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MSc Programme in Urban Management and Development

Rotterdam, The Netherlands

September 2017

Thesis

Title: The influence of paratransit – informal transportation on public
bus policy implementation in Phnom Penh, Cambodia

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Specialization: Urban Strategies and Planning

UMD 13

MASTER'S PROGRAMME IN URBAN MANAGEMENT AND DEVELOPMENT

(October 2016 – September 2017)

The influence of paratransit – informal transportation on public bus policy implementation in Phnom Penh, Cambodia

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UMD 13 Report number: 1001

Rotterdam, September 2017

Summary

Rapid urbanization and increased of motorization have resulted in congestion and pollution that requires the need for a shift towards the use of more sustainable transportation mode like public transportation. In most major cities of developing countries, traffic congestion and air pollution have been observed to be associated with the operation of informal transportation and huge number of private vehicles uses, and there is no exception to Phnom Penh. Since public transport such as buses and subways is not well developed in the city, paratransit, such as motor taxis and auto rickshaws is the main mode of travel. In order to deal with serious traffic congestion, city bus was introduced in 2014, expecting to reduce the number of vehicles commuting on the roads. However, this initiative has not been successful since paratransit is still the most preferred mode for travellers though the trip fare of city bus is relatively cheap.

The purpose of this study is to provide insights about the influence of paratransit in application of city bus policies and also explain the reasons why travellers do not prefer to use public bus services for commuting. The research method is a mixed strategy of using survey and semi-structured interview. A total number of 335 commuters in Phnom Penh were interviewed to hear their perceptions on the level of service delivery of both public bus and paratransit and particularly the reasons behind non-preference of city bus service. The key informants are users of public bus and paratransit, and experts who involved with public transport improvement project.

Major findings and analysis cover four main categories including 1). Differences in perception between public bus and paratransit, 2), Encouraging factors for using public bus, 3). Encouraging factors for using paratransit, and 4). Discouraging factors for using public bus. The study shown that commuters have positive perception on paratransit in terms of its availability, accessibility, reliability and flexibility, while they perceived these characteristics provided by public bus were poor. Nonetheless, commuters were satisfied with public bus when it comes to trip fare, comfortability, safety and driver's behavior. The study further revealed that students and elderly were in favor of using public bus, while middle age people and wage-paid employees were not satisfied with its services.

It was observed that the reasons that travellers do not prefer to use public bus are because of low level of flexibility, reliability and accessibility that resulted in longer travel time, being delayed and especially they still have to use another transportation mode in order to connect with bus service. These three indicators were considered as priority factors that needed to be improved. Public bus quality could be improved by expanding bus routes to sub-urban areas and increasing frequency of bus operation. It is also recommended that law enforcement should be done on on-street parking, illegal use of sidewalks, traffic management and vehicle growth control to enhance the smooth operation of public bus. Finally, awareness campaigns should be highly promoted to spread the information of bus operation networks as well as the necessity of using formal public transportation to reduce the serious traffic congestion.

Keywords:

Acknowledgements

Abbreviations

BRT	Bus Rapid Transit
CBA	City Bus Authority
DPWT	Department of Public Works and Transport
EBSF	European Bus System of the Future
ERTRAC	European Road Transport Research Advisory Council
IHS	Institute for Housing and Urban Development
JICA	Japan International Cooperation Agency
LRT	Light Rail Transit
MPP	Municipality of Phnom Penh
MPWT	Ministry of Public Works and Transport
RRT	Rapid Rail Transit
SPSS	Statistical Package for Social Science

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Chapter 1: Introduction

1.1 Background

Cities are complex, dynamic and emerge as they are composed of extremely diverse and heterogeneous city scape. According to Portugali (2012), cities are dual complex self-organizing systems since the city itself and its components such as individual humans, households, firms are both complex system. It is not a simple task to understand the spatial processes of the city from all different perspectives (social, economic, political) and propose spatial strategies to address the issues that can be generated by globalization processes. In addition to this concept, Castells added that "Spatial forms and processes are formed by the dynamics of the overall social structure" (Castells, 1996, p. 410).

Flows of people, goods and information foster urban sprawl that do not always necessarily mean equal to every side of the city. Therefore, mobility should be taken into consideration for new urban development plan. In fact, the trends in growth of cities can be estimated from mobility characteristics since mobility systems shape the city. Mobility fulfils the basic need for passengers, goods and information of going from one location to another (Geerlings, Shiftan, et al., 2012). It is common to see that city mobility plans are generally influenced by decisions from the government both at local and national level, not from the community and that is the reason why sustainable mobility cannot be reached easily (Gil, Calado, et al., 2011). However, mobility cannot be designed by a top-down approach because of the complexity of cities. As a consequence, it is important to consider mobility from another way around that also engages people on the ground in planning process as it is responsibility of all stakeholders including governments, experts and especially citizens themselves to make their city a livable place (Sorensen and Sagaris, 2010).

1.2 Problem Statement

Phnom Penh is the capital and largest city of Cambodia. Its population was 1,501,725 with the total area of 678.46 square kilometers and the density was 2,213 people per square kilometer (data 2008) (Phnom Penh Capital Hall, 2017). With economic growth and urbanization, more and more people from rural areas migrant to the city for studying and working. Furthermore, in 2011, the city was enlarged by adding 20 communes from Kandal province (the nearby province) into the city's administration, lead to both internal and external expansion (Vannarin, 2010). According to Phnom Penh Capital City Urban Transport Master Plan handbook (JICA, 2014), the population growth is projected to increase from 2,15 million people in 2016 to approximately 2,87 million people by 2035. Rapid growth rate of inhabitants, increased number of new residential areas, huge number of private vehicles and lack of sufficient public transportation, results in congestion and hostile mobility. "Since public transport such as buses and subways is not well developed in the city, paratransit, including taxis, motos (motorcycle taxis), tuk-tuks (auto rickshaws) and cyclos (pedicabs) is the main mode of travel" (Mo, Kwon, et al., 2014, p. 140). Moto taxis and auto rickshaws are the fastest and cheapest form of informal public transport, whereas pedicabs are also considered as affordable but take longer time to reach the destination as it is run by human-power.

Due to the fact that public transportation provided by the state is inadequate (JICA, 2014), citizens have organized themselves in order to response their demands. The number of registered vehicle has been increasing at an average rate of about 19% each year, and reached more than 1,200,000 in 2013 in which the number of motorcycles dominates the biggest share

of registered vehicle (accounted about 80% of all registrations) (Mo, Kwon, et al., 2014). Another study conducted by Japanese experts in 2012 shows similar observation that private cars, motorbikes, walking and paratransit (informal public transportation) are the only travel modes available in Phnom Penh (JICA, 2014). It was found that traffic congestions and traffic accidents have increased because public transportation has yet to be introduced. Moreover, misuse of public spaces is also partially causing congestion since people use those areas to park their cars and motorbikes illegally without any respect for pedestrian. Congestion tends to happen every day on primary and secondary roads, especially during peak hours at 7:30-9:30, 11:00-13:30 and 17:00-19:30, not only in the city center but also on the roads that connect to suburbs where high income people are living. Some motorbikes have to travel more than 20km per day and this is unfavorable from the view point of safety and comfort. As a consequence, almost the whole city has environmental and traffic problems that include traffic congestions, traffic accidents, noise pollution and bad air quality due to high amount of CO_2 emission generated by all type of vehicles in the city.

In order to deal with this situation, changes in travel behavior is required to enrich the approach. It implies considering accessibility as a priority rather than only travelling. "Effective transportation systems are essential for people's prosperity, having significant impacts on economic growth, social development and the environment" (Geerlings, Shiftan, et al., 2012, p.5). This is the reason why the government introduced the public transportation - city bus in 2014, expecting to reduce the number of vehicles commuting on the roads. The bus service was launched in 2014 with supporting from Japan International Cooperation Agency, the buses run every day from 5:30 to 20:30 (JICA, 2014). However, this initiative has not been successful as predicted due to the lack of public interest.

Figure 1: Phnom Penh City's expansion
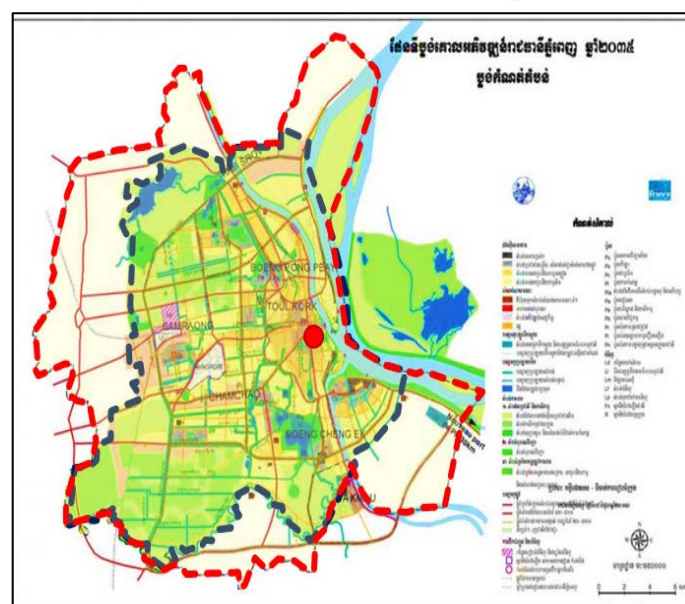
Source: Phnom Penh Municipal, 2016

There is a vast literature which explain the reasons why public transportation is necessary for reducing traffic congestions, traffic accidents and environmental pollution. "… Phnom Penh and other provinces had more than 60% of the accidents that involved motorcycle stands out in the chart" (Mo, Kwon, et al., 2014). In addition, public transportation plays important role in improving livability in Phnom Penh and reducing the use of fuel which will lead to

decrease in environmental pollution in the city. However, empirical studies (Hidalgo and Graftieaux, 2008, Beirão and Sarsfield Cabral, 2007) show contradictory results, therefore, the relationship between city bus policy and citizen participation in Phnom Penh has still remained a mystery. It is also necessary to study about another side of public transportation, paratransit – self-organized transport system the reason why it is so popular in terms of daily commuting, yet it is not as comfortable as public transportation.

There is a number of literature which confirms negative perceptions on public transportation and explains the reason why commuters prefer to choose private vehicles or paratransit as the mode of travel. Hine and Scott conducted a study in Scotland and United Kingdom and found that passengers felt unsatisfied with the level of courtesy, comfort and assistance offered by the staff that was generally poor (Hine and Scott, 2000). The study added that it is not only about comfortability and flexibility but also risky if there are delays or cancellations, passengers might miss appointments or being stranded. Hidalgo and Graftieaux in their study of 11 cities in Latin America and Asia showed that "the public bus policy is not successful as the lowest operational productivities have been reported in Jakarta, Beijing and Bogota (around five passengers' boarding per bus kilometers)" (Hidalgo and Graftieaux, 2008, p. 79). Furthermore, the study has observed that users in Mexico were disappointed due to expected speeds not achieved, problems at intersections and with driver training.

Nevertheless, this is not the case in Phnom Penh, where the fare is relatively cheap compared with using either private vehicles or paratransit. The buses are equipped with air-conditioner and not too crowded, yet they are almost empty buses since commuters prefer to use their private vehicles and paratransit for daily traveling instead of sitting and relaxing on the bus.

"The reduction of CO_2 emissions, an important cause of global warming, is a priority and there is increasing pressure on governments and industries to come forward with initiatives to reduce these emissions" (Geerlings, Shiftan, et al., 2012, p.4). Hence, public transportation plays important roles in reducing traffic congestion and that is the reason why the Phnom Penh municipality introduces "City Bus" project. However, it is also necessary to explore the side of informal public transportation which is self-organized by groups of people in order to have a deep understanding of commuter's travel behavior which will lead to have an effective city bus policy.

1.3 Research Objectives

The objective of this research is to provide insights about people's preferences which is favorable in using paratransit – informal transportation though they acknowledge the risks of traffic accidents and crimes including robbery that might occur. It also attempts to explain the reasons why commuters do not prefer to use public bus services for commuting. Consequently, this research seeks to make policy recommendations for improving the city bus services.

1.4 Research Question

Why do commuters in Phnom Penh prefer to use paratransit – informal transportation over public buses?

Sub Research Questions

1. To what extent, paratransit transportation encourages commuters to use its system?
2. What factors influence the use of paratransit by commuters?

3. What factors influence the use of public transportation by commuters?

1.5 Significance of the Study

In Phnom Penh, during the past years, while the city bus was first introduced in 2014, a significant number of self-organized groups have appeared particularly in transport sector to promote mobility in addition to public services provided by the government. In city planning, understanding of self-organizing processes enhances the utilization of the regional innovation capacity, (Partanen, 2015). Self-organized transportation – paratransit has observed to assist travellers in the city of Phnom Penh to fulfil their transportation needs for more than 30 years (Phun, Masui, et al., 2016), even before the public bus initiative started. "Although self-organizing networks might imply the absence of governmental involvement, it can be argued that the role of government is not obsolete" (Nederhand, Bekkers, et al., 2014, p. 6).

The research work was a combination of academic and empirical study. Undertaking this research will contribute as inputs into policy and planning interventions for encouraging sustainable public transportation in Phnom Penh. It helps in bridging up the missing links between top-down local planning process and real demands on the ground. By determining what factors encourage commuters to use paratransit – self-organized transportation, existing strategies can be revised, re-designed and implemented to make city bus more favorable, inspiring a modal shift from less sustainable modes. Methodology developed and demonstrated in this research is a useful reference for urban transport planners and policy makers.

1.6 Scope and Limitation

This research aims at explaining how self-organized transportation has influenced city bus policy. It particularly considers how the situation affects the use of public buses, a mass transit system in Phnom Penh. The research focused on intra-city bus service in Phnom Penh capital city which is rapidly urbanizing and experiencing traffic congestion, and will not assess the intercity linkage. This scope was chosen because Phnom Penh is considered as one of the most densify city in Cambodia, and at the same time have no proper attention on paratransit in world research.

The study used survey research strategy to assess commuter's perception and reasons behind their decision making for choosing any transportation mode. Obviously, it requires large units of study to statistically generalize results, nevertheless due to time constraint, the number of respondents were limited.

Chapter 2: Literature Review / Theory

2.1 Introduction

Transportation is an essential need in order to exchange, for both people and goods, from one place to another. To secure people's mobility need is implemented by providing both accessibility and mobility to urban facilities necessary for their daily life (JICA, 2014). It is considered as important activity taking place in urban areas for its characteristics in moving people and goods within cities. For people, it ensures travelling to work, school, shopping or other places as daily life needs. For firms, it forms a vital link with suppliers and customers in delivering goods to doors (Crainic, Ricciardi, et al., 2004). In majority of cities, people live at suburb areas and work in the central city. This implies that people need to commute into the city to go to work, particularly in metropolitan areas where employment opportunities are high (Glaeser, Kahn, et al., 2008). In addition to this, rapid population growth is inevitably happening in many cities and also uncontrolled immigration that drives a city to grow spontaneously and exceed the existing infrastructure plans. Moreover, the use of automobiles in developing countries is increasing at about 15-20% of growth rate per year, even faster than the population growth (Gwilliam, 2003), resulted in traffic congestion. The costs of congestion are enormous, lost time and money which cannot be calculated easily. As noted by Crainic (2004), public awareness has been observed to be increased regarding the issue of the quality of life within cities. He has highlighted that authorities have also started to take notice and display increasing willingness to do something and eventually control the movements of vehicles in cities. Similarly, effective transportation systems are essential for people's prosperity, having significant impacts on economic growth, social development and the environment (Geerlings, Shiftan, et al., 2012). Buses are unsurprisingly the workhorse of the transit world. Indeed, there are many public transportation services provided, and it is certainly that bus component is always included in those transit operations (Grava, 2003).

Nevertheless, numerous authors tend to focus on Paratransit transportation studies, as it becomes popular issues, mainly in developing countries in Global South. It provides jobs to low-educated people but also blames as the fundamental cause for congestion, accident, and environmental problems (PHUN and Tetsuo, 2016). The notion of paratransit transportation as a feeder system had mentioned in numerous literatures, as it can be both complimenting the existing transportation systems and also able to connect those areas which uncover by formal modes of transportation to its system (Tangphaisankun, Nakamura, et al., , 2009).

2.2 Urban Public Transport Systems

Due to rapid population and economic growth, urban centers are becoming crowded and attractive to inhabitants both insiders and outsiders. This trend indicates higher demand in mobility of people and goods within urban areas since cities are said to be economic centers with high level of economic activities and employment source (Rodrigue, Comtois, et al., 2013). They add that movement of people, goods and information have always been fundamental components of human societies. In order to response to increased economic activities, high demand in commuting, supplying and distributing channels in manufacturing, cities have become heavily dependent on transportation systems. They conclude with the important of transport system by arguing that developing transport systems have been a continuous challenge to satisfy mobility needs, to support economic development and to participate in the global economy (Rodrigue, Comtois, et al., 2013).

In Phnom Penh, the trip area of people becomes much wider today than that of previous times when walking was the only means of transport because of the popularity of motor vehicles such as motorcycles and cars. However, cars might not be available for all the people and occasionally even car drivers are unable to use their own cars due to specific reasons. This is the first reason why public transport is needed (JICA, 2014).

Currently, congestion seems to be a major concern in most cities due to rapid population growth and high level of migration, particularly in global south's cities. In order to cope with these urban and transport constraints, it is necessary to introduce the public transport to improve the urban mobility. Hensher (2007), agreed that urban traffic congestion could be mitigated if public transportation were improved. There are many ways in developing public transportation including investing in heavy rail transit, light rail transit and BRT which allowing buses to have segregated roads just as trains have their own separated tracks.

2.2.1 Characteristics of Public Transport Services

While most people rely on their private vehicles for travelling, a vast majority also depend on public transport to response their travel needs. Due to Harriet (2013), urban transport can be described as transportation system that provides people and goods the accessibility and mobility within cities and can be appeared in form of public transit (collective transport), non-motorized transport (pedestrians, cyclists) and freight.

There are important properties of each mode of transport and of course also the pints that users expect from those services namely speed, ability to fulfil users' demands, safety, reliability, capacity, efficiency, energy consumption and many others. Shiftan (2003) defined five key factors that will help driving transportation to become a sustainable system. Those factors are 1) spatial and land use patterns (considering urban area size, building density and activities distribution that influence spatial patterns of transport planning), 2) economic forces (comparing amount of capital investment in transportation projects with return rate), 3) technology (improving communication and reducing pollution), 4) government policy (prioritizing transport planning by reserving rights-of-way for future development) and 5) social and behavioural trends (considering individual habits, attitudes and emotional that can affect individual travel mode choice). He emphasized that it is significant to have a combination of land use planning, technology and resource allocation with clear policy that response to high demand of mobility in the future.

Another author Litman (2008) explained a comprehensive public transportation system is the one that fits into three goals including economic, social and environmental which are often called "triple bottom line". These goals can be reached through various performances. For instance, providing more transportation choices with affordable price and efficient operations to support a vibrant economy is considered as economic goal. Social goal can be achieved by improving safety and security for each transport mode and station. Lastly, environmental goal can be measured by using renewable energy, protecting environment by reducing gas emission and prevent public transport modes from air, noise and water pollution. The authors agreed that in order to have a comprehensive transport planning, these three goals should be balanced and integrated.

Grava (2003) identified characteristics of public transportation services shall have for considering the attractiveness:

- Carrying Capacity

Each transportation mode has different carrying capacity base on demand volumes. It is a fundamental task to select the right mode that match with market demand. If considering about residents in a district or individual street-based vehicles, an in joint use can be taken into account. Nevertheless, if there are more people (several tens of thousands), a subway will have to be constructed. Due to large scale of carrying capacity, high cost will have to be considered in responding to high demand.

- Speed

Speed is one of passengers' concern. Users may have less interested in using public transportation if expected is not achieved. Moreover, conveniences in transferring along the way from the original point to final destination are also of interest as the total time consumed will be increased if there are more interchanges.

- Passenger Environment

Comfortability feature is increasingly significant in today society. In fact, people expect they can relax during travelling back home from school or workplace. This is an element of life quality which can be achieved though cleanliness, comfortable seats, privacy (at least some distance from strangers), smoothness of the ride, vehicle condition, climate and so on that make people feel good and relax.

- Reliability

Punctuality is an essential trait and a virtue of being human. Usually, users feel stressful when there are delays in traffic or travel, particularly when they have appointment. There are modes of transport that can deal with this problem though under bad weather condition or traffic overload so-called rail-based and some others that are vulnerable to traffic disruptions so-called street-based.

- Safety and Security

Safety and security are perceived as important when sharing space, seat and time with strangers. Passengers need to be sure that they are well protected by the staffs or else it will be a challenge to measure up to what private vehicles provide.

- Conservation of the Natural Environment and Fuel

Currently, people are paying attention to environmental protection and concerning about resource depletion that can be made through any development project or planning, also with urban transport design.

