norms, and perceived risk. Results from the

study showed that people who showed greater tendencies towards social conformity also had stronger road crossing intentions than low conformity people. Attitude, subjective norm, perceived behavioral control, and perceived risk are found to be significant predictors of behavioral intention of road-crossing. Age also emerged as a significant predictor of intentions to cross the road. It was found that older pedestrians would be less likely to intend to cross road whereas there were no gender differences in road crossing intentions.

In Norway, Iversen (2004) investigated whether attitudes towards traffic safety issues are predictors for future risk behavior in traffic. The study examined the identical item tools measuring attitude and behavior among 1640 drivers at two data collection points which enables investigation of consistency of measurements, and also a study of the relationship between the two variables. Results show a high correlation between the dimensions of attitudes and behavior at the two data collection points. Attitudes measured at the first survey had consistent effects on risky driving behavior measured at the second survey. Drivers who were involved in traffic accidents or crashes in the last year took more risks when driving.

In Turkey, Simsekoglu and Lajunen (2008) applied the TPB to investigate seat belt use in reducing injury severity in road traffic accidents, a large number of car occupants do not use a seat belt in Turkey. The study aimed to explain self-reported seat belt use among front seat passengers with the basic and extended of theory of planned behavior including habit, moral norm and anticipated regret added. 277 students were asked to complete questionnaire including demographic information and the TPB and the health belief model (HBM) items applied to seat belt use. Structural equation modeling (SEM) techniques were used in analysis of the data. Results showed that the basic TPB model showed a good fit to the data whereas the extended TPB model and the HBM model fitted the data poorly. Within the basic TPB model, attitudes and subjective norm had a positive relationship to seat belt use intention for both urban and rural roads.

Another application of TPB was on intention to use bus in Ho Chi Ming city. Fujil and Van (2009) explored the behavioral intention to use the bus while considering the

perceived quality of bus service, problem awareness, and moral obligation of people in Ho Chi Minh City. A mail-back survey was conducted in late August 2007 in HCMC. Questionnaires were mailed to 1,000 households randomly chosen from the city's phone list and evenly distributed across 18 districts of the city. The purpose was to test the feasibility of developing mobility management measures persuading motorcycle users to use the bus more, and if so, how. Principal components analysis on a set of psychological factors related to various aspects of bus use yielded four factors: moral concerns, negative expression, quality perception, and social status. The regression of the intention on these four factors revealed that determinants of intention to use the bus in HCMC are moral concerns and the perception of quality. Based on the psychological relationships, mobility management measures can be applied in persuading people to change their behavior toward using the bus.

Last but not least, Zhou R. et al. (2009) applied TPB to examine young driving learners' intention to use a handheld or hands-free mobile phone when driving. A sample of 164 young driving learners completed a questionnaire based on the theory of planned behavior (TPB), which measured people's intentions to use mobile phone while driving in handheld condition or hands-free condition, along with their attitudes towards the behavior, subjective norms, perceived behavioral control. The regression analysis models revealed that the TPB was able to explain 43 and 48 percent of variance in hands-free mobile phone use intention and handheld mobile phone use intention, respectively, with perceived behavioral control emerging as the strongest predictor. In addition, TPB components, usage frequency and perceived risk were more dependent on gender than age.

**Table 2.4** Summary of TPB applications

| Authors (Published year) | Country | Constructs (sample size) | Research on |
|---|---|---|---|
| Yang, Hsiao (2010) | Taiwan | TPB core construct, novelty and trust (300 students) | Traveler's intention to take high speed rail |
| Lam and Hsu (2006) | | TPB core construct, past behavior (299 travelers) | Behavioral intention of choosing travel destination |
| Norman, vans (1998) | England | TPB core construct, Self-identity (210 road users) | Pedestrians' road crossing intentions |
| Elliot et al. (2003) | | TPB core construct, demographic info., self-reported prior , self-reported subsequent behavior (598 drivers) | Driver's compliance with speed limits |

| Authors (Published year) | Country | Constructs (sample size) | Research on |
|---|---|---|---|
| Warner and Aberg(2006) | Sweden | TPB core construct (250 drivers) | Driver's decision to speed |
| Forward(2009) | | TPB core construct, descriptive norms, past behavior, perceived ease, perceived risk (500 drivers) | Intention to commit two different driving violations: speeding in urban area and dangerous overtaking |
| Letirand, et al. (2005) | France | TPB core construct | Speed behavior |
| Paris, Broucke (2008) | Belgium | TPB core construct (116 drivers) | Determinants of speeding behavior |
| Diaz (2002) | Chile | TPB core construct (146 pedestrians) | Pedestrians' intentions to violate traffic regulations |
| Abrahamse (2009) | Canada | TPB core construct, morality (personal norm) | Factors influencing car use for commuting and intention to reduce it |
| Choocharukul et al. (2007) | Thailand | TPB core construct, moral obligation (156 students) | Behavioral intention of using private car in the future work trips |
| Fujii and Van (2009) | Veitnam | Perceived quality of bus service, problem awareness and moral obligation (1000 household) | Intention to use bus |
| Van and Fujii (2007) | | TPB core construct, moral obligation (208 people) | Attitudinal aspects of six travel modes currently in use in Ho Chi Minh City |
| Zhou et al. (2009) | China | TPB core construct, age, gender conformity tendency (426 people) | Chinese pedestrians' intention to cross the road |
| Zhou et al. (2009) | | TPB core construct (164 drivers) | Young driving learners' intention to use handheld or hand-free mobile phone when driving |
| Iversen (2004) | Norway | TPB core construct (1640 drivers) | Attitudes towards traffic safety |
| Simsekoglu and Lajunen (2008) | Turkey | TPB core construct, habit, moral norm, anticipated regret (277 students) | Seat belt use in reducing injury severity |

## 2.5 Summary

In summary, traffic condition in Phnom Penh has been gradually worsening due to the rapid increase of motorized vehicles caused by the concentration of population in the capital. Urban traffic congestion has grown to critical proportions. In terms of traffic composition, both private and public motorcycles account for nearly 80 percent of total traffic in Phnom Penh; thus, traffic problems caused by motorcycles are lately considered one of the most serious social issues in Phnom Penh. Improper public transportation system in the city is regarded as the main reason for increasing number of motorcycles. At present, the main modes of public transport in the city consist of motorcycle-taxis, tricycles and taxi-cars. To cope with traffic congestion, the Municipality of Phnom Penh has thus initiated a plan for an urban rail transportation system. The commuters along this corridor may not be familiar with this new system and none of the

past studies has focused on the psychological factors and behavioral intention of using future sky train. Therefore, this study will investigate the psychological factors that can help explain the likelihood of using future sky train in Phnom Penh city. Therefore, the Theory of Planned Behavior (TPB) is used as methodology for this research study.

From the literature reviews, it is observed that most of TPB applications were applied on car, motorcycle, bus, high speed rail, pedestrians, and other road users by focusing on speed, seat belt use, driving violation, safety, traffic regulation, choosing travel mode and travel destination, road crossing and so forth. It can be seen that there is a limit on studies that have been conducted between psychological factors and the behavioral intention of future urban rail transport. As Phnom Penh commuter, no implication was found. Thus, there is still a research gap to further explore the potential of psychological methods to predict commuter's behavioral intention. It can be seen that some variables, namely, gender, age, moral obligation, attitudinal factors, novelty seeking, trust, self-reported and other variables were added to the TPB constructs to investigate the behavioral intention or behavior.

# CHAPTER III

# METHODOLOGY

## 3.1 General

In order to accomplish the objective of this thesis, the Theory of Planned Behavior (TPB) and Structural Equation Modeling (SEM) are used. This Chapter presents the methodology in order to study commuters' behavioral intention towards future sky train usage. The structural equation modeling, modeling framework, TPB questionnaire design and others measures are described in this chapter.

## 3.2 Structural Equation Modeling

Structural equation modeling (SEM) is a very general, very powerful multivariate analysis technique, having its roots in the 1970s. Most applications have been used in psychology, sociology, the biological sciences, educational research, political science, and market research. It has been used in modeling travel behavior and values since 1980 (Golob, 2003). SEM is a modeling technique that can handle a large number of endogenous and exogenous variables, as well as latent (unobserved) variables specified as linear combinations (weighted averages) of the observed variables. Regression, simultaneous equations (with and without error-term correlations), path analysis, and variations of factor analysis and canonical correlation analysis are all special cases of SEM. It is a confirmatory, rather than exploratory method, because the modeler is required to construct a model in terms of a system of unidirectional effects of one variable on another. Each direct effect corresponds to an arrow in a path (flow) diagram. In SEM one can also separate errors in measurement from errors in equations, and one can correlate error terms within all types of errors (Golob, 2003).

The general SEM system is estimated using covariance (structure) analysis, whereby model parameters are determined such that the variances and covariance of the variables implied by model system are as close as possible to the observed variances and covariance of the sample. In other words, the estimated parameters are those that make the variance–covariance matrix predicted by the model as similar as

possible to the observed variance–covariance matrix, while respecting the constraints of the model. An SEM structural model is used to capture the causal influences (regression effects) of the exogenous (independents) variables on the endogenous (dependents) variables and the causal influences of endogenous variables upon one another. The structural model also allows specification of error-term covariance. Goodness-of-fit tests are used to determine if a model specified by the researcher is consistent with the pattern of variance–covariance in the data.

SEM softwares are generally available. Kline (1998a; b) and Golob (2003) provided three of the most popular SEM programs:

1. AMOS (Arbukle, 1994, 2006) is a general-purpose SEM package and also available as a component of SPSS statistical analysis software.
2. EQS (Bentler, 1989, 1995) is a well-known SEM package focusing on estimation with non-normal data.
3. LISREL (Joreskog and Sorbom, 1993), with coupled modules PRELIS and SIMPLIS, is one of the oldest SEM software packages. It has been frequently upgraded to include alternative estimation methods and goodness-of-fit tests, as well as graphical interfaces.

### 3.2.1 Sample Requirements

Sample size issues have received considerable attention. Maximum Likelihood (ML) estimation required a sufficient sample size, particularly when non-normal data are involved. Based on Monte Carlo studies of the performance of various estimation methods, several heuristics for have been proposed: (1) a minimum sample size of 200 is needed to reduce biases to an acceptable level for any type of SEM estimation. (2) Sample size for ML estimation should be at least 15 times the number of observed variables. (3) Sample size for ML estimation should be at least five times the number of free parameters in the model, including error terms and (4) with strongly kurtotic data, the minimum sample size should be 10 times the number of free parameters (Golob, 2003).

### 3.2.2 Assessing goodness- of- fit and finding the best model

Many criteria have been developed for assessing overall goodness-of-fit of an SEM and measuring how well one model does versus another model. Most of these

evaluation criteria are based on the chi-square statistic given by the product of the optimized fitting function and the sample size (Golob, 2003). One rule of thumb for good fit is that the chi-square should be less than two times its degrees of freedom (Golob, 2003). There are problems associated with the use of fitting-function chi-square. For large samples, critical number gives the sample size for which the chi-square value would correspond to p = 0.05; a rule of thumb is that critical number should be greater than 200 for an acceptable model (Tanaka, 1987). For small sample sizes, asymptotic assumptions become weak, and the chi-square value derived from the ML fitting function is particularly sensitive to violations from multi-normality. Goodness-of-fit measures for a single model based on chi-square values include root mean square error of approximation (RMSEA) which measures the discrepancy per degree of freedom. It is generally accepted that the value of RMSEA for a good model should be less than 0.05 (Browne and Cudeck, 1992). MacCallum et al. (1996) recommends that the entire 90% confidence interval for RMSEA should be less than 0.05. But Byrne (2009) accepted that RMSEA, the obtained value less than 0.05 indicate good fit; those ranging from 0.08 to 0.10 indicate mediocre fit and those greater than 0.10 indicate poor fit. For several goodness-of-fit indices, baseline comparison such as normed fit index (NFI), comparative fit index (CFI), a rule of thumb for most of the indices is that a good model should exhibit a value greater than 0.90 (Bentler, 1990; McDonald and Marsh, 1990). But Byrne (2009) accepted that the recommended acceptance of a good fit to a model requires the obtained NFI, CFI value should be in range from zero to one.

Based on these goodness-of-fit tests for a model, the modeler can take one of three different courses of action:

1. Confirm or reject the model being tested based on the results. If a model is accepted, it should be recognized that other unexamined models might fit the data as well or better. Confirmation only means that a model is not rejected.
2. Two or more competing models can be tested against each other to determine which has the best fit. The candidate models would presumably be based on different theories or behavioral assumptions.

3. The modeler can also develop alternative models based on changes suggested by test results and diagnostics, such as first-order derivatives of the fitting function (Golob, 2003).

## 3.3 Modeling Framework

A statistical software package, SPSS and AMOS 18, is used for both the statistical analysis and structural equation modeling analysis. Figure 3.1 shows the general procedure of model development.

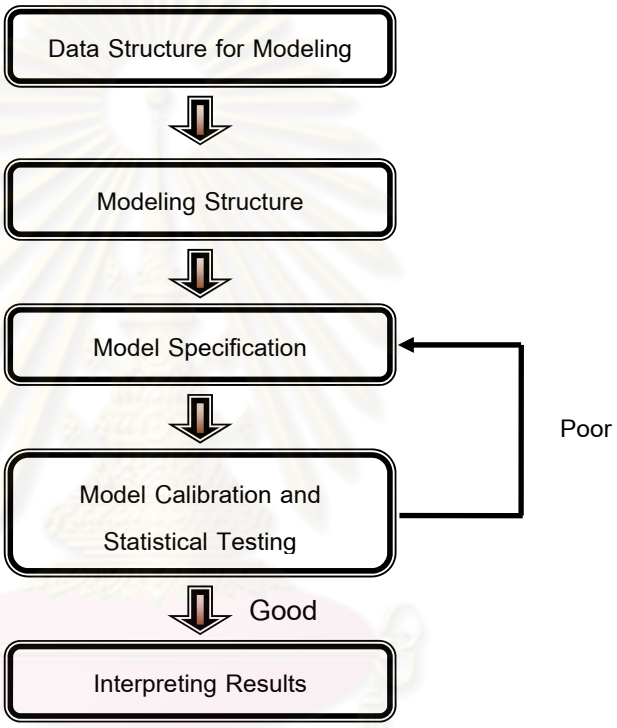



**Figure 3.1** Modeling Framework

### 3.3.1 Data Structure for Modeling

Prior to modeling framework, the data obtained from the survey was cleaned and input into a single file for SPSS. All information obtained from the survey was processed and kept in the database. Each piece of information was represented in a numerical form data with different types of measurement (scale, nominal, ordinal) according to its natural value.

### 3.3.2 Modeling Structure

This research study investigates the Phnom Penh commuters' behavioral intention toward future sky train usage by using three sets of structural equation model.

First, we develop the basic model containing only TPB variables (see Figure 3.2). Under this model structure, we hypothesize that the TPB variables, i.e. attitude, subjective norm, and perceived behavioral control, can be applied to predict the behavioral intention towards sky train usage.

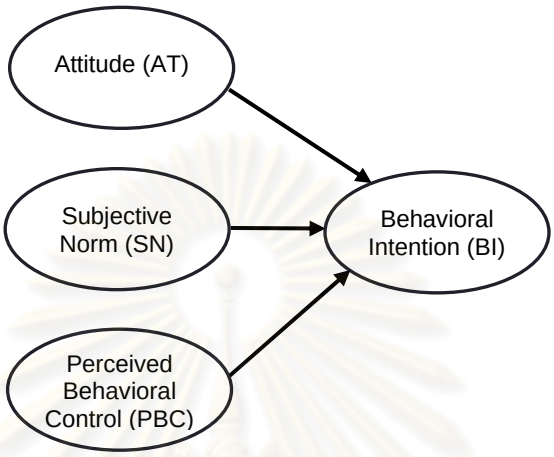



**Figure 3.2** Hypothesized model I of casual structure

To augment the fit of the model, we propose the second model with addition of psychological variables, namely, moral obligation and awareness of consequences. At the same time, we introduce additional latent variables reflecting beliefs on attitudinal-aspects of future sky train, i.e. attitudinal beliefs on symbolic, instrumental, and social orderliness aspects (see Figure 3.3).

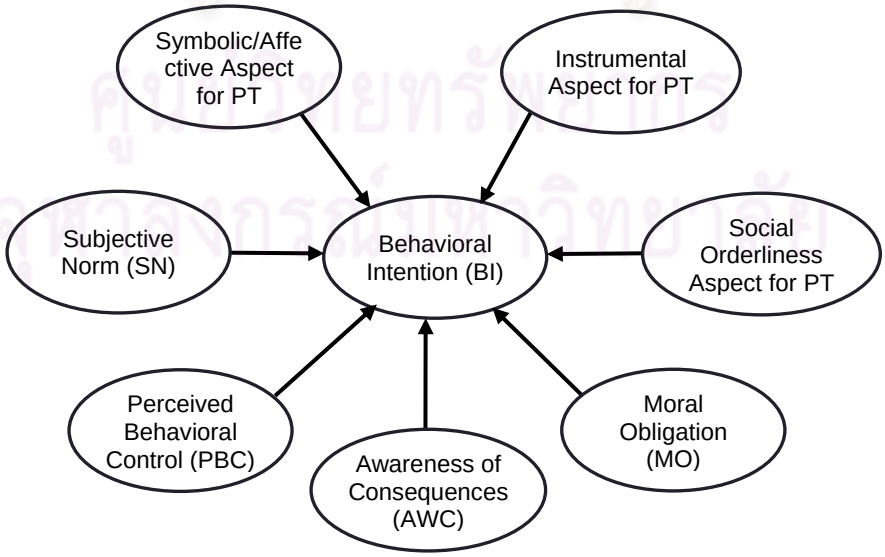



**Figure 3.3** Hypothesized model II of casual structure

In the last set of structural equation model, we test whether socioeconomic and current travel characteristics of respondents would have any effects on the behavioral intention towards future sky train usage. Specifically, we test various variables, including, gender, occupation, income, vehicle ownership, and availability of driving license (see Figure 3.4).

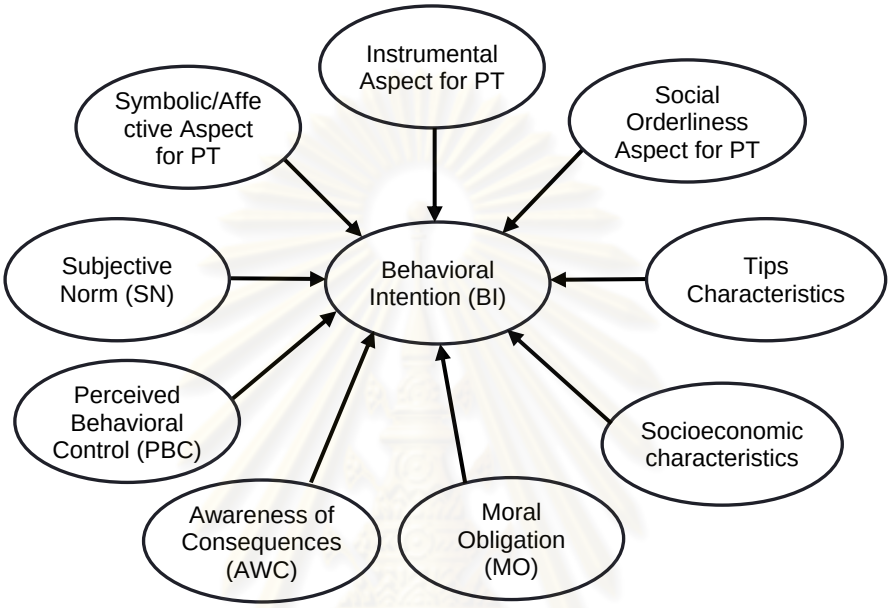



**Figure 3.4** Hypothesized model III of casual structure

### 3.3.3 Model Specification

In model construction, a number of variables were analyzed based on relevant statistical test, structural equation modeling analysis and goodness of fit of the models. The psychological factors and other variables in the models were believed to be able to explain the respondents' behavioral intention towards future sky train usage. The homogeneity of psychological questionnaires was checked by based on the value of Cronbach's alpla. It is important to find out the reliability of scale of the questionnaires to check the consistency of the constructs. Field (2005) noted that a value of 0.70-0.80 is an acceptable value of Cronbach's alpha; values substantially lower indicate an unreliable scale. Generally, the accepted value of 0.80 is appropriate for cognitive tests such as intelligent tests; for ability tests a cutoff point of 0.70 is more suitable. When dealing with psychological constructs, value below even 0.70 can realistically be expected because of the diversity of the constructs being measured. However,

Choocharukul and Fujii, (2007) noted that a value of the 0.6 is regarded as a lower acceptable value of the Cronbach's alpha.

### 3.3.4 Model Calibration

The coefficients of standardized estimates are obtained through running the structural equation modeling in software AMOS 18. Each developed model is calibrated on the basis of t-statistic value, p-value, chi-square statistics, degree of freedom, comparative fit index (CFI), normed fit index (NFI), and root mean square error of approximation (RMSEA) until the best model is obtained.

## 3.4 TPB Questionnaire Design

Jillian et al. (2004) provided nine phases in the construction of the TPB questionnaire to measure the variables in the TPB model, some of which involve short but important tasks, with others involving a long process of empirical investigation. These steps are:

1. Define the population of interest (medical practitioners, general dental practitioners). Decide how best to select a representative sample from this population.
2. Carefully define the behavior under study (explained using the TACT: Target, Action, Context and Time principle). Use this definition to construct a general introductory statement for the start of the questionnaire.
3. Decide how best to measure intentions.
4. Determine the most frequently perceived advantages and disadvantages of performing the behavior.
5. Determine the most important people or groups of people who would approve or disapprove of the behavior.
6. Determine the perceived barriers or facilitating factors which could make it easier or more difficult to adopt the behavior.
7. For a standard TPB-based study, include items to measure ALL of these constructs in the first draft of the questionnaire.
8. Pilot test the draft and reword items if necessary.

9. Assess the test-retest reliability of the indirect measures by administering the questionnaire twice to the same group of people, with an interval of at least two weeks.