- Achievement of a Superior Built Environment

To build a major transportation system, it is necessary to take into consideration the effect on land use and distribution of activities in that area. This feature has potential for organizing the urban pattern, but it does not happen automatically unless other supporting programs are also introduced.

- Costs

As mentioned above, the costs that have to spend are different depends on transport mode. Some modes require massive capital investments for construction, while others involve large

amount of budget for operating and maintenance. The costs can be the life-or-death factor for any transport project as it has to be ensured that the construction is successfully completed with a specific period.

- Implementability

Implementability involves political and institutional support which sometimes are not always well defined. It can be critical issue and often unique to a specific area that have different habits, social, administrative, and political system.

- Image

Transportation systems represent the level of civilization and management of a city. They can usually the first impression that a visitor from the outside experiences. They show how livable a city is and give pride to inhabitants who live in that city.

2.2.2 Modes of Urban Public Transport

The main modes of urban public transport according to Wright and Fjellstrom (2003), Van As and Joubert (1990) and Grava (2003) generally comprise of:

- Para-transit (including minibus-taxi)

It is considering as public transportation, with the ownership can be both by public and private companies, which consists of conventional modes, private motorized and non-motorized vehicles.

- Bus (mini, midi, standard and articulated)

Bus is a large motorized vehicle, carrying many passengers by road, typically driven and steered by individual person, always utilizing a diesel engine (could be electricity for advance technology countries) and rubber tires.

- Bus rapid transit (BRT)

Bus rapid transit (BRT) is an upgraded level from normal bus. It is a form of customer-oriented transit using an integrated system by combining intelligent transport elements, planning, vehicles and stations with electronic system. BRT typically has separated busways, corridors and modernized bus technology. In addition to separated lanes, BRT systems also commonly involve efficient fare collection, comfortable seats, clean buses and stations, rapid boarding and discharging, modal integration with other modes, good marketing strategies and satisfied customer service.

- Light rail transit (LRT)

A light rail transit (LRT) system is metropolitan electronic railway system. It has ability to run at ground level both with exclusive and without exclusive right-of-way, operated by short trains to board and discharge passengers. LRT systems include tramways that are often sharing the same streets with other vehicles so-called mixed traffic.

- Suburban rail and rapid rail transit/Metro-rail (RRT)

Suburban rail is a part of rail road operations that carries passengers with urban areas, or between urban areas and their suburbs. It differs from LRT and Metro in which cabin cars

usually are heavier, the average trip lengths generally are longer and operating on railway tracks that are part of railroad system in the area.

Metro is very well known as an element of heavy rail systems or mostly called subway. Metro is used to refer to urban rail systems in that operations are carried out on grade-separated lanes underground. Metro is commonly the most expensive form of mass rapid transit for its construction techniques, equipment and maintenance, yet providing highest carrying capacity compared with other modes.

2.2.3 Sustainable Urban Public Transportation

There is growing support for an attractive alternative means of transportation to the car in cities (Hensher, 2007). He further noted that many cities experienced traffic congested and dense, leading to growing support for offering public transportation modes such as BRT, light rail and heavy rail. There is a remarkable need that BRT should not be provided only within cities centers, but also intra city services should be taking into account. However, he argued that despite adding more bus routes, many possible solutions can be done to deal with the issue such as improving information and fare collection systems and providing more buses. This will help to promote environmental friendly and is more favorable from economic perspective as buses infrastructure costs are not that much higher compared with other modes of transport. Not only environmental and economical, but also social benefits since buses offer cheap fare and comfortable enough to urban poor and others who cannot afford their own means of transport. In addition to this, Anin, (2013) elaborated that mass transit has been observed to be more more fuel efficient compared with other modes of transport such as car, SUV and mini bus. The study concluded that accessibility would be improved by expanding the mass transit systems through increasing the number of metro buses within the city, particularly during peak hours.

As stated by the European Road Transport Research Advisory Council (ERTRAC, 2011), the bus is the most competent mode of public transportation due to its flexibility, price, speed and carrying capacity. The study highlighted that urban buses have a stake of 60% of the total European public transport in urbanized areas. The study showed that buses have many positive aspects in terms of capital investment and less space needed to fulfil mobility needs of people. Buses are recognized as the most efficient solution for sustainable transportation system to all cities from an economic, environmental and social point of view. Apparently, buses have often suffered from a poor public image as less attractive mode than others. The study concluded that in order to attract more users, EBSF (the European Bus System of the Future) is necessarily needed as a driver to raise image and attractiveness of bus systems in both urban and suburban areas by presenting new technologies on vehicle and infrastructures together with efficient operations.

Recognition of bus system as a sustainable public transport is not only in Europe, but also spread in Asia. BRT is now becoming an option for consideration for policy makers in some large Asian cities. Jakarta, Seoul and Beijing has installed BRT as a part of their public transport reform (Matsumoto, 2006). She noted that the awareness of BRT has increased and spread in Asia since 2004. In Asia, the growth rate of automobiles has observed to be increased dramatically in most cities and is projected to continue this upward trend. The increase in motorized vehicle has threatened the existing infrastructures and resulted in heavy traffic congestion, air and noise pollution, traffic accidents and parking space issue. Matsumoto argued that it is crucial to start developing comprehensive transport policies to diminish those issues without affecting the current accessibility. Introducing public

transportation is a strategic solution to reduce the use of private vehicles. She highlighted that rail-based transit systems which offer high capacity in carrying passengers, speed and less emissions requires large capital investment for construction, operation and maintenance in which most Asian cities were not able to afford it. They were first struggling in attracting passengers to travel by bus as it was a new system to all commuters. However, Asian policy makers prioritized BRT initiatives as one of their major political commitments, making it more significant when discussing, planning or making decisions related to urban development (Matsumoto, 2006).

Similarly, the Project for Comprehensive Urban Transport Plan in Phnom Penh Capital City conducted by Japan International Cooperation Agency (JICA) shows that for Phnom Penh, which is a medium-sized city with its historically developed structure, it is necessary to decrease car trip demand coming into its center due to the low road capacity and difficulty in eliminating spatial constraints in the center district. Its population was 1,501,725 with the total area of 678.46 square kilometers and the density was 2,213 people per square kilometer (Phnom Penh Capital Hall, 2017). Additionally, in 2011, the city was enlarged by adding 20 communes from nearby province into the city's administration, leads to both internal and external expansion. New inhabitants bring with them demand for transportation by car and motorbike. It is assumed that they make one round trip per day per person (JICA, 2014). The Ministry of Public Works and Transport (MPWT) claims that the resulting increase in the number of trips by car or motorbike has big effect on the congestion. Congestion is expressed here as the ratio between the use of roads and the availability or capacity of roads for transportation during peak hours. As a consequence, an efficient public transport system is necessary to promote the modal shift and encourage the shift from car trips. This is the reason why the Ministry of Public Works and Transport introduced public buses for Phnom Penh city (JICA, 2014).

There are three bus lines, 43 bus fleets and 36 bus stops operating everyday within the city, (Kong, 2016). However, the number of bus routes are very limited that are not accessible by travellers from every corner of the city. Moreover, the buses used are an old type that have only one door and they run at irregular intervals (Mo, Kwon, et al., 2014). He further added that only few bus stops with shelters and not many ways for users to access to the bus stop safely due to a lack of sidewalks and heavy traffic. With limited development of roads in the city center and inadequate traffic management, buses cannot go faster and reach narrow alleys, being the reason discouraging people from using the public buses.

2.3 Self-organization and the complex city

A city is a combination of people, infrastructures, activities and administration. The city keeps changing since its people have different backgrounds, cultures and thoughts; they are definitely diverse. Due to the fact that population will grow, there will be new people, new environment that could be both in good order and chaos.

According to Boonstra (2011) and Portugali (2012), the city as a whole is a complex system with endless and continuous movement and interaction between all its elements – the urban agents (people, places and institutions), which at the same time is also a complex system within themselves as well – dual complex. Interaction among components means that the system has emergent properties which are dissipative far from equilibrium system (Byrne, 2001). It can be said that the city is a nonlinear system which consists of many parts interdependent and interconnected, hence adaptation is needed and self-organization is undoubtedly part of it.

One of the elements of complex systems is self-organization which can be understood as unforeseen spontaneous initiatives, a way to manage and respond to complexity in society. Boonstra (2011) defined self-organization in urban development as initiatives for spatial interventions that originate in civil society itself, via autonomous community-based networks for citizens, outside government control. However, governance and self-governance are not exclusive and contrasting developments, but developments that influence each other in a specific local context (Nederhand, Bekkers, et al., 2014). In a complex system without centralize control, self-organization is an emergence feature of the local interaction between the parts. The field of self-organization seeks to adapt to changes by synchronizing behaviors, generating feedback loops and creating new patterns. Obviously, self-organized initiatives are made of "street-level experts" that "have a ready understanding of the complexity of the issues that affect them, although they do not use the analytical lingua franca of the academic experts or policy consultants to describe what is wrong" (Wagenaar, 2007). In addition, Partanen (2015) argued that self-organization can be considered one of the most powerful explanations of how complex open systems operate. She raised a crucial question is how we could understand this phenomenon better, and integrate such understanding into city management and planning to support these autonomous processes.

When the system is far from equilibrium, it can find dynamic states between order and chaos to regenerate itself for prolonged periods of time through self-organization. If people have a prepared mind and are open to unexpected events, they can foster creativity, for example responding to traffic issue in a growing city.

2.3.1 Self-organization in mobility

Mobility is one of the most fundamental and important characteristics of modern societies, as it satisfies the basic need of going from one location to another (Geerlings, Shiftan, et al., 2012). Sustainable Mobility is a symbol of city development, economic growth, environmental friendly, decline in traffic accident which will lead to better quality of life and making it a livable city for citizens. He noted that transport is associated with many positive connotations: it enables individuals to fulfil their needs in terms of opportunities for employment, education, recreation and so on. However, transport sector is a complex system that requires multiple actors involved including government, private sectors, experts and inhabitants themselves, collaborating with each other to create a right decision in order to tackle mobility issue.

According to Banister (2008), sustainable mobility provides an alternative paradigm within which to investigate the complexity of cities and to strengthen the links between land use and transport. For an accessible sustainable city to become a reality, it requires active citizen support, communication between experts and citizens, and the involvement of all major stakeholders. He highlighted the concept of a sustainable mobility is balancing physical dimensions (urban form and traffic) with social dimensions (people and proximity), aims at reducing travel time and travel need. However, the notion of a transport system without congestion has never been a realistic objective, yet we are trying to minimize the congestion as much as possible we can through establishing a comprehensive transport planning and integration with informal transport sector.

Informal transport exist everywhere in the world both in the developed and developing worlds. According to Loo (2007), currently informal transport is often a solution to urban transport problems in both the global north and global south. In the global north, paratransit is used to provide special support to elderly and disabled people, while in global south, informal

transport plays essential role to complement the missing links provided by the public transportation. In the case of developing country, Cambodia, people are of forced to work in the informal sector due to the factors of low education, lack of skills, gender or they are marginal to the main labor force (Etherington and Simon, 1996). Due to poverty, people seek for jobs that do not require much capital investment, particularly in informal transport sector which do not require high skill workers. The traffic issues in Phnom Penh have become a common social problem which has decelerated the economic activities, intensified the travel cost and time and degraded the quality of life (Phun, Pheng, et al., 2015). The number of registered vehicle in Phnom Penh has been increasing at an average rate of about 20% each year, and has reached almost 1,500,000 in 2015. The number of motorcycles dominates the biggest share of registered vehicle (accounted about 84% of all registrations) (Kong, 2016). Within this huge percentage, they register their vehicles as private property, yet in reality, they use it as public transportation such as taxi and sharing with others to earn more income. For instance, some students and workers use their motorbikes as motorcycle taxi during free time and after class or office. Additionally, some people invent their motorcycle into auto-rickshaw (Tuk Tuk) without proper technical inspection and use them as informal public transport illegally. Organizational support appears limited to the development of urban transport, this will lead to increase in number of self-organized transportation groups who seek for opportunity to improve their travel needs. Kong (2016) and Phun (2015) agreed that Cambodia remains at an early stage in its evolution while there is no clear authority, agency or legal framework from the national government responsible for urban transport in Phnom Penh. The lack of regulation may have increased the number of informal public transportation.

With lack of mass transit system, citizens of Phnom Penh primarily rely on paratransit as public transportation mode. Paratransit can be explained as a self-organized transportation, initiated by citizens themselves to deal with traffic issue and find ways to make their life easier. It offers a personalized and flexible transport service to different income classes of people, particularly the urban poor. According to Phun (2015), an association was established by groups of paratransit driver so-called route association. He explained that route association is a form of self-organization in which it has its own internal rules to ensure the fairness, efficiency and quality of transportation services among its members. It is established to avoid an open market competition with other drivers by defining a particular service area. For example, their pick up points are at Phnom Penh international airport and Tonlebassac tourist place.

2.4 Paratransit Transportation

According to Lave and Mathias (2000), paratransit transportation can be described as alongside transit. Generally, the term is applied to small passenger transport which operates informally on a fare paying basis by private companies. It consists of both private motorized and non-motorized vehicles. Currently, since the development of mass transit system in developed countries is functioning well, paratransit is often used for demand responsive systems such as shared-ride taxis, dial-a-ride and subscription buses for a certain group of users including elderly and disable people (Shimazaki and Rahman, 1996).

In contrast, the use of paratransit in developing world has different contexts. Paratransit modes play a significant role in urban transport sectors of global south due to limited capacity and budget in developing mass transport systems, resulting in inadequate public service provision. In the context of developing countries, the lower standard living, high population density, insufficient mass transit systems, urging people continue to rely on the transport

services provided by paratransit as it is the most affordable mode of transport (PHUN and Tetsuo, 2016). Furthermore, they have become very popular because they fill the gap where growing demand has not been satisfied by organized public transport services. Paratransit operations have built-in flexibility, in that operators can change their services to respond to passenger needs. They can also closer to the home; thereby providing a more accessible service.

2.4.1 Characteristics of paratransit

The paratransit is made up of self-employed entrepreneurs who lack of official registration and who work long, hard hours in a highly competitive market place. It is classified into four key traits namely Entrepreneurialism, Small and Aging Vehicles, Low-performance Services, and Competitive Market (Cervero, 2000). In addition, he further noticed that paratransit has both benefits and issues contributing to the whole society.

- **Benefits of Paratransit Transportation**

Mobility and Development

The important role of paratransit is connecting poor neighborhoods to school and job centers. Hundred households especially the poor who are not able to afford private automobile, are heavily depend on informal transportation such as jitney, minibus and rickshaw as means of transportation since bus and metro services are irregular, unreliable and inaccessible to their area.

Source of employment

Most cities in developing countries experienced rapid population growth and urbanization in which people from rural areas move to city in hopes of improving their lives. Paratransit is often a gateway to these people since they are low-skilled workforce and no social assistance is provided.

Complementarities

In many cities of developing world, paratransit modes like pedicabs and jitneys enhance mobility by compensating for the absence of functional road hierarchies. In South East Asia where there is lack of road connectivity in local streets or having geographical issues, paratransit offers better service in filling the gap and adapting to these constraints easily.

Efficient and Low Cost Service

Since most paratransit operators are self-employed and independent, they are inspired to maximize income as much possible as they can and also ultra-responsive to emerging and shifting market trends. Study shows that paratransit operators has benefit economic advantages with high rate of return in capital investment.

Market Responsiveness and Flexibility

Paratransit can easily change their schedules, routes and operating time and it has ability to response to shifting market conditions and increasing demand in a suburb to other areas.

- **Issues and concerns of Paratransit Transportation**
However, apart from benefits, paratransit also creates negative issues in cities. Cervero (2000), also highlighted six issues and concerns generated by paratransit.

Traffic Congestion.

Paratransit has inevitably grown as excessive supplies of service providers due to no restriction or detailed regulation is applied. Since there is no proper terminal, they ended up by stopping almost everywhere to load customers even in the middle of the road and at intersections, causing bottlenecks and congestion.

Disorderly Operation and Unfair Practices.

As paratransit operators generate profits for themselves, competition is an extreme critical way to achieve their goals. Fierce competition for customers calls for chaotic and damaging driving behavior.

Accidents and Public Safety.

As mentioned earlier, most drivers are low-educated and no proper driving training were conducted, thus they were blame to cause traffic accidents and damaging public safety through overloading, violating traffic rules, stopping in almost everywhere to pick up customers which will harm passengers who are using their services.

Air pollution and Environmental Problem.

Old and poor maintenance vehicles are certainly causing noise and air pollution. Residents in certain areas where paratransit operated suffer from respiratory diseases attributable to airborne pollutants.

Cream-skimming.

Usually, paratransit drivers offer frequent service during peak hours and on busy routes, leaving high-cost and unprofitable services to the public transportation during off-peak hours.

Intangible Factors.

Local and provincial governments may understand the role of paratransit differently according to their geographic, knowledge and perception toward informal transportation. In developing countries, some local governments may see paratransit as complementary to the public transport, while others may see it as competition or even restricted their operations.

2.4.2 Modes of Paratransit Transportation

Paratransit comprises of both motorized and non-motorized vehicles with different capacity ranges from high to low transporting capacity. The main modes of paratransit in developing world according to Cervero (2000) is categorized into five classes in which class 1 to 4 is defined as motorized transportation whereas class 5 is non-motorized transportation.

- Class 1 Conventional Bus

Conventional Bus is double-decker buses that provide trunk-line service and under public sector control or franchise arrangement, yet few are unregistered and operates illegally. It has fixed routes, fixed-schedule, can accommodate between 25-60 passengers with region and sub-region area.

- Class 2 Minibus

Minibus operates as fixed-route, semi-fixed schedule with capacity range of 12-24 persons,

running with sub-region. It can board and discharge passengers anywhere along the way and charge variable fares.

- Class 3 Microbus

Microbus is locally designed for less passenger loads with the capacity for 4-11 riders, operating with fixed-routed and semi-fixed schedule with sub-region. Due to its small capacity, some drivers to avoid lost, offer door-to-door service in return for surcharge.

- Class 4 Three-Wheelers and Motorcycles

Cambodia's Moto-dub, Indonesia's Ojek, Nigeria's Okada, Bangkok's tuk-tuk and Manila's tricycle are examples of three-wheelers and motorcycle taxi which can serve 1-4 passengers, running as feeder within neighborhood. They are very popular in developing world due to their small size vehicles and flexibility in changing the routes and schedules in response to traffic congestion and geographical constraint (narrow roads, unpaved roads).

- Class 5 Pedicab/ Horse-Cart

All forms of non-motorized transportation are categorized in this class, operating with neighborhood as feeder with free routes and schedules and can carry 1-6 passengers.

Table 1: Classes of paratransit vehicles and services that operate informally

Class	Service features		Passenger		
	Routes	Schedules	Capacity	Service niche	Service coverage
Conventional Bus	Fixed	Fixed	25-60	Line-Haul	Region/Subregion
Minibus/jitney	Fixed	Semi-fixed	12-24	Mixed	Subregion
Microbus	Fixed	Semi-fixed	4-11	Distribution	Subregion
Three-wheeler/motorcycle	Variable	Variable	1-4	Feeder	Neighborhood
Pedicab/horse-cart	Variable	Variable	1-6	Feeder	Neighborhood

Source: Cervero (2000).

According to Tangphaisankun (2009), paratransit has a unique capability in terms of serving as a feeder function into urban transportation by utilizing its compact size and speed to shuttle people up and down the narrow streets off the main streets and especially from their origin destinations to public transits.

In Phnom Penh, paratransit has observed to support social economy (provide job opportunities to low-skilled people) and serve travelers in the city to fulfill their transportation needs for more than 30 years since the end of civil war in 1979 (Phun, Reiko, et al., 2016). The most common modes of paratransit in Phnom Penh are moto-dup (motor taxi) and remork (auto rickshaw). He added that any motorcycle owner can easily become a motor taxi driver if he or she wanted to do so because there is no requirement (for example license, regulation) to control over this operation, resulted in plenty of available paratransit operators within the city. Some people live along the public bus routes, nevertheless they still prefer paratransit since they perceived it as more flexible and convenience door-to-door

service. The low willingness to take public bus is because of limited bus lines and long waiting periods at bus stations (Phun, Iv, et al., 2015).

2.5 Empirical Literature Review

There is a number of literature which confirms negative perceptions on public transportation and provides recommendations of which quality services could be improved to attract users.

Beirão, and Cabral, (2007) conducted in-depth interviews with public transport users and car users in Porto, Portugal to obtain a better understanding of users' perceptions on public transport service quality. The study showed that the choice of transport mode is influenced by individual's characteristics and life style, type of journey, perceived service performance of each mode and situational variables. The study also noticed that sharing experiences of friends or family members through word-of-mouth is partially causing negative perception which appear to discourage people from using public transportation. Furthermore, the results indicated that passengers claim for comfortable relaxed journey by having a seat on the vehicle, good smells, enough space and air, and a smooth ride. The authors highlighted that travel time and reliability are the most important keys of transport mode decisions since passengers want to be in control by being punctual, having less waiting time and a fast journey. The study concluded that in order to attract users, public transport service could be improved by building good image and providing reliable services, particularly information related to timetable and routes that can bring passengers to the destination faster.

A study of Hine and Scott, (2000) reviewed that interchange attributes, trip and personal characteristics influence decision making of public transport and car users in Scotland and United Kingdom. The results showed that public transport users were dissatisfied with the trip fare that was higher compared to the level of courtesy, comfortability and assistance provided by staffs. Passengers complained that there should be more staffs to help them with giving information, direction, luggage, children or especially disabilities. In addition, the research indicated that travelling through public transport required much more planning than usual in which they have to be aware of travel information and finding way at each transfer. With the lack of information and familiarity, most people find it difficult to use public transport and decided to use private cars since they perceived as more flexible and convenience. The study concluded that public transport services could become more attractive to all users if burdens of interchange are reduced, accurate information and assistance are provided, walking distances to stations and waiting time are shorter, the trip fare is adjusted and no longer free parking is allowed.

According to Redman (2013), the quality attributes of public transport can attract car users unless some key features are improved including reliability, comfortability, speed and price. The study showed that reliability is the most important key factor followed by frequency service, affordable price, available seats and vehicle speed which are all contribute to the quality of public transport services. Furthermore, the authors noticed that users characteristics are inevitably affect decision making of users in choosing public transport. Personal behaviour, background, socio-demographic and previous experiences with public services can be both discourage and encourage travellers to use public transport. The study revealed that passengers' perception on public transport are based on two attributes: physical attributes include travel information, frequency, speed, reliability, affordability, accessibility, vehicle condition, and interchanges, while perceived attributes include safety, comfortability, cleanliness and convenience. The study concluded that private car users will switch to use public transport if these feature are improved.

2.6 Conceptual framework

On the basis of the theories explained above, the conceptual framework explains the relationship between the concepts used to address how paratransit transportation has influenced alternative city bus implementation.

Figure 2: Conceptual Framework
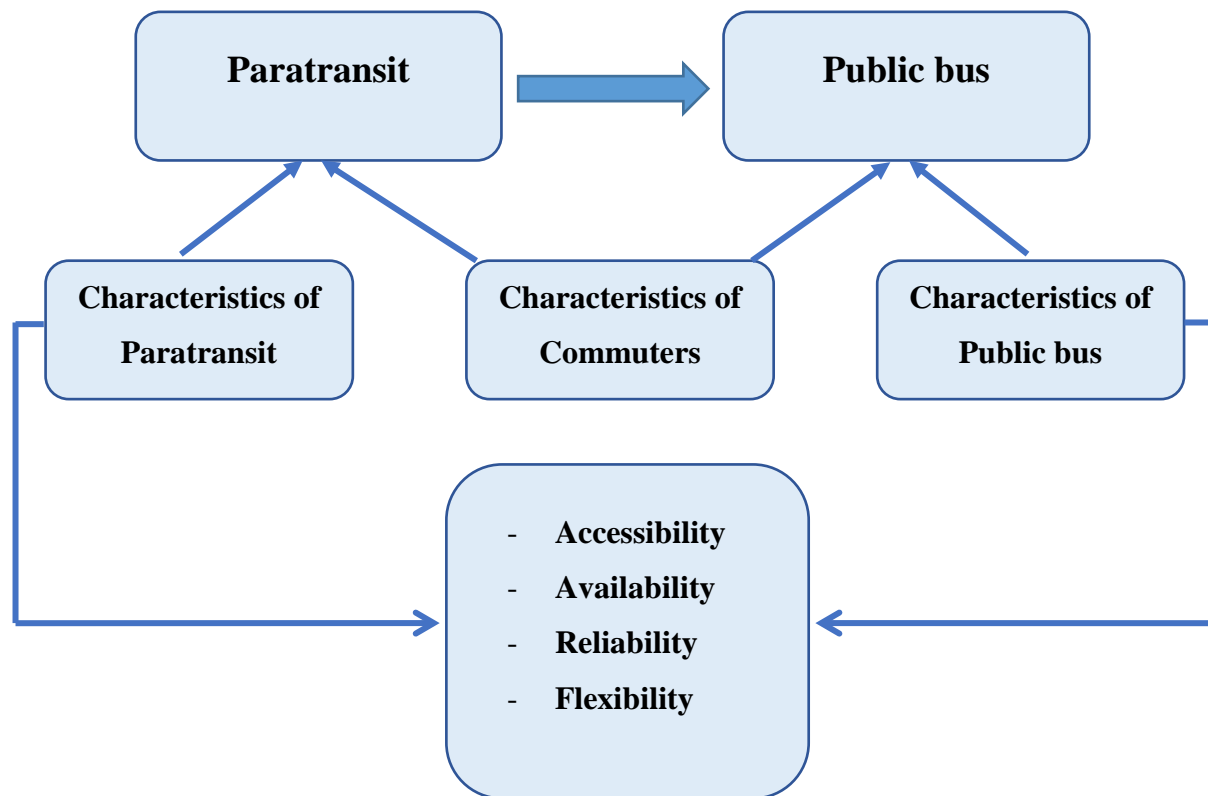
Chapter 3: Research Design and Methods

This chapter presents the methodology used to answer the research question. It begins with operationalization of variables and indicators, selects research strategy, specifies sample size and selection, and identifies formats used in data collection method as well as techniques used for data analysis.

On the basis of literature review discussed in Chapter 2 by Grava (2003), Beirão, and Cabral, (2007), and PHUN and Tetsuo (2016), a hypothesis can be established to explain the phenomenon. Therefore, I hypothesize that:
"Accessibility, Availability, Reliability and Flexibility are key factors that make paratransit more favourable than public transportation".
A deductive research was employed in order to prove this hypothesis.

3.1 Revised research questions

Why do commuters in Phnom Penh prefer to use paratransit – informal transportation over public buses?

3.1.1 Sub research questions

1. To what extent, paratransit transportation encourages commuters to use its system?
2. What factors influence the use of paratransit by commuters?
3. What factors influence the use of public transportation by commuters?

3.2 Operationalization: Variables, Indicators

The operationalization was based on the concepts mentioned in Chapter 2 which were elaborated by Grava (2003), Cervero (2000), Beirão, and Cabral (2007), and Redman (2013). The variables identified elements in the key concepts, while the indicators focuses on concrete data that needed to be collected. Characteristics of transportation modes are important factors for passengers to take into consideration when choosing their travel modes. It comprises of availability, reliability, accessibility, affordability, comfortability and many more variables as clearly described by Grava (2003) and Cervero (2000). Since the two main variables, paratransit and public bus are modes of transportation, they both share similar indicators. At the same time, it is also necessary to study about travellers' behaviors which were operationalized base on their socio-demographic.

Table 2: Operationalization, Variables and Indicators

Concept	Variables	Indicators
Characteristics of commuters	Socio-demographic	- Gender - Age - Employment status - Monthly income
Characteristics of paratransit	Travel information	- Convenience of getting travel information
	Availability	- Number of vehicles, stops

		- Operating hours
	Accessibility	- Distance from home to pick up point - Distance from pick up point to final destination
	Reliability	- Punctuality - Waiting time
	Affordability	- Trip fare
	Flexibility	- Ability to change routes during peak hours
	Comfortability	- Number of seats available - Crowdedness - Temperature in vehicle
	Hygiene	- Cleanliness of vehicles - Cleanliness of waiting areas
	Speed	- Expected speed is achieved
	Vehicle condition	- Physical condition of vehicle - Mechanical condition of vehicle
	Driver's behaviors	- Carefully driving - Helpfulness, politeness
	Safety	- Feeling of safe from traffic accidents, pick pocket, luggage
Characteristics of public bus	Travel information	- Convenience of getting travel information
	Availability	- Number of vehicles, stops - Operating hours
	Accessibility	- Distance from home to pick up point - Distance from pick up point to final destination
	Reliability	- Punctuality - Waiting time
	Affordability	- Trip fare
	Flexibility	- Ability to change routes during peak hours
	Comfortability	- Number of seats available - Crowdedness - Temperature in vehicle

	Hygiene	- Cleanliness of vehicles - Cleanliness of waiting areas
	Speed	- Expected speed is achieved
	Vehicle condition	- Physical condition of vehicle - Mechanical condition of vehicle
	Driver's behaviors	- Carefully driving - Helpfulness, politeness
	Safety	- Feeling of safe from traffic accidents, pick pocket, luggage

3.3 Research strategy

Due to the nature of research question, a survey strategy is employed. It is a large-scale approach as it allows researcher to collect a considerable body of data on a large number of variable and many units of study – respondents (Van Thiel, 2014). Survey can be used to collect new information, measure people's opinion through standardize forms of measurement such as likert scale or answer categories. Survey is the most appropriate strategy to answer the question is because of its efficient way in data collection methods which enables large number of respondents involved that can represent the perception of whole population regarding their perceptions on transportation modes.

Service quality which is derived from being comfortable, reliable, accessible, affordable and so on, is a subjective topic which means that how people define and rate of satisfaction level is entirely depends on several factors including socio-demographic, social environmental in where they live, their vision on society and features of services attribute to the transport mode. In fact, the scores on travel modes will not be the same for specific groups of citizens such as: male and female, youth and elder, rich and poor, and so on. Therefore, to avoid bias in explaining the differences in perception of travel mode, it is important to reach every group of citizens as their opinions will sure be different by what might be important for one, could be less important for the others. For this reason, survey is the most applicable and adequate way to reach majority of people as much as possible it can go.

In addition to quantitative data, interviews were conducted to collect qualitative data from different groups of people. It aims to seek for in-depth information by allowing interviewer to ask supplementary questions in order to gain better understanding of any answers that have been given to know more about the context and phenomenon.

3.4 Data collection Methods

The data collection methods selected includes questionnaire (online and face-to-face surveys) and semi-structure interviews. Questionnaires were used to collect quantitative data from majority of commuters as much as possible and semi-structure interviews were used to gain in-depth information and better understanding about commuter's perceptions.

3.4.1 Questionnaire

The questionnaire consisted of a list of closed-ended questions, asking respondents to rate the service quality provided by public bus and paratransit. The questionnaire was divided into two formats namely online and face-to-face. Due to only high educated people who use email for communication, the online questionnaires were sent to respondents through a very popular social media in Cambodia so-called facebook which were used by many people from all backgrounds (sex, age, income class, education level and employment status). With online surveys, respondents can read and answer the questions carefully at his or her own pace at anytime and anywhere, resulting more consistent answers will be given and less error will be detected. However, it cannot always be certain of the quality of findings though respondents completed the questionnaires that is called respondents' answering tendencies (Van Thiel, 2014). This means that respondents might give answers that researcher expected because they don't want to be in a case for studying or just go through the questions quickly to complete the requirement. He further explained that answering tendencies can be solved by providing respondents with clear instructions, pleasant formats and avoid ambiguity. Moreover, the questionnaire should be pre-tested with a pilot group to ensure that the content of questionnaire is understood by respondents before the actual survey is conducted (De Leeuw and Hox, 2011).

Apart from online questionnaire, face-to-face survey will be employed with the poor and elderly who have difficulty in filling online survey, not familiar with electronic system or cannot access to internet. For instance, face-to-face questionnaires were needed and conducted with elderly (who mostly do not use internet) and garment workers who mostly are low-income people. Garment workers are potential customers since they need to travel long distance every day from their houses to Phnom Penh special economic zone, located at the edge of the city and along bus line.

3.4.2 Semi-structure interview

Semi-structure interview were used to seek for in-depth information from key informants who are knowledgeable in the field of study including students, housewives and workers at different ages who travel every day for studying, working and shopping. As mentioned in Chapter 2 above, the role of paratransit is to fill in the gap resulting from insufficient mass transit systems to travellers, particularly people have who lower standard of living (Shimazaki and Rahman, 1996, PHUN and Tetsuo, 2016). In this case, students and housewives were categorized as unemployed (have no salary) and workers (both low and medium income) were defined as potential customers since they use paratransit for commuting everyday as they perceived it as the most affordable mode of travel. Interviews were conducted at schools, markets and office areas where key informants are.

In addition, semi-structured interview were also applied with government officials (City Bus Authority and Phnom Penh Department of Public Works and Transport) and Japan International Cooperation Agency (JICA) who are experts in developing and implementing public transport in Phnom Penh city. This method was useful to generate in depth information about people's perception with its flexibility in leaving rooms for open questions. The benefits of this technique is that it underlines stakeholders' perspectives, behaviors and opinions to review and rebuild the policy.

3.5 Sample size and selection

A sample is the select population derived from a possible unit (Van Thiel, 2014). In this research, a probability sampling was employed for collecting data from respondents. Probability sampling facilitates the option to generalize the findings. There are many ways to improve the representativeness of a probability sample. However, due to time constraint, stratified random sampling were applied by dividing population into sub-groups and then selecting respondents randomly from those groups. The respondents of this research were divided into five categories which consist of gender (male and female), age (below 30 years and above 30 years), employment status (unemployed, self-employed, workers and students) monthly income class (low, medium and high) and types of passenger (users of public and users of paratransit). Understanding socio-demographic is useful to analyse the perceived behaviors and dynamics of population in preferring paratransit as the main modal choice. It offers insights from different sub-groups that might have different reasons though they made the same choice. For instance, low-income people prefer paratransit because it is cheaper than public bus while elderly people prefer paratransit because it provides door-to-door service in which they do not have to walk to pick up station. Moreover, studying about socio-demographic allows researcher to determine whether he or she is actually reaching target audience and whether or not gather the information he or she is seeking.

In order to make a good generalization, it requires large number of respondents that can represent the whole population. According to Barlett (2001), Cochran's formula was used to determine the sample size. The formula is:

$$n_0 = \frac{z^2 pq}{e^2}$$

$$n_0 = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2} = 384$$

Where n_0 is sample size, z is the score of 95% confidence interval (use 1.96), p is estimated percentage of the population (50%), $q = 1-p$, and e is acceptable margin of error (5%)

However, since there is a finite number of population (N), Cochran's correction formula was adopted to calculate the final sample size as follow:

$$n = \frac{n_0}{1+(n_0/N)} = \frac{384}{1+(384/1,501,725)} = 383.9018$$

Therefore, a minimum of 384 respondents are required for data collection. However, due to time limitation (only one month for data collection), it will be difficult to reach that target. Meanwhile, the rule leaves rooms for researcher when the population is sizeable (for instance, all inhabitants of a country or a city), a lower percentage suffices, as long as the sample remains representative (Van Thiel, 2014).

Due to the fact that those subgroups are not homogeneous, non-probability sample were also used by applying purposive sample for semi-structure interviews. In this approach, interviews were conducted with selected respondents in the categorized groups. Those respondents can be representative of elderly, unemployed, workers, students and government officials who are implementing the policy base on their knowledge and experiences in using those

transportation modes to gain in-depth information, perspective and opinion about their satisfaction and ways to improve the transportation system.

Despite achieving the expected number of respondents set by rule, 335 respondents were interviewed. Those key informants played significant roles in both giving information and spreading the questionnaires through their networks. The results were a combination of members of Phnom Penh Youth Association, members of Student Association, City Bus Authority staffs, JICA study team, MPWT staffs, private sector workers, housewives, self-employed, unemployed (very few), paratransit users and public bus passengers (mostly elderly and students). Since elderly are not well familiar with using new technology which is a convenient way of collecting data, majority of the total number of respondents were young people.

3.6 Validity and reliability

With respect to large population and time constraint, a combination of survey and semi-structure interview are the most appropriate strategy to reach both internal and external validity. Since all important indicators were given by many respondents from the questionnaire, it produced high validity in terms of answering to the research questions and can be generalized for each sample group of population base on their socio-demographic.
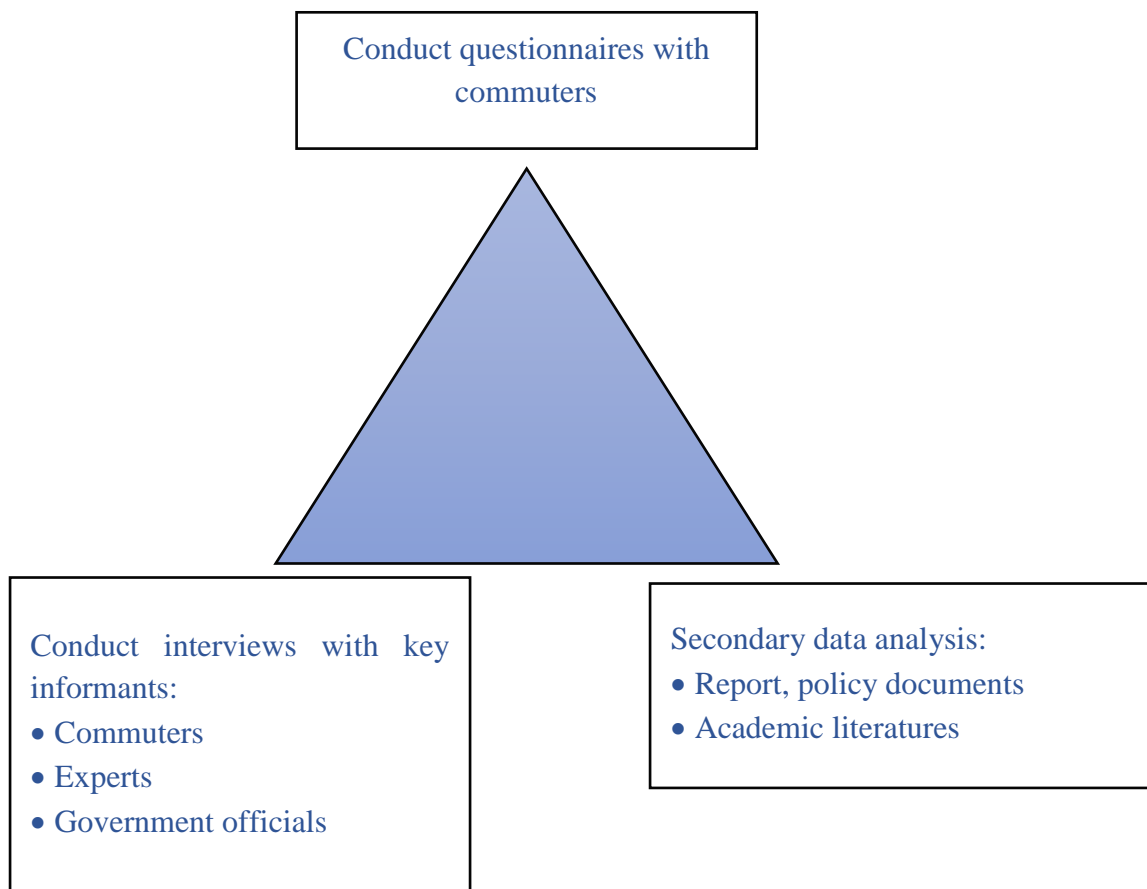
For reliability, all important variable were measured in clear distinction through sufficient indicators and accurate measurement. Furthermore, the representativeness from different backgrounds of key informants was fulfilled as they are knowledgeable in the research field.

3.7 Data analysis methods

The data collected from questionnaires were interpreted into tables, graphs, charts and excel spread sheets by using a statistical program, Statistical Package for Social Science (SPSS). The data were analysed base on perception of group of people who have different backgrounds. For instance, it illustrated how the high income and low income people formulate their decision making and how they perceived the service quality attributes to each transportation mode. The same methods were applied to gender, age, employment status and passenger types groups. Then all data were combined, compared and checked if different characteristics of people are truly influence their answers and perception of transportation modes. Both questionnaire and interview were conducted in Khmer language, recorded, transcribed and translated into English in order to code them in the software Atlas.Ti and SPSS. Descriptive and inferential statistics analysis were used in this study. The descriptive statistics analysis includes mean, frequency, and percentage of recorded data in the SPSS, while inferential statistics includes mean comparison, using T-test and one-way-ANOVA.

To enhance the quality of data collected, triangulation were used by two ways: method and source. Triangulation by methods were done through interviewing with key informants who are representative of small groups and experienced in the study field to get better understanding about the context that researcher might not know before or expected. In addition, the advantage of this technique is that it is useful to rebuild or revise transport policy base on new detail information, perspectives and opinion from key stakeholders. Moreover, triangulation by resources (secondary data analysis) were also done through using previous data collected by government or academia. By doing so, it will help to enhance the level of validity and reliability to be higher.

Figure 3: Triangulation by methods and sources

Conduct questionnaires with commuters

Conduct interviews with key informants:
- Commuters
- Experts
- Government officials

Secondary data analysis:
- Report, policy documents
- Academic literatures

Chapter 4: Research Findings

This chapter demonstrates findings on transportation survey where data for analysis was collected. It captured socio-demographic characteristics of commuters, their modes of transport and their general perceptions toward public and informal transportation. It then followed by an analysis to define the reasons why commuters prefer to use paratransit and what factors they consider the most importance for their travel mode choices. This research study also explored some perceptions of relevant stakeholders in order for identifying their perceptions on the current transport, issues and challenges and policies or action plan for the transport development in Phnom Penh city.