### 3.4.1 Measuring Behavioral Intention

Behavioral intentions were measured by three methods. Firstly, Method 1 is called intention Performance, because in some situations, it would be possible to observe actual performance using the same measurement scale, and this direct comparability could be useful for some studies. Secondly, Method 2, namely, Generalized Intention, is most commonly used in individual's own health-related behavior (e.g. smoking, exercise). When investigating the behavior of health care professionals, Method 3 (intention simulation) could be a more valid proxy measure for actual behavior, because it more closely approximates real situations that require complex clinical decisions. However, it is time consuming and should be prepared with great care, or it may be misleading. In general, the methods used to measure intentions should be guided by researchers' judgments about which types of questions seem to make sense for the behavior and sample under investigation (Jillian et al., 2004). Generalized intention is used in the present study to understand the behavioral intention commuter's own individual intention.

### 3.4.2 Measuring Attitude towards Behavior

Attitudes could be measured by two methods, namely, direct measurement and indirect measurement. Direct measurement involves the use of bipolar adjectives (i.e. pairs of opposites) which are evaluative (e.g. good-bad). Ideally, it is used about four items following a single 'stem' which defines the behavior under investigation. It includes instrumental items whether the behavior achieves something (e.g. *useful-worthless*) and experiential items how it feels to perform the behavior (e.g. pleasant-unpleasant). It also includes the good-bad scale if it is appropriate to the topic, as it captures overall evaluation (Jillian et al., 2004). Indirect measurement measures behavioral beliefs and outcome evaluations. The stages of development of indirect measurement of attitudes are: (1) conduct an elicitation study to elicit commonly held beliefs; it means to identify the content of behavioral beliefs that are shared by the target population, (2) construct

questionnaire items to assess the strength of behavioral beliefs and (3) construct questionnaire items to assess outcome evaluations (Jillian et al., 2004). Direct measurement of attitudes is used in the present study.

### 3.4.3 Measuring Subjective Norm

Similarly, Subjective norm was measured by two measurements: direct measurement and indirect measurement. The direct measurement of subjective norm involves the use of questions referring to the opinions of important people in general. It is used to arrange the items so that the ends of the scales are a mix of positive and negative endpoints. However, where an item is a complete sentence, and the responses range from “strongly agree” to “strongly disagree” endpoints should not be mixed (Jillian et al., 2004).

Indirect measurement measures normative beliefs and motivation to comply. Following is the stage of development of indirection measurement of subjective norm: (1) identify groups, organizations and categories of individuals (reference groups) who are likely to apply social pressure with respect to the behavior, (2) construct questionnaire items to assess strength of normative beliefs with respect to each reference group and (3) construct questionnaire items to assess motivation to comply: add items in standard format for assessing motivation to comply with pressure from each reference group (Jillian et al., 2004). The present study uses the direct measurement to conduct the TPB questionnaire for the subjective norm.

### 3.4.4 Measuring Perceived Behavioral Control

The perceived behavioral control was also measured by two measurements: direct and indirect measurement. For direct measurement, items should reflect people’s confidence that they are capable of performing the target behavior. This can be achieved assessing the person’s self-efficacy and their beliefs about the controllability of the behavior. Self-efficacy is assessed by asking people to report how difficult it is to perform the behavior and how confident they are that they could do it. Whereas, controllability is assessed by asking people to report whether performing the behavior is up to them and whether factors beyond their control determine their behavior (Jillian et al., 2004). Similarly, for indirection measurements firstly, identify the content of control

beliefs which are shared by the target population about the behavior. Secondly, construct questionnaire items to assess the strength of these control beliefs and lastly construct questionnaire items to assess the power of these control factors to influence the behavior (Jillian et al., 2004). Direct measurement of perceived behavioral control is used in this study.

### 3.4.5 Sample Size

Required sample size is determined by statistical power analysis. This requires the specification of the study design and the expected effect size. Generally, a sample size of 80 would be acceptable. Note that response rates are often around 50 percent, so you need to send out 160 questionnaires to achieve this sample size unless you have reasons for thinking that the response rate will be better than 50 percent (Jillian et al., 2004).

## 3.5 Survey Location

The data survey was conducted at several locations such as schools, markets and gasoline stations along the study line linking from the Central market to the Airport (see Figure 3.5).

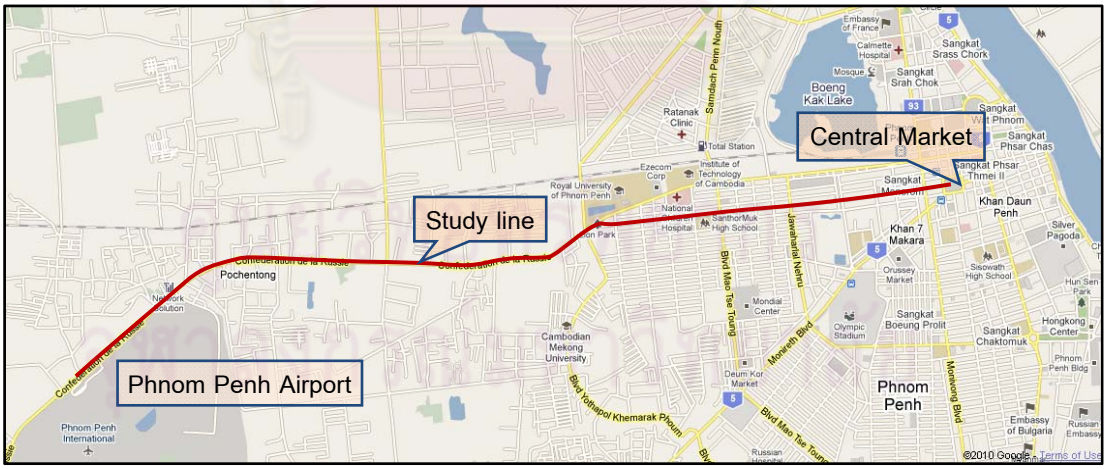



**Figure 3.5** Survey Locations

## 3.6 Pilot Survey

### 3.6.1 Data Collection

The pilot survey was done in order to test the survey instruments and data collection procedure and to obtain the reliable result. Moreover, the pilot survey is a guiding tool for the real survey.

The pilot survey was conducted on the 1st and 2nd of February, 2010, along Kampuchea Krom and Russian Boulevard, Airport Line liking from Central Market in CBD to Phnom Penh International Airport (see Figure 3.5). The Survey was done with 8 people, students from Institute of Technology of Cambodia. Before conducting the field survey, they had been trained with the developed survey forms until they fully understood how to explain the questionnaire to the respondents. The target of our survey was aimed at respondents who ride motorcycle. The first question to be asked to the respondents was whether they used this road corridor every day. Some similar sky train pictures had been used to make the respondents easily understand (appendix C).

### 3.6.2 Survey Questionnaires

To obtain information needed and to get data for the analysis of the commuter's intention toward the future urban rail transport, a set of questionnaires was designed in the pilot survey. There are 2 sections in the survey form; first section asks about the commuter's socio-economic information and the second section consists of commuter's intension to use future sky train which involved the items for psychological measures. Three-sheet survey form was done in double translation: English into Khmer and Khmer into English. The first page of the survey form covered the introduction and the map showing the future public transportation system in Phnom Penh City and the location of the study area. The second page comprised of the socio-economic status and trip characteristics. And the last page consists of the psychological questions used to analyze the commuter's intention toward future sky train usage. The survey form of the questionnaires will be shown in the appendix B.

The behavioral intention towards future sky train usage had been measured by using the generalized intention method. The seven-point Likert scale with "strongly disagree" and "strongly agree" was designed to measure respondents' intention toward sky train usage. Also the attitude, subjective norm and Perceived behavioral control

used the same level of Likert scale within the direct measurement method. These can be summarized as followed:

1. Attitude

To measure attitudes, respondents were asked to rate five statements: *"I prefer using the future urban rail transit"* (AT1), *"I have good feeling toward using future urban rail transit"* (AT2), *"Using future urban rail transit is desirable to me"* (AT3), *"Using future urban rail transit is beneficial to me"* (AT4) and *"Using future urban rail transit is the right thing to do"* (AT5).

2. Subjective norm

Subjective norm was measured by asking respondents to rate six statements: *"My friends or my family want me to take urban rail transit"* (SN1), *"If I took the urban rail transit, my friend or my family would have no problem with it"* (SN2), *"My friends or my family would agree with using the future urban rail transit"* (SN3), *"My friends or my family think that I should use future urban rail transit"* (SN4), *"Most of my friends will use future urban rail transit"* (SN5), *"I feel under social pressure to use future urban rail transit"* (SN6).

3. Perceived behavioral control

To measure respondent's perceived behavioral control, five statements were used: *"It is easy for me to use future urban rail transit"* (PBC1), *"I am confident that I can use future urban rail transit"* (PBC2), *"Whether I use future urban rail transit is completely up to me"* (PBC3), *"The decision to use future urban rail transit is under my control"* (PBC4), *"I could use future urban rail transit if I want to"* (PBC5).

4. Moral obligation

Moral obligation was measured by a statement: *"In term of morality, I think that using future urban rail transit is not problematic"* (MO1).

5. Behavioral intention

Five statements were used to measure the respondent's behavioral intention. They are: *"I should use urban rail transit"* (BI1), *"In regard to my decision, I will*

*use future urban rail transit"* (BI2), *"I want to use future urban rail transit"* (BI3), *"I plan to use future urban rail transit"* (BI4) and *"I will make an effort to use future urban rail transit"* (BI5).

6. External variable

By using the same seven-point likert scale, eight statements of the external variables were used to measure the respondent's attitudes. Those statements are related to the travel distance, travel cost, travel time, traffic congestion, traffic accidents, safety and environment issue. They are: *"If I take future urban rail transit, I will arrive at the destination faster"* (AT6), *"Using future urban rail transit depends on the travel distance"* (AT7), *"Using future urban rail transit depends on the travel cost"* (AT8), *" Using future urban rail transit depends on the level of traffic congestion"* (AT9), *"Using future urban rail transit will reduce the traffic congestion"* (AT10), *"Using future urban rail transit will reduce traffic accident"* (AT11), *"I think that future urban rail transit is safe"* (AT12), *"I feel that the air pollution is getting worse"* (AT13).

### 3.6.3 Descriptive Statistics

A total of 493 passengers were randomly interviewed during pilot survey. The socio-economic characteristics of the surveyed passengers are summarized in Table 3.1. Approximately one third of the total respondents (27%) are female. Most of respondents are in range from 15 to 25 years old which account for 49% of the respondent, 27% in range from 26 to 35 years old, 16% in range from 36 to 50 years old and 7% in range from 51 to 70 years old. Approximately one third of the total respondents were students; beside this 23% were employers, 17% were seller, 12% were civil servants and the rest were employee, teacher, unemployed and others. The majority of the respondents had monthly income in range of $101-$200 and nearly half of the respondents came from the household of more than 5 members.

**Table 3.1** Summary of Socio-economic Characteristics for Pilot Survey

| Variable | Levels | Percentage |
|---|---|---|
| Gender | Female | 27 |
| | Male | 73 |
| Age | 15-25 years old | 49 |
| | 26-35 years old | 27 |
| | 36-50 years old | 16 |
| | 51-70 year old | 7 |
| Occupation | Student | 34 |
| | Teacher | 4 |
| | Employer | 2 |
| | Employee | 23 |
| | Seller | 17 |
| | Civil Servant | 12 |
| | Unemployed | 2 |
| | Others | 5 |
| Monthly Income | <$100 | 15 |
| | $101-$200 | 43 |
| | $201-$300 | 27 |
| | $301-$400 | 8 |
| | $401-$500 | 5 |
| | $501-$1000 | 1 |
| | $1000-$2000 | 0 |
| | >$2000 | 0 |
| Member in household | <=4 | 35 |
| | 5 | 23 |
| | >5 | 42 |

Nearly half of respondents have at least one motorcycle in their household and have no car in the household which accounted for 95 percent of the total respondents. Regarding to the mode of transportation, 83 percent of the total respondents regularly use private motorcycle while 12 percent use the motor-taxi and the rest sometime use private motorcycle, motor-taxi, private car or bicycles. Approximately 50 percent of the respondents used this road corridor for work purpose which mostly took 11 minutes to 25 minutes with the travel cost of 500 Riel to 2,000 Riel (see Table 3.2).

**Table 3.2** Trip Characteristics for Pilot Survey

| Variable | Levels | Percentage |
|---|---|---|
| Number of cars | No car | 95 |
| | 1 | 3 |
| | 2 | 1 |
| | >2 | 1 |
| Number of motorcycles | <2 | 48 |
| | 2 | 27 |
| | 3 | 17 |
| | >4 | 8 |
| Mode of travel | Motorcycle | 83 |
| | Motor-taxi | 12 |
| | Others | 5 |
| Trip purpose | Study | 33 |
| | work | 49 |
| | Business | 8 |
| | Shopping | 9 |
| Travel time | 2-10 minutes | 17 |
| | 11-25 minutes | 44 |
| | 26-45 minutes | 32 |
| | 46-60 minutes | 2 |
| Travel cost | 500R-2000R | 46 |
| | 2100R-3500R | 24 |
| | 3600R-4900R | 25 |
| | 5000R-10000R | 5 |



## 3.7 Main Survey

### 3.7.1 Modification of Pilot Survey

From the pilot survey, some problems were found and corrected for the real survey. Firstly, key information obtained from the pilot survey was not complete, while some information was not necessary and could be improved. Secondly, the questionnaire design did not yet fulfill the objective of our research and the quality of collected data was still low; thus, some modification was needed. Furthermore, the understanding of respondents on the survey forms was not yet fully satisfaction,

particularly their socioeconomic information, their travel information and their image/opinion on future sky train.

### 3.7.2 Modification of Questionnaires

Given the aforementioned issues, the following modifications were considered for the main survey:

1. Occupation: Employer was deleted from the pilot survey since very few of these groups of respondents were found and these groups of people are unlikely to change private car use to the future sky train.
2. Education: Education was added and categorized into six groups, namely, primary school, secondary school, high school, associate bachelor, bachelor and higher than bachelor.
3. Monthly income: No income was added and higher than $2,000 income was deleted because there were no these groups of respondents found in the pilot survey.
4. Vehicle availability: Vehicle availability was added to the main survey to ask the respondents whether they are able to use the vehicle in their household.
5. Driving license: Driving license was additionally asked in the main survey.
6. Private vehicle use: the question asking about the private vehicle use during the last 4 weeks was added into the main survey.
7. Travel frequency: Travel frequency was added to ask how many times they travel per week.
8. Frequency of use of private car, motorbike, bicycle and motor-taxi questions were added.
9. Psychological questions: some psychological questions were deleted and some were added in the main survey. The questions were changed from putting in order to mixing up throughout the section two of the survey questionnaires.
10. Additional questions: the questions asking the attitudinal variable and image or the opinions of respondents on the sky rail system were added.

### 3.7.3 Data Collection

The main survey was conducted during May 27, 2010 and May 31, 2010 for a total of 2 days at several locations such as schools, markets and gasoline stations along the study corridor (see Figure 3.5). Respondents were voluntarily recruited from commuters who travel along the study line on a regular basic. The survey was conducted by 10 surveyors from the Institute of Technology of Cambodia, who have been trained and fully understood the questionnaires. About 550 sets of questionnaires were distributed. Among these, a total of 398 respondents were useable for the data analysis.

### 3.7.4 Survey Questionnaires

The survey questionnaire consists of three sections (see Appendix C). The first section asks the respondents' socioeconomic characteristics and travel characteristics, while the second section consists of psychological items used to analyze the commuter's intention toward future sky train usage. The last part of the questionnaire additionally solicits information about respondents' opinions and attitudes on the future sky train usage. To avoid error in measurement, the four-sheet survey form is done in double translation, i.e. from English to Khmer and from Khmer back to English. In addition, to facilitate a clear understanding of the future public transportation system in Phnom Penh City, some similar sky train pictures are illustrated for respondents during the survey (see Appendix C). Similar to the pilot survey, all psychological items used in the questionnaire are measured based on a seven-point Likert scale with "Strongly disagree" and "Strongly agree" at each end point. Table 3.3 shows the psychological questionnaires in the second section of the survey questionnaire form.

Table 3.3 Psychological Items for the Main Survey

| Constructs | Items | Questionnaires |
|---|---|---|
| Attitude (AT) | Q01 | I have good feeling towards using the Sky Rail System |
| | Q05 | For me, to use the Sky Rail System will be extremely pleasant |
| | Q10 | For me, to use the Sky Rail System is interesting |
| | Q16 | I would enjoy using the Sky Rail System |
| Subjective Norm (SN) (Descriptive) | Q07 | My friends or my family will be likely to use the Sky Rail System on a regular basis |
| | Q17 | Most people who are important to me will use the Sky Rail System on a regular basis |
| Subjective Norm (SN) (Injunctive) | Q15 | If I take the Sky Rail System on a regular basic, my friends or my family would have no problem with it |
| | Q21 | Most people whose opinions I value would approve my usage of the Sky Rail System on a regular basis |
| | Q23 | Most people who are important to me think that I should use the Sky Rail System on a regular basis |
| Perceived Behavioral Control (PBC) (Capability) | Q03 | I could use the Sky Rail System on a regular basis if I want to |
| | Q19 | For me, to use the Sky Rail System on a regular basis is possible |
| Perceived Behavioral Control (PBC) (Controllability) | Q08 | The decision to use Sky Rail System on a regular basis is under my control |
| | Q11 | Whether I use the Sky Rail System on a regular basis is completely up to me |
| | Q14 | There will be many problems and difficulties with using the Sky rail System on a regular basis |
| Behavioral Intention (BI) | Q04 | I intend to use the Sky Rail System on a regular basis |
| | Q12 | My intention to use Sky Rail System on a regular basis instead of my existing travel mode is strong |
| | Q20 | I plan to use Sky Rail System on a regular basis instead of my existing travel mode |
| | Q22 | I will make an effort to use Sky Rail System on a regular basis |
| Moral Obligation (MO) | Q02 | Using Sky Rail System on a regular basis is the right thing to do |
| | Q09 | I should use the Sky Rail System because it is good for the environment |
| | Q24 | I should use the Sky Rail System because it is good for society and the city |
| Awareness of Consequences (AWC) | Q06 | Using Sky Rail System on a regular basis will reduce traffic congestion |
| | Q13 | Using Sky Rail System on a regular basis will reduce traffic accidents |
| | Q18 | Using Sky Rail System on a regular basis will reduce air pollution |

Other six variables, attitudinal variables, are additionally measured to quantify images of public transport from respondent's perspectives by asking them to rate their beliefs on attitudinal-aspects of public transportation. These variables are measured based on a seven-point Likert scale with a pair of adjectives, including "Boring-Exciting", "Poor-Rich", "Inconvenient-Convenient", "Slow-Fast", "Destructive-

Constructive", and "Environmental damaging-Environmental friendly". Appendix C provides questionnaire survey forms of the main survey.

### 3.8 Summary

In summary, the procedures employed in this research started from TPB questionnaire design and the pilot survey. From the results of the pilot survey, the survey form was modified for the main survey. The sample size for both the pilot and main surveys were followed based on TPB and SEM sampling. As a result, a total number of 398 respondents were collected for the main survey. The characteristics of the sample will be described in the next chapter.

# CHAPTER IV

# DESCRIPTIVE STATISTICS

## 4.1 Socio economic Characteristics

Table 4.1 summarizes the socio economic characteristics obtained from the main survey. From the table, approximately 75 percent are male. About 67 percent of the total respondents are in range of 18-25 years old; 19.7 percent are in range of 26-25 years old; 10.6 percent are in range of 36-50 years old and 2.6 percent are in range of 51-70 years old. In terms of occupation, 59 percent of the total respondents are students; 14 percent are employees; 12 percent are civil servants and the rest are teachers, sellers, unemployed and others.

**Table 4.1** Summary of Socioeconomic Characteristics

| Variable | Levels | Percentage |
|---|---|---|
| Gender | Female | 24.6 |
| | Male | 75.4 |
| Age | 18-25 years old | 67.0 |
| | 26-35 years old | 19.7 |
| | 36-50 years old | 10.6 |
| | 51-70 year old | 2.6 |
| Occupation | Student | 59.0 |
| | Teacher | 3.8 |
| | Employee | 13.8 |
| | Seller | 7.8 |
| | Civil Servant | 11.8 |
| | Unemployed | 1.0 |
| | Others | 2.8 |
| Education | Primary school | 3.0 |
| | Secondary school | 8.3 |
| | High school | 19.1 |
| | Associate Bachelor | 11.1 |
| | Bachelor | 55.3 |
| | Higher than Bachelor | 3.3 |

Figure 4.1 illustrates the distribution of the household monthly income. It can be seen that 53.5 percent of the respondents have no monthly income, presumably the students; 18.1 percent have monthly income smaller than $100 and approximately, 20 percent of total respondents have in range of $101-$200.

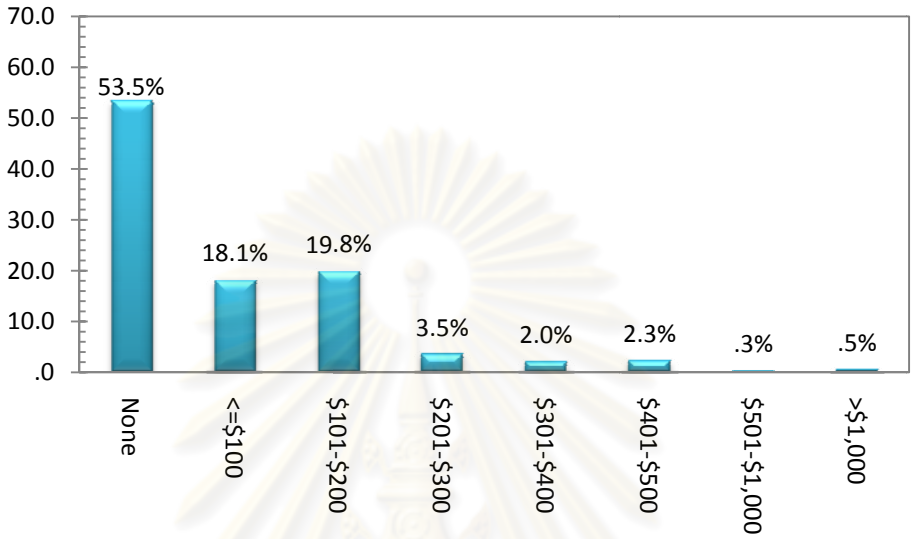



**Figure 4.1** Distribution of Household Monthly Income

Figure 4.2 shows the distribution of the household size. From the survey, the size of the households range from 1 to 12. A majority of the respondents are from the household with 5 members. The average household size is 5.44 with the standard deviation of 1.86.