The main layout in this chapter includes as followings; Commuter's characteristics, Transportation mode in Phnom Penh, General perception on current transport situation and perception on public bus service in Phnom Penh.

4.1 Commuter's characteristics

This research study employed two forms of survey, i.e. online survey namely survey monkey which was shared in a well-known social media so called face-book; and face-to-face interview. The online survey received a total of 213 responses, while face-to-face interview obtained a total of 122 responses in which the research study obtained a total samples of 335 respondents. In order to maintain a research ethic, respondents were able to not answer any questions they feel uncomfortable to them. Further, an introductory of survey questionnaires also explained the objective of this research study which will make respondents feel confident with providing answers to the questionnaire. This section is categorized into three main parts: gender and age of respondents, employment and income.

4.1.1 Gender and age of respondents

The result of this research study showed that about 45% of respondents were female, while 55% were male respondents. Knowing percentage of gender participated in this study is very helpful for the analysis of how is different perception between male and female respondent on transportation mode in Phnom Penh capital city.

Table 3: Gender of respondents participated in the survey

Gender		Frequency	Percent	Valid Percent
Male		184	54.9	55.4
Female		148	44.2	44.6
	Total	332	99.1	100
Missing System		3	0.9	
Grand Total		**335**	**100**	

Source: Author's survey, 2017

The survey also enumerated age of respondents in order for understanding of how their sincerity of age influences their decision or perception on transportation situation in Phnom Penh city. As a result, both online survey and face-to-face interview found that an average age of respondent participated in this survey was 24 year-old, a minimum age was 13 year-old and maximum age was 59 year-old. In term of age by gender, the statistic suggested that

an average age of female respondent was about 25, while female respondent was about 26 years old and the statistic also suggested that on average in age between male and female respondent were no significantly different. Further, this survey study maintained a normal distribution of age respondents with 1.45 of t-statistic of a skewness which is lower than 2. Figure 4 below illustrated age group of respondent in which it is categorized based on the labour-force. In this regard, we found that approximate of 48% were respondents aged from 19-25 year-old, following by 29% aged from 26-32 year-old. Very few respondents aged less than 18 year-old and more than 40 year-old participated in this survey study.
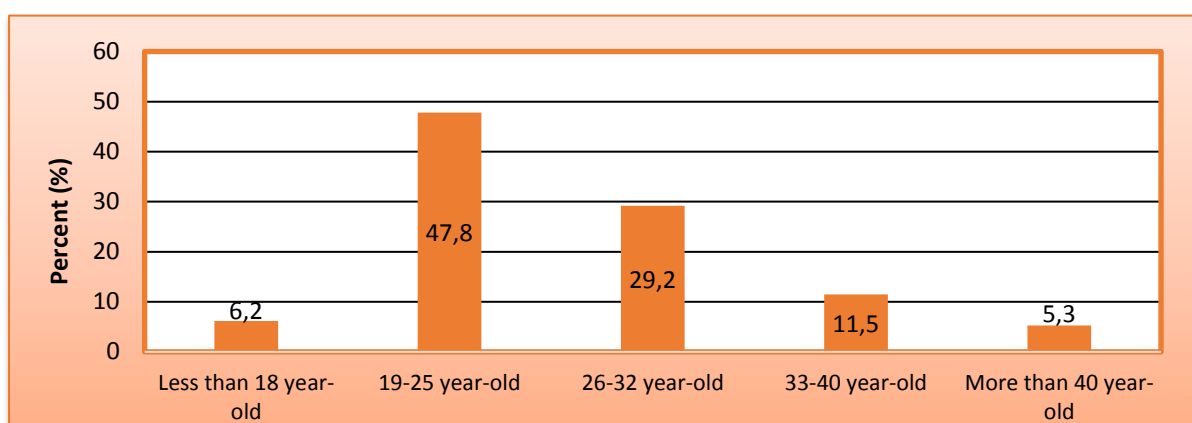
Figure 4: Age group of respondent (percent)

4.1.2 Employment and Income of respondents

The survey also enumerated for types of employment of respondents who participated in this research study. The enumerating for occupation of respondents is to explore how different occupation of respondents explains their perception on transportation mode in Phnom Penh. This research study aimed at obtaining variety of occupation and equal shared of each occupation, though student and wage-paid employee (NGOs, public and private sector) are prevalent occupation in this study. The result showed that about 45% of students participated in this study, while approximate of 49% were wage-paid employee. Only 2.4% and 4% were unemployed and self-employed, respectively.

Figure 5: Occupation of respondents participated in the survey, percent (%)

Income of respondents was also included in this study due to being low or higher income of respondents would be influence on how they perceive on transportation mode in the city. In this regard, this study also disaggregates income into income generated by income earners (self-employed and wage-paid employee) and non-income earner (students and unemployed).
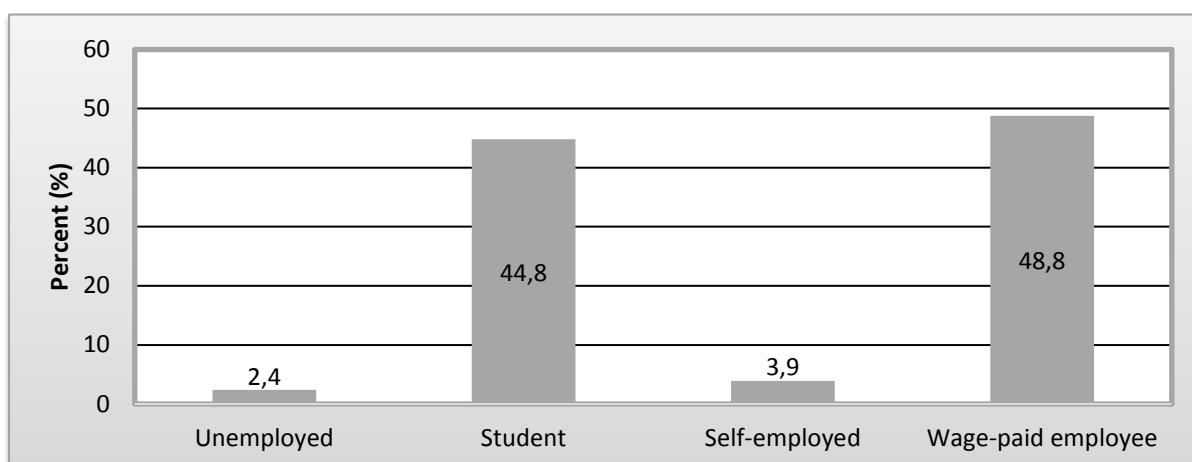
Normality of data distribution on income was also assessed differently for income earners and non-income earner, but the statistics revealed abnormality of income data distribution for both groups. Therefore, nonparametric analysis for average in income was employed, so called median. As a result, the median in income for income earner participated in this study was about USD 360 per month, while monthly income for non-income earners, student in particular, was USD150.

Table 4: Key statistics of respondents' income, in USD

	N	Mean	Median	Std. Deviation	Skewness
Non-income earner	57	267.54	150	649.401	7.156
Income earner	156	506.7	360	405.741	2.585
Total	**213**	**442.7**	**300**	**492.975**	**4.95**

4.2 Transportation mode in Phnom Penh

Phnom Penh is a capital of the Kingdom of Cambodia where economic activities, commercial, centre of education and political activities taken place. With a rapid economic development and urban spurring, Phnom Penh city comprises of different transportation mode.

4.2.1 Number of vehicles in Phnom Penh

According to the 2016 annual report of Phnom Penh Department of Public Works and Transport (DPWT), the number of registered vehicles in Phnom Penh city which was gathered by Phnom Penh DPWT was observed to be increased from 2012 to 2016. This growing trend of vehicles indicated residents' preferences of having private vehicles and the negative result of this development was therefore resulted in traffic congestion.

Table 5: Number of registered vehicles in Phnom Penh from 2012 to 2016 by vehicle types

Vehicle types	2012	2013	2014	2015	2016
Family car	20,147	18,106	22,667	34,178	31,595
Small passenger car	2,727	2,552	2,969	4,152	3,376
Big passenger car	328	214	285	363	343
Light-duty truck	5,294	5,731	6,387	8,610	7,075
Heavy-duty truck	3,107	3,150	3,569	4,281	5,493
Motorcycle	123,199	123,729	155,887	166,335	156,680
Total	**154,802**	**153,482**	**191,764**	**217,919**	**204,562**

Source: Phnom Penh DPWT annual report, 2016

4.2.2 Types of vehicle and transportation mode reported by respondents

Transportation mode in Phnom Penh was surveyed in order to understand the majority of fleet of passenger. Survey result of this study indicated that motorcycle, used as transportation mode by respondents in Phnom Penh, is a predominant vehicle, following by car. About 76.5% of respondents used motorcycle, while 38% used car as their daily transportation and movement for their daily activities. Apart from using private vehicles as daily mode for commuting, the third favorable choice is paratransit which was used by about 18.5% of respondents, 10% higher compared to public bus.
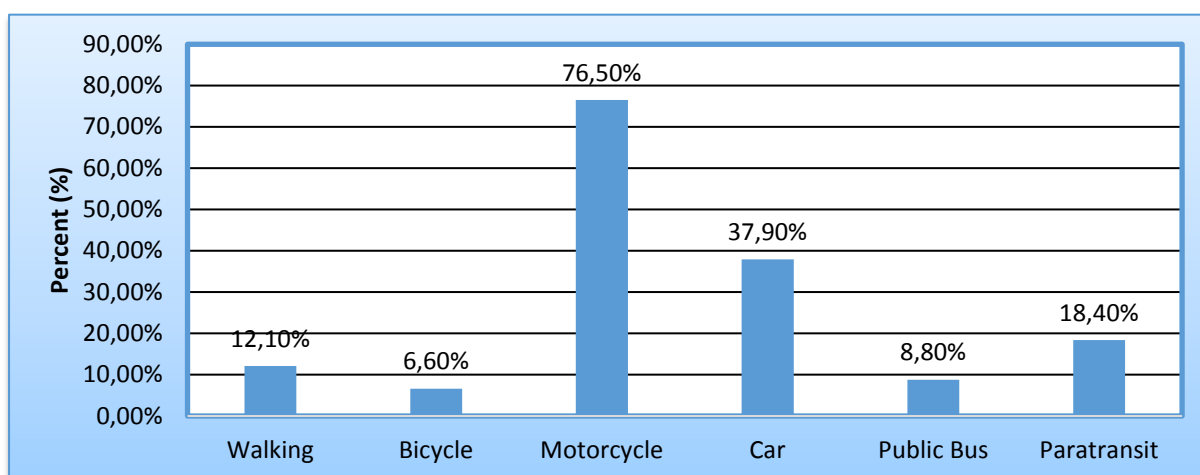

Figure 6: Percent of transportation mode used in Phnom Penh

As we can see from figure 7 below, motorcycle was rated as the most frequent use of travel mode which accounted for 81% of respondents, followed by car and walking with the response rate of about 34% and 20% respectively. On the other hand, the travel mode that was the least frequent use is public bus in which roughly 66% of respondents reported never use the bus or less than once in a month. Approximately 60% and 47% of respondents were also less interested in using bicycle and paratransit by rating either never use or less than one time per month. It can be concluded from this chart that people are not likely to use public bus as the main mode for travelling as the results showed lower percentage of frequent use of public bus compared to other modes of transportation such as motorcycle, car and paratransit.

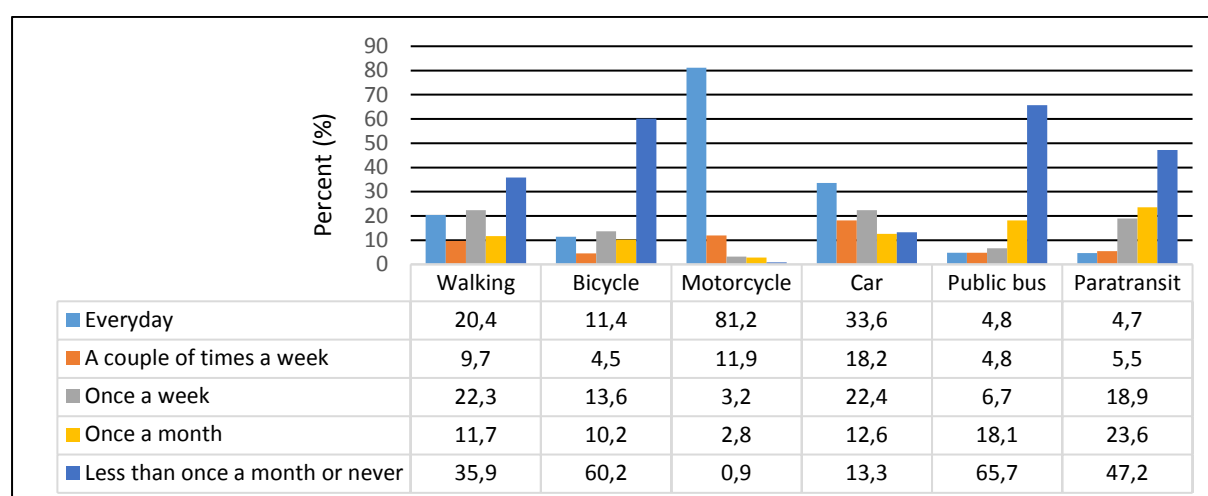|	Walking	Bicycle	Motorcycle	Car	Public bus	Paratransit
Everyday	20,4	11,4	81,2	33,6	4,8	4,7
A couple of times a week	9,7	4,5	11,9	18,2	4,8	5,5
Once a week	22,3	13,6	3,2	22,4	6,7	18,9
Once a month	11,7	10,2	2,8	12,6	18,1	23,6
Less than once a month or never	35,9	60,2	0,9	13,3	65,7	47,2

Figure 7: Frequent use of transportation mode of commuters in Phnom Penh, percent (%)

4.3 General perception on current transport situation

The increasing in economic development the increasing in number of vehicles in which it may be a problem to social and economic development in the city. As of the present day, transport situation in Phnom Penh city become challenges to social and economic development. Those challenges includes, traffic congestion, insufficient of transport infrastructure for public transportation, traffic accidence and safety, and the slow movement of service and goods shipment.

With technical assistant from JICA, Municipality of Phnom Penh had the first Urban Transport Master Plan in Phnom Penh Metropolitan Area which was developed in 2001 and with target year of 2015. The master plan called for the installation of traffic lights at the major road intersections across the capital in order for easing the traffic congestion and helped to alleviate the problem, however traffic congestions and accidents remained challenges due to public transportation has yet been introduced. In March 2012, JICA launched technical cooperation project "Project for Comprehensive Urban Transport Plan in Phnom Penh City" with a target year of 2035. The goal of 2035 urban transport master plan is to solve the current transport issues and support the 2035 urban vision and structure, which will maintain the people-environment-friendly urban conditions and vitalize the urban activities in Phnom Penh city (MPWT, 2015).

This section tends to explore the point-of-view of people, living in Phnom Penh; especially in regarding to traffic situation, environmental quality in term of air quality and the road safety during their travel along the road. As a result, this study depicted that people, residing in Phnom Penh, are likely to rate traffic situation, air quality and road safety in Phnom Penh as very bad and bad, while only few people rated these issues as good (Figure 8). Similarly, a study conducted by Kong (2010) revealed that vehicle was the primary source of aerosol emissions in Phnom Penh capital in which 89% of emissions was from vehicle. Vehicle will be acted as the highest contributed source of aerosol emissions in the future though other sources would be included, he added.

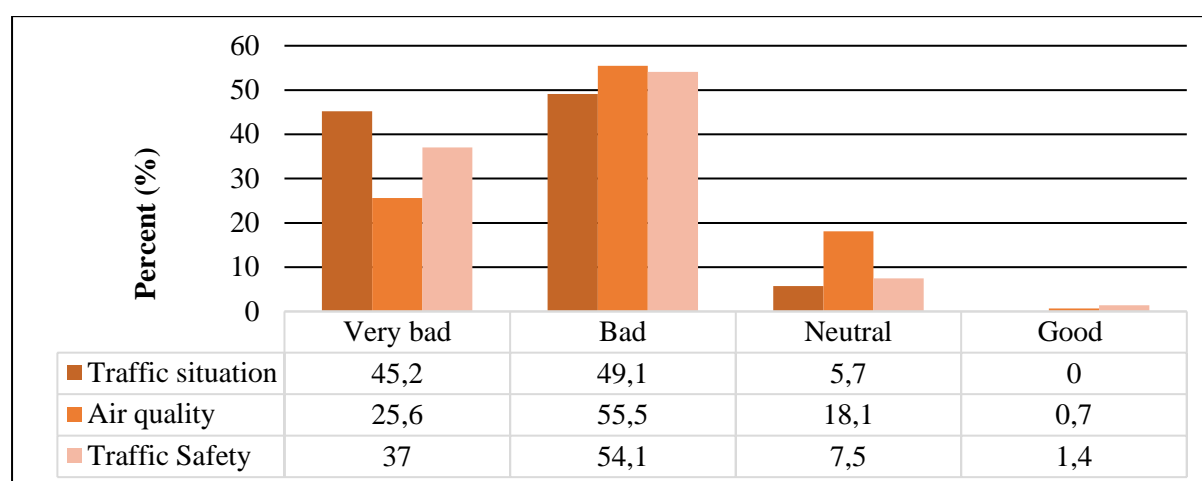|	Very bad	Bad	Neutral	Good
Traffic situation	45,2	49,1	5,7	0
Air quality	25,6	55,5	18,1	0,7
Traffic Safety	37	54,1	7,5	1,4

Figure 8: Respondent's perception on the existing traffic situation in Phnom Penh

In addition to this, Norm Vanna (interview 2017) expressed his opinion on traffic situation by saying:

> "I realize that it is not safe to take a motor taxi and indeed it is a part of air pollution in the city. I agree that the current traffic situation in our city is getting worse and worse from year to year. I do have a willingness to use public bus unless the bus can go faster than today's speed since some of my works are urgent works".

Table 6: Traffic accidence recorded in Phnom Penh from 2012 to 2015

Description	Unit	2012	2013	2014	2015
Traffic accident	Case	501	700	573	493
Death	person	278	371	254	252
Little injury	person	241	305	242	169
Serious injury	person	481	716	519	438

Source: Phnom Penh DPWT annual report, 2016

The table 6 above depicted that traffic accident happened every day with a rate of 1.35 times per day. As a consequence of traffic accident, life, time, money and property have lost. Majority of victims got serious injury (438 persons) in 2015, followed by death (252 persons) and little injury (169 persons). It was observed to be decreased compared to 2014 statistics though this number was higher than the government planning to reduce traffic accident in the city as well as the whole country.

4.4 Perception on public bus service in Phnom Penh

In 2001, Municipality of Phnom Penh (MPP), with supported by JICA, was operating public bus service as a public transportation in Phnom Penh in order for reducing traffic congestion in the city; however, this project was failed due to lacking of government subsidizes and public interest, City Bus Authority (2017). The second trial of bus service was once again supported by JICA in 2014 with 10 buses. Though the public bus service operation was not achieved, the MPP remains keeping their effort and commitment in introducing the public transportation project, public bus service in particular. In 2014, the MPP restarted its operation of public bus project in Phnom Penh with the support of JICA in which it started with about 57 buses and three lines. In recent year, city bus service gained the trust of the public and it remains operating today.

In August 2017, the Chinese government through the Embassy of the People's Republic of China in Cambodia provided additional 100 buses to the MPP for their continuous operation. The Governor of Phnom Penh City Bus Authority (interview 2017) said:

> "The existing 57 buses will be replaced by new 100 buses to provide more comfortability, credibility and particularly to attract more users with its good images".

In addition to Chinese grant aid, the Japanese government through JICA will also provide MPP 140 buses in which 80 buses will be provided in 2018 and another 60 buses in 2020, City Bus Authority (2017). Level of availability and capacity to increase more bus lines will

be enhanced through these supports, yet people's perception toward public bus is still lower than other travel modes.

This section demonstrated how respondents rated the services delivered by the public bus. Respondents were asked to rate the services of public bus regarding to 12 indicators namely travel information, availability, accessibility, reliability, affordability, flexibility, comfortability, hygiene, speed, vehicle condition, driver's behaviors and safety. These indicators were further broken down into specific indicators to allow simple and convenience rating by respondents. However, only four main indicators: availability, accessibility, flexibility and reliability were described in this section since they are the most priority indicators that respondents considered when choosing paratransit as a travel mode.

Respondents were asked to rate these indicators on five point Likert scales from very dissatisfied to very satisfied with very dissatisfied being assigned as the lowest score of 1 point, dissatisfied (2 points), neutral (3 points), satisfied (4 points) and very satisfied (5 points).