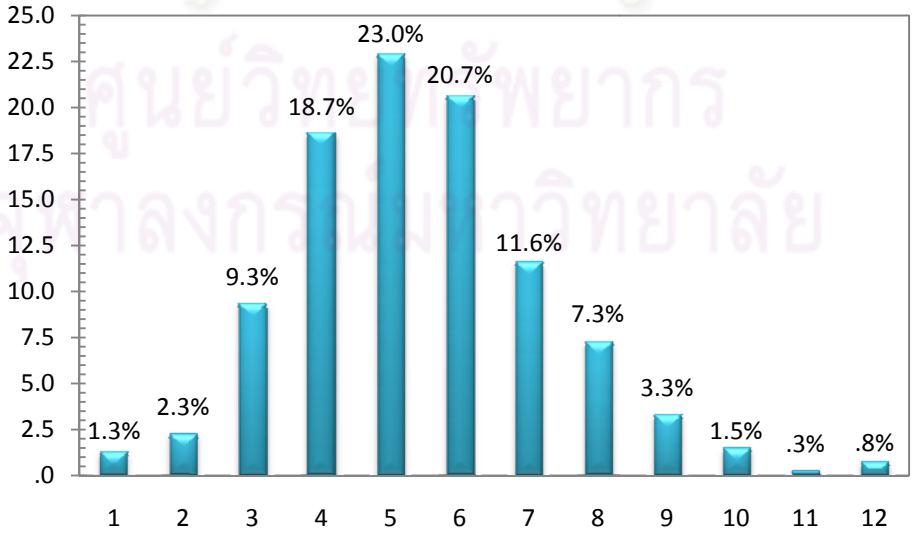



**Figure 4.2** Distribution of Household Size

Figure 4.3 summarizes the number of vehicles in the household. It can be seen that the majority of the respondents have no car in their household which accounts for 71.80 percent of the total respondents and nearly 45 percent of the total respondent have at least one motorcycle in their household; 27.10 percent of respondents have 2 motorcycles in their household; 18.60 percent have 3 motorcycles and 9.80 percent possess more than 4 motorcycles in their household.

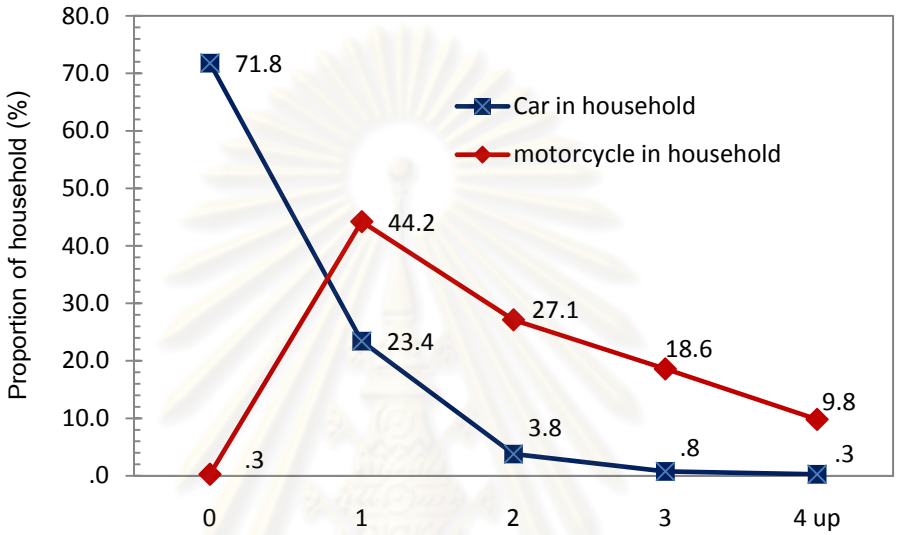



**Figure 4.3** Summary of Number Vehicle in Household

## 4.2 Trip Characteristics

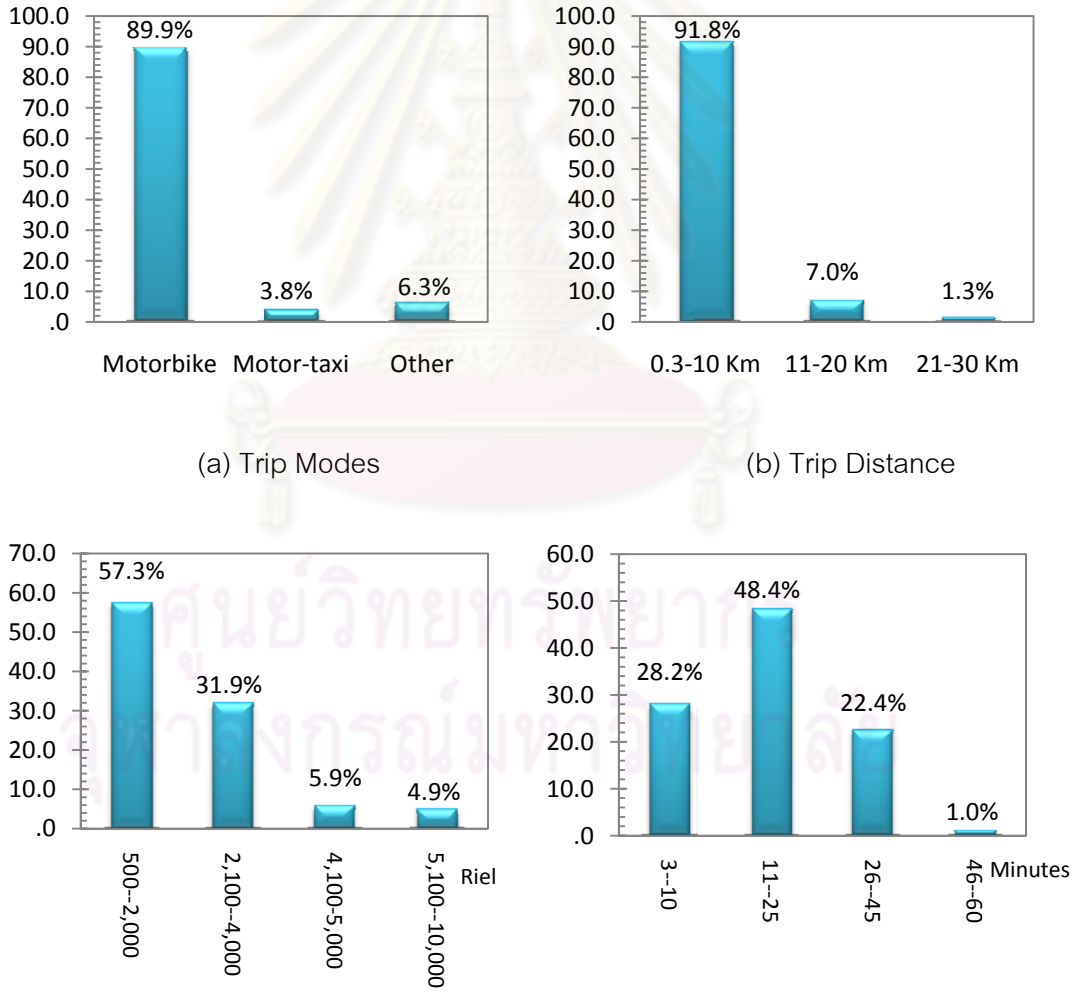
Table 4.2 and Figure 4.4 present the distribution of the trip characteristics. From Table 4.2, it can be seen that approximately 89 percent of the total respondents have availability to use their vehicles when they want to. Approximately, 44 percent of the total respondents have a driving license whereas another 56 percent have no driving license. In terms of private vehicle usage, it can be found the majority of respondents used their private vehicle during last 4 weeks which accounts for 88.3 percent of the total respondents.

Figure 4.4 shows respondents' current trips characteristics in terms of trip mode, cost, time, and distance. It can be seen that about 90 percent of the total respondents use their own motorcycles while 3.8 percent use motor-taxi and another 6.3 percent use other modes of transports, presumably private cars or bicycles. Approximately, 92 percent of the total respondents make their trips a distance of about 3 to 10 Kilometers. 60 percent of the total respondents spend about 500 to 2,000 Riel per trip followed by

2,100 to 4,000 Riel (31.9 percent), 4,100 to 5,000 Riel (5.9 percent) and 5,100 to 10,000 Riel (4.9 percent). In terms of travel time, nearly half of respondents take around 11 to 25 minutes to reach their destination; 3 to 10 minutes (28.2 percent); 26 to 45 minute (22.4 percent) and 46 to 60 minutes (1 percent).

**Table 4.2** Trip Characteristics

| Variable | Levels | Percentage |
|---|---|---|
| Vehicle availability | Available | 88.9 |
| | Not available | 11.1 |
| Driving license | Have | 43.7 |
| | Not have | 56.3 |
| Private vehicle usage | 0-50% | 11.7 |
| | 51-100% | 88.3 |

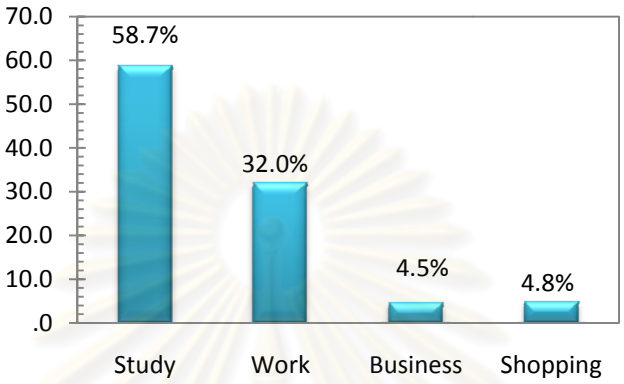



(a) Trip Modes (b) Trip Distance

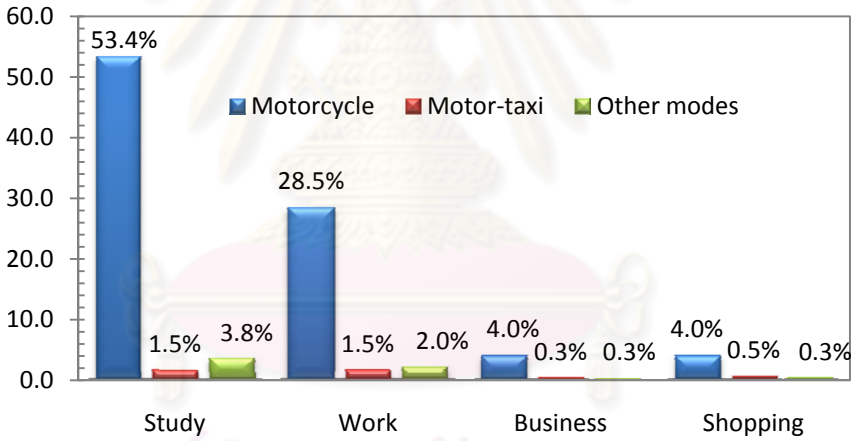
(c) Trip Cost (d) Trip Time

**Figure 4.4** Distributions of Trip Characteristics

Figure 4.5 illustrates the distributions of trip purpose in terms of study, work, business, and shopping. From the Figure 4.5(a), it can be seen that 58.7 percent of the total respondents are study trips followed by 32 percent (work trip), 4.5 percent (business trip) and 4.8 percent (shopping trips). It can be seen that motorcycle is the predominant mode of transportation for the respondents (see Figure 4.5 (b)).




(a) Trip Purpose




(b) Study, Work, Business and Shopping Trips

**Figure 4.5** Distributions of Trip Modes

Table 4.3 shows the frequency of transportation modes usage corresponding to the respondents' commute trips. The data collected were what transportation modes respondents used during the previous week. From the table, it can be seen that about 76 percent of the total respondents used motorcycle as their commute mode every day. More than half of the respondents have stated that they never used private cars, motor-taxi or bicycles as their commute modes during the previous week. On the other hand, 26.6 percent of the total respondents rarely used motor-taxi during the previous week,

i.e. they probably used other transportation modes or they did not travel often during the previous week.

**Table 4.3** Frequency of Mode Usage

| Mode | Everyday | 4-5 days/week | 2-3 days/week | Rarely | Never |
|---|---|---|---|---|---|
| Private car | 3.0 | 1.0 | 1.5 | 5.6 | 88.9 |
| Motorcycle | 75.6 | 12.1 | 3.5 | 4 | 4.8 |
| Motor-taxi | 0.5 | 1.3 | 2 | 26.6 | 69.6 |
| Bicycle | 5.1 | 1.3 | 3 | 13.7 | 76.9 |

## 4.3 Descriptive of Psychological Questionnaires

Table 4.4 and Figure 4.6 summarized the respondent's response on attitude variable. It shows the percentage of seven-point Likert scale, mean and standard deviation value for four attitudinal statements.

**Table 4.4** Percentage, Mean and Standard deviation of Attitudes

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| AT1 | Q01 | 0.30 | 0.80 | 0.80 | 4.80 | 10.60 | 30.90 | 52.00 | 6.25 | 1.00 |
| AT2 | Q05 | 1.00 | 0.80 | 1.80 | 5.50 | 21.60 | 35.90 | 33.40 | 5.87 | 1.13 |
| AT3 | Q10 | 0.30 | 0.50 | 1.00 | 6.00 | 18.30 | 39.90 | 33.90 | 5.97 | 0.99 |
| AT4 | Q16 | 0.50 | 0.80 | 1.50 | 6.30 | 17.80 | 38.40 | 34.70 | 5.94 | 1.07 |

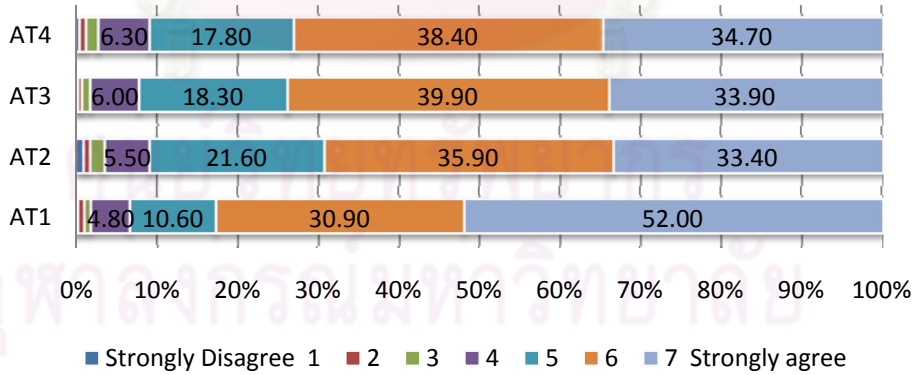



**Figure 4.6** Percentages of Attitude Statements

It can be observed from the Table 4.4 that most of the respondents have positive feeling to use future sky train. On the average, 38.5 percent of the total respondents prefer selecting the highest scale of number (number 7). About 92 percent of the total respondents give the scale number bigger than 4.

In terms of mean, it can be denoted that the first statement of attitude give the value of 6.25 with the standard deviation 1.00 followed by second statement (5.87 with dev. 1.13), third statement (5.97 with the standard deviation 0.99) and forth statement (5.94 the standard deviation 1.07). Overall, respondents seem to have a good feeling toward future sky train usage providing the average mean of attitudes mostly bigger than 5. Figure 4.6 shows the percentage of seven-point Likert scale in form of bar chart.

**Table 4.5** Percentage, Mean and Standard deviation of Subjective Norms

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| SN1 | Q07 | 2.00 | 1.80 | 4.00 | 13.80 | 16.60 | 39.20 | 22.60 | 5.49 | 1.35 |
| SN2 | Q15 | 3.80 | 3.80 | 4.30 | 11.60 | 19.10 | 36.40 | 21.10 | 5.32 | 1.53 |
| SN3 | Q17 | 3.00 | 1.50 | 4.80 | 14.60 | 23.60 | 32.20 | 20.40 | 5.32 | 1.41 |
| SN4 | Q21 | 0.50 | 1.30 | 3.30 | 11.80 | 19.30 | 36.20 | 27.60 | 5.67 | 1.21 |
| SN5 | Q23 | 1.50 | 2.80 | 3.80 | 11.80 | 16.60 | 33.70 | 29.90 | 5.59 | 1.39 |

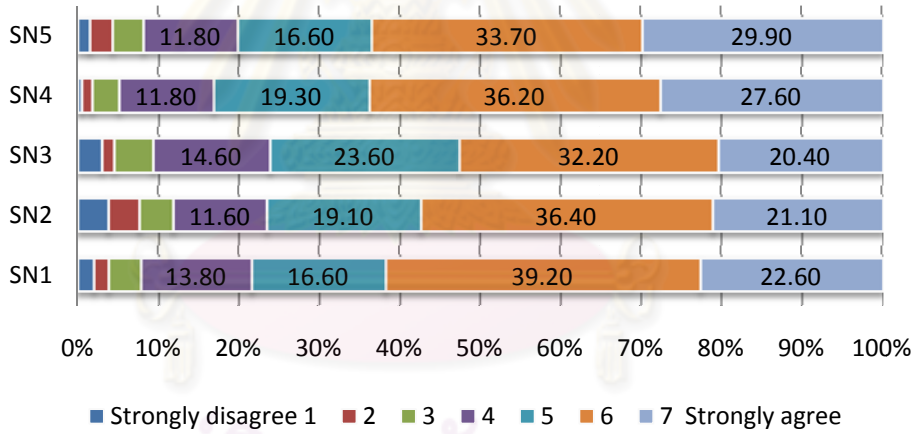



**Figure 4.7** Percentages of Subjective Norm Statements

From Table 4.5, it can be observed that respondents strongly agree with the first statement of the subjective norm (SN1) giving the mean of 5.49 with the standard deviation of 1.35. Similarly to the second statement, SN2 have the mean value of 5.32 with standard deviation of 1.53, SN3 (5.32 with standard deviation of 1.41), SN4 (5.67 with standard deviation of 1.21) and SN5 (5.59 with standard deviation of 1.39), respectively. In terms of mean, it can be seen that the mean of each subjective norm statements are pretty much the same value. It means that the respondents are more likely to use the future sky train depending on their family or friend. It can be seen from

Figure 3.4 that about 79 percent of the total respondents strongly agree to use future urban rail transit because of their family or friend and people who are important to respondents.

Perceived behavioral control (PBC) was measured by asking respondents to rate four statements. Table 4.6 shows the percentage of Lirkert scale, mean and standard deviation of PBC. It can be seen that the respondents strongly agree with the first statement of PBC (PBC1) than other statements. Figure 4.8 shows the percentage in form of bar chat. It can be quickly seen that almost all respondents strongly agree. On the average, the mean of PBC is 5.68 with the average of standard deviation of 1.31. It means that respondents feel able to use future sky train.

**Table 4.6** Percentage, Mean and Standard deviation of PBC

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| PBC1 | Q03 | 1.80 | 1.50 | 2.80 | 4.80 | 18.30 | 38.40 | 32.40 | 5.81 | 1.26 |
| PBC2 | Q08 | 2.30 | 0.80 | 2.50 | 9.00 | 19.80 | 35.90 | 29.60 | 5.69 | 1.29 |
| PBC3 | Q11 | 2.30 | 1.80 | 2.30 | 9.80 | 19.30 | 33.40 | 31.20 | 5.67 | 1.35 |
| PBC4 | Q19 | 1.50 | 2.80 | 3.80 | 8.30 | 23.60 | 36.40 | 23.60 | 5.53 | 1.32 |

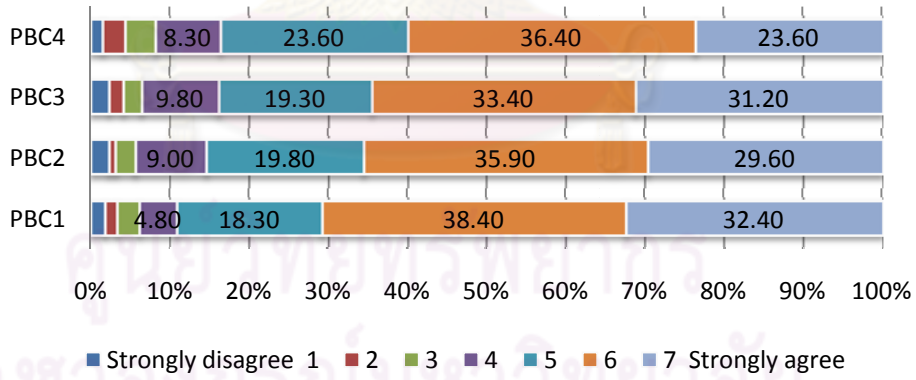



**Figure 4.8** Percentages of Perceived Behavioral Control Statements

From Table 4.7 and Figure 4.9, it can be easily seen that the respondents do agree with the measured statements with the average of mean 5.97 and standard deviation of 1.15. It can be seen that the respondents more strongly agree with the third statement of the moral obligation (MO3) than other statement with the mean of 6.41 and standard deviation of 0.99 followed by second statement (MO2) (mean of 6.06 and

standard deviation of 1.06) and first statement (MO1) (mean of 5.43 and standard deviation of 1.39).