4.4.1 Perception on public bus's accessibility

Accessibility for public bus service in this study was defined into two aspects such as distance travelled from home to pick-up point of public bus and distance from get-off point to final destination. These two sub-variables were assessed and evaluated by the perception of respondents involved in this study. The five-point Likert scales technique was used to assess the satisfactory of respondents toward the public bus service in Phnom Penh. The result of this study found that very few people (about 15%) rated satisfactory on the distance travelled from their home to pick-up point, while approximate of 35% are unlikely to rate for either satisfactory or dissatisfactory. About 50% of respondents are likely dissatisfied with distance traveled from their home to the get on point of public bus. In this regards, the people need to take a long distance from their home to get on the public bus (Figure 9).
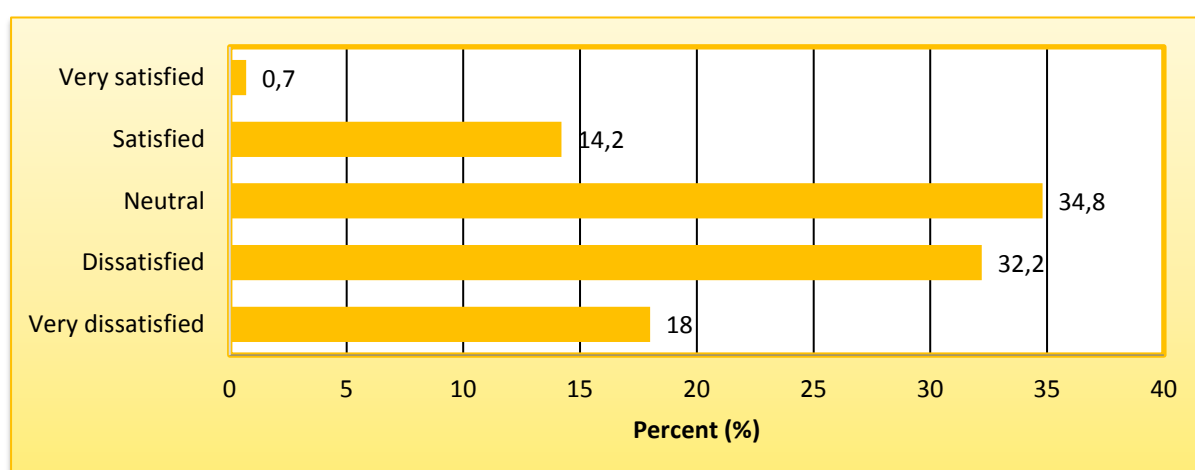

Figure 9: Respondent's perception on distance from home to pick-up point for public bus

Unlike the perception on distance from home to pick-up point, only about 14% of respondents rated as satisfactory for their perception on distance from get-off point to final destination, while 44% are unlikely to provide satisfaction or dissatisfaction for this regard. An approximate, 42% of respondents provided dissatisfactory to distance travelled from get-off point to final destination if they take public bus service as their travel mode (Figure 10).

The overall score of public bus's accessibility was graded as dissatisfied service, while the highest mean scores of M=2.58 and M=2.59 were rated by respondents at the age 19-25 years-old (part time labor force) and non-income earner (student and unemployment) consistently (Table 7 and Table 8).
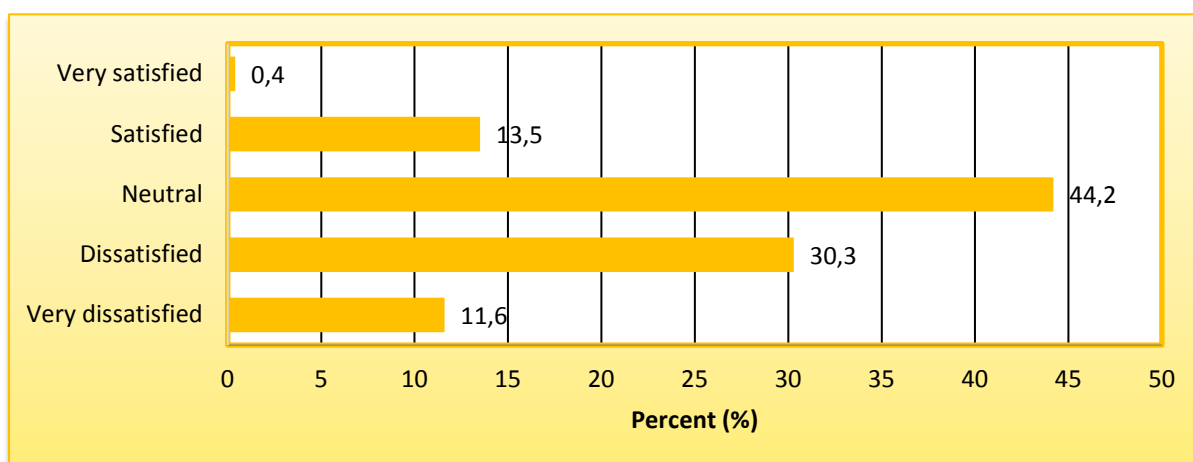

Figure 10: Perception on distance from get-off point to final destination for public bus

Table 7 below shows the perception of respondents by age group on public bus's accessibility and the analysis used the one-way-ANOVA tool to assess their differences in the perception on this variable. The result from one-way-ANOVA indicated that there is no statistically significant difference between age group of respondent for which perceiving on the public bus's accessibility. They appear to rate from unsatisfactory to neutral on the accessibility of public bus service in Phnom Penh city in which the city bus programme in Phnom Penh has restarted operating and growing in this recent year with support from Japanese government through JICA to MPP.

Table 7: Perception on public bus's accessibility by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	18	2.50	1.00
19-25 year-old	131	2.58	0.75
26-32 year-old	67	2.56	0.79
33-40 year-old	29	2.43	0.95
More than 40 year-old	12	2.54	0.89
Total	257	2.55	0.81

Unlike age group of respondents, assessment of differences between income groups also depicted that no statistically significant difference in perception on the accessibility of public bus service in Phnom Penh city (table 8 below).

Table 8: Perception on public bus's accessibility by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	133	131	264	
Mean Score	2.59	2.50	2.55	0.38
Std. Deviation	0.77	0.83	0.80	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.4.2 Perception on public bus's availability

Similarly, availability of public bus were broken down into two factors are number of bus stops and operating hour of public bus service. These two aspects were evaluated base on the ability of the bus being available at anytime and anywhere passengers need. From figure 11 below, whilst majority of respondents (about 45%) rated dissatisfaction and 37% thought it is an average service, the opposite was true for 18% of respondents were likely to be happy with the number of bus stops being available.
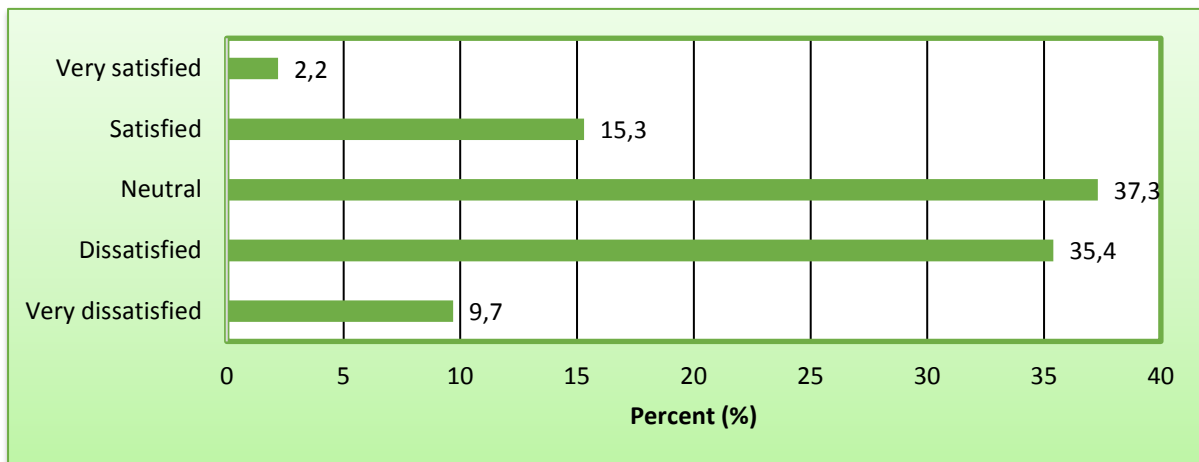

Figure 11: Perception on number of public bus stops

In contrast to the perception on number of bus stops, most respondents roughly 43% rated the operating hour of public bus as fair, while 37% and 20% of respondents feel dissatisfied and satisfied with the service separately (Figure 12). Conclusively, the highest mean score of public bus's availability was found to be an average with the score M=2.95 given by respondents with the age of more than 40 year-old (Table 9) and M=2.74 rated by non-income earners (Table 10). An observation was made that public bus's availability was perceived as somewhat average for middle age, students and unemployed people since the highest mean score failed less than 3 points.
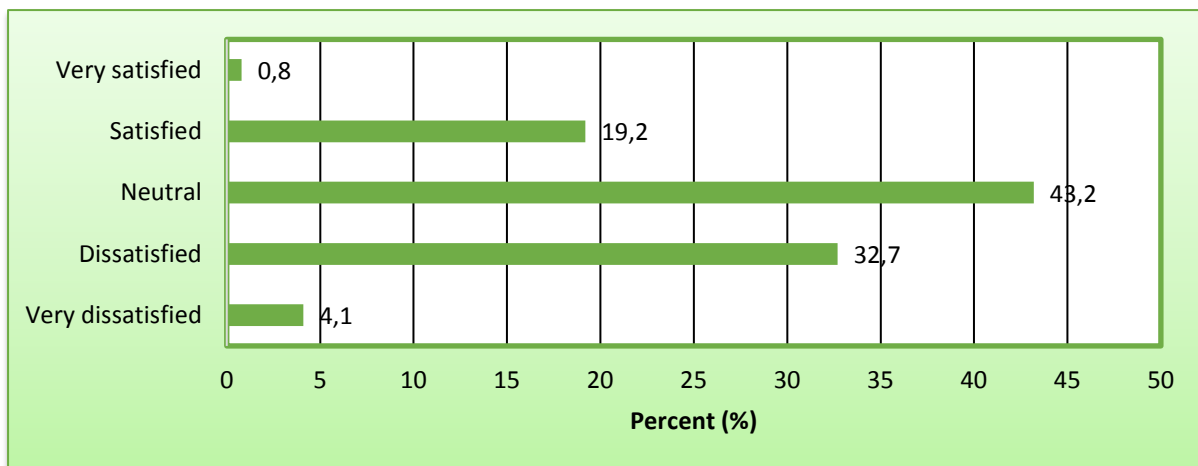
Figure 12: Perception on operating hour of public bus service, percent (%)

Using one-way-ANOVA for age group of respondent for their perception on public bus's availability also revealed no statistically significant difference. They are likely to perceive neutral on the availability of public bus service in Phnom Penh city (Table 9).

Table 9: Perception on public bus's availability by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	18	2.81	0.97
19-25 year-old	131	2.74	0.67
26-32 year-old	68	2.60	0.74
33-40 year-old	30	2.68	0.70
More than 40 year-old	11	2.95	0.88
Total	258	2.71	0.72

Employing T-test for income group for their perception on the availability of public bus also indicated no statistically significant and they are likely to perceive from moderately satisfaction to satisfaction on the public bus availability. Therefore, the income group (either non-income earner or income earner) has rated the same perception on this variable.

Table 10: Perception on public bus' availability by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	132	132	264	
Mean Score	2.74	2.69	2.71	0.527
Std. Deviation	0.68	0.77	0.73	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.4.3 Perception on public bus's flexibility

Flexibility was weighted according to capability of public bus to respond to traffic congestion. Flexibility is an essential characteristic to be assessed when asking respondents to evaluate the ability of changing route or time in rush hour, particularly in a congested city like Phnom Penh. It can be clearly seen from Figure 13 below that vast majority of respondents (roughly 55%) rated dissatisfaction with public bus's service of being flexible during peak hours. Whilst 38% of respondents felt neutral, only 8% were satisfied with this service. As further shown in Table 11, it can be observed that the most unhappy people was respondents at the age group of 26-32 year-old who are full time labor force that gave the lowest mean score of M=2.14. Unsurprisingly, income earner group who are wage-paid employees and self-employed were also rated the flexibility of public bus lower than non-income earner group by giving a score M=2.27 being assigned as dissatisfied (Table 12)
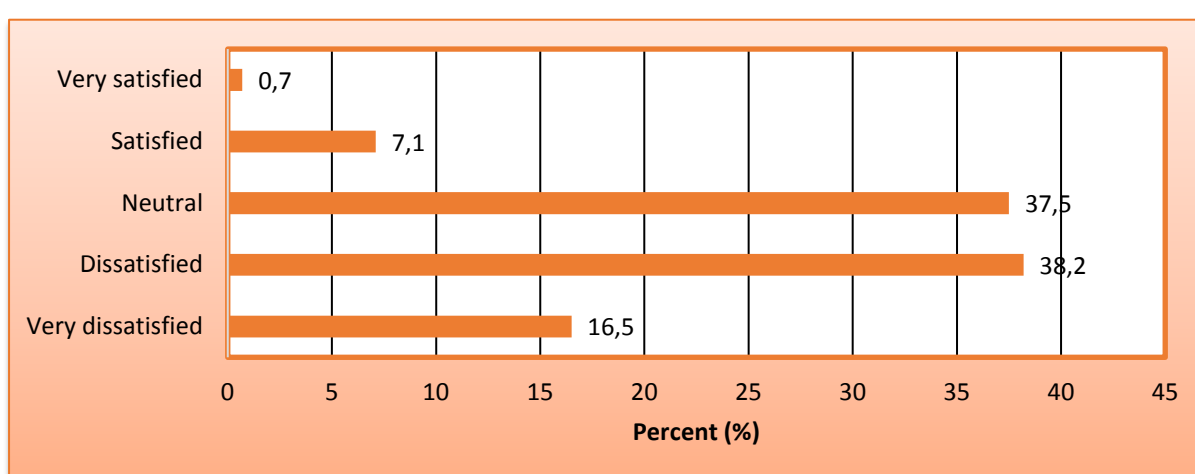

Figure 13: Perception on flexibility of changing route or time in rush hour

Result on public bus's flexibility by age group also showed no significant difference in perceiving on the public bus service's flexibility. They seem to be unsatisfactory with the flexibility of public bus service due to taking the public bus service very often encounters traffic congestion and the movement of the city bus shower than the paratransit.

Table 11: Perception on public bus's flexibility by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	18	2.39	1.04
19-25 year-old	130	2.48	0.83
26-32 year-old	69	2.14	0.81
33-40 year-old	30	2.17	0.83
More than 40 year-old	12	2.58	1.00
Total	259	2.35	0.86

The result on perception of income group (income earners and non-income earners) on the flexibility of public bus showed significant different at 0.06 level (or 10% level). The non-income group rated the score higher than the income group. They rated unsatisfactory on the flexibility of the public bus service though. The non-income earner group fall to be those who

are students and housewife whom travel for school and shopping and they rated higher due to most of public bus's passengers are students and housewife and they are likely to know about the public bus service other than income earner group whom very often use their own vehicles for travelling.

Table 12: Perception on public bus's flexibility by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	132	134	266	
Mean Score	2.46	2.27	2.36	0.06+
Std. Deviation	0.87	0.83	0.86	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.4.4 Perception on public bus's reliability

The reliability of public bus was defined in two manners such as punctuality (arrival time) and waiting time. Figure 14 below showed that only 15% of people are likely satisfied with the punctuality of public bus, while approximately 38% of respondents rated neutral being neither satisfied nor dissatisfied. About 47% of respondents rated dissatisfaction on the bus arrival. An attention can draw that almost half of respondents experienced the bus did not come on time, making the trip delayed.
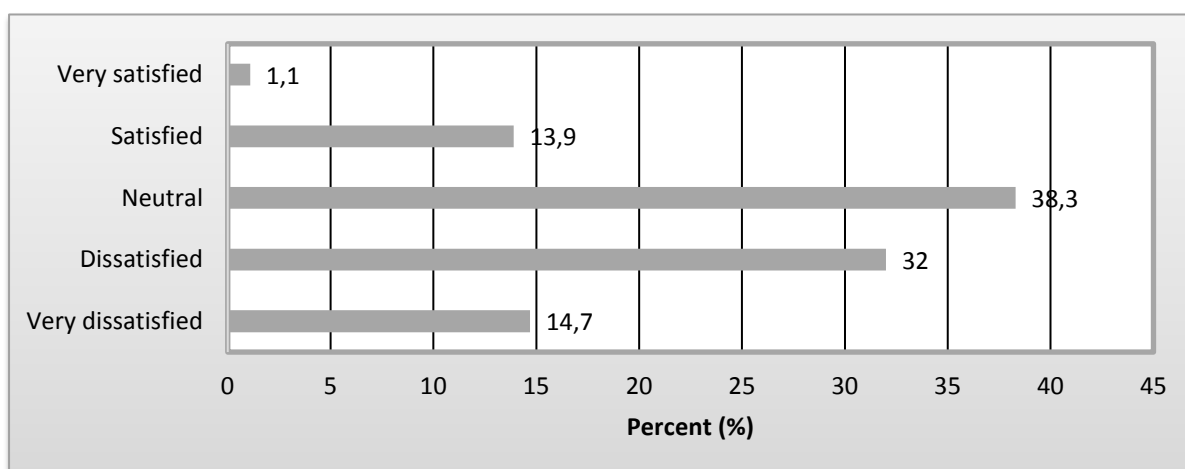

Figure 14: Perception on punctuality of public bus

Correspondingly, the perception on waiting time was reported dissatisfied by most respondents (about 53%). Whilst, 39% of respondents rated the waiting time for public bus as fair, only 8% of them thought the waiting time for public bus were somewhat satisfied (Figure 15). The overall mean score of public bus reliability was about dissatisfaction since the highest score M=2.56 rated by respondents between the age of 19 and 25 and M=2.57 given by non-income earner group (Table 13 and 14).
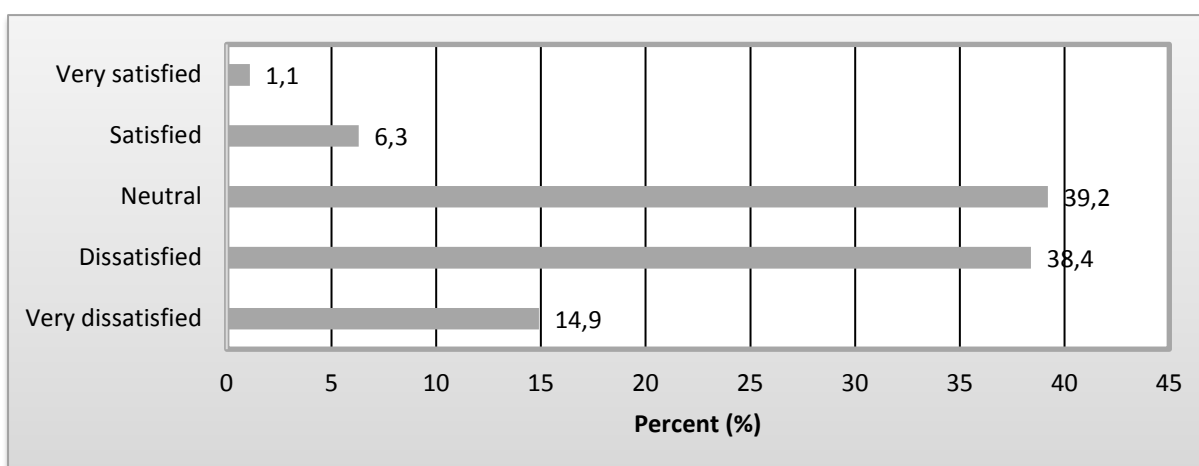
Figure 15: Perception on waiting time for public bus

The perception on reliability of public bus service by age group of respondents showed that respondents age 19 to 25 year-old are likely to rate the highest score, while respondent age from 33-40 year-old rated the least in the variable of reliability of public bus service in Phnom Penh city. By comparing within these two age-groups (group ages 19-25 and 33-44 year-old), the statistics showed significant difference at 0.02 (or 5%) level on the reliability of public bus service in which those age group of 19 to 25 year-old fall to be students who are often taking public bus service for their travelling mode to school and they are likely aware of the service other than the other groups.

Table 13: Perception on reliability of public bus service by age group, in mean score

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	17	2.41	1.05
19-25 year-old	132	2.56 [a]	0.76
26-32 year-old	67	2.40	0.78
33-40 year-old	30	2.18 [b]	0.83
More than 40 year-old	11	2.55	1.04
Total	257	2.47	0.81

Note: a and b means significant difference at 0.02 level, otherwise no significant.