**Table 4.7** Percentage, Mean and Standard deviation of Moral Obligation

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| MO1 | Q02 | 2.50 | 3.00 | 3.30 | 10.30 | 22.40 | 37.70 | 20.90 | 5.43 | 1.39 |
| MO2 | Q09 | 0.80 | 0.30 | 1.80 | 3.80 | 17.60 | 34.20 | 41.70 | 6.06 | 1.06 |
| MO3 | Q24 | 0.50 | 0.80 | 1.00 | 2.30 | 9.50 | 22.40 | 63.60 | 6.41 | 0.99 |

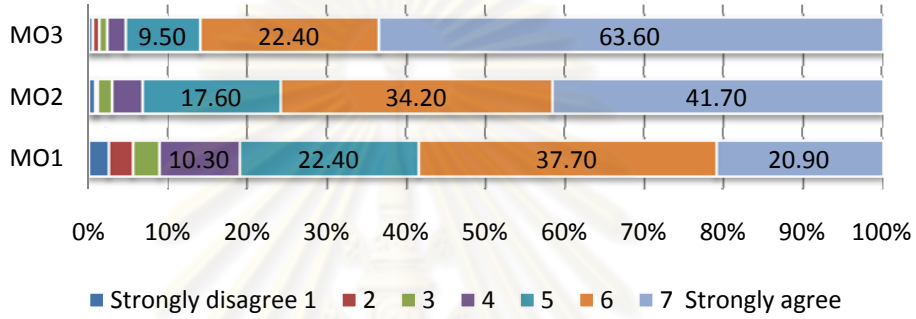



**Figure 4.9** Percentages of Moral Obligation Statements

**Table 4.8** Percentage, Mean and Standard deviation of Awareness of Consequences

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| AWC1 | Q06 | 0.30 | 0.00 | 2.00 | 1.50 | 9.00 | 32.20 | 55.00 | 6.36 | 0.90 |
| AWC2 | Q13 | 0.30 | 1.00 | 1.00 | 4.30 | 12.10 | 36.20 | 45.20 | 6.16 | 1.02 |
| AWC3 | Q18 | 0.50 | 1.00 | 2.80 | 4.30 | 15.30 | 38.70 | 37.40 | 5.98 | 1.11 |

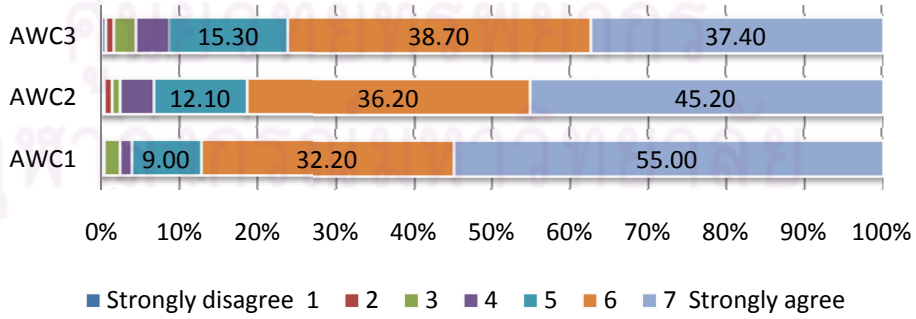



**Figure 4.10** Percentages of Awareness of Consequences Statements

Table 4.8 and Figure 4.10 summarized the respondent's response on awareness of consequence variable. It can be observed that respondents strongly agree these 3

statements of AWC with the following value of the mean 6.36 (AWC1), 6.16 (AWC2), and 5.98 (AWC3). From the Figure 4.10, it can be easily seen that these 3 statements have the high percentage of agreement to use future sky train giving the awareness of consequence.

**Table 4.9** Percentage, Mean and Standard deviation of Behavioral Intention

| Code | Item No. | Strongly disagree → Strongly agree | | | | | | | Mean | Std. Dev. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| BI1 | Q04 | 3.80 | 1.80 | 3.80 | 12.80 | 18.30 | 36.40 | 23.10 | 5.42 | 1.47 |
| BI2 | Q12 | 3.30 | 3.30 | 3.80 | 13.30 | 25.40 | 32.70 | 18.30 | 5.26 | 1.45 |
| BI3 | Q20 | 1.80 | 3.50 | 4.30 | 11.30 | 25.10 | 35.20 | 18.80 | 5.35 | 1.37 |
| BI4 | Q22 | 0.80 | 1.50 | 5.80 | 9.30 | 22.10 | 31.20 | 29.40 | 5.61 | 1.30 |

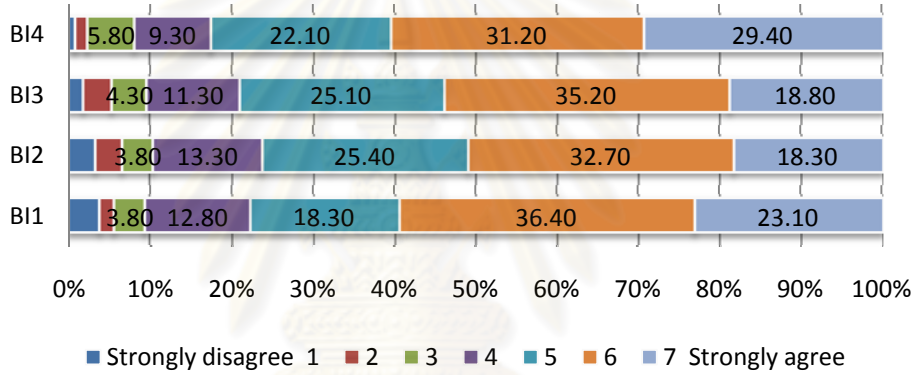



**Figure 4.11** Percentages of Behavioral Intention Statements

It can be denoted from Table 4.9 and Figure 4.11 that the percentage of these four statements is pretty much the same. Approximately 10 percent of the total respondents are neutral and mostly the rest of the total respondents strongly agree to use future sky train. Regarding to the mean of the behavioral intention, all statements are in value more than 5. In other words, the respondents have likely intent to use future sky train.

## 4.4 Descriptive of Respondents' opinion on Sky Rail System

Results from the third section of the questionnaire form are summarized here. In that section we asked the respondents to give their opinion and their image on the sky rail system as well as their current mode usage. From Table 4.10, it is found that 40.8 percent of the total respondents used to hear about the sky rail system whereas 59.2 never hear about that. About 52 percent of the respondents stayed from the sky rail

system about 1 kilometer, 40 percent about 1 to 5 kilometers and 7.70 percent of those respondents stayed further than 5 kilometers. Most of the respondents are willing to use the sky rail system when it is available in the future. Approximately, 31 percent of them are willing to pay less than 1,000 Riel, 35 percent are willing to pay in range of 1,000-2,000 Riel, 26.40 percent are willing to pay from 2,100 Riel to 4,000 Riel and 7.20 percent are willing to pay more than 4,000 Riel, respectively. About 67 percent of the total respondents are willing to take 10 minutes for their trip, 11-30 minutes (32.50 percent) and more than 30 minutes (0.80 percent), respectively.

**Table 4.10** Summary of Respondent's Opinion and Willingness

| Variable | Levels | Percentage |
|---|---|---|
| Awareness | Yes | 40.8 |
| | No | 59.2 |
| Distance from House to SRS | 0-1 km | 52.3 |
| | 1-5 km | 40.0 |
| | >5 km | 7.7 |
| Willing to pay | <1,000 Riel | 31.3 |
| | 1000-2,000 Riel | 35.0 |
| | 2,100-4,000 Riel | 26.4 |
| | > 4,000 Riel | 7.2 |
| Willing time | 1-10 minutes | 66.8 |
| | 11-30 minutes | 32.5 |
| | > 30 minutes | 0.8 |

In section 3 of the questionnaire form, three questions are used to ask the respondents to rate about their opinions on the sky rail system. Those questions are: "*How likely will you use the sky rail system on a regular basis?*"; "*Do you think the sky rail system will help alleviating traffic congestion in Phnom Penh?*"; and "*Do you think the sky rail system will help alleviating pollution issue in Phnom Penh?*". Table 4.11 summarizes the respondents' willingness to use sky rail system. It is found that 1.50 percent of the total respondents are very unlikely to use sky rail system, 2 percent are unlikely, 14.10 percent are not sure, 48.70 percent are likely and 33.70 percent are very likely to use sky rail system.

**Table 4.11** Summary of Respondent's Willingness to Use SRS

| Variable | Levels | Percentage |
|---|---|---|
| Willingness to use SRS | Very unlikely | 1.50 |
| | Unlikely | 2.00 |
| | Not sure | 14.10 |
| | likely | 48.70 |
| | Very likely | 33.70 |

Table 4.12 and Table 4.13 represent the cross table between the occupation and willingness to use sky rail system and willingness to pay of the respondents. It can be seen that students are more likely to use sky rail system than the other road users like employee, civil servant, seller, teacher, unemployed and others. Most of respondent are willing to pay from 1,000 Riel to 2,000 Riel (see Table 4.13).

**Table 4.12** Respondent's Willingness to Use SRS

| Occupation | Willingness to use SRS | | | | | Total |
|---|---|---|---|---|---|---|
| | Very unlikely | Unlikely | Not sure | Likely | Very likely | |
| Student | 5 | 6 | 38 | 119 | 67 | 235 |
| Teacher | 0 | 0 | 0 | 7 | 8 | 15 |
| Employee | 1 | 1 | 5 | 27 | 21 | 55 |
| Seller | 0 | 0 | 5 | 12 | 14 | 31 |
| Civil servant | 0 | 1 | 6 | 23 | 17 | 47 |
| Unemployed | 0 | 0 | 1 | 1 | 2 | 4 |
| Other | 0 | 0 | 1 | 5 | 5 | 11 |
| **Total** | 6 | 8 | 56 | 194 | 134 | 398 |

**Table 4.13** Respondent's Willingness to pay

| Occupation | Willingness to pay | | | | Total |
|---|---|---|---|---|---|
| | < 1,000 Riel | 1,000-2,000 Riel | 2,100-4,000 Riel | > 4,000 Riel | |
| Student | 81 | 86 | 46 | 13 | 235 |
| Teacher | 1 | 6 | 7 | 1 | 15 |
| Employee | 19 | 17 | 15 | 4 | 55 |
| Seller | 4 | 8 | 13 | 3 | 31 |
| Civil servant | 11 | 14 | 15 | 7 | 47 |
| Unemployed | 3 | 1 | 0 | 0 | 4 |
| Other | 2 | 3 | 6 | 0 | 11 |
| **Total** | 121 | 135 | 102 | 28 | 398 |

Table 4.14 represents the percentage, mean and standard deviation of respondents' opinion of these three statements. In term of bar chat, most of respondents think that the sky rail system will help alleviating both traffic congestion and pollution issue in Phnom Penh city (see Figure 4.12). In term of means, the majority of the respondents have positive opinion on the sky rail system (see Table 4.14).

**Table 4.14** Percentage, Mean and Standard Deviation of Respondent's Opinions

| *If SRS was available, respondents' opinion on* | | | | | | | |
|---|---|---|---|---|---|---|---|
| Statement | 1 | 2 | 3 | 4 | 5 | Mean | S.D. |
| Traffic congestion | 0.50 | 2.00 | 7.10 | 45.10 | 45.30 | 4.32 | 0.73 |
| Pollution | 2.00 | 4.30 | 10.60 | 43.10 | 40.10 | 4.15 | 0.91 |

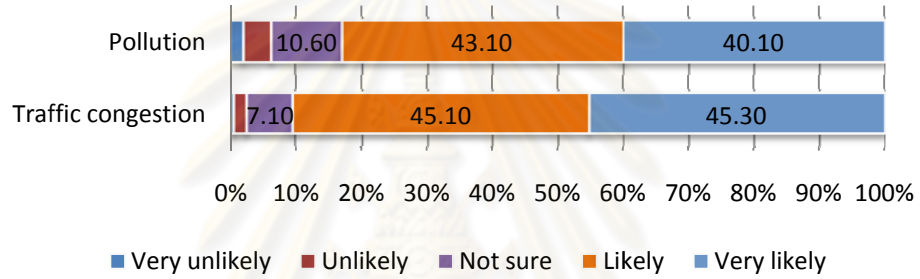



**Figure 4.12** Percentages of Respondents' Opinion Statements

## 4.5 Attitudinal-Aspects Variables

Attitudinal-aspect variables are additionally measured to quantify images of public transport from respondent's perspectives by asking them to rate their beliefs on attitudinal-aspects of future public transportation mode. These variables are measured based on a seven-point Likert scale with a pair of adjectives including, "Boring-Exciting", "Poor-Rich", "Inconvenient-Convenient", "Slow-Fast", "Destructive-Constructive", and "Environmental damaging-Environmental friendly" (Choocharukul, Tan and Fujii, 2006). Table 4.15 and Figure 4.13 summarized the respondent's response on attitudinal aspects. It can be seen from Table 4.15 that respondents seem to have positive feeling on the future sky train mode. The first statement of the attitudinal aspects variables is measured by asking the respondents to rate the statement of the pair adjectives "boring-exciting" on the future sky train. It is found that the mean of the first statement has the value of 6.08 with the standard deviation 1.13 followed by the second

statement, “poor-rich” (mean 5.30 and standard deviation 1.40); third statement, “inconvenient-convenient” (mean 6.04 and standard deviation 1.04); forth statement, “slow-fast” (mean 5.98 and standard deviation 1.14); fifth statement, “destructive-constructive” (mean 6.13 and standard deviation 0.99); and sixth statement, “environmental damaging-environmental friendly” (mean 6.31 and standard deviation 1.12). It can be seen quickly from Figure 4.13 that the majority of the respondent give positive attitudinal aspect towards future sky train usage.

**Table 4.15** Percentage, Mean and Standard deviation of Attitudinal-aspects

| | Future Sky Train | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Attitudinal factors | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Mean | SD. |
| Boring-exciting | 0.80 | 0.50 | 2.30 | 4.50 | 16.80 | 27.90 | 47.20 | 6.08 | 1.13 |
| Poor-rich | 2.00 | 1.30 | 2.50 | 29.40 | 12.10 | 28.90 | 23.90 | 5.30 | 1.40 |
| Inconvenient-convenient | 0.80 | 0.00 | 1.50 | 5.50 | 15.10 | 38.70 | 38.40 | 6.04 | 1.04 |
| Slow-fast | 0.80 | 0.80 | 1.00 | 8.00 | 16.10 | 32.70 | 40.70 | 5.98 | 1.14 |
| destructive-constructive | 0.50 | 0.30 | 1.00 | 4.80 | 13.60 | 37.20 | 42.70 | 6.13 | 0.99 |
| environmental damaging-environmental friendly | 1.00 | 0.80 | 0.80 | 5.80 | 7.50 | 24.10 | 60.10 | 6.31 | 1.12 |

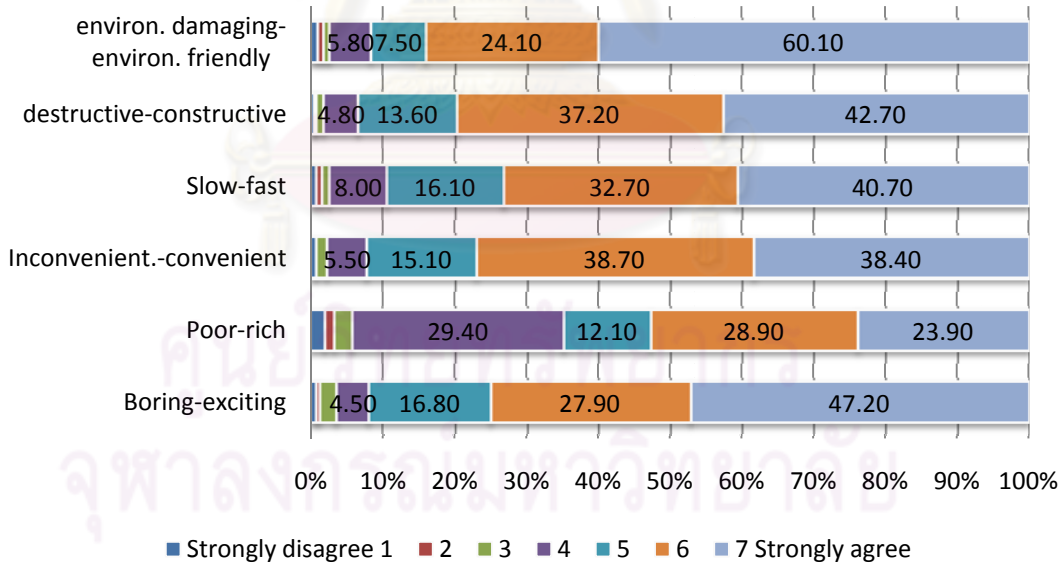



**Figure 4.13** Percentages of Attitudinal-Aspects Statements

## 4.6 Summary

This chapter summarizes the results obtained from the main survey. A sample size of 398 was obtained, comprising 89.9%, 3.8%, and 6.3% of motorcycles, motor-taxis, and other users of modes, respectively. Most respondents are students, who age

between 18 to 25 years old. About half of the respondents have no monthly income, presumably the high school students; 18 percent have monthly income smaller than $100; 20 percent is in range of $101 to $200. Nearly half of the respondents are from the household with more than 5 members. The majority of the respondents have no car in their household but nearly half of the total respondents have at least one motorcycle in their household. Results show that respondents spent approximately 2,000 Riel for their trip. The average trip time is found to be 18.84 minutes and the average trip length is found to be 5.77 kilometers. It is found that approximately 89 percent of the total respondents have availability to use their vehicle when they want to use; this affect the preference of using the public transportation. Whereas 56.3 percent of the total respondents have no driving license; this showing that among of the motorists currently commute on this study line, some of them are riding without the driving license. In other words, even though they do not have the driving license but they still have the vehicle availability to use. This can be one of reasons of poor use of the public transportation. It can be observed that 83 percent of the total respondents in the pilot survey ride the motorcycle for commuting whereas in the main survey approximately 90 percent of those are found.

The statement of attitudes, subjective norms, perceived behavioral control, behavioral intention, moral obligation, awareness of consequences, and attitudinal aspects toward future sky usage are found to be strongly in agreement. In addition, almost 82 percent of the total respondents stated that they will use the future sky train when the system is available and about 66 percent of them willing to spend about 2,000 Riel. The majority of respondents think that the sky rail system will help alleviating both traffic congestion and pollution issue in Phnom Penh city.

# CHAPTER V

# MODELING RESULTS

## 5.1 General

In order to study commuters' behavioral intention towards future sky train usage, modeling analysis is necessary. Three sets of structural equation model are estimated. This chapter presents the model development process and its results. In this study, a set of theory of planned behavior models are developed.

## 5.2 Data Structure for Modeling

Such information included respondents' socioeconomic characteristics, trip characteristics, psychological questionnaire towards future sky train usage, and the additional questions of the attitudinal aspects were keyed and input into the database using SPSS. Each piece of information was represented in a numerical form data with different types of measurement (scale, nominal, ordinal) according to its natural value; for instance, the variable gender would value 1 if it was a male respondent and 0 otherwise. Descriptions of all the variables used in the modeling are shown in Table 5.1.

**Table 5.1** Description of Variables

| No. | Variables | Measure | Value | Description |
|---|---|---|---|---|
| 1 | Gender | Dummy | 0/1 | Gender of respondent (1: male; 0: otherwise) |
| 2 | Occupation | Dummy | 0/1 | respondent 's occupation(1:student; 0:otherwise) |
| 3 | Income | Scale | integer | Respondents' categorical income |
| 4 | Vehicle availability | Scale | integer | Vehicle availability of respondent |
| 5 | Driving license | Scale | integer | Respondents' driving license holder |
| 6 | Attitudes (AT) | Scale | integer | Respondent's attitude toward future sky train usage |
| 7 | Subjective norms (SN) | Scale | integer | Respondent's SN toward future sky train usage |
| 8 | Perceived behavioral control | Scale | integer | Respondent's PBC toward future sky train usage |
| 9 | Moral obligation | Scale | integer | Respondent's MO toward future sky train usage |

| No. | Variables | Measure | Value | Description |
|---|---|---|---|---|
| 10 | Awareness of consequences | Scale | integer | Respondent's AWC toward future sky train usage |
| 11 | Behavioral intention (BI) | Scale | integer | Respondent's BI toward future sky train usage |
| 12 | Instrumental aspect of PT | Scale | integer | Respondent's instrumental aspect of future sky train usage |
| 13 | Symbolic/ affective aspect of PT | Scale | integer | Respondent's symbolic/affective aspect of future sky train usage |
| 14 | Social orderliness aspect of PT | Scale | integer | Respondent's social orderliness aspect of future sky train usage |

## 5.3 Homogeneity of Construct Items

The homogeneity of the items within the dimensions measuring each psychological factor was evaluated by means of the Cronbach's alpha coefficients. From Table 5.2 it can be seen that those construct variables can be used in the structural equation modeling analysis with the acceptable reliability. It can be observed that the value of cronbach's alpha of moral obligation and symbolic/affective aspect for public transport are a little bit lower than the acceptable limit of cronbach's alpha. We assume these are acceptable for the model analysis since only one statement can be used in the structural equation modeling analysis.