Assessment of the difference in the perception on reliability of public bus service by income group (income earner and non-income earner) showed the significant difference at 5% level for which non-income earner appears to rate higher score on the reliability than income earner. This is due to non-income earner group (students and housewife) are likely to take public bus more often than the other groups and they may have better perception on this service. Though both groups remain rating unsatisfactory to neutral (either satisfactory or unsatisfactory).

Table 14: Perception on reliability of public bus service by income group, in mean score

Statistics	Non-income earner	Income earner	Total	Sig.
N	133	131	264	
Mean Score	2.57	2.38	2.48	0.05^+
Std. Deviation	0.76	0.84	0.81	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

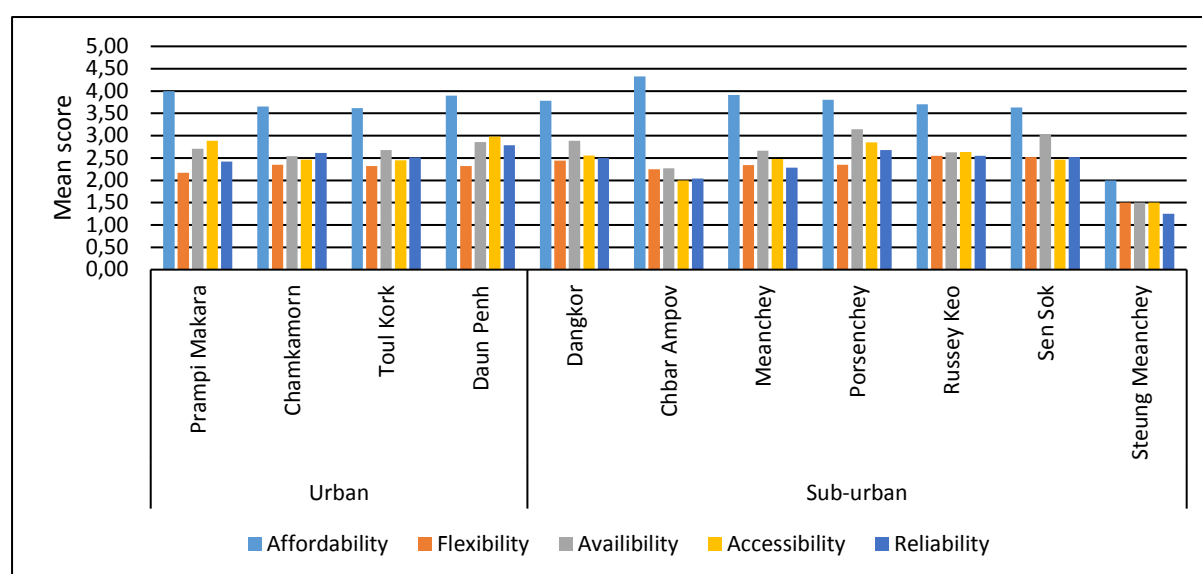## 4.4.5 Perception on public bus by urban and sub-urban residents

Figure 16: Perception on public bus service by urban and sub-urban

The results from figure 16 above showed respondents in almost all districts located in both urban and suburban area rated affordability of bus fare higher than other service indicators. While Porsenchey, a district that has the highest availability of public bus, Steung Meanchey was the lowest one, though both districts are in the same sub urban region. Respondents in Daun Penh district, the city center was observed to rate highest on accessibility and reliability of public bus, whilst again Steung Meanchey residents rated lowest score for bus services in terms of accessibility and reliability. These were because the bus routes were generally covered in urban area that was crowded with people and vehicle, and only some parts in sub-urban area (Figure 17).

Figure 17: Public buses' operating routes in Phnom Penh city
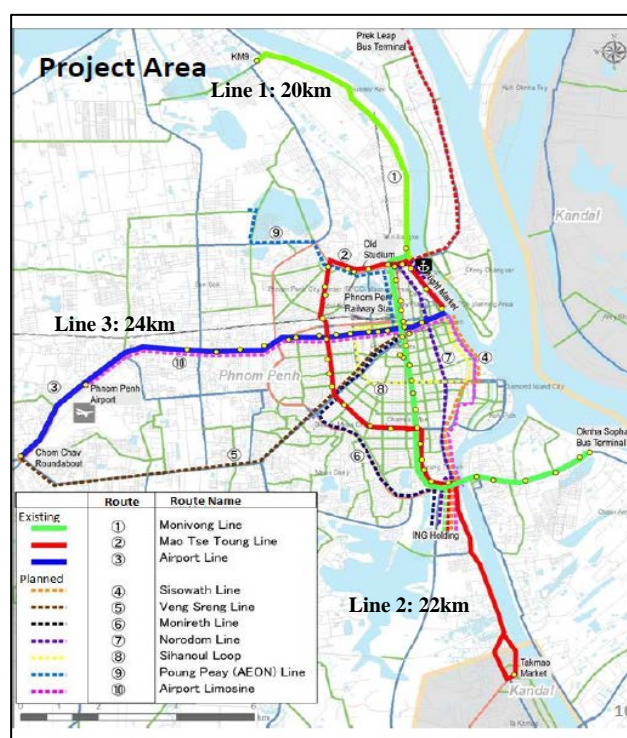
Source: JICA, as of July 2017

4.5 Perception on Paratransit in Phnom Penh

In general, studying on paratransit is referred to those transportation mode that are private-own vehicles includes, auto-rickshaw, motorcycle, scooter and are used as alongside transit in complement to public transport service. In this section, this study focused on the perception of accessibility, availability, flexibility and reliability of paratransit in Phnom Penh city. In addition to this section, the comparison of perception of respondents on paratransit between urban and sub-urban residents also be explored and discussed.

4.5.1 Perception on paratransit's accessibility

The accessibility of paratransit was broken down further into two specific indicators such as distance from home to pick-up point for paratransit and distance from get-off point to final destination. Looking at figure 18 below, whilst 31% of respondents were satisfied on the distance from their homes to paratransit pick up point, only 15% were not that happy with this distance. And about 53% of respondents remained neutral by not rating either satisfied or dissatisfied.
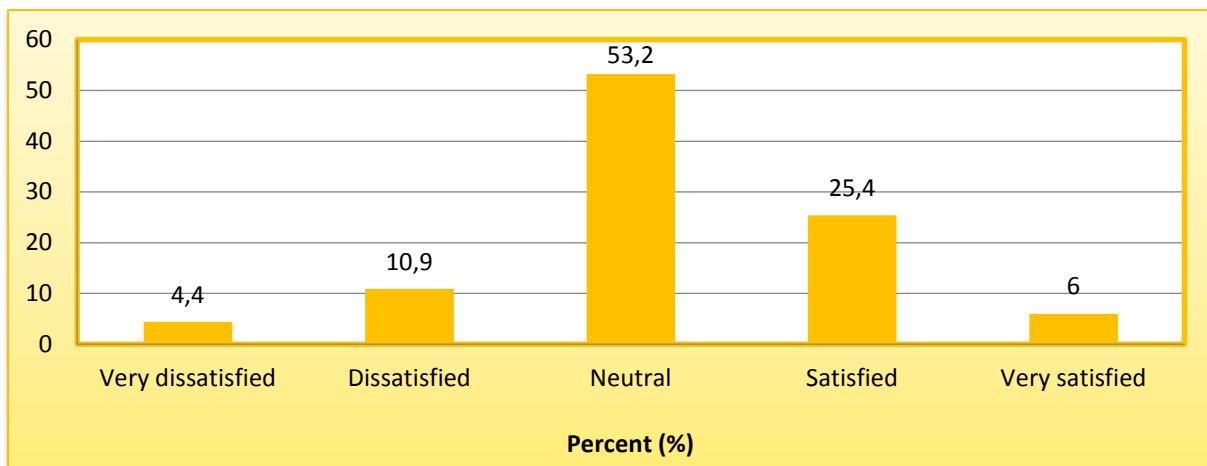
Figure 18: Perception on distance from home to pick-up point for paratransit

Likewise, a similar trend was observed in figure 19 below as it confirmed 14% of respondents were dissatisfied on the distance from get-off point of paratransit to their final destinations, while about 37% of people interviewed had positive perception with this regard. An approximately 47% of respondents were unlikely to rate satisfaction or dissatisfaction on this indicator. Conclusively, the highest mean score of paratransit's accessibility was observed to be rated by respondents at the age between 19 and 25 and non-income earner group with the score M=3.28 and M=3.30 respectively meaning the service was perceived as above average (Table 15 and 16).
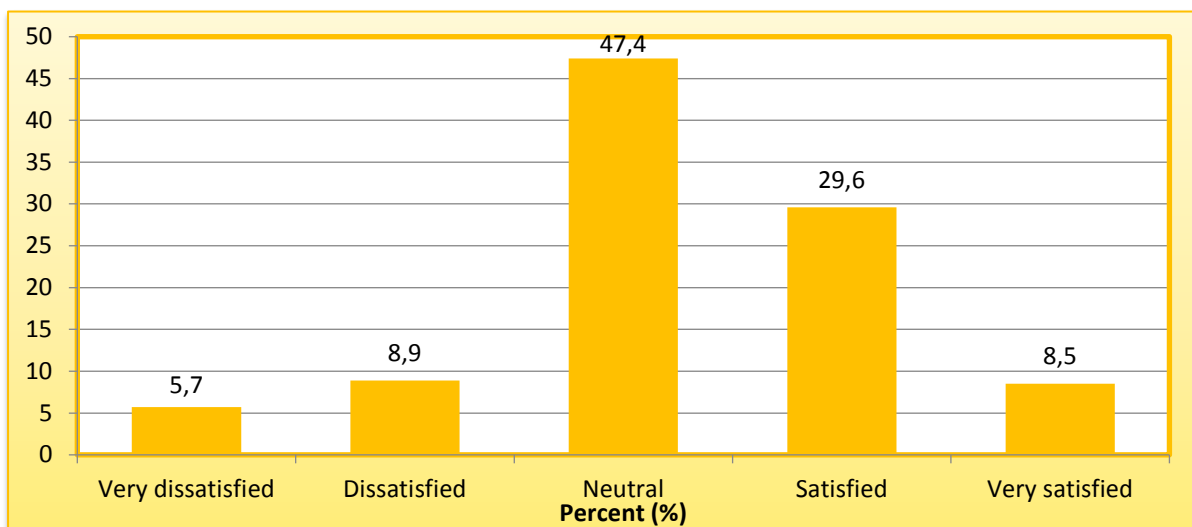

Figure 19: Perception on distance from get-off point to final destination for paratransit

Using one-way-ANOVA analysis on paratransit's accessibility by age group revealed no statistically significant difference at either 10%, 5% or 1% level (table 15). However, these respondents are likely to rate the accessibility of paratransit as neutral to satisfactory.

Table 15: Perception on paratransit's accessibility by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	16	3.28	0.95
19-25 year-old	113	3.28	0.81

26-32 year-old	66	3.11	0.81
33-40 year-old	29	3.16	0.81
More than 40 year-old	14	3.14	0.77
Total	238	3.21	0.81

The T-test analysis for comparison perception of income groups on paratransit's accessibility revealed that no statistically significant different between the groups (Table 16). Therefore, respondent's perception on paratransit's accessibility can be said that no different perception between income earner and non-income earner. They seem to regard the accessibility of paratransit in Phnom Penh city as neutral to satisfaction.

Table 16: Perception on paratransit' accessibility by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	118	125	243	
Mean Score	3.30	3.14	2.48	0.13
Std. Deviation	0.84	0.82	0.83	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.5.2 Perception on paratransit's availability

Availability of paratransit was defined base on two manners namely number of stations for paratransit and its operating hour. Referring to figure 20 below, it can be seen that about 37% of respondents were dissatisfied with the number of stations for paratransit, while 44% of answers failed in average score and only 17% of respondents rated satisfaction with this matter. The reason was because paratransit's station was not fixed in one place since some paratransit service providers keep moving to areas where most people is clustered.
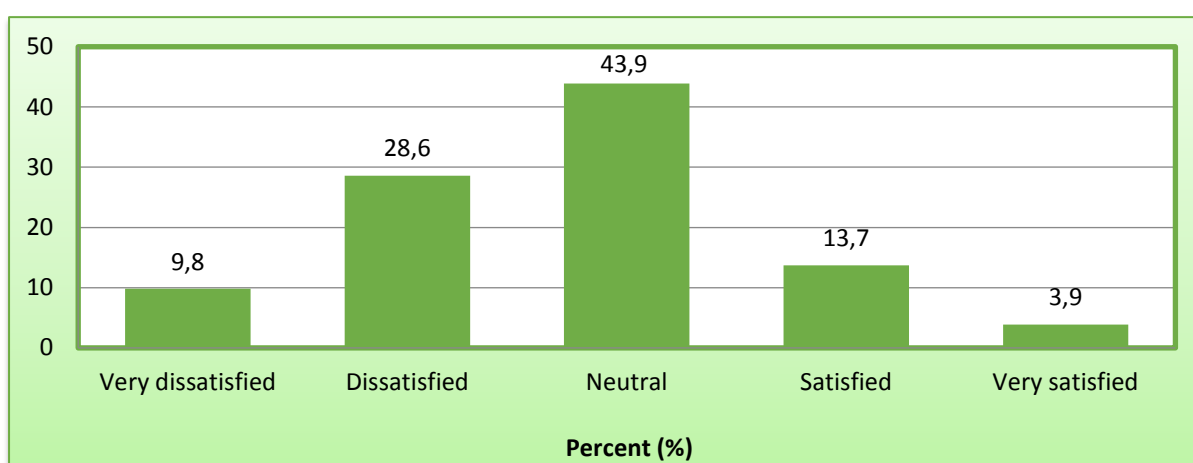

Figure 20: Perception on number of stations for paratransit

Unlike the perception on number of stations for paratransit, more respondents (33%) rated the operating hour of paratransit as satisfaction, while only few people (16%) were dissatisfied with its operating hour service (Figure 21). Furthermore, the figure showed about half of

respondents (51%) felt neutral about this service by neither rating satisfied nor dissatisfied. It was noticed that respondents who were less than 18 year-old gave the highest score M=3.16, while non-income earner provided the score of M=3.04 (Table 17 and 18) to the level of availability of paratransit which was above an average level.
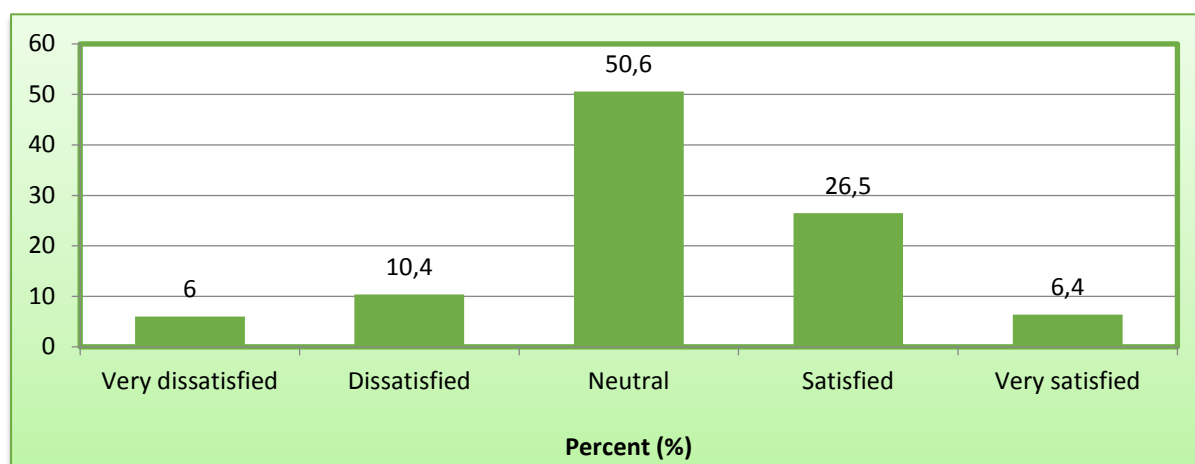

Figure 21: Perception on operating hour of paratransit

Unlike the perception on public bus's availability, the perception of respondents, disaggregated into age group, gave similarly on the paratransit's availability as neutral, meaning that they felt either satisfaction or dissatisfaction (Table 17).

Table 17: Perception on paratransit's availability by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	16	3.16	0.96
19-25 year-old	115	2.99	0.79
26-32 year-old	69	2.83	0.77
33-40 year-old	28	3.02	0.94
More than 40 year-old	13	2.85	0.77
Total	241	2.95	0.81

Using T-test analysis for comparison of the perception between income group and non-income group on the paratransit's availability found that there was a statistically significant different at 10% level between these two group on the availability of paratransit. The non-income group seem to give the score higher than income group, however they remain giving the availability of paratransit as neutral.

Table 18: Perception on paratransit's availability by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	121	125	246	
Mean Score	3.04	2.87	2.95	0.09
Std. Deviation	0.83	0.79	0.81	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.5.3 Perception on paratransit's flexibility

In the context of Phnom Penh city which suffered from traffic congestion, flexibility can be said as an important indicator to be taken into account when deciding to use any mode of transportation. Surprisingly, from figure 22 below, about 34% of respondents felt somewhat dissatisfied with the flexibility of paratransit, followed by 37% rated neutral and 29% rated satisfaction on this service. This was because paratransit here refers to motor taxi and auto rickshaw (tuk tuk). In this case, the auto rickshaw's size is seen as bigger than motor taxi. It is almost the same size to a family car which causes difficulty in moving or changing route. Nevertheless, "paratransit was still a better option for travelling if comparing to public bus", Chan Thy (interview, 2017). As further shown in table 19 and 20 below, it can be noticed that the most dissatisfied people failed in respondents group at the age of more than 40 year-old and income earners who are wage-paid employees and self-employed people.
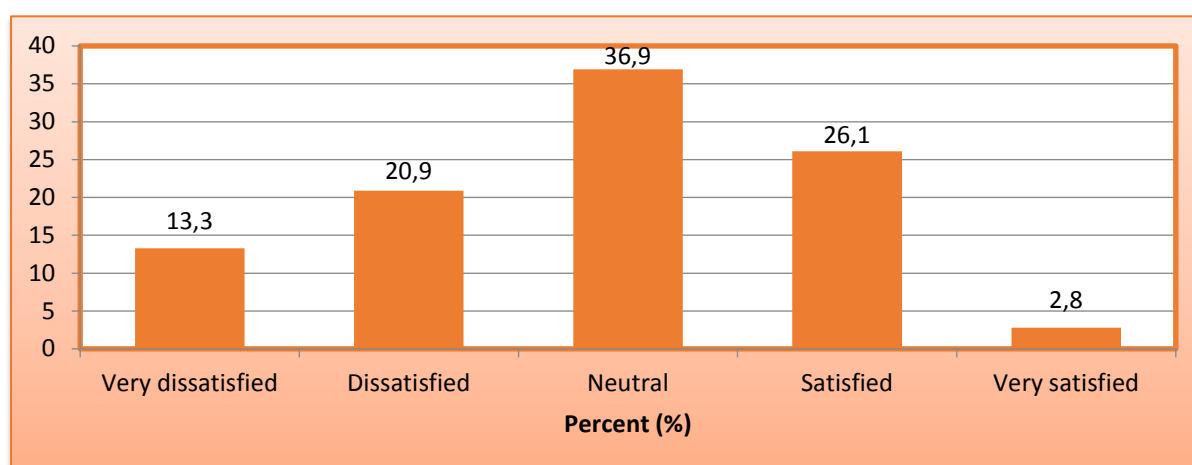

Figure 22: Perception on flexibility of changing route and time in rush hours for paratransit

The one-way-ANOVA for comparison of the perception on paratransit's flexibility between the age group was also employed and the result found that there was no statically significant difference between the groups on the perception on the flexibility of the paratransit. And, many of them regard flexibility of paratransit as neutral, which mean that they are either dissatisfied or satisfied with this regard.

Table 19: Perception on paratransit's flexibility by age group

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	15	3.07	1.03
19-25 year-old	114	2.87	0.97
26-32 year-old	71	2.73	1.12
33-40 year-old	29	2.93	1.07
More than 40 year-old	14	2.64	1.08
Total	243	2.84	1.04

Likewise, the T-test analysis for the perception between income groups on paratransit's flexibility was indicated as no significant difference at 0.24, which mean that both income earner and non-income earners perceived similarly paratransit's flexibility as either dissatisfaction or satisfaction.

Table 20: Perception on paratransit's flexibility by income group

Statistics	Non-income earner	Income earner	Total	Sig.
N	122	125	247	
Mean Score	3.25	2.98	2.95	0.24
Std. Deviation	0.81	0.79	0.81	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

4.5.4 Perception on paratransit's reliability

Reliability of paratransit is this study was assessed according to two aspects such as punctuality of paratransit and waiting time. Referring to figure 23 below, about half of respondents (50%) confirmed neither satisfied nor dissatisfied by rating neutral. Whilst 32% of respondents rated satisfaction of the punctuality of paratransit, only few people (18%) reported unhappy with paratransit's arrival time.
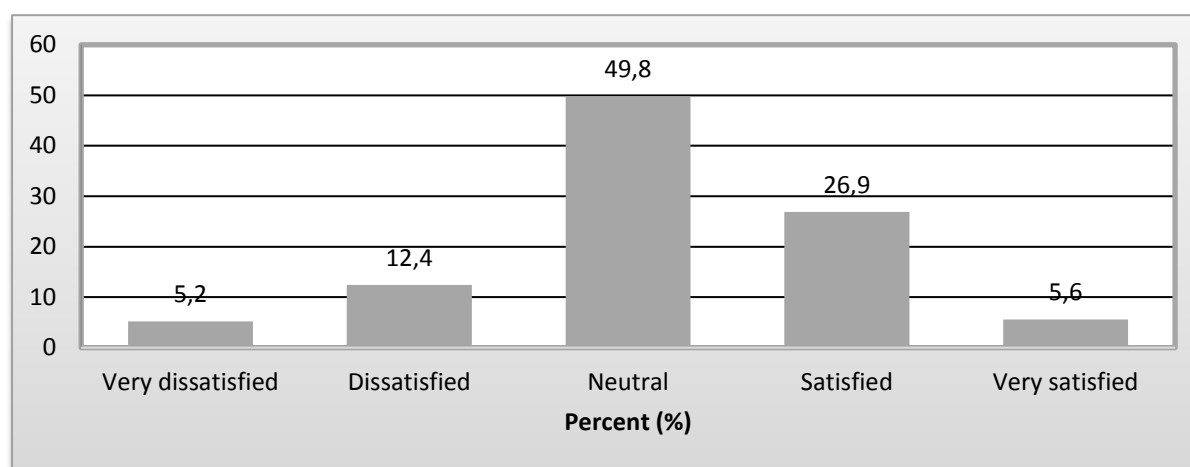

Figure 23: Perception on punctuality of paratransit service

A similar trend was observed on perception on waiting time for paratransit. A little more than half (52%) of respondents remained neutral, while more respondents were satisfied with the service and only few people were not satisfied by giving the rate of 29% and 18% of all respondents separately. Conclusively, from table 21 and 22, it can be said that the highest mean score of paratransit's reliability was above average and given by respondents with the age less than 18 year-old and non-income earner group with M=3.22 and M=3.25 respectively.
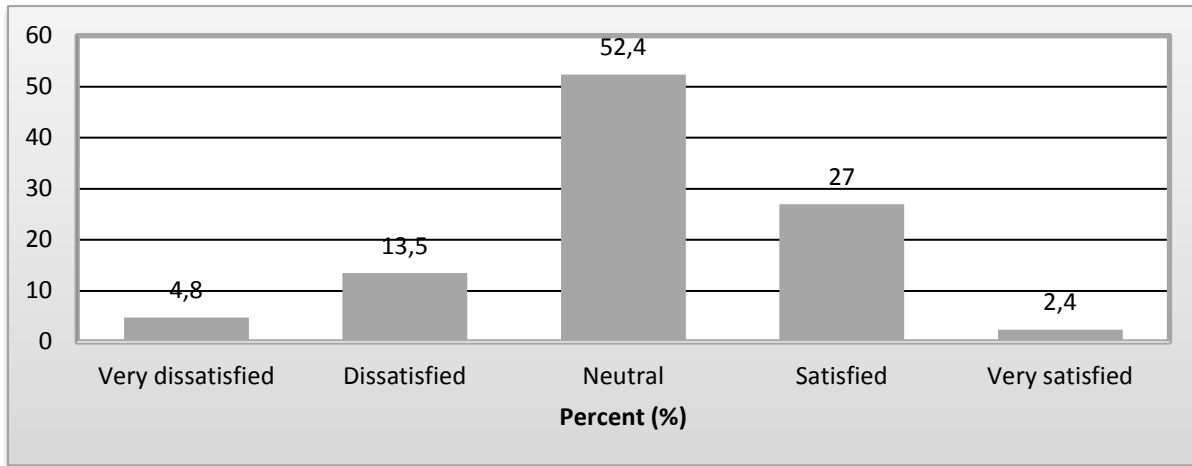
Figure 24: Perception on waiting time of paratransit service

The perception on reliability of paratransit service, using one-way ANOVA analysis, was revealed that the comparison between the age group has no statistically significant difference in perception. They appear to perceive paratransit's reliability service as neutral.

Table 21: Perception on reliability of paratransit service by age group, in mean score

Age group	N	Mean score	Std. Deviation
Less than 18 year-old	16	3.22	0.98
19-25 year-old	117	3.19	0.77
26-32 year-old	67	3.05	0.75
33-40 year-old	29	2.88	0.93
More than 40 year-old	14	3.11	0.79
Total	243	3.11	0.80

The T-test analysis for the comparison of the difference perception between income groups on the reliability of paratransit service suggested to be statistically significant difference at 0.07 (or 10%) level. The non-income earner group seem to rate higher in this regard than income earner group.

Table 22: Perception on reliability of paratransit service by income group, in mean score

Statistics	Non-income earner	Income earner	Total	Sig.
N	122	125	247	
Mean Score	3.25	2.98	3.12	0.07
Std. Deviation	0.81	0.79	0.81	

Note: significant level, + means sig. at 10%, * means sig. at 5%, and ** means sig. at 1% level

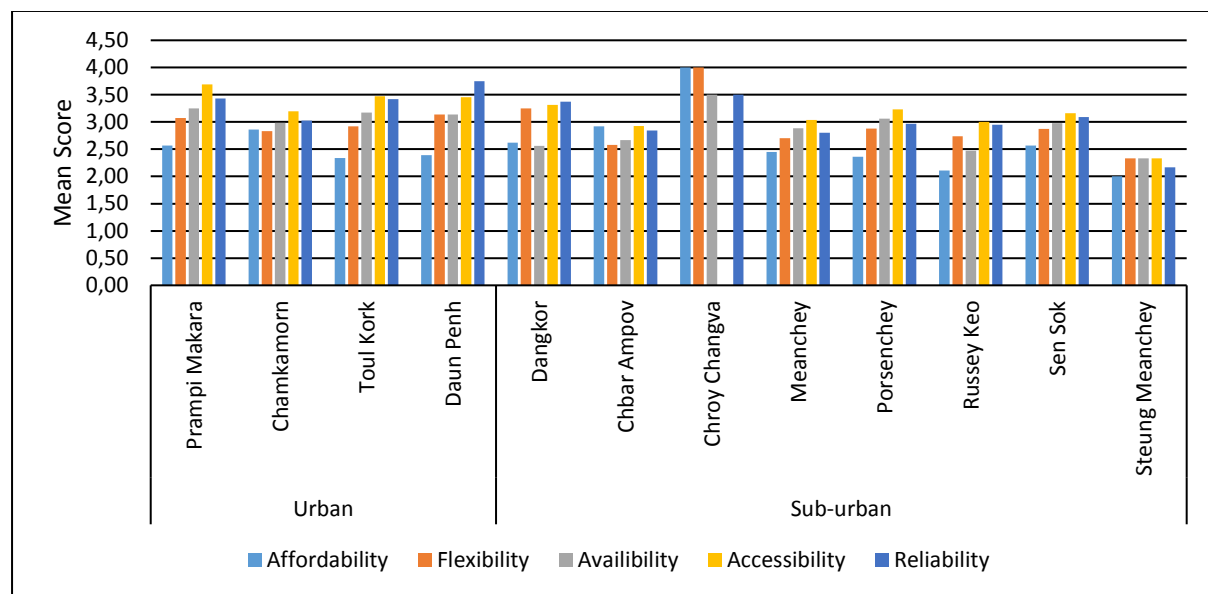## 4.5.4 Perception on paratransit by urban and sub-urban residents

Figure 25: Perception on Paratransit by urban and sub-urban

Looking at figure 25 above, the results showed accessibility of paratransit was rated highest in almost all 12 districts in the city, followed by reliability that received higher score as well. Contrary to the perception on accessibility and reliability, the mean score of affordability for paratransit was perceived lower in most districts both urban and sub-urban area. Whilst, Chroy Changva was the only residential district that respondents tended to rate all indicators of paratransit higher, residents in Steung Meanchey district were observed to have lower perception on paratransit's services compared to other areas.

4.6 Difference in perception between public bus service and paratransit in Phnom Penh

Comparing the different perception of respondents between public bus and paratransit aimed to assess their view-point on these two transportation modes' service. Twelve-main indicators of assessment on people's perception on these two transportation modes were employed in the survey form and were scored by five-point Likert scale. Some main indicators consist of two or more than two variables, such as availability, accessibility, reliability, comfortability, hygiene, vehicle condition and driver's behavior (see chapter 3 for details).

The result of statistical analysis revealed that there is no significant difference in people's perception on travel information, hygiene, and vehicle speed of public bus service and paratransit. People are likely to rate similar score on travel information, hygiene and vehicle speed for both public bus and paratransit. However, the respondents seem to perceive differently between public bus and paratransit on the availability, accessibility, reliability, affordability, flexibility, comfortability, vehicle condition, driver's behavior and safety. Statistically, these above indicators to be compared between public bus and paratransit were found as significant difference at 0.01 level.

Table 23: Comparison of the difference in perception of respondents between public bus and paratransit

Indicators	N	Public bus		Paratransit		Difference		Sig. (2-tailed)
		Mean	STD	Mean	STD	Mean	STD	
Travel information	221	2.86	0.92	2.81	0.96	0.05	1.26	0.594
Availability	215	2.75	0.73	2.93	0.80	-0.18	0.96	0.007**
Accessibility	214	2.53	0.80	3.21	0.82	-0.68	0.96	0.000**
Reliability	215	2.45	0.82	3.12	0.81	-0.67	1.00	0.000**
Affordability	216	3.81	0.85	2.44	0.90	1.37	1.26	0.000**
Flexibility	213	2.33	0.87	2.85	1.04	-0.52	1.18	0.000**
Comfortability	205	3.02	0.55	2.78	0.65	0.24	0.68	0.000**
Hygiene	205	2.62	0.75	2.68	0.67	-0.05	0.79	0.357
Vehicle speed	212	2.88	0.83	2.81	0.96	0.07	1.16	0.376
Vehicle condition	215	2.85	0.63	2.70	0.70	0.15	0.77	0.004**
Driver's behavior	212	2.98	0.69	2.69	0.76	0.29	0.77	0.000**
Safety	215	3.26	1.01	2.27	1.02	0.99	1.31	0.000**

Note: ** means significant at 1% level, * means significant at 5% level and + means significant at 10% level
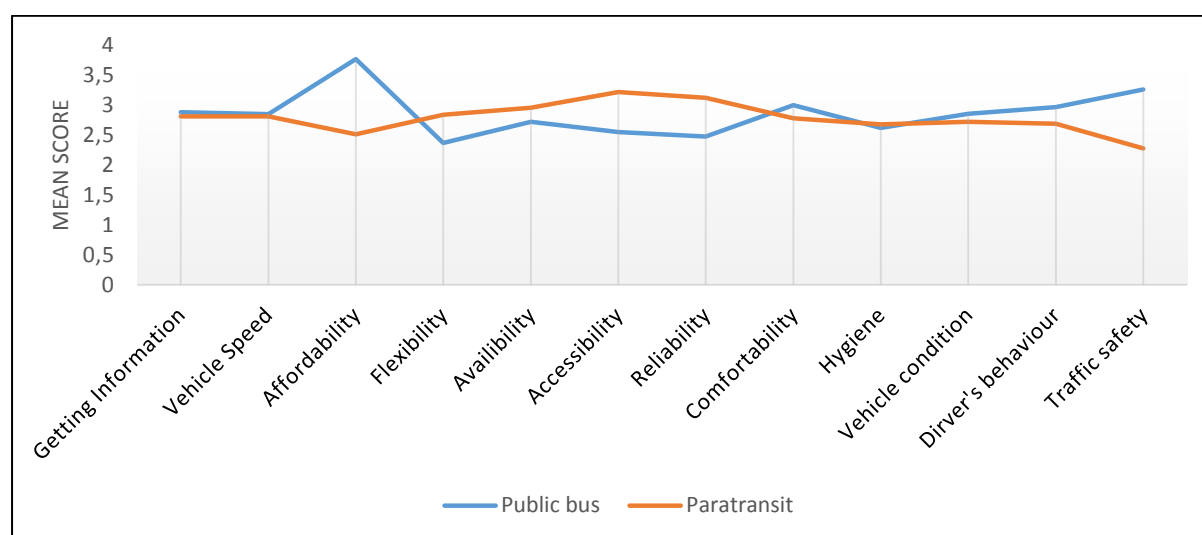

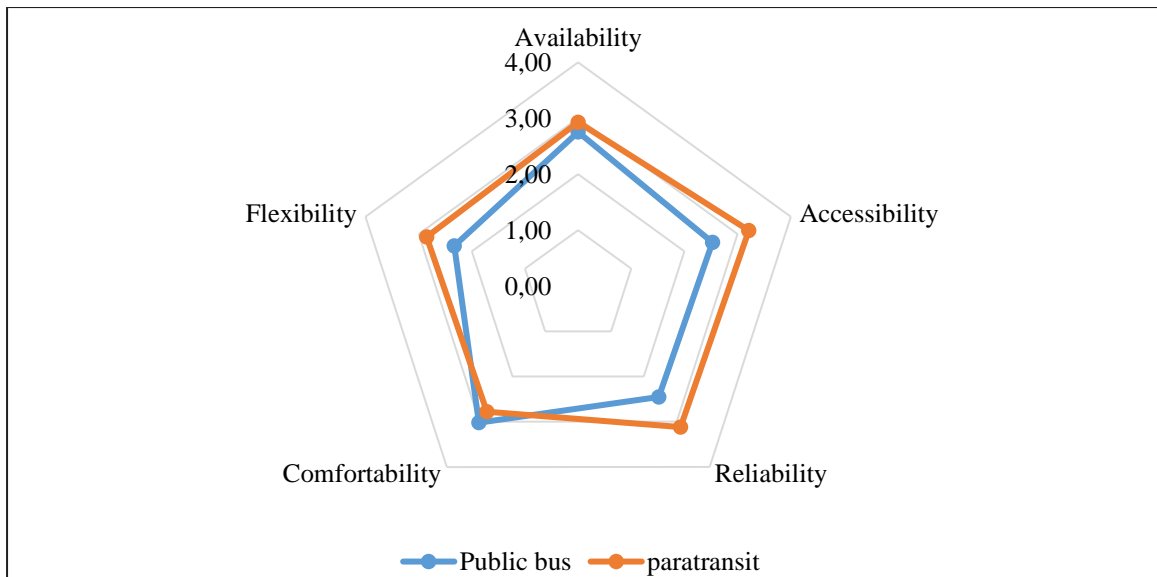Figure 26: Level of Scoring on public bus and paratransit service

Figure 27: Five primary indicators of the perception on public bus and paratransit

The twelve indicators were divided into two categories such as primary and secondary indicators due to its strong relationship with travellers' choice in transport mode. Accessibility, Reliability, Flexibility and Availability were chosen to be part of primary indicators of the perception on public bus and paratransit because these four indicators were the top highest scores rated by respondents when they were asked to give perception on paratransit services. Furthermore, it can be seen from table 23 that these four indicators of paratransit got higher scores compared to the same indicators of public bus. This implied that accessibility, reliability, flexibility and availability of paratransit were the most important factors in attracting commuters to prefer its services over public bus which answering to the main research question. Additionally, comfortability was also included in the primary indicators category since it is the most sustainable factor for encouraging commuters to use public bus, while the trip fare (affordability) which currently is most satisfied by all users would be revise to some extent to reduce the financial deficit of CBA.
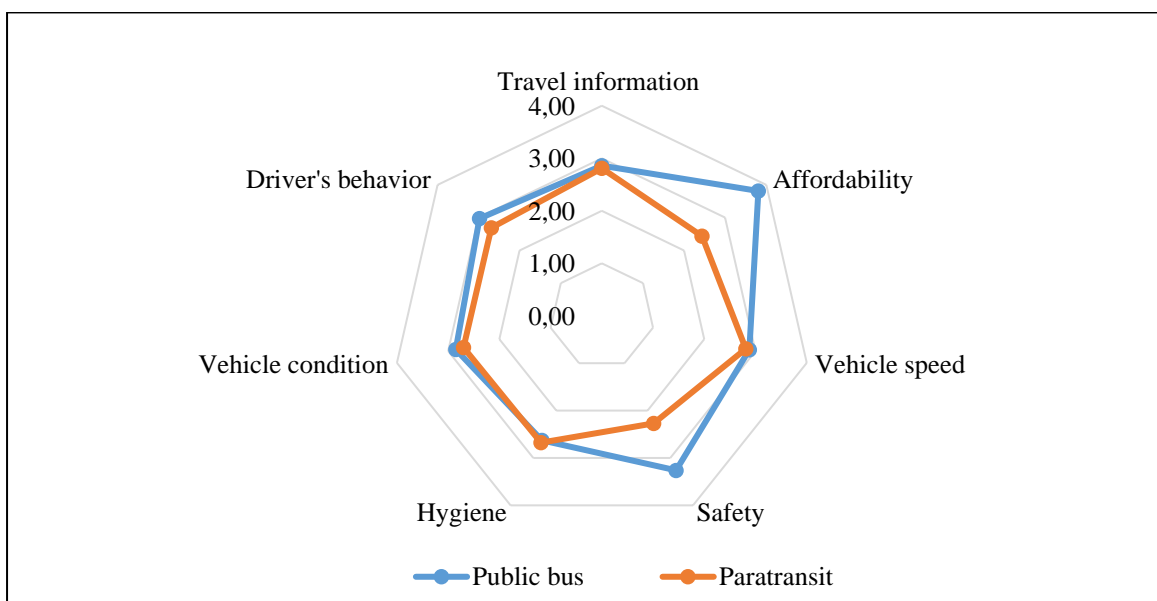

Figure 28: Seven secondary indicators of the perception on public bus and paratransit

4.6.1 Encouraging factors for using public bus

With a belief that public bus is best for travelling, respondents seem to rate higher score on its trip fare, safety and comfortability of being on the bus as the top three indicators that influencing their choices of using public bus. If compared to other characteristics, affordability, safety and comfortability got highest mean score evaluated by respondents with M=3.81, M=3.26 and M=3.02 respectively meaning satisfaction (Table 23).

In support of government poverty reduction policy, City Bus Authority (CBA) who operates public bus service charges lower flat fares at a relative cheap fee of only 1,500 Khmer Riels (about 0.37 USD) per trip. This fixed fare policy aims at ensuring affordability of the poor. In addition, the bus service is free for all students (primary to university) with a valid student identification card, elderly with age of 70 or higher, Buddhism monks, children with the height of one meter or less and disabled. With this fare discount policy, free riders accounted about 40% of the total number of passengers (Phun, Pheng, et al., 2015). This proportion has led to a concern on the sustainability of bus service in terms of its profitability. According to JICA team for the improvement of public bus project, the CBA lost 1.2 million USD for its operation in 2015 with unsustainable subsidy burden.

In terms of safety, bus service was perceived as good since respondents reported that they have lower risk of traffic accidents, robbery, pick pocket and fee from breathing polluted air which damage their health. With this regard, a bus passenger Ly Kunthy (interview 2017) said:

> "I am glad that the government introduced public bus. I feel relax and safer than when I was driving my motorcycle. By being on bus, I have less concern on my personal safety and free from unforeseen accident that might happen at any time".

This implies that road safety concern was one of the reasons why passengers decided to commute by the public bus.

In addition to trip fare and safety, the data showed comfortability characteristics was likely to be satisfied by most respondents. This is true because passengers who use public bus service already had a positive image on it, especially comfortability since a vast majority of them travelled by motorcycle or paratransit before switching to public bus. It was satisfied much by commuters, particularly elderly and staffs who live in some parts of suburban area as they have to travel long distance everyday coming into the city for daily work.

4.6.2 Encouraging factors for using paratransit

The study revealed that people tend to satisfied with paratransit service in terms of its accessibility, reliability and availability. These three indicators were defined as the important factors for commuters when deciding to use paratransit. The accessibility, reliability and availability were rated by respondents with highest mean score M=3.21, M=3.12 and M=2.93 individually (Table 23).

From accessibility perspective, paratransit was observe to be most flexible and can be served in small alley areas easily since they are forms of motorcycle freely operated in the mixed traffic. Paratransit is inevitably covers all major and small roads within and around the city, being perceived as a door-to-door service in a more convenient and fasted way (Figure 29). Paratransit drivers are being known that basically operated on non-shared, non-fixed stops,

non-fixed route and non-fixed timetable. In this regard, paratransit drivers knew better which optimal roads they should choose, especially during peak hours based on their experiences for a given time of a day.