**Table 5.2** Summary of Homogeneity of Constructs Items

| Variables | Number Of Items | Mean | SD. | Cronbach's Alpha ($\alpha$) |
|---|---|---|---|---|
| Perceived Behavioral Control (PBC) | 4 | 5.68 | 0.90 | 0.63 |
| Moral Obligation (MO) | 3 | 5.97 | 0.86 | 0.59 |
| Attitude (AT) | 4 | 6.01 | 0.80 | 0.75 |
| Subjective Norm (SN) | 4 | 5.52 | 1.06 | 0.80 |
| Awareness of Consequence (AWC) | 3 | 6.17 | 0.79 | 0.67 |
| Behavioral Intention (BI) | 4 | 5.41 | 1.11 | 0.80 |
| Social Orderliness | 2 | 6.22 | 0.91 | 0.63 |
| Symbolic/Affective | 2 | 4.45 | 1.06 | 0.53 |
| Instrumental aspect | 2 | 6.01 | 0.95 | 0.68 |

| Variables | Number Of Items | Mean | SD. | Cronbach's Alpha (α) |
|---|---|---|---|---|
| Income | 1 | 1.93 | 1.29 | - |
| Occupation | 1 | 0.41 | 0.49 | - |
| Gender | 1 | 0.75 | 0.43 | - |
| Vehicle Availability | 1 | 1.11 | 0.31 | - |
| Driving License | 1 | 1.56 | 0.50 | - |
| Willingness to pay | 1 | - | - | - |

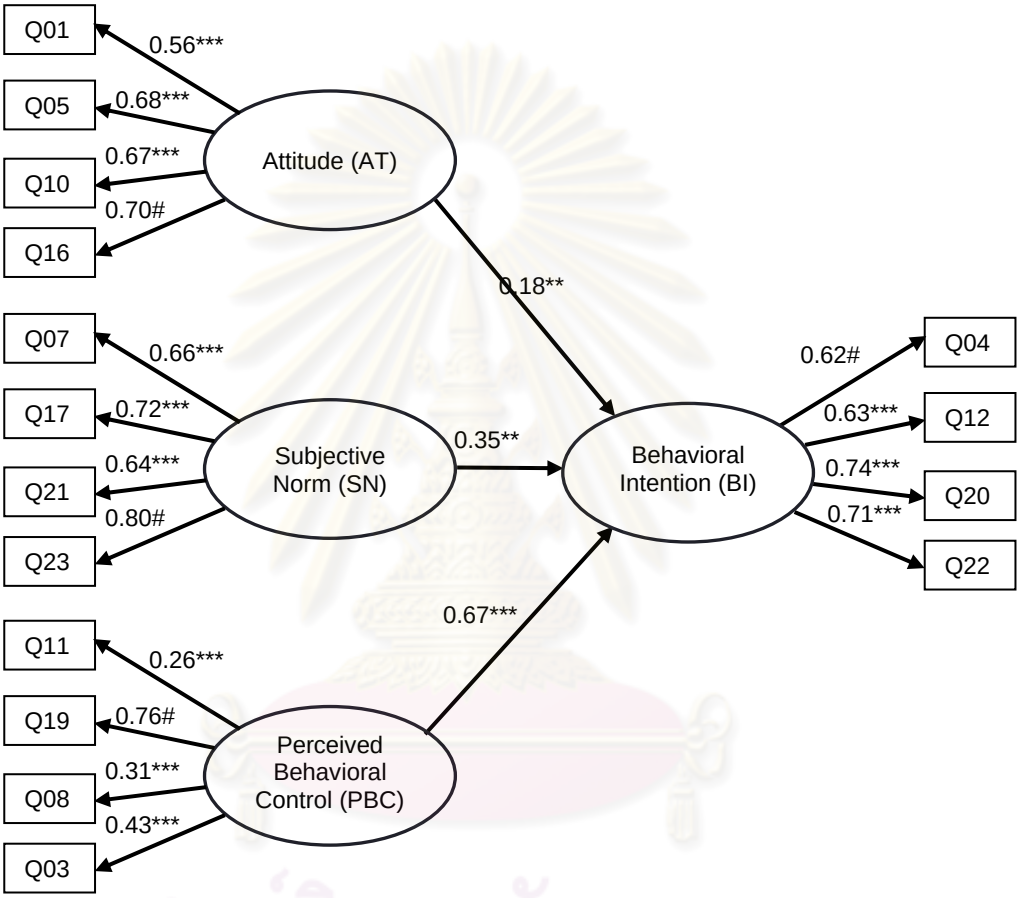
## 5.4 Modeling Results

We investigated three set of structural equation models. The models to be tested in the first set (Model I) strictly followed the TPB concept. In the second set of the structural equation model (Model II), we enhance Model I with addition of psychological variables, namely, moral obligation and awareness of consequences. We also introduced additional variables, attitudinal-aspect of future sky train, namely, symbolic/affective aspect for public transport, instrumental aspect for public transport, and social orderliness aspect for public transport. In the last model, we extended Model II, taking into account additional variables such as gender, occupation, income, vehicle ownership and availability of driving license.

### 5.4.1 Model I (Basic Model of TPB)

In the first model, we estimate the commuter's behavioral intention toward future sky train usage based on the basic model of TPB. We hypothesize that respondents' attitude, subjective norm and perceived behavioral control have a positive influence on behavioral intention towards future sky train usage. Figure 5.1 presents the result of structural model with standardized path coefficients. Overall, this model gives a $\chi^2$ value of 360.283 with 88 degrees of freedom. The standardized direct effects on the behavioral intention are 0.18 for attitude, 0.35 for subjective norm and 0.67 for perceived behavioral control (see Table 5.3). It is found that all TPB core constructs are statistically significant determinants for behavioral intention of using future sky train and perceived behavioral control is found to be a high influencing determinant to the behavioral intention. The goodness of fit statistics indicates that this model fits the data well. Specifically, the RMSEA value of 0.088 is lower than the upper limit of 0.10 and NFI value of 0.872 and CFI value of 0.899 are better in range of the cutoff value of 0 to 1. As

hypothesized, attitude, subjective norm and perceived behavioral control is found to have a significantly positive influence on behavioral intention towards future sky train usage. From Table 5.3, it is found that the standardized direct effects of attitude, subjective norm and perceived behavioral control are significantly at 95% of confident level.




$\chi^2$=360.283, d.f. = 88, NFI = 0.872, CFI = 0.899, RMSEA = 0.088

Note: # Value fixed at 1.00; * p<.05, ** p<.01, *** p<0.001

**Figure 5.1** SEM Result for Model I

**Table 5.3** Standardized Regress Weights of Model I

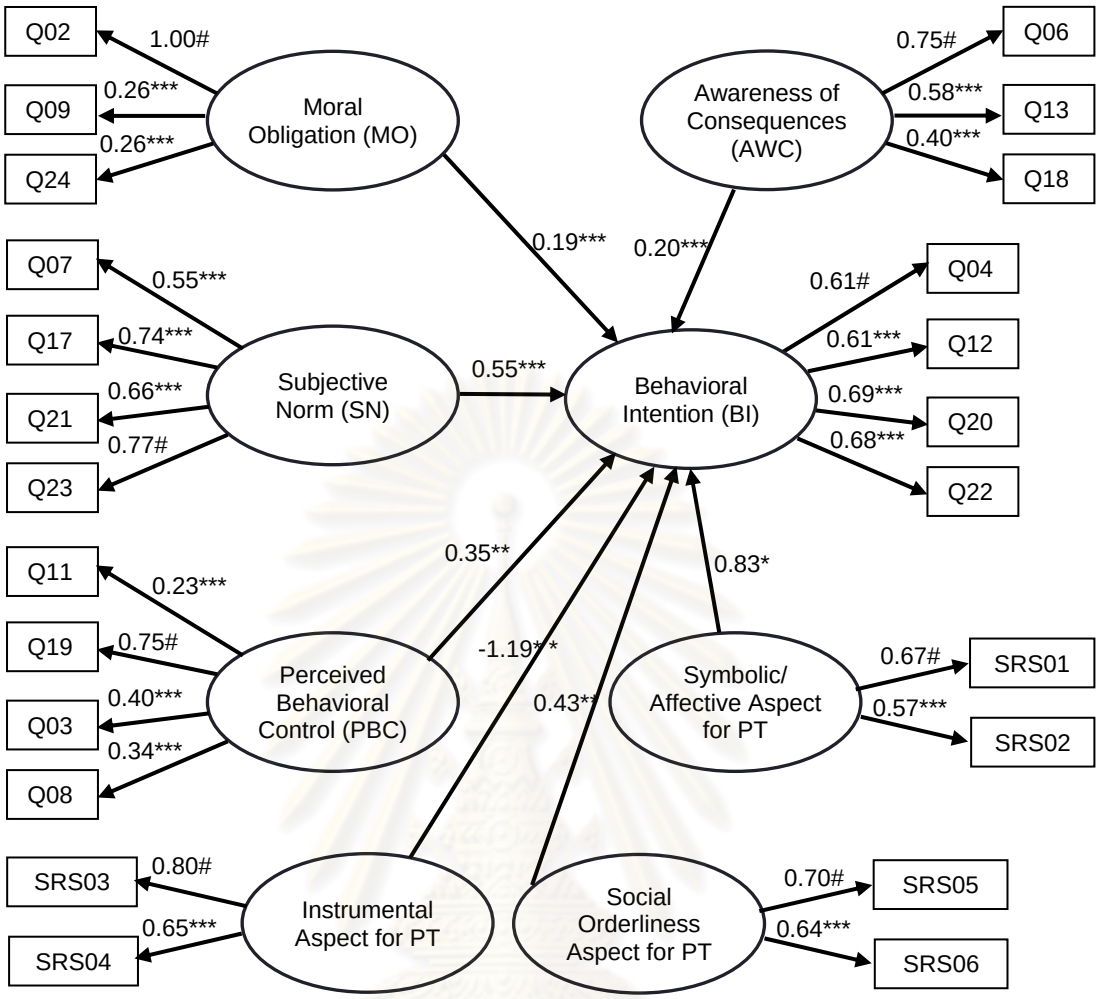
| | | | Estimate | t-stat | p-value |
|---|---|---|---|---|---|
| Behavioral Intention (BI) | <--- | Attitude (AT) | 0.179 | 2.628 | 0.009 |
| Behavioral Intention (BI) | <--- | Perceived Behavioral Control (PBC) | 0.673 | 5.213 | <0.001 |
| Behavioral Intention (BI) | <--- | Subjective Norm (SN) | 0.348 | 2.692 | 0.007 |

### 5.4.2 Model II (Enhanced TPB Model)

In the second model, we enhance the first model by adding the moral obligation and awareness of consequence. Additionally, we replaced the attitude variable by three groups of attitudinal aspects, namely, symbolic/affective, instrumental and social orderliness aspect. We hypothesized that the behavioral intention toward future sky train could be explained by the subjective norm, perceived behavioral control, moral obligation, awareness of consequences, and the three attitudinal aspects on public transport. Figure 5.2 presents the model estimation result. We found that moral obligation, awareness of consequences, symbolic/affective and social orderliness attitudinal aspects positively influence the behavioral intention toward future sky train usage. However, the instrumental aspect is found to be statistically significant but negatively influences the behavioral intention. The results depicted in Figure 5.2 have $\chi^2$ value of 905.150 with 214 degrees of freedom, NFI value of 0.778, CFI value of 0.818 and RMSEA value of 0.090. Although the NFI is slightly low and the RSMEA is marginally higher than 0.08, the model fitted the data moderately well. The standardized direct effects on the behavioral intention are 0.55 for subjective norm, 0.35 for perceived behavioral control, 0.19 for moral obligation, 0.20 for awareness of consequence, 083 for symbolic/affective aspect, 0.43 for social orderliness aspect and -1.19 for instrumental aspect (see Table 5.4). From Table 5.4, it can be seen that the standardized path coefficients are significant at 95% of confident level.

**Table 5.4** Standardized Regress Weights of Model II

| | | | Estimate | t-stat | p-value |
|---|---|---|---|---|---|
| Behavioral Intention (BI) | <--- | Perceived Behavioral Control (PBC) | 0.354 | 2.793 | 0.005 |
| Behavioral Intention (BI) | <--- | Moral Obligation (MO) | 0.189 | 5.335 | <0.001 |
| Behavioral Intention (BI) | <--- | Subjective Norm (SN) | 0.546 | 4.23 | <0.001 |
| Behavioral Intention (BI) | <--- | Awareness of Consequence (AWC) | 0.197 | 3.622 | <0.001 |
| Behavioral Intention (BI) | <--- | Social Orderliness | 0.433 | 2.887 | 0.004 |
| Behavioral Intention (BI) | <--- | Symbolic/Affective | 0.827 | 2.239 | 0.025 |
| Behavioral Intention (BI) | <--- | Instrumental aspect | -1.185 | -3.049 | 0.002 |




$\chi^2$=905.150, d.f.= 214, NFI = 0.778, CFI = 0.818, RMSEA = 0.090

Note: # Value fixed at 1.00; * p<.05, ** p<.01, *** p<0.001

**Figure 5.2** SEM Result for Model II

### 5.4.3 Model III (Extension of TPB Model)

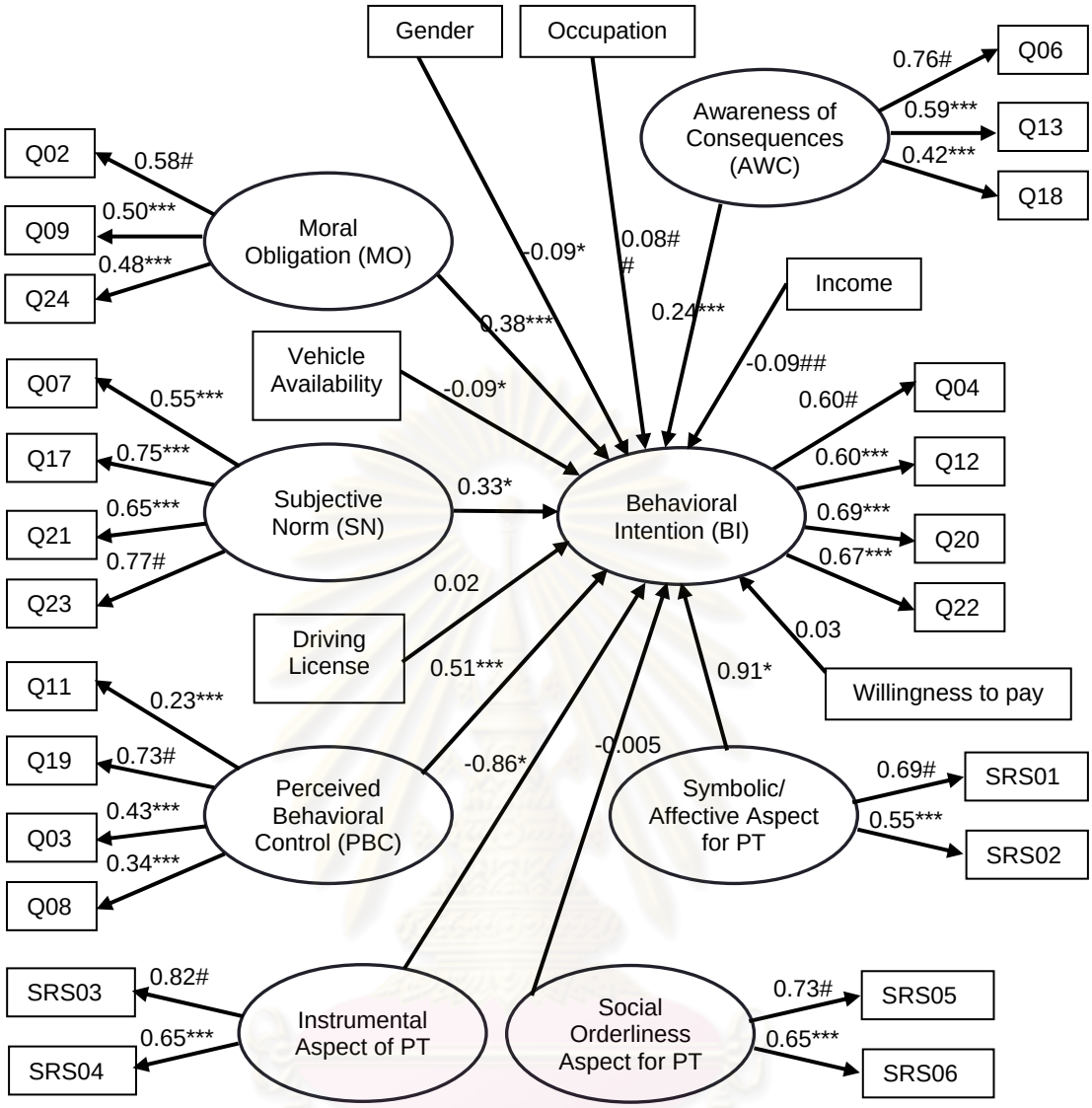
In the third model, we extend the second model by adding potential socioeconomic and travel characteristic variables, namely, gender, occupation, driving license and vehicle availability. We hypothesize that these variables may have some effects on the behavioral intention towards future sky train usage, while keeping other variables similar to model II.

From the model estimation results in Figure 5.3, the standardized direct effects on behavioral intention are 0.51 for perceived behavioral control, 0.38 for moral obligation, 0.33 for subjective norm, 0.24 for awareness of consequences, -0.005 for

social orderliness aspect, 0.91 for symbolic/affective aspect, -0.86 for instrumental aspect, -0.09 for income, 0.08 for occupation, -0.09 for gender, -0.09 for vehicle availability, 0.02 for driving license, and 0.03 for willingness to pay (see Table 5.5). We observed that for socioeconomic variables, respondents' occupation, income and gender are found to significantly influence the behavioral intention. In particular, gender and income are found to significantly influence the behavioral intention in negative sign. Similarly for travel characteristic variables, vehicle availability is found to negatively influence the behavioral intention, while the estimated coefficient for driving license and willingness to pay are positive but not statistically significant. Overall, this model yields a $\chi^2$ value of 1037.514 with 355 degrees of freedom, NFI value of 0.771; CFI value of 0.834 and RMSEA value of 0.071. It can be observed from the results that the model fitted the data well. Although the NFI, CFI are slightly lower than 0.90, the RMSEA value is in the recommended value.

**Table 5.5** Standardized Regress Weights of Model III

| | | | Estimate | t-stat | p-value |
|---|---|---|---|---|---|
| Behavioral Intention (BI) | <--- | Perceived Behavioral Control (PBC) | 0.510 | 3.273 | 0.001 |
| Behavioral Intention (BI) | <--- | Moral Obligation (MO) | 0.383 | 4.871 | <0.001 |
| Behavioral Intention (BI) | <--- | Subjective Norm (SN) | 0.327 | 2.092 | 0.036 |
| Behavioral Intention (BI) | <--- | Awareness of Consequence (AWC) | 0.241 | 3.450 | <0.001 |
| Behavioral Intention (BI) | <--- | Social Orderliness | -0.005 | -0.032 | 0.974 |
| Behavioral Intention (BI) | <--- | Symbolic/Affective | 0.939 | 2.504 | 0.012 |
| Behavioral Intention (BI) | <--- | Instrumental aspect | -0.893 | -2.295 | 0.022 |
| Behavioral Intention (BI) | <--- | Income | -0.089 | -1.808 | 0.071 |
| Behavioral Intention (BI) | <--- | Occupation | 0.083 | 1.711 | 0.087 |
| Behavioral Intention (BI) | <--- | Gender | -0.089 | -2.477 | 0.013 |
| Behavioral Intention (BI) | <--- | Vehicle Availability | -0.092 | -2.290 | 0.022 |
| Behavioral Intention (BI) | <--- | Driving License | 0.018 | 0.514 | 0.607 |
| Behavioral Intention (BI) | <--- | Willingness to pay | 0.032 | 0.941 | 0.347 |




$\chi^2$=1037.514, d.f.= 355, NFI = 0.771, CFI = 0.834, RMSEA = 0.071

Note: # Value fixed at 1.00; ## p<0.10, * p<.05, ** p<.01, *** p<0.001

Gender is a dummy variable, where 1=male and 0 = female. Similarly, occupation is a dummy variable, where 1 = students and 0 otherwise. The income variable is categorical.

**Figure 5.3** SEM Result for Model III

### 5.4.4 Model Comparisons

In terms of root mean square error approximation value (RMSEA) and the value of $\chi^2$/df among these three models, it can be seen that model III is the best model to investigate Phnom Penh commuters' behavioral intention towards future sky train usage (see Table 5.6). In this model, the behavioral intention toward future sky train usage can be explained by many variables more than other two models such as attitudinal aspect for sky train usage, subjective norm, perceived behavioral control, moral obligation, and awareness of consequences, socioeconomic characteristics and trip characteristics.

**Table 5.6** Model comparisons

| Goodness-of-fit Indices | Model I | Model II | Model III |
|---|---|---|---|
| $\chi$2 | 360.283 | 905.150 | 1037.514 |
| df | 88 | 214 | 355 |
| $\chi^2$ / df | 4.090 | 4.229 | 2.922 |
| NFI | 0.872 | 0.778 | 0.771 |
| CFI | 0.899 | 0.818 | 0.834 |
| RMSEA | 0.088 | 0.090 | 0.071 |

## 5.5 Discussions

Using empirical data from Phnom Penh commuters, results from structural equation models reveal that the behavioral intention towards future sky train usage is significantly influenced by attitudes, subjective norm, perceived behavioral control, moral obligation, awareness of consequences, attitudinal aspect variables, socio economic variable and travel characteristics. The instrumental attitudinal aspect, income, gender, and vehicle availability are found to influence negatively on the behavioral intention in our models. This may be because of the respondents' belief on the speed and convenience of the public transport that is quite low given that they currently experience poor public transport service. Thus, this result prompts transport operators to seriously consider the quality of service of public transport, the issue that has not been taken care much in Phnom Penh. Female respondents are more likely to

use sky train, and respondents who own vehicles already or those who have high income are less likely to use the future sky train.

In terms of travel characteristic variables, driving license is not significant in the model. It can be implied that the behavioral intention of using future public transport does not depend on whether the respondents own the driving license. It should be noted from our finding that the behavioral intention toward future sky train usage is also influenced by the moral obligation and awareness of consequences. Moreover, the determinants of attitudes, which in this case consist of symbolic/affective and instrumental aspects, are also found to be of statistical significance. Consequently, it can be implied that intervention of attitudes would be the most effective way in changing the behavioral intention of using urban public transportation.

In terms of willingness to pay variable, the estimated coefficient is found in positive value but the p value is found bigger than 0.10. This means that willingness to pay variable is found insignificant in the model. It can be seen that the behavioral intention towards future sky train usage is pretty much less depend on willingness to way comparing with other variables in the model which are the high determinants of intention to use future sky train.

It can be observed from the 3 models that the estimated coefficient of each latent variables always change the order of the influence to the behavioral intention. For example in the model I, perceived behavioral control (PBC) is found to be the highest determinant of intention to use future sky train, while in the model II with the additional of moral obligation, awareness of consequences and the new attitudinal aspects variables, the perceived behavioral control is found to be the fourth order of the influence determinants of the behavioral intention. This may be due to the fact that the other variables that we have added into the model I have more influence to the intention than the basic variable of the TPB in model I; for example the symbolic/affective aspect is found to be the highest influent determinant of the behavioral intention of using future sky train.

From the result of the models, it can be implied that the Phnom Penh commuter's behavioral intention towards future sky train usage should consider on attitudes, subjective norm, perceived behavioral control, moral obligation, and awareness of

consequences, attitudinal aspect variables, socio economic variable and travel characteristics. The transportation operators should seriously consider the quality of service of public transport, since this issue has not been taken care much in Phnom Penh. In terms of perceived behavioral control, moral obligation and awareness of consequences, transportation planners should provide campaign or advertisement to Phnom Penh road users about the way how to use sky train and its advantages. In terms of attitudinal aspects, the transport planners should also take lesson learnt from others countries which are successful on this area to covey the Phnom Penh road users about urban public transportation to make them more confident on their individual feeling or perception to use public transportation such rail system. In term of driving license and vehicle available, it can be observed that most of the respondents have high availability to use the vehicle, whereas only about 44 percent of the total respondents who have the driving license are found. This may result in the high probability of making traffic accident as JETRO (2008) reported that most of the traffic accident is made up of the motorcycles. Due to these issues, transportation operators should take measures to reduce vehicle availability and convince road users to use more public transport.

# CHAPTER VI

# CONCLUSIONS AND FUTURE STUDY

## 6.1 Conclusions

This study addresses the commuters' behavioral intention towards future sky train usage in the city of Phnom Penh, which currently lacks a formal public transport mode. A pilot survey was conducted as a preliminary study on the feasibility of the application of the Theory of Planned Behavior (TPB). Afterwards, a main survey was further conducted during May 27 and May 31, 2010 to collect the information on respondents' socioeconomic and travel characteristics, psychological characteristics, and their attitudinal aspects towards future sky train. Based on a total of 398 respondents, the data obtained from the survey was input into a database and was analyzed using both descriptive statistics and structural equation models in order to discover passengers' behavioral intention towards future sky train usage.

From our results, approximately one third of the respondents are female. Most of respondents are bachelor students in range between 18 to 25 years old. About 90 percent of respondent use the private motorcycle while the motor-taxi is found 3.8 percent and other modes are 6.3 percent. Nearly half of the respondents are from the household with more than 5 members. The majority of the respondents have no car in their household but nearly half of the total respondents have at least one motorcycle in their household. About 56 percent of the total respondents do not have the driving license. In average, the respondents spent approximately 2,000 Riel for their trip in the average travel time of 18.84 minutes.

Female respondents are more likely to use sky train, and respondents who own vehicles already or those who have high income are less likely to use the future sky train. Almost 95 percent of the total respondents stated that they will use the future sky train when the system is available, about 66 percent of them willing to spend about 2,000 Riel. This finding is quite positive for transport operators since more customers in

several market segments can be attracted, giving that a good quality service is provided.

In terms of travel characteristic variables, the behavioral intention of using future public transport does not depend on whether the respondents own the driving license. It should be noted from our finding that the behavioral intention toward future sky train usage can be investigated by the theory of planned behavior. The behavioral intention toward future sky train usage is also influenced by the moral obligation and awareness of consequences. Increasing the level of moral obligation and awareness of consequences may be reasonable to reduce the private vehicle usage in the future. Moreover, the determinants of attitudes, which in this case consist of symbolic/affective, instrumental and social orderliness attitudinal aspects, are also found to be of statistical significance. Consequently, it can be implied that intervention of attitudes would be the most effective way in changing the behavioral intention of using urban public transportation.

In conclusion, the present study demonstrates that the strategies to induce road users to use more public transportation such as a future sky train should be aimed at attitudes, subjective norm, perceived behavioral control, moral obligation, awareness of consequences, and some socioeconomic and travel characteristics information. To the author's knowledge, this study is the early study regarding psychological factors that could affect travel behavior for Phnom Penh's commuters. The actual behavioral intention towards future sky train usage is yet to be investigated. Contribution of the results from the present study is hoped to shed some light on future sky train in terms of travel demand. In addition, the analysis results can be additionally used for future research and study on transportation planning in order to induce the Phnom Penh commuters to use more public transportation.

## 6.2 Recommendations and Future Study

Further study is called for when the project is implemented. From the study results and personal viewpoints, it is recommended that Municipality of Phnom Penh should initiate the sky train project based on the outputs of this study in terms of potential travel demand and focus on the psychological factors to induce the road users

to use public transport. Since the current study investigates the commuters, motorists, further research is needed for other road users such as tourists. Different users with different socioeconomic characteristics would have different behavioral intention towards future sky train. Therefore, to induce road users to use future sky train, transportation planners should aim at these psychological factors by focusing on the different group of respondents.

Although the outcomes of the models are good to investigate the Phnom Penh commuters toward future sky train usage, this study can be improved by including more variables such as past behavior, private vehicle usage, frequency of mode usage and other variables might improve the explanatory power of intention to use future sky train. We ought to take more attention on the respondent's answer. Clear explanation to the respondents is required before asking them to give the answer.

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# APPENDICES

# Appendix A

## JETRO Survey Forms

Katahira & Engineers International
Japan Export & Trade Organization (JETRO)

Ministry of Public Works and Transport
Phnom Penh Municipality

*Phnom Penh Sky Rail System Project*

## SOCIAL SURVEY ON ATTITUDE OF TRANSPORT USERS

for study purpose only

**General Info.**

**A Sample No** ☐☐☐ **C Date (month/day)** ☐☐☐☐

**B Location** ☐ **D Time (hour/min)** ☐☐☐☐ *hour* *min*

**E Vehicle** ☐
1-Passenger car 2-Taxi 3-Bus 4-Truck 5-Motor Cycle 6-Moto-Rumok 7-Moto-Dop

**Trip Information**

**1 Trip OD**
Where did you start this trip? _____ ☐☐☐ (Zone Code)
Landmark, Road Name _____

Where do you go this trip? _____ ☐☐☐ (Zone Code)
Landmark, Road Name _____

**2 Travel Time** How long does it take? ☐☐☐ Min.

**3 Frequency** How often do you use a car for this trip purpose and OD ? ☐
1 Daily (7 days) 2 work days only 3 2-3 days
4 once a week 5 rarely 6 just this time

**4 Trip purpose** ☐
1 Job 2 Study 3 Business 4 Shopping
5 Private 6 Airport 7 Home 8 Others

**5 When Sky Rail is completed, do you want to use the Sky Rail ?** ☐
1 Yes 2 No

**6 What purpose do you want to use the Sky Rail when Question 5 answer Yes ?** ☐
1 Job 2 Study 3 Business 4 Shopping
5 Private 6 Airport 7 Home 8 Others

**7 How much would you pay when Sky Rail System is completed ?** ☐
1 1000 Riels 2 2000 Riels
3 3000 Riels 4 More than 4000 Riels

**Personal Information**

**8 Gender** ☐
1 Male 2 Female

**9 Age** 1)20-29 2)30-39 3)40-49 4)50-59 5)>60 ☐

**10 Car availability** ☐
1-Always 2-Often 3-Not avaiable 0- No have

**11 Moto availability** ☐
1-Always 2-Often 3-Not available 0- No have

**12 Qualification** ☐
1 Ph. D 2 M. Sc. 3 B. Sc. or diploma 4 technical secondary school
5 primary or elementary school 6 no qualification 7. High School

**13 Monthly Income (US $)** ☐
1) <100 2) 101-200 3) 201-300 4) 301-400
5) 401-500 6) 500-1000 7) 1000-2000 8) 2000>

**14 How much do you pay for gasoline in one month ?** ☐☐☐ US$

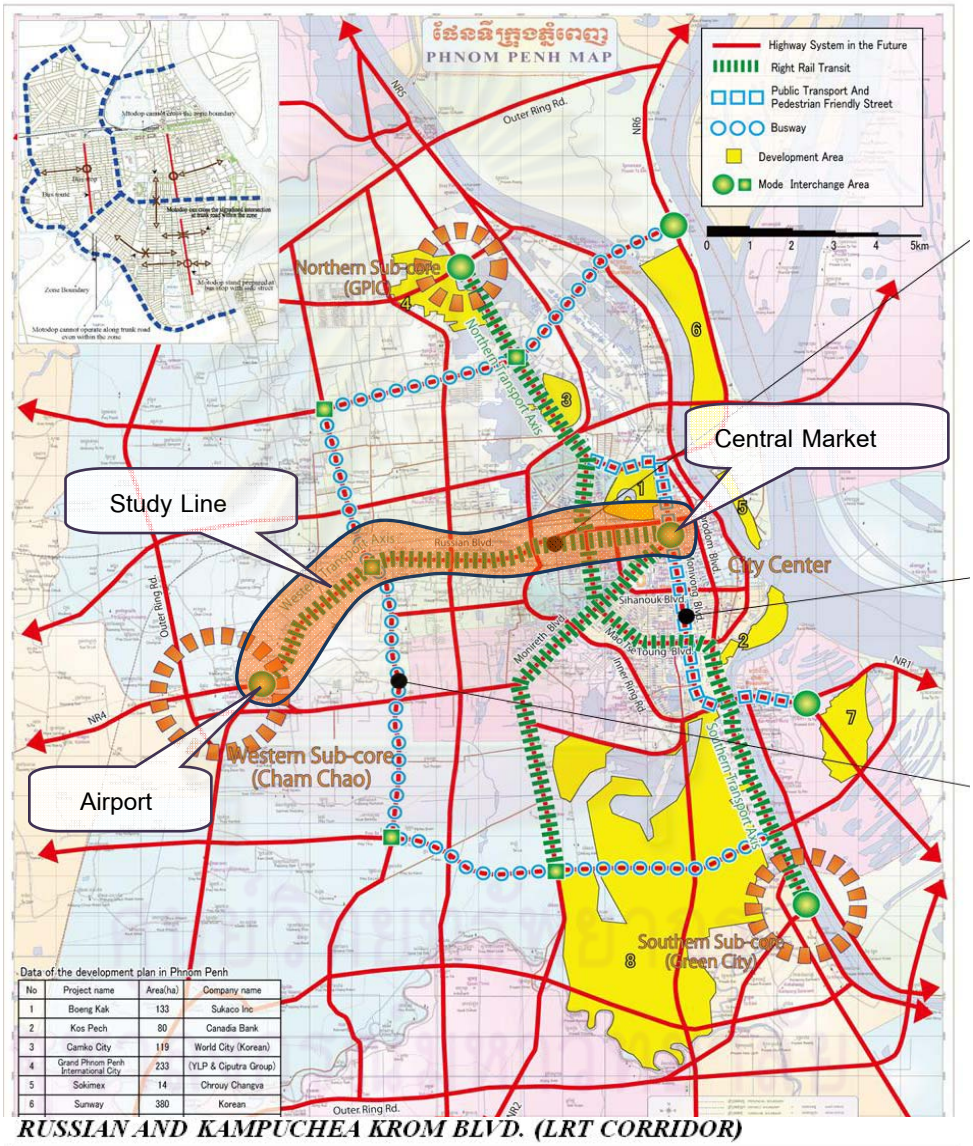
**That's All. Thank You Very Much for Your Cooperation.**

# Appendix B

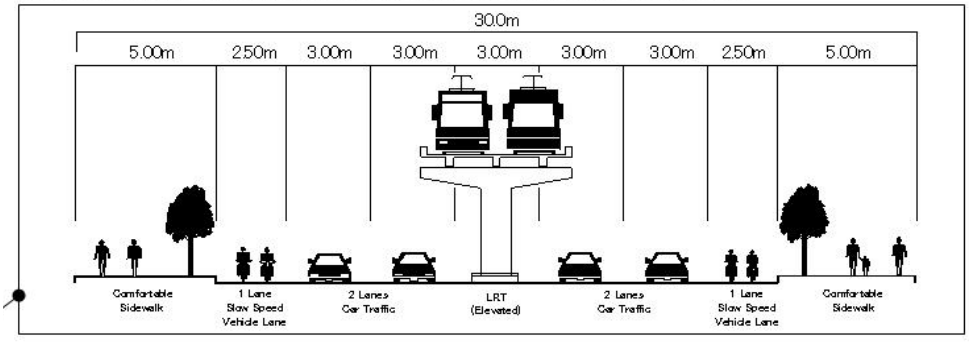
## Pilot Survey Forms

Suppose there is a rail transit system running in Phnom Penh with 3 lines (see the map). Our research study will choose one of these lines, Airport line linking from City center (Central Market) to the western sub-core (Cham Chao). It's about 8.5 km long elevated along Russian and Kampuchea Krom Boulevard (as shown below). We will refer this rail transit system in the survey as future urban rail transit. We would like to ask you some questions for better understanding your future behavioral intention.

***FUTUER PUBLIC TRANSPORT SYSTEM IN PHNOM PENH CITY***




***RUSSIAN AND KAMPUCHEA KROM BLVD. (LRT CORRIDOR)***



Interviewer: _____Location: _____

Survey date: _____Survey time: _____

## Study of Urban Rail Transit in Phnom Penh City

Please take a few minutes to answer these questions. There will be 2 sections in this survey. Section 1 will ask about the demographic and socioeconomic information. Section 2 measures the predictor variables and intentions.

### Section I:

Age: _____ Gender: ❑ Female ❑ Male

Occupation: ❑ Student ❑ Teacher ❑ Employer ❑ Employee
❑ Seller ❑ Civil servant ❑ Unemployed
Other, please specify: _____

Monthly income: ❑ <$100 ❑ $101-$200 ❑ $201-$300 ❑ $301-$400
❑ $401-$500 ❑ $500-$1,000 ❑ $1,000-$2,000 ❑ >$2,000

Members in household (including yourself): _____

Number of vehicles in household: Car/Pick-up_____Motorbike_____

When you travel along this corridor, what is the typical transportation mode that you use the most? ❑ Motorbike ❑ Motor-taxi other, please specify: _____

When you travel along this corridor, what is the typical trip purpose?
❑ Study ❑ Work ❑ Business ❑ Shopping

From: _____To: _____

Time: _____Travel time: _____Cost: _____

In which District/Commune have you lived? District: _____Commune: _____

### Section II:

Please mark (√) the answer for the following questions:

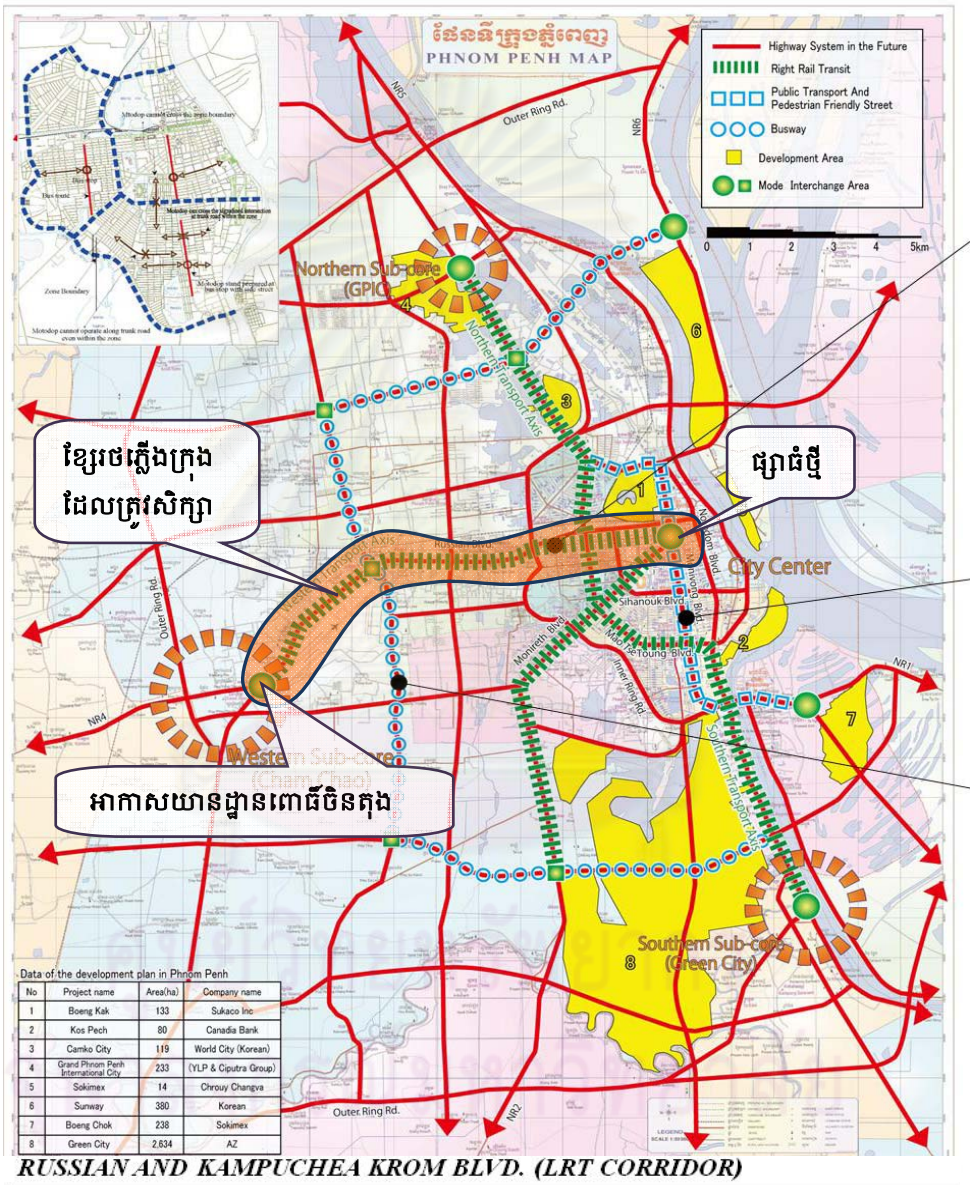
| Questions | Strongly Disagree ⟹ Strongly Agree | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. I prefer using the future urban rail transit. | | | | | | | |
| 2. I have good feeling towards using future urban rail transit. | | | | | | | |
| 3. Using future urban rail transit is desirable to me. | | | | | | | |
| 4. Using future urban rail transit is beneficial to me. | | | | | | | |
| 5. Using future urban rail transit is the right thing to do. | | | | | | | |

| Questions | Strongly Disagree ⇨ Strongly Agree | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. My friends or my family want me to take future urban rail transit. | | | | | | | |
| 7. If I took the urban rail transit, my friends or my family would have no problem with it. | | | | | | | |
| 8. My friends or my family would agree with using the future urban rail transit. | | | | | | | |
| 9. My friends or my family think that I should use future urban rail transit. | | | | | | | |
| 10. Most of my friends will use future urban rail transit. | | | | | | | |
| 11. I feel under social pressure to use future urban rail transit. | | | | | | | |
| 12. It is easy for me to use urban rail transit. | | | | | | | |
| 13. I am confident that I can use future urban rail transit. | | | | | | | |
| 14. Whether I use the future urban rail transit is completely up to me. | | | | | | | |
| 15. The decision to use future urban rail transit is under my control. | | | | | | | |
| 16. I could use future urban rail transit if I want to. | | | | | | | |
| 17. In term of morality, I think that using future urban rail transit is not problematic. | | | | | | | |
| 18. I should use urban rail transit. | | | | | | | |
| 19. In regard to my decision, I will use future urban rail transit. | | | | | | | |
| 20. I want to use future urban rail transit. | | | | | | | |
| 21. I plan to use future urban rail transit. | | | | | | | |
| 22. I will make an effort to use future urban rail transit. | | | | | | | |
| 23. If I take future urban rail transit, I will arrive at the destination faster. | | | | | | | |
| 24. Using future urban rail transit is depending on the travel distance. | | | | | | | |
| 25. Using future urban rail transit is depending on the travel cost. | | | | | | | |
| 26. Using future urban rail transit is depending on the level of traffic congestion. | | | | | | | |
| 27. Using future urban rail transit will reduce the traffic congestion. | | | | | | | |
| 28. Using future urban rail transit will reduce traffic accidents. | | | | | | | |
| 29. I think that future urban rail transit is safe. | | | | | | | |
| 30. I feel that the air pollution is getting worse. | | | | | | | |

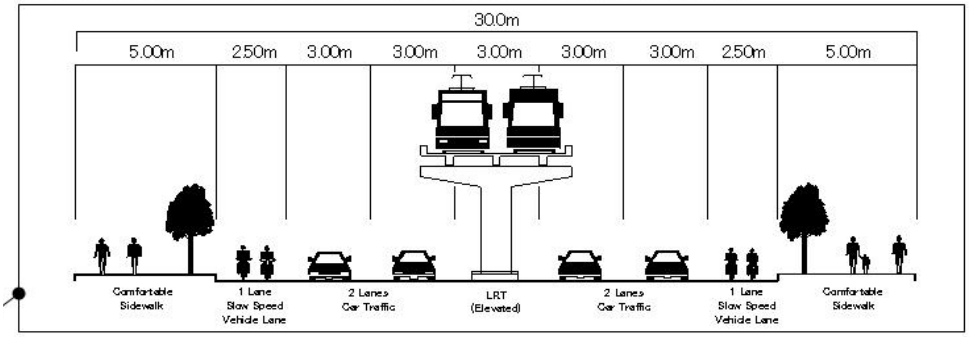
Thank You for Your Participation

ឧទាហរណ៍ថា មានខ្សែរថភ្លើងក្រុង រត់នៅក្នុងទីក្រុងភ្នំពេញ ចំនួន៣ខ្សែ ដូចក្នុងរូបភាពខាងក្រោម។ ១ខ្សែក្នុងចំនោម ខ្សែទាំង៣ គឺខ្សែដែលតភ្ជាប់ពី ផ្សារធំថ្មី ទៅអាកាសយានដ្ឋានអន្តរជាតិពោធិ៍ចិនតុង (ចោមចៅ) ត្រូវបានយកមកសិក្សា។ ខ្សែរថភ្លើងនេះ មានប្រវែងប្រមាណ៨,៥គីឡូម៉ែត្រ ដែលសង់នៅពីលើតាមបណ្តោយ មហាវិថីសហព័ន្ធរុស្ស៊ី និង មហាវិថីកម្ពុជាក្រោម ដូចបង្ហាញ ក្នុងរូបភាពខាងក្រោម។ យើងសន្មតថាខ្សែរថភ្លើងនេះ ជាខ្សែរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ។ ដូច្នេះ យើងត្រូវការស្វែងមតិរបស់លោកអ្នកដើម្បីស្វែងយល់ពីគោលបំណងនៃការប្រើប្រាស់ខ្សែរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ។

*FUTUER PUBLIC TRANSPORT SYSTEM IN PHNOM PENH CITY*




*RUSSIAN AND KAMPUCHEA KROM BLVD. (LRT CORRIDOR)*



អ្នកសំភាស: _____ ទីកន្លែង: _____

កាលបរិច្ឆេទ: _____ ម៉ោង: _____

## ការសិក្សាខ្សែរថភ្លើងក្រុងនៅក្នុងទីក្រុងភ្នំពេញ

សូមមេត្តាផ្តល់ពេលវេលាពី ពីរ ទៅ បីនាទី ដើម្បីឆ្លើយសំនួរ និង បំពេញនូវពត៌មានមួយចំនួនដូចខាងក្រោម។ នៅក្នុងសំនួរនៃការស្ទង់មតិនេះ ចែកចេញជាពីរផ្នែកសំខាន់ៗ។ ផ្នែកទី១ នឹងសុំអោយលោកអ្នក បំពេញនូវពត៌មានដែលទាក់ទងទៅនឹងពត៌មានអំពីខ្លួនអ្នកផ្ទាល់។ ផ្នែកទី២ នឹងសុំអោយលោកអ្នក ឆ្លើយនូវសំនួរដែលទាក់ទងនឹងគោលបំណងនៃការចង់ប្រើប្រាស់មធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុងនៅថ្ងៃអនាគត។

### ផ្នែកទី១:

អាយុ: _____ ភេទ: ❑ ស្រី ❑ ប្រុស

មុខរបរ: ❑ សិស្ស ❑ គ្រូបង្រៀន ❑ និយោជក ❑ និយោជិត
❑ អ្នកលក់ដូរ ❑ មន្ត្រីរាជការ ❑ មិនមានការងារ
ផ្សេងៗចូរបញ្ជាក់: _____

បៀវត្សប្រចាំខែ: ❑ <$100 ❑ $101-$200 ❑ $201-$300 ❑ $301-$400
❑ $401-$500 ❑ $500-$1,000 ❑ $1,000-$2,000 ❑ >$2,000

ចំនួនសមាជិកនៅក្នុងគ្រួសារ (រួមទាំងខ្លួនអ្នក): _____

ចំនួនរថយន្តនៅក្នុងផ្ទះ: រថយន្តតូច/រថយន្ត១បាំងកន្លះ _____ ម៉ូតូ _____

ជាញឹកញាប់ តើអ្នកប្រើប្រាស់មធ្យោបាយអ្វី ពេលដែលលោកអ្នកធ្វើដំនើរតាមមហាវិថីនេះ?