Figure 29: Servicing routes of Paratransit in Phnom Penh city
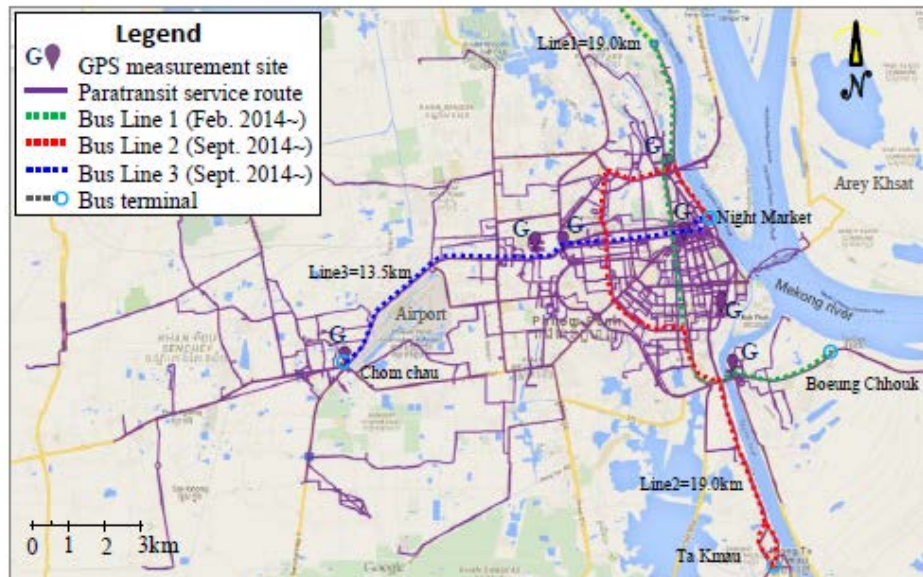
Source: (Phun, Iv, et al., 2015)

Due to the fact that any motorcycle owner can be eventually a paratransit driver (without proper registration) if he or she wanted to do so, the availability of paratransit is pretty high and is located almost everywhere in the city. Paratransit drivers traveled from 3.3 km to 97.3 km per day, with an average speed of about 40km/h (Phun, Iv, et al., 2015). Moreover, the operating hours of paratransit service is roughly 12 hours per day, making it the most available transport mode in regards of number and working period at both day and night time. Nevertheless, due to lack of government control on paratransit, we do not have sufficient information on how many paratransit service providers are operating their services.

Because there are numbers of paratransit being available, commuters find it easier to call anyone of them in just few minutes. Obviously, most of the time they are punctual and coming at the right time due to its small and flexible size of vehicle, though during rush hours.

4.6.3 Discouraging factors for using public bus

Contrary to affordability, safety and comfortability, public bus was perceived as not satisfaction when it comes to flexibility, reliability and accessibility. The statistic revealed that these three characteristics received lower mean scores from respondents with Flexibility M=2.33, Reliability M=2.45 and Reliability M=2.53 (Table 23). With negative perception, it can be said that these three characteristics are discouraging factors for commuters from using public bus and are priority factors that needed to be improved.

Figure 30: Public Bus operation in Phnom Penh city during peak hours

Source: Author's photograph

As mentioned earlier in section 4.4.3, flexibility is an important indicator to be assessed when considering the ability of public bus in responding to serious traffic congestion in the city. It was not surprise that city bus cannot either move or go faster since there is no bus priority lane in Phnom Penh city. The more interruptions and disruptions along the way, the longer the travel is perceived to take despite actual travel time being exactly the same as in uninterrupted circumstances, (Vanhanen and Kurri, 2007). Unlike paratransit, public bus does not have alternative routes to change since it must be operated on designated fixed-routes and fixed-schedule. Furthermore, it was observed that the public bus share the same lanes with other vehicles both motorized and non-motorized vehicle, resulted in non-identical and no added value for patronizing the public bus (Figure 30). This could be one of the reasons pushing bus passenger to re-consider if other modes of transport will be a better option.

Apart from flexibility, reliability is a key indicator that all passengers most value and thus indeed impacting on total quality. Due to Friman (2004), punctuality of service has a very high impact on passenger satisfaction and passengers' perception of public transport quality. Since the public bus does not have bus priority lane, missing schedules are reported everday. According to Team Leader of JICA experts for Phnom Penh Public Bus Improvement Project (interview 2017) claimed that:

> "The punctuality of the bus is not here at the moment, nearly 33% of the bus missed schedule because of traffic congestion. The bus is supposed to arrive in 10-15 minutes; however some of the bus is always delayed 20-40 minutes sometimes".

Consequently, the impact of this delay will lead to customer disappointment and feel depressed of being waiting for longer than expected time and what is even worse is that passengers who are staffs or students could miss important meeting or class because of the delay.

From accessibility point of view, it is not sufficient to cover the whole city since there are only 57 fleets with three lines of total 56km of bus routes (Line 1=20km, Line 2=22km and

Line 3=14 km), CBA annual report 2016. Referring to figure 29 (section 4.6.2), it can be clearly seen that all three lines are placed on major roads only. They are not enough to serve people who live in suburban areas or small roads who are also potential customers. This is not yet confirm with the government policy of poverty alleviation since suburban residents find it hard to access to bus stop and they still have to use another transportation mode in order to connect with bus service.

Chapter 5: Conclusions and recommendations

The findings of this study are expected to find out reasons of not using public transportation, then to provide some insights into strategic planning for sustaining the public bus service by increasing demand of bus passengers and reducing the current traffic issues in Phnom Penh. Personal characteristics were found to have some sort of negative effects on the perceived bus performance since the bus service is still new (introduced in 2014), citizens seem not fully familiar with the service yet, comparing to their previous travel modes. In the meantime, bus service itself still has low performance that needed to be improved in order to attract customers.

5.1 Commuter's perception on public bus and paratransit services

The literature review showed that there are many factors that influence travelers in choosing transportation mode for traveling. These include Travel Information, Availability, Accessibility, Reliability, Affordability, Flexibility, Comfortability, Hygiene, Vehicle Speed, Vehicle Condition, Driver's behavior and Safety. Since most Cambodians do not have an open mindset in giving interviews, the survey is the most appropriate choice to involve them in this study. The most important thing is to raise their awareness by using an easy and less time-consuming way.

The findings have a positive result in which allows for determining the difference between paratransit and public bus as to how it has different advantages and disadvantages. The survey results of 335 respondents showed that among the 12 factors mentioned above there are four major factors which are key factors that are most important when considering of using paratransit or public bus. Those key factors are accessibility, Availability, Reliability and Flexibility.

Answering to the main research question "Why do commuters prefer to use paratransit over public buses?" The answers are: first, they are already built their lives without existing of public transport for centuries. They usually use the paratransit to transport them by a door-to-door service, with a reasonable price that is acceptable. For this reason, the public bus will never be able to provide them with a door-to-door service as the paratransit does. Moreover, currently the state has given a lot of subsidies to cope with the loss of a public bus profit encountered by a low charge policy that is trying to attract users. It still remains unclear if this policy can be sustainable if there are no other effective strategies, while the state budget is limited. Second, Phnom Penh commuters have no hobbies in walking because it is considered as an unfriendly environment and unsafe for them. The study revealed that only 12% of respondents use walking as part of their transportation While the bus stop is away from their home and travelers do not want to walk, they have to use paratransit for delivering them to a bus stop. The problem is that commuters have to transfer several times; hence, the paratransit is still an inevitable travel mode since it cannot be avoided. An idea has come up whether using paratransit is the best choice because there is no need to transfer or wait for the bus that is unreliable.

Responding to sub-questions 1 and 2, "To what extent, paratransit transportation encourages commuters to use its system?" and "What factors influence the use of paratransit by commuters?" In terms of using paratransit as their travel mode, people tend to rate higher on their availability (number of vehicles, operating hours), accessibility (reliability distance from home to pick up point), reliability (punctuality, waiting time) and flexibility (ability to change

routes during peak hours). This means that they believe using paratransit would serve their satisfaction. This was because there are plenty of paratransit service providers located at anywhere and anytime travelers want them. Some people even book monthly paratransit service because they will come and wait at his / her door at the exact time he / she wants to travel. It can be said that the rate of accessibility, availability, reliability and flexibility of paratransit are high as commuters can travel at any time on any road without obstruction. During traffic jams, paratransit drivers can use the other routes they know either small or narrow, but customers do not have to waste time or frustration in getting stuck because of traffic jams. However, paratransit also has some shortcomings, such as safety and comfortability. Since most paratransit drivers are low educated people, some of them do not have a driving license, meaning they are not trained properly on traffic rules, traffic safety and driving attitudes that may disappoint their customers. Sometimes, they just stopped in the middle of the road to pick up or drop off their passengers without considering safety issue. For those who consider health and safety issues primarily, they will not use paratransit service very often.

In response to sub-question 3, "What factors influence the use of public transportation by commuters?" It was observed that respondents seem to satisfy some public bus service, such as traveling fees for public bus, comfortability (number of seats available, crowdedness, temperature in vehicle) , public bus 's condition, driver' s behavior (safe driving, helpfulness, politeness) and safety (feeling of safety from traffic accidents, picking pocket and luggage). These characteristics are appealing to consumers trying to ride a bus because they have noticed some of the benefits they will get from using the bus service. For instance, bus users save a lot of money because of the relatively cheap trip fare, compared to other transportation modes. With less cost, users get extra value such as comfortability and safety, which paratransit cannot provide them as good as public bus. Nevertheless, the buses also have some weakness is unreliability, which is often delayed (could be 40 minutes to 60 minutes late) because of traffic congestion and especially the buses do not have a priority lane to take, resulting in getting stuck on the road just like other vehicles. In addition, the number of buses operating is low, and in particular, urban residents cannot access buses. Because the public bus is the first public transportation in Cambodia, launched in 2014, people do not seem to be aware of the importance of using public transportation and do not familiar with its system.

In brief, it was discovered that young people at the age of 19-25 (university students and part-time labor force) and elderly (40 year-old and above) were in favor of public bus service, while another group of middle age from 33 to 40 (full time labor force) were not satisfied with service delivered by the public bus. This is true because students and elderly are allowed to use public bus service for free of charge. Furthermore, most bus stops are placed nearby schools and universities. Surprisingly, all respondents who are young students at the age of 18 or lower preferred to use paratransit instead of public bus, though they are in free riders categories. This could be because they are not yet convinced about the importance of using public transportation and probably they are familiar with paratransit that can take them home quickly. In contrast, it is unquestionable that elderly were not in favor of paratransit since it is perceived as lower level of safety and comfortability for them.

5.2 Lessons learned

After conducting surveys and interviews, it can be assumed that public bus service is not that really bad compared to paratransit, though it is newly operated just within three years. The main issue is cultural perspective in which people are not confident to use the new and first

public transportation system. Apart from improving bus service quality, changing people's behaviors is also an important mission to undertake. It has been more than three decades that commuters depends on paratransit for daily travelling and especially it provides door-to-door services that public bus will never be able to do so. Contrary to the concept of paratransit defined by Cervero (2000), paratransit drivers in Phnom Penh, Cambodia are not only providing feeder services within neighborhoods but also occupying all routes in the city, exceeded their scopes. This prevents people from breaking their negative perception on public transportation and changing their behaviors to use a more sustainable travel mode. In order to deal with this issue, creating clear corridors between public bus and paratransit have been raised by designing specific routes or areas for paratransit to be operated. This confirms with the study of Lave and Mathias (2000) that described paratransit as alongside transit. As a consequence of this initiative, paratransit service providers will be under threat because they will lose customers, profits and even their jobs. However, a win-win solution has been established by the government by giving opportunities to every paratransit drivers who would like to become a staff of CBA such as bus driver or ticket seller while 237 bus drivers are needed for bus operation in 2018 due to increases in bus routes and frequency. This solution could be a good starting point for integration policy between formal and informal transportation.

5.3 Recommendation

It was discovered that areas with particular room for public bus improvement in Phnom Penh city is strongly related to level of traffic congestion. The question is which strategies the government should consider and prioritize in order to improve the overall traffic flow in the city. There are several aspects that the government should consider of in order to encourage commuters to use the public bus service. First, the bus quality itself should be improved by building good image and credibility to bus passengers. This could be done by having dedicated corridors (bus priority lanes) to ensure that the bus can maintain its speed and goes smoothly even during peak hours. Second, the bus routes should be expanded to suburban areas and frequency of bus operation should be increased by having more buses. Third, accessibility to a bus stop should be improved. Currently, it is unsafe for pedestrian to reach a bus stop as most of the available sidewalks were used for parking or vendors. Therefore, the government should invest more on the enforcement of on-street parking, illegal use of sidewalks, traffic management, and vehicle growth control to enhance the smooth operation of public bus. Fourth, fare payment system such as distance-based or electronic collecting system should be taken into account to attract more users as well as to enhance the sustainability of bus services that is facing financial deficit. Fifth, it was found very helpful if a map of bus route network is also attached inside the bus, not only at the bus stop because many passengers are not familiar with the bus service and they have no idea which bus stop they shall get off for a transfer to other bus lines. Sixth, a clear corridor between public bus and paratransit should be established. To have a very well-organized of paratransit which has never been controlled before, paratransit pick-up and drop-off points should be indicated to make sure that paratransit is a complementary service and not a competitor to public bus. This will provide commuters the convenience of seamless transfer among transport modes. Finally, the promotion of public bus service through an effective media to the public might be useful. Awareness campaigns should be done to spread the information of bus operation networks as well as the necessity of using formal public transportation in order to diminish the serious traffic condition in Phnom Penh.

5.4 Limitation of the research

Although the research has reached its aims, there were some unavoidable limitations. First, this research focused on the city level, so that it cannot investigate each neighbourhood in details, for example to understand how public transportation was perceived by people in each particular district and also reasons behind their decisions on choosing travel mode. Second, the limitation of dataset regarding to the distribution of respondents, young adults and wage-paid employees may interfere the outcomes. This was because this research was the first study on passengers' perception towards paratransit and public bus in Phnom Penh city. It was noticed that people were not confident with answering both the survey and interview. While elderly, self-employed, unemployed and housewife were suspicious with the questions, only these groups of respondents (young adult and employee) who were more actively involved in contribution to this study. Third, due to the study did not employ the field survey form face-to-face with many respondents (about 60% of total respondents), thus those respondents seem to rate their perception as neutral. If those respondents were explained verbally about the benefit of this survey, they would have provided a better response. Lastly, though the twelve variables of paratransit and public bus were assessed, only four prioritized characteristics were discussed to seek for in-depth understanding and find ways to improve the most important factors.

5.5 Suggestion for further research

It is recommended for further study should focus on:

- Willingness of commuters to pay for improved level of service provided by public bus as the current trip fare is relatively lower comparing to other means of transportation.
- Alternative solutions to the impacted paratransit drivers following the introduction of public bus, so-called "Integration Policy".
- Other research methodologies may be employed, particularly on sub-urban residents. The survey that was conducted now on passengers at city level could be a good starting point for further study.

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Annex 1: Data Collection Instruments

Annex 1.1: Questionnaire

Questionnaire

Thank you for your time for participating in this survey. My name is Sopheavatey Sorn, a master student of Urban Management and Development, Institute of Housing and Urban Development Studies, Erasmus University Rotterdam. With my research, I try to understand what motivates people to use, or not to use, public buses and paratransit.

Please be assured that all your responses will be treated confidentially and used for academic purpose only. This questionnaire will take approximately five minutes to complete.

Part I: Commuters' characteristics

1. Gender   ☐ Male   ☐ Female

2. Age (Please indicate your age in years)   ………………..

3. Employment status

    ☐ Unemployed (including housewife)   ☐ Students

    ☐ Self-employed   ☐ Workers (NGOs, private and public sector)

4. Monthly income: ………………………………… USD

5. Address (District name): ………………………………

6. In a typical day, estimate how many minutes do you spend for your traveling?

    …………………. Minutes

7. In a typical month, how much money in U.S dollar do you spend for your trips (fuel, maintenance, taxi payment, etc.)

    …………………. USD

Part II: General opinions for current situation

8. What do you think about the existing traffic situation?

    ☐ Very bad   ☐ Bad   ☐ Neutral   ☐ Good   ☐ Very good

9. How do you view air quality in the city?

    ☐ Very bad   ☐ Bad   ☐ Neutral   ☐ Good   ☐ Very good

10. How do you view traffic safety?

    ☐ Very bad   ☐ Bad   ☐ Neutral   ☐ Good   ☐ Very good

Part III: Trip characteristics

11. Which of the following forms of transportation do you usually use for your travel? (Check all that apply)

☐ Walking   ☐ Bicycle   ☐ Motorcycle   ☐ Car

☐ Public bus   ☐ Paratransit ☐ Other (Please specify) …………..

12. Do you use public bus service?

☐ Yes   ☐ No (If no, skip to question #14)

13. If yes, what do you use the bus for?

☐ School   ☐ Work   ☐ Shopping   ☐ Leisure

14. How often do you use the selected modes of transport? (Please answer for the applicable modes you selected in question #11)

Mode of transport	Everyday	A couple of times a week	Once a week	Once a month	Less than once a month or Never
Walking					
Bicycle					
Motorcycle					
Car					
Public bus					
Paratransit					
Other (Specify)					

Part IV: Perception on travel mode choices

This set of questions is to measure the quality of bus service and paratransit. Please check the answer that reflects your experiences and opinion about both modes on each indicator below (with 1 being very dissatisfied and 5 being very satisfied).

If you experienced only one of them, please fill in the ONE that experienced either public bus or paratransit.

Factors	Public bus					Paratransit				
	Very dissatisfied				Very satisfied	Very dissatisfied				Very satisfied
	1	2	3	4	5	1	2	3	4	5
15. Convenience of getting travel information (time schedule, routes)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Number of station	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Operating hours	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Distance from home to pick up point	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Distance from get off point to final destination	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Punctuality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
21. Waiting time	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Cost of trip	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Ability to change routes during peak hours	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Number of seats available	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Crowdedness	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. Temperature in vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
27. Cleanliness of vehicles	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
28. Cleanliness of waiting areas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
29. Vehicle speed	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

30. Physical condition of vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
31. Mechanical condition of vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
32. Driver's behavior (addiction to alcohol/phone, obey traffic rules, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
33. Helpfulness and politeness of drivers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
34. Feeling safe (from traffic accident, pick pocket, luggage)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Annex 1.2: Interview guide for semi-structure interview

Interview guide

Thank you for your time for participating in this interview. My name is Sopheavatey Sorn, a master student of Urban Management and Development, Institute of Housing and Urban Development Studies, Erasmus University Rotterdam. With my research, I try to understand what motivates people to use, or not to use, public buses and paratransit.

Please be assured that all your responses will be treated confidentially and used for academic purpose only. This interview will take approximately thirty minutes and with your permission, it will be recorded for performing analysis later.

A. Interview guide with users of public bus

1. Could you please introduce yourself?
   - Name
   - Gender
   - Age
   - Employment status
2. How would you describe the service of public bus?
   - Information, time schedule
   - Bus station, bus routes
   - Punctuality of bus arrival
   - Cleanliness
   - Trip fare
   - Vehicle condition etc.
3. What factors encourage you to use the public bus? Why?
4. What do you use the bus for?
5. How do you feel about safety and comfortability of being on bus?
6. How do you view the characteristics of staff and bus driver?
7. What improvements do you think could be made to attract more users?
8. Do you want to say anything else about public bus?

B. Interview guide with users of paratransit

1. Could you please introduce yourself?
   - Name
   - Gender
   - Age
   - Employment status
2. How would you describe the service of paratransit?
   - Information, time schedule
   - Routes, waiting areas

- Punctuality of vehicle arrival
- Cleanliness
- Trip fare
- Vehicle condition etc.
3. What factors encourage you to use paratransit? Why?
4. What do you use paratransit for?
5. How do you feel about safety and comfortability of being on paratransit?
6. How do you view the characteristics of driver?
7. Is there any factor that you do not like about paratransit? What are they?
8. If yes, why do you prefer not to use the public bus?
9. If the discouraging factors you mentioned were improved, would you use public bus? If no, please explain why?
10. Do you want to say anything else?

C. Interview guide with local government and expert

1. Could you please introduce yourself?
   - Name
   - Professional background
   - Position
   - Working experience for this organization
2. How would you describe the service of public bus?
   - Information
   - Bus station, bus routes
   - Punctuality of bus arrival
   - Cleanliness
   - Trip fare
   - Vehicle condition etc.
3. What factors do you think influence people's preference in using the public bus?
4. What has been done by the local government to promote public bus?
5. What challenges does the authority face in delivering service?
6. How do you view paratransit? Why?
7. Do you believe paratransit is important to consider in making public bus policy? Why?
8. How has it influenced on public bus service?
9. What improvements do you think the public bus could be made to attract more users?
10. Can you provide me statistical data related to the public bus?
    - Amount of budget spent on public bus service
    - Number of buses, bus stations, bus routes
    - Number of bus users from previous years till now
    - Percentage of bus users compared to users of other modes from previous years till now

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