❑ ម៉ូតូ ❑ ម៉ូតូដុប ផ្សេងៗចូរបញ្ជាក់: _____

តើអ្នកធ្វើដំនើរតាមមហាវិថីនេះក្នុងគោលបំណងអ្វី?

❑ សិក្សា ❑ ការងារ ❑ មុខជំនួញ ❑ ទិញឥវ៉ាន់

ចាកពី: _____ ទៅកាន់: _____ ពេលធ្វើដំនើរ: _____

រយៈពេលធ្វើដំនើរ: _____ តំលៃធ្វើដំនើរ: _____

តើសព្វថ្ងៃ អ្នកស្នាក់នៅក្នុងខណ្ឌ/សង្កាត់ណា? ខណ្ឌ: _____ សង្កាត់: _____

### ផ្នែកទី២:

ចូរគូសសញ្ញា(√) ដើម្បីឆ្លើយនឹងសំនួរខាងក្រោម:

| សំនួរ | មិនយល់ស្រប ⇨ យល់ស្រប | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. ខ្ញុំ ចង់ធ្វើដំណើរដោយរថភ្លើងក្រុងជាងមធ្យោបាយធ្វើដំណើរឯទៀត | | | | | | | |
| 2. ខ្ញុំ រីករាយនឹង ប្រើប្រាស់រថភ្លើងក្រុងនៅថ្ងៃខាងមុខ | | | | | | | |
| 3. ការធ្វើដំណើរដោយរថភ្លើងក្រុងនៅថ្ងៃខាងមុខគឺជាបំណងប្រាថ្នារបស់ខ្ញុំ | | | | | | | |
| 4. ការធ្វើដំណើរដោយរថភ្លើងក្រុង មានផលល្អច្រើនសំរាប់ខ្ញុំ | | | | | | | |
| 5. ការប្រើប្រាស់រថភ្លើងក្រុង គឺជាជំរើសល្អសំរាប់ការធ្វើដំណើរ | | | | | | | |
| 6. មិត្តខ្ញុំ រីគ្រួសារខ្ញុំ ចង់អោយខ្ញុំ ធ្វើដំណើរដោយរថភ្លើងក្រុង | | | | | | | |

| សំនួរ | មិនយល់ស្រប ⟹ យល់ស្រប | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. ប្រសិនបើ ខ្ញុំធ្វើដំណើរដោយរថភ្លើងក្រុង វានឹងមិនមានបញ្ហាចោទអ្វីដល់មិត្តខ្ញុំ រឺគ្រួសារខ្ញុំទេ | | | | | | | |
| 8. មិត្តខ្ញុំ រឺគ្រួសារខ្ញុំ យល់ព្រមអោយ ខ្ញុំប្រើប្រាស់រថភ្លើងក្រុងនៅថ្ងៃខាងមុខ | | | | | | | |
| 9. មិត្តខ្ញុំ រឺគ្រួសារខ្ញុំ យល់ថា ខ្ញុំគួរតែប្រើប្រាស់រថភ្លើងក្រុង | | | | | | | |
| 10. មិត្តភ័ក្ត្រខ្ញុំជាច្រើន នឹងប្រើមធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុងនេះ | | | | | | | |
| 11. ខ្ញុំ មានអារម្មណ៍ថាមានការគាបសង្កត់ពីសង្គមអោយខ្ញុំ ប្រើប្រាស់រថភ្លើងក្រុងនេះ | | | | | | | |
| 12. ជាការងាយណាស់សំរាប់ខ្ញុំ ក្នុងការប្រើប្រាស់រថភ្លើងក្រុងនៅថ្ងៃខាងមុខ | | | | | | | |
| 13. ខ្ញុំមានទំនុកចិត្តថា ខ្ញុំ អាចធ្វើដំណើរដោយរថភ្លើងក្រុងបាន | | | | | | | |
| 14. ទោះបីខ្ញុំធ្វើដំណើរ រឺអត់ធ្វើដំណើរដោយរថភ្លើងក្រុងក៏ដោយ វាអាស្រ័យលើការសំរេចចិត្តរបស់ខ្ញុំទាំងស្រុង | | | | | | | |
| 15. ការសំរេចចិត្តធ្វើដំណើរដោយរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ វាស្ថិតនៅក្រោមការគ្រប់គ្រងរបស់ខ្ញុំ | | | | | | | |
| 16. ខ្ញុំ អាចប្រើមធ្យោបាយដំណើរដោយរថភ្លើងក្រុងបានប្រសិនបើ ខ្ញុំចង់ប្រើ | | | | | | | |
| 17. តាមការយល់ដឹង ខ្ញុំគិតថាប្រើប្រាស់រថភ្លើងក្រុងនៅថ្ងៃខាងមុខមិនមានការលំបាកអ្វីទេ | | | | | | | |
| 18. ខ្ញុំ គួរតែប្រើមធ្យោបាយដំណើរដោយរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ | | | | | | | |
| 19. តាមការសំរេចចិត្តរបស់ខ្ញុំ ខ្ញុំនឹង ធ្វើដំណើរដោយរថភ្លើងក្រុង | | | | | | | |
| 20. ខ្ញុំ ចង់ធ្វើដំណើរដោយរថភ្លើងក្រុង | | | | | | | |
| 21. ខ្ញុំ មានគំរោងនឹងប្រើមធ្យោបាយដំណើរដោយរថភ្លើងក្រុង | | | | | | | |
| 22. ខ្ញុំ នឹងជំរុញខ្លួនឯងអោយប្រើមធ្យោបាយដំណើរដោយរថភ្លើងក្រុង | | | | | | | |
| 23. ប្រសិនបើ ខ្ញុំធ្វើដំណើរដោយរថភ្លើងក្រុងពិតមែននៅថ្ងៃខាងមុខ ខ្ញុំនឹងទៅដល់គោលដៅបានឆាប់រហ័ស។ | | | | | | | |
| 24. ការប្រើប្រាស់មធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុង វាអាស្រ័យទៅនឹងចំងាយនៃការធ្វើដំណើរ។ | | | | | | | |
| 25. ការប្រើប្រាស់មធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុង វាអាស្រ័យទៅនឹងតំលៃឈ្នួលនៃការធ្វើដំណើរ។ | | | | | | | |
| 26. ការប្រើប្រាស់មធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុង វាអាស្រ័យទៅនឹងកំរិតនៃការស្នះចរាចរណ៍។ | | | | | | | |
| 27. ការប្រើប្រាស់រថភ្លើងក្រុងនឹងកាត់បន្ថយការកកស្ទះចរាចរណ៍។ | | | | | | | |
| 28. ការប្រើប្រាស់មធ្យោបាយដំណើរដោយរថភ្លើងក្រុង នឹងជួយកាត់បន្ថយការគ្រោះថ្នាក់ចរាចរណ៍។ | | | | | | | |
| 29. ខ្ញុំ គិតថា មធ្យោបាយធ្វើដំណើរដោយរថភ្លើងក្រុង មានសុវត្ថិភាពល្អ។ | | | | | | | |
| 30. ខ្ញុំ គិតថាការកង្វក់ខ្យល់បរិយាកាសកំពុងស្ថិតក្នុងស្ថានភាពអាក្រក់ទៅៗ។ | | | | | | | |

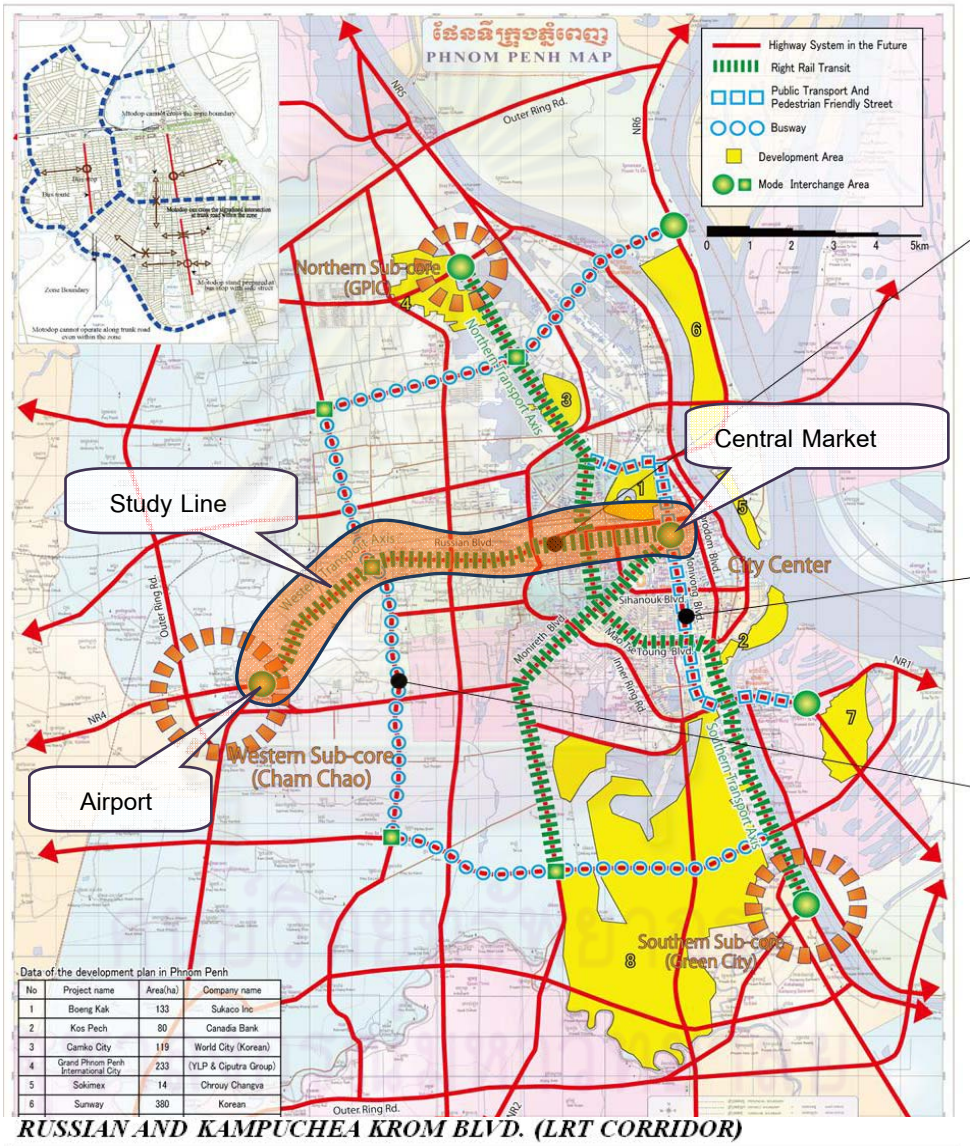
**សូមអរគុណសំរាប់ការសហការណ៍!!!**

# Appendix C

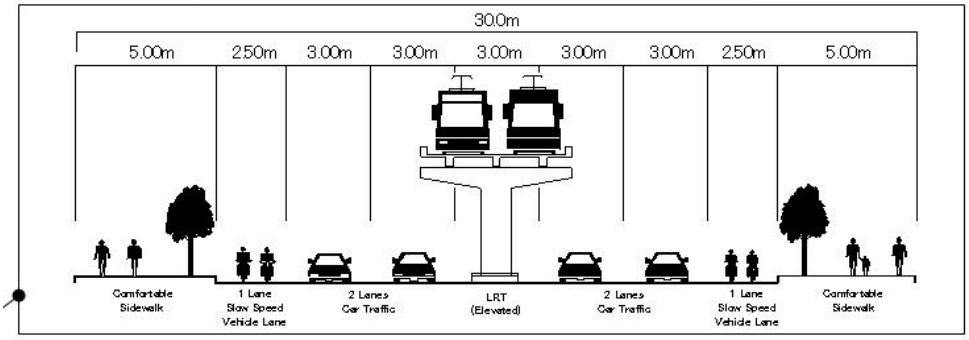
## Main Survey Forms

Suppose there is a rail transit system running in Phnom Penh with 3 lines (see the map). Our research study will choose one of these lines, Airport line linking from City center (Central Market) to the western sub-core (Cham Chao). It's about 8.5 km long elevated along Russian and Kampuchea Krom Boulevard (as shown below). We will refer this rail transit system in the survey as future urban rail transit. We would like to ask you some questions for better understanding your future behavioral intention.

***FUTUER PUBLIC TRANSPORT SYSTEM IN PHNOM PENH CITY***




***RUSSIAN AND KAMPUCHEA KROM BLVD. (LRT CORRIDOR)***



Interviewer: _____Location: _____Survey date: _____time: _____

**Study of Urban Rail Transit in Phnom Penh City**

Please take a few minutes to answer these questions.

**Section I: About Yourself**

Age: _____ Gender: ❑ Female ❑ Male

Occupation: ❑ Student ❑ Teacher ❑ Employee ❑ Seller
❑ Civil servant ❑ Unemployed ❑ Other, please specify: _____

Education: ❑ Primary school ❑ Secondary school ❑ High school
❑ Associate bachelor ❑ Bachelor ❑ Higher than Bachelor.

Monthly income: ❑ None ❑ <=$100 ❑ $101-$200 ❑ $201-$300
❑ $301-$400$ ❑ 401-$500 ❑ $500-$1,000 ❑ >$1,000

Members in household (including yourself): _____

Number of vehicles in household: Car/Pick-up_____ Motorbike _____

Is there any vehicle available to you all the time? ❑ Yes ❑ No

Do you have driving license? ❑ Yes, for _____ years ❑ No

In which District/Commune have you lived? District: _____Commune: _____

During the last 4 weeks, I used private vehicles about _____ percent of my total travel.

When you travel along this corridor, what is the typical travel mode that you use the most?

❑ Motorbike ❑ Motor-taxi ❑ Other, please specify: _____

When you travel along this corridor, what is the typical trip purpose?

❑ Study ❑ Work ❑ Business ❑ Shopping

From: _____To: _____

Travel time (minutes): _____Cost (Riel): _____ Distance_____ Kilometers

Travel frequency for this purpose: _____ times/week

Within the last week, how often did you use the following modes of transport?

| | | | | | |
|---|---|---|---|---|---|
| Private car: | ❑ Everyday | ❑ 4-5 days/week | ❑ 2-3 days/week | ❑ Rarely | ❑ Never |
| Motorbike: | ❑ Everyday | ❑ 4-5 days/week | ❑ 2-3 days/week | ❑ Rarely | ❑ Never |
| Bicycle: | ❑ Everyday | ❑ 4-5 days/week | ❑ 2-3 days/week | ❑ Rarely | ❑ Never |
| Motor-taxi: | ❑ Everyday | ❑ 4-5 days/week | ❑ 2-3 days/week | ❑ Rarely | ❑ Never |

Section II: What do you think about Sky Rail System?

Please mark (√) the answer for the following questions:

| Questions | Strongly Disagree ⇨ Strongly Agree | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. I have good feeling towards using the Sky Rail System. | | | | | | | |
| 2. Using Sky Rail System on a regular basis is the right thing to do. | | | | | | | |
| 3. I could use the Sky Rail System on a regular basis if I want to. | | | | | | | |
| 4. I intend to use the Sky Rail System on a regular basis. | | | | | | | |
| 5. For me, to use the Sky Rail System will be extremely pleasant. | | | | | | | |
| 6. Using Sky Rail System on a regular basis will reduce traffic congestion. | | | | | | | |
| 7. My friends or my family will be likely to use the Sky Rail System on a regular basis. | | | | | | | |
| 8. The decision to use Sky Rail System on a regular basis is under my control. | | | | | | | |
| 9. I should use the Sky Rail System because it is good for the environment. | | | | | | | |
| 10. For me, to use the Sky Rail System is interesting. | | | | | | | |
| 11. Whether I use the Sky Rail System on a regular basis is completely up to me. | | | | | | | |
| 12. My intention to use Sky Rail System on a regular basis instead of my existing travel mode is strong. | | | | | | | |
| 13. Using Sky Rail System on a regular basis will reduce traffic accidents. | | | | | | | |
| 14. There will be many problems and difficulties with using the Sky Rail System on a regular basis. | | | | | | | |
| 15. If I take the Sky Rail System on a regular basis, my friends or my family would have no problem with it. | | | | | | | |
| 16. I would enjoy using the Sky Rail System. | | | | | | | |
| 17. Most of people who are important to me will use the Sky Rail System on a regular basis. | | | | | | | |
| 18. Using Sky Rail System on a regular basis will reduce air pollution. | | | | | | | |
| 19. For me, to use the Sky Rail System on a regular basis is possible. | | | | | | | |
| 20. I plan to use Sky Rail System on a regular basis instead of my existing travel mode. | | | | | | | |
| 21. Most people whose opinions I value would approve my usage of the Sky Rail System on a regular basis. | | | | | | | |
| 22. I will make an effort to use Sky Rail System on a regular basis. | | | | | | | |
| 23. Most of people who are important to me think that I should use the Sky Rail System on a regular basis. | | | | | | | |
| 24. I should use the Sky Rail System because it is good for society and the city. | | | | | | | |

Section III: About your opinions

1. Have you heard about the Sky Rail System before? ❑ Yes ❑ No

2. How likely will you use it on a regular basis?

❑ Very unlikely ❑ Unlikely ❑ Not sure ❑ Likely ❑ Very likely

3. What do you think about the current traffic situation in Phnom Penh?

❑ Very bad ❑ Bad ❑ Not sure ❑ Good ❑ Very good

4. Do you think that the Sky Rail System will help alleviating traffic congestion in Phnom Penh?

❑ Very unlikely ❑ Unlikely ❑ Not sure ❑ Likely ❑ Very likely

5. Do you think that the Sky Rail System will help alleviating pollution issue in Phnom Penh?

❑ Very unlikely ❑ Unlikely ❑ Not sure ❑ Likely ❑ Very likely

6. When the Sky Rail System is available in the future,

How far is the place you live from the Sky Rail System? _____ Kilometers

Will you use it for this trip? ❑ Yes ❑ No

If "Yes", how much are you willing to pay? _____ Riel

If "Yes", how long do you think this trip will take? _____ Minutes

7. When the Sky Rail System is available in the future, please rank these factors in terms of their importance. (From 1, 2, 3 where 1 is the most important)

_____Access time to the station _____Access cost to the station

_____Cost of Sky Rail System _____Travel time of Sky Rail System

_____Comfort of Sky Rail System _____Egress time from the station

_____Egress cost from the station

8. Please mark (√) the following images for your current travel mode and Sky Rail System

Current Mode

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Austere | | | | | | | | Luxurious |
| Inferior | | | | | | | | Superior |
| Unpleasant | | | | | | | | Pleasant |
| Useless | | | | | | | | Useful |
| Risky | | | | | | | | Safe |
| Boisterous | | | | | | | | Quiet |

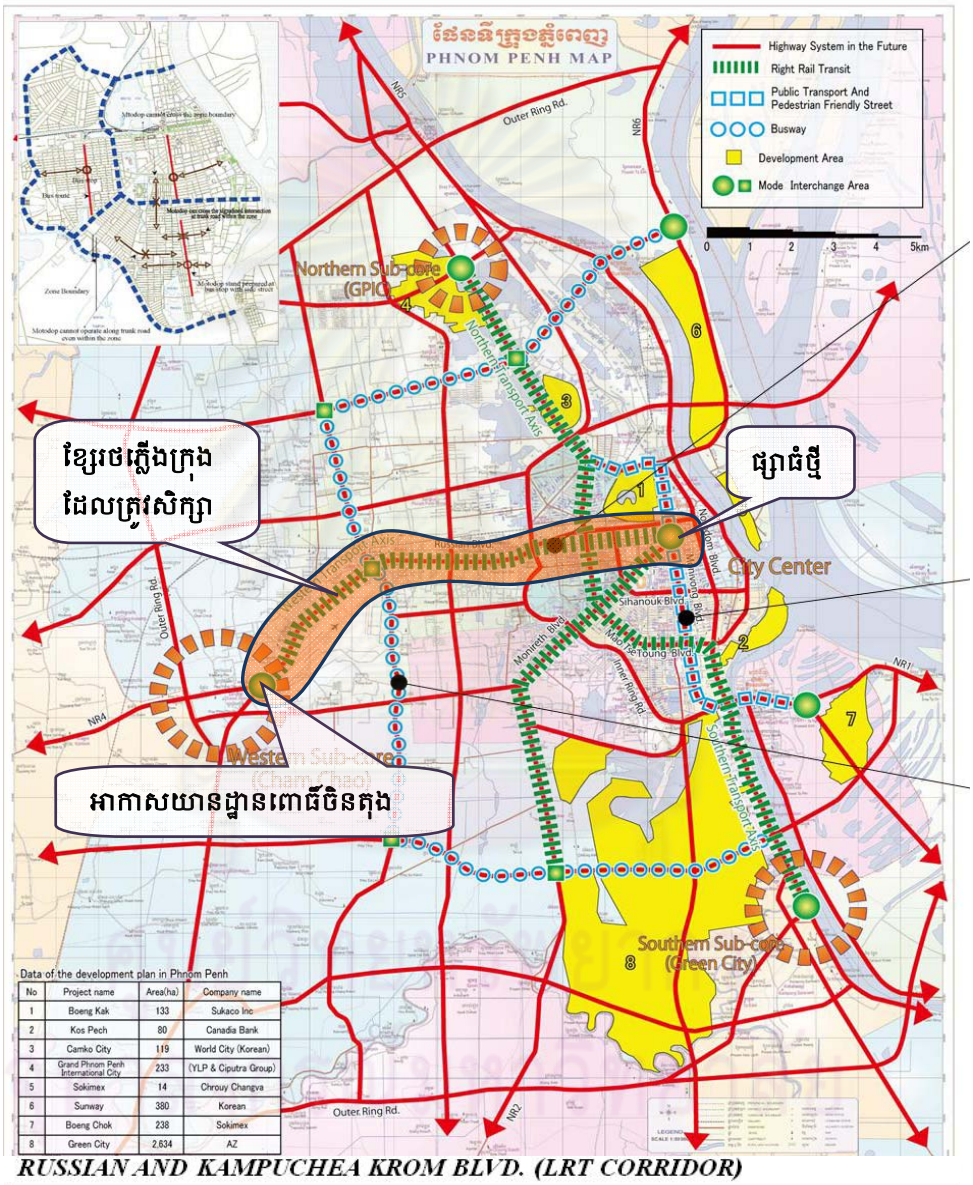
Sky Rail System

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Boring | | | | | | | | Exciting |
| Poor | | | | | | | | Rich |
| Inconvenient | | | | | | | | Convenient |
| Slow | | | | | | | | Fast |
| Destructive | | | | | | | | Constructive |
| Environmental Damaging | | | | | | | | Environmental Friendly |

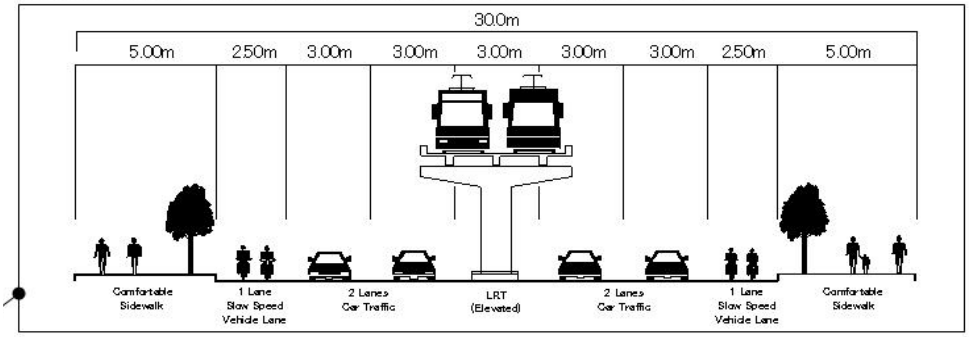
Thank You very much for Your Participation

ឧទាហរណ៍ថា មានខ្សែរថភ្លើងក្រុង រត់នៅក្នុងទីក្រុងភ្នំពេញ ចំនួន៣ខ្សែ ដូចក្នុងរូបភាពខាងក្រោម។ ១ខ្សែក្នុងចំនោម ខ្សែទាំង៣ គឺខ្សែដែលតភ្ជាប់ពី ផ្សារធំថ្មី ទៅអាកាសយានដ្ឋានអន្តរជាតិពោធិ៍ចិនតុង (ចោមចៅ) ត្រូវបានយកមកសិក្សា។ ខ្សែរថភ្លើងនេះ មានប្រវែងប្រមាណ៨,៥គីឡូម៉ែត្រ ដែលសង់នៅពីលើតាមបណ្តោយ មហាវិថីសហព័ន្ធរុស្ស៊ី និង មហាវិថីកម្ពុជាក្រោម ដូចបង្ហាញ ក្នុងរូបភាពខាងក្រោម។ យើងសន្មតថាខ្សែរថភ្លើងនេះ ជាខ្សែរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ។ ដូច្នេះ យើងត្រូវការស្វែងមតិរបស់លោកអ្នកដើម្បីស្វែងយល់ពីគោលបំណងនៃការប្រើប្រាស់ខ្សែរថភ្លើងក្រុងនៅថ្ងៃខាងមុខ។

*FUTUER PUBLIC TRANSPORT SYSTEM IN PHNOM PENH CITY*




*RUSSIAN AND KAMPUCHEA KROM BLVD. (LRT CORRIDOR)*



អ្នកសំភាស: _____ទីកន្លែង: _____ កាលបរិច្ឆេទ: _____ម៉ោង: _____

## ការសិក្សាខ្សែរថភ្លើងក្រុងនៅក្នុងទីក្រុងភ្នំពេញ

សូមមេត្តាផ្តល់ពេលវេលាពីរទៅបីនាទីដើម្បីឆ្លើយសំនួរខាងក្រោម:

**ផ្នែកទី១**: ពត៌មានអំពីខ្លួនអ្នក

អាយុ: _____ ភេទ: ❑ ស្រី ❑ ប្រុស

មុខរបរ: ❑ សិស្ស ❑ គ្រូបង្រៀន ❑ និយោជិត ❑ អ្នកលក់ដូរ
❑ មន្ត្រីរាជការ ❑ មិនមានការងារ ❑ ផ្សេងៗចូរបញ្ជាក់: _____

កំរិតវប្បធម៌: ❑ បឋមសិក្សា ❑ អនុវិទ្យាល័យ ❑ វិទ្យាល័យ ❑ បរិញ្ញប័ត្ររង
❑ បរិញ្ញប័ត្រ ❑ ខ្ពស់ជាងបរិញ្ញប័ត្រ

ប៉ៀវត្សប្រចាំខែ: ❑ មិនមាន ❑ <=$100 ❑ $101-$200 ❑ $201-$300
❑ $301-$400$ ❑ 401-$500 ❑ $500-$1,000 ❑ >$1,000

ចំនួនសមាជិកនៅក្នុងគ្រួសារ (រួមទាំងខ្លួនអ្នក): _____

ចំនួនរថយន្តនៅក្នុងផ្ទះ: រថយន្តតូច/រថយន្ត១បាំងកន្លះ _____ ម៉ូតូ _____

តើអ្នក អាចប្រើយានយន្តទាំងនោះបានគ្រប់ពេលដែលអ្នកចង់ប្រើដែរឬទេ? ❑ បាន ❑ មិនបាន

តើអ្នក មានប័ណ្ណបើកបរដែរឬទេ? ❑ មាន, សំរាប់ _____ ឆ្នាំ ❑ មិនមាន

តើសព្វថ្ងៃ អ្នកស្នាក់នៅក្នុងខណ្ឌ/សង្កាត់ណា? ខណ្ឌ: _____សង្កាត់: _____

កាលពី៤សប្តាហ៍មុន ខ្ញុំ បានប្រើយានយន្តផ្ទាល់ខ្លួនប្រហែល_____ ភាគរយនៃការធ្វើដំណើររបស់ខ្ញុំ។

ជាញឹកញាប់ តើអ្នកប្រើប្រាស់មធ្យោបាយអ្វី ពេលដែលលោកអ្នកធ្វើដំនើរតាមមហាវិថីនេះ?

❑ ម៉ូតូ ❑ ម៉ូតូដុប ផ្សេងៗចូរបញ្ជាក់: _____

តើអ្នក ធ្វើដំនើរតាមមហាវិថីនេះក្នុងគោលបំណងអ្វី?

❑ សិក្សា ❑ ការងារ ❑ មុខជំនួញ ❑ ទិញឥវ៉ាន់

ចេញពី: _____ ទៅកាន់: _____

រយៈពេលធ្វើដំនើរ(នាទី): _____ តំលៃធ្វើដំនើរ(រៀល): _____ចំងាយ:_____ គីឡូម៉ែត្រ

ចំនួនធ្វើដំណើរ:_____ ដងក្នុង១សប្តាហ៍

កាលពីសប្តាហ៍មុន តើអ្នក បានធ្វើដំនើរដោយ មធ្យោបាយខាងក្រោមយ៉ាងដូចម្តេច?

រថយន្តផ្ទាល់ខ្លួន: ❑ រ៉ាល់ថ្ងៃ ❑ 4-5 ថ្ងៃ/សប្តាហ៍ ❑ 2-3 ថ្ងៃ/សប្តាហ៍ ❑ កំរ ❑ មិនមាន

ម៉ូតូ: ❑ រ៉ាល់ថ្ងៃ ❑ 4-5 ថ្ងៃ/សប្តាហ៍ ❑ 2-3 ថ្ងៃ/សប្តាហ៍ ❑ កំរ ❑ មិនមាន

កង់: ❑ រ៉ាល់ថ្ងៃ ❑ 4-5 ថ្ងៃ/សប្តាហ៍ ❑ 2-3 ថ្ងៃ/សប្តាហ៍ ❑ កំរ ❑ មិនមាន

ម៉ូតូដុប: ❑ រ៉ាល់ថ្ងៃ ❑ 4-5 ថ្ងៃ/សប្តាហ៍ ❑ 2-3 ថ្ងៃ/សប្តាហ៍ ❑ កំរ ❑ មិនមាន

**ផ្នែកទី២**: តើអ្នកគិតយ៉ាងដូចម្តេចអំពីរថភ្លើងអាកាស?

ចូរគូសសញ្ញា(√) ដើម្បីឆ្លើយនឹងសំនួរខាងក្រោម:

| សំនួរ | មិនយល់ស្រប ⟶ យល់ស្រប | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. ខ្ញុំ មានអារម្មណ៍ល្អចំពោះការប្រើរថភ្លើងអាកាស | | | | | | | |
| 2. ការប្រើរថភ្លើងអាកាសជាប្រចាំ គឺជាការត្រឹមត្រូវដែលខ្ញុំត្រូវធ្វើ | | | | | | | |
| 3. ខ្ញុំ អាចប្រើរថភ្លើងអាកាសប្រសិនបើខ្ញុំចង់ប្រើ | | | | | | | |
| 4. ខ្ញុំ មានបំណងនឹងប្រើ រថភ្លើងអាកាសជាប្រចាំ | | | | | | | |
| 5. សំរាប់ខ្ញុំ វាពិតជាសប្បាយក្នុងការប្រើរថភ្លើងអាកាស | | | | | | | |
| 6. ការប្រើរថភ្លើងអាកាសជាប្រចាំ នឹងកាត់បន្ថយការកកស្ទះចរាចរណ៍ | | | | | | | |
| 7. មិត្តខ្ញុំ រឺគ្រួសារខ្ញុំ ទំនងជាពេញចិត្តប្រើរថភ្លើងអាកាសជាប្រចាំ | | | | | | | |
| 8. ការសំរេចចិត្ត ប្រើរថភ្លើងអាកាសជាប្រចាំ វា ស្ថិតនៅក្រោមការពិចារណារបស់ខ្ញុំ | | | | | | | |
| 9. ខ្ញុំ គួរតែប្រើរថភ្លើងអាកាសពីព្រោះវាល្អសំរាប់បរិស្ថាន | | | | | | | |
| 10. សំរាប់ខ្ញុំ ការប្រើរថភ្លើងអាកាសគឺគួរអោយចាប់អារម្មណ៍ | | | | | | | |
| 11. ទោះជាខ្ញុំប្រើ រថភ្លើងអាកាសជាប្រចាំ រឺ មិនប្រើ វាអាស្រ័យលើការសំរេចចិត្តរបស់ខ្ញុំ | | | | | | | |
| 12. ខ្ញុំ មានបំណងនឹងប្រើ រថភ្លើងអាកាសជាប្រចាំ ជាង មធ្យោបាយដែលខ្ញុំកំពុងតែប្រើ | | | | | | | |
| 13. ការប្រើរថភ្លើងអាកាសជាប្រចាំ នឹងកាត់បន្ថយ ការគ្រោះថ្នាក់ចរាចរណ៍ | | | | | | | |
| 14. វានឹង មានបញ្ហានិងការលំបាកយ៉ាងច្រើនចំពោះការប្រើ រថភ្លើងអាកាសជាប្រចាំ | | | | | | | |
| 15. ប្រសិនបើ ខ្ញុំប្តូរមកធ្វើដំណើរដោយរថភ្លើងអាកាសជាប្រចាំ មិត្តខ្ញុំ រឺគ្រួសារខ្ញុំ នឹងមិនមានបញ្ហាជាមួយការសំរេចចិត្តរបស់ខ្ញុំទេ | | | | | | | |
| 16. ខ្ញុំ រីករាយនឹងប្រើរថភ្លើងអាកាស | | | | | | | |
| 17. មនុស្សភាគច្រើន ដែលសំខាន់សំរាប់ខ្ញុំ នឹងប្រើរថភ្លើងអាកាសជាប្រចាំ | | | | | | | |
| 18. ការប្រើប្រាស់មុធ្យោបាយដំណើរដោយរថភ្លើងអកាស នឹងជួយកាត់បន្ថយកង្វក់ខ្យល់បរិយាកាស | | | | | | | |
| 19. សំរាប់ខ្ញុំ ការប្រើរថភ្លើងអាកាសជាប្រចាំគឺអាចធ្វើទៅបាន | | | | | | | |
| 20. ខ្ញុំគ្រោង នឹងប្រើ រថភ្លើងអាកាសជាប្រចាំ ជំនួសអោយ មធ្យោបាយ ដែលខ្ញុំកំពុងតែប្រើ | | | | | | | |
| 21. មនុស្សភាគច្រើន ដែលមានមតិយោបល់ល្អៗ នឹងយល់ស្របជាមួយការសំរេចចិត្តប្រើរថភ្លើង អាកាសជាប្រចាំរបស់ខ្ញុំ | | | | | | | |
| 22. ខ្ញុំ នឹងព្យាយាមប្រើរថភ្លើងអាកាសជាប្រចាំ | | | | | | | |
| 23. មនុស្សភាគច្រើន ដែលសំខាន់សំរាប់ខ្ញុំ គិតថា ខ្ញុំគួរតែប្រើ រថភ្លើង អាកាសជាប្រចាំ | | | | | | | |
| 24. ខ្ញុំ នឹងគួរតែប្រើរថភ្លើងអាកាស ពីព្រោះវាល្អសំរាប់សង្គម និងទីក្រុង | | | | | | | |

**ផ្នែកទី៣: អំពីមតិយោបលរបស់អ្នក**

1. តើអ្នកធ្លាប់បានលឺពត៌មានអំពីរថភ្លើងអាកាសកាលពីមុនដែរឬទេ? ❑ ធ្លាប់ ❑ មិនធ្លាប់

2. តើអ្នក ទំនងជាប្រើរថភ្លើងអាកាសជាប្រចាំ?

❑ មិនប្រើ ❑ ប្រហែលជាមិនប្រើ ❑ ដឹងមិនច្បាស់ ❑ ប្រហែលជាប្រើ ❑ ច្បាស់ជាប្រើ

3. តើអ្នក គិតដូចម្តេចអំពីស្ថានភាពចរាចរណ៍បច្ចុប្បន្ននៅទីក្រុងភ្នំពេញ?

❑ អាក្រក់ណាស់ ❑ អាក្រក់ ❑ ដឹងមិនច្បាស់ ❑ ល្អ ❑ ល្អណាស់

4. តើអ្នក គិតថាបណ្តាញរថភ្លើងអាកាសនឹងជួយសំរាលការកកស្ទះចរាចរណ៍នៅទីក្រុងភ្នំពេញ?

❑ មិនអាច ❑ ប្រហែលជាមិនអាច ❑ ដឹងមិនច្បាស់ ❑ ប្រហែលជាអាច ❑ ច្បាស់ជាអាច

5. តើអ្នកគិតថាបណ្តាញរថភ្លើងអាកាសនឹងជួយធ្វើអោយបញ្ហាកង្វក់អាកាសទីក្រុងភ្នំពេញមានភាពធូរស្រាលឡើង?

❑ មិនអាច ❑ ប្រហែលជាមិនអាច ❑ ដឹងមិនច្បាស់ ❑ ប្រហែលជាអាច ❑ ច្បាស់ជាអាច

6. នៅពេលដែលបណ្តាញរថភ្លើងអាកាស អាចប្រើប្រាស់បាននៅថ្ងៃអនាគត:

តើកន្លែងស្នាក់នៅរបស់អ្នក នៅឆ្ងាយពីបណ្តាញរថភ្លើងអាកាសប៉ុន្មានគីឡូម៉ែត្រ? _____គីឡូម៉ែត្រ

តើអ្នកនឹងប្រើប្រាស់វា? ❑ ប្រើប្រាស់ ❑ មិនប្រើប្រាស់

ប្រសិនបើ "ប្រើប្រាស់" តើអ្នក ចង់ចំនាយប្រាក់ប៉ុន្មាន? _____ រៀល

ប្រសិនបើ "ប្រើប្រាស់" តើអ្នក គិតថានឹងប្រើនឹងធ្វើដំណើរយះពេលប៉ុន្មាននាទី? _____ នាទី

7. នៅពេលដែលបណ្តាញរថភ្លើងអាកាស អាចប្រើប្រាស់បាននៅថ្ងៃអនាគត សូមមេត្តាបង់លេខជាចំនាត់ថ្នាក់ខាងក្រោមនេះ (ពីលេខ ១, ២, ៣ ដែលលេខ១ គឺសំខាន់បំផុត)

_____រយៈពេលធ្វើដំណើរមកដល់ស្ថានីយ _____តំលៃធ្វើដំណើរមកដល់ស្ថានីយ៍

_____តំលៃធ្វើដំណើររបស់រថភ្លើងអាកាស _____រយៈពេលធ្វើដំណើររបស់រថភ្លើងអាកាស

_____ផាសុកភាពរបស់រថភ្លើងអាកាស _____រយៈពេលធ្វើដំណើរពីស្ថានីយ៍ទៅគោលដៅ

_____តំលៃនៃការធ្វើដំណើរពីស្ថានីយ៍

8. ចូរគូសសញ្ញា(√) ដើម្បីឆ្លើយនឹងសំនួរខាងក្រោមអំពី មធ្យោបាយធ្វើដំនើរបច្ចុប្បន្ននិង បណ្តាញរថភ្លើងអាកាស:

មធ្យោបាយធ្វើដំនើរបច្ចុប្បន្ន

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| មិនផាសុកភាព | | | | | | | | ផាសុកភាព |
| ទាបជាងគេ | | | | | | | | ប្រសើរជាងគេ |
| មិនសប្បាយចិត្ត | | | | | | | | សប្បាយចិត្ត |
| គ្មានប្រយោជន៍ | | | | | | | | មានប្រយោជន៍ |
| មិនសុវត្តិភាព | | | | | | | | សុវត្តិភាព |
| អ៊ូអរ | | | | | | | | ស្ងប់ស្ងាត់ |

បណ្តាញរថភ្លើងអាកាស

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| ធុញទ្រាន់ | | | | | | | | រីករាយ |
| ក្រ | | | | | | | | មាន |
| មិនងាយស្រួល | | | | | | | | ងាយស្រួល |
| យឺត | | | | | | | | លឿន |
| ធ្វើអោយវិនាស | | | | | | | | មានប្រយោជន៍ |
| ខូចបរិស្ថាន | | | | | | | | បរិស្ថានល្អ |

**សូមអរគុណសំរាប់ការសហការណ៍!!!**

# BIOGRAPHY

Borith LONG was born in 1985 in Kampong Thom province, Cambodia. He finished high school in 2002 at Taing Krassaing High school in Kampong Thom province. In the same year, he came to Phnom Penh, the capital city of Cambodia, and passed the entrance exam to pursue his study at the Institute of Technology of Cambodia (ITC) where he earned his Bachelor of Engineering in 2008. He studied in Department of Civil Engineering, Institute of Technology of Cambodia. Soon after he graduated, he was awarded AUN/SEED-Net scholarship to continue his Master's study in field of Transportation Engineering, Department of Civil Engineering, Faculty of Engineering, Chulalongkorn University, Thailand in 2008. Upon graduation, Borith has planned to pursue his Ph.D. in Transportation Engineering with the research interest of transportation planning before returning to work in Cambodia.