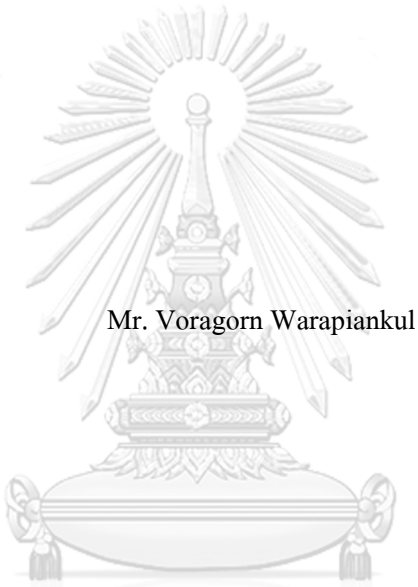
A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers.

Mr. Voragorn Warapiankul



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การศึกษาความยืดหยุ่นของอุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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Accepted by the FACULTY OF ENGINEERING, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Engineering

..... Dean of the FACULTY OF ENGINEERING

(Professor Dr. SUPOT TEACHAVORASINSKUN)

THESIS COMMITTEE

..... Chairman

(Professor Dr. PARAMES CHUTIMA)

..... Thesis Advisor

(Associate Professor Dr. MANOJ LOHATEPANONT)

..... Examiner

(Assistant Professor Dr. Pisit Jarumaneeroj)

..... External Examiner

(Associate Professor Dr. Vanchai Rijiravanich)

วรกร วรเพียรกุล : การศึกษาความยืดหยุ่นของอุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม. (A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers.) อ.ที่ปรึกษาหลัก : รศ. ดร.มาโนช โลหเตปานนท์

ในปัจจุบัน ประชาชนในกรุงเทพมหานครต้องเผชิญกับมลภาวะและการเดินทางที่ไม่สะดวก เหตุผลหลักประการหนึ่งคือคนกรุงเทพฯมักจะเดินทางด้วยรถยนต์ส่วนตัวแทนการเดินทางด้วยขนส่งสาธารณะ สาเหตหลักคือการขนส่งในกรุงเทพฯโดยเฉพาะอย่างยิ่งรถไฟฟ้าขนส่งมวลชนในกรุงเทพฯนั้นเข้าถึงยาก ทั้งการเดินทางไปยังสถานี และเดินทางจากสถานีไปยังจุดหมายปลายทาง หรือที่เรียกว่าปัญหาการขนส่งจากต้นทางและสู่ปลายทาง ยิ่งไปกว่านั้นค่าโดยสารรถไฟฟ้าขนส่งมวลชนในกรุงเทพฯ ถูกมองว่าสูงเกินไปเมื่อเทียบกับค่าครองชีพและค่าแรงขั้นต่ำในกรุงเทพฯ งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาความยืดหยุ่นของอุปสงค์ต่อราคาค่าโดยสารรถไฟฟ้าขนส่งมวลชนในกรุงเทพมมหานครซึ่งเป็นดัชนีชี้วัดสำหรับการจัดการวางแผนค่าโดยสารรถไฟฟ้าขนส่งมวลชน และรับฟังความคิดเห็นของประชาชนเกี่ยวกับระดับราคาค่าโดยสารที่เหมาะสม อีกทั้งเพื่อวิเคราะห์การทำงานร่วมกันระหว่างผู้ให้บริการรถไฟฟ้าขนส่งมวลชนในกรุงเทพและผู้ให้บริการเครือข่ายคมนาคม เพื่อหาแนวทางในการปรับปรุงการขนส่งจากต้นทางและสู่ปลายทางของรถไฟฟ้าขนส่งมวลชน ขั้นตอนการวิจัยคือการทำแบบสอบถามผู้ใช้งานรถไฟฟ้าในกรุงเทพฯเพื่อรับฟังความคิดเห็นเกี่ยวกับค่าโดยสาร และสัมภาษณ์ผู้ให้บริการรถไฟฟ้าในกรุงเทพฯและผู้ให้บริการเครือข่ายคมนาคม สำหรับแนวทางในการร่วมมือกันของผู้ให้บริการขนส่งและกลยุทธ์ค่าโดยสาร ผลลัพธ์ของการทำวิจัยแดงให้เห็นว่าโดยสารของเส้นทางรถไฟฟ้าที่ให้บริการโดย บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน) (BTSC) มียืดหยุ่นต่ออุปสงค์ และควรลดราคาค่าโดยสาร ตามความเห็นของผู้ใช้บริการ ในขณะที่ค่าโดยสารของเส้นทางรถไฟฟ้าซึ่งให้บริการโดย บริษัท ทางด่วนและรถไฟฟ้ากรุงเทพ จำกัด มหาชน (BEM) นั้น ไม่ยืนหยุ่นต่ออุปสงค์ และราคาค่าโดยสารปัจจุบันอยู่ในระดับที่ยอมรับได้ นอกจากนั้น ผู้ให้บริการรถไฟฟ้าขนส่งมวลชนและผู้ให้บริการเครือข่ายคมนาคม เห็นด้วยกับการร่วมมือกัน ซึ่งจะได้รับผลประโยชน์ร่วมกันทั้งสามารถเพิ่มผู้ใช้บริการ เพิ่มความสะดวกสบายต่อผู้ใช้บริการ และลดค่าใช้จ่ายในการเดินทางในชีวิตประจำวัน

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ปีการศึกษา 2562 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

6071221721 : MAJOR ENGINEERING MANAGEMENT

KEYWORD: Bangkok metro transit, ride sharing services, First Mile/Last Mile, Price elasticity of demand

Voragorn Warapiankul : A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers.. Advisor: Assoc. Prof. Dr. MANOJ LOHATEPANONT

Since today, Bangkok faces the big pollution and low mobility. One main reason is Bangkok people tend to travel by automobiles instead of the transit. The main problem of Bangkok transit especially Bangkok metro is the low accessibility to travel to/from the transit nodes and between nodes or as called First Mile Last Mile problem. Moreover, Bangkok metro transit fare is claimed that is too expensive compared to the cost of living and minimum wages in Bangkok. This research aims to study the price elasticity of demand for Bangkok metro which is the indicator of fare demand management in Bangkok metro transit that is important to have the public opinion on the fare with their range of acceptable price. Following to analyse the approach for the collaboration between Bangkok metro transit and ride sharing providers, in order to find the solution to improve the First Mile Last Mile of Bangkok metro transit and the accepted service fare strategy. The research methods are surveying the Bangkok metro users for the accepted fare opinion and interviewing the metro operators and ride sharing providers for the collaborative approach with their fare strategies. The results show the metro routes which is operated by Bangkok Mass Transit System Public Company Limited (BTSC) is elastic to demand and should discount its current fare base on users opinion. While the metro routes which is operated by Bangkok Expressway and Metro Public Limited Company (BEM) is inelastic to demand that its current fare is already in the accepted range. Moreover, the Bangkok metro operator and ride sharing provider accept the collaborative approach that is able to gain the mutual benefit for the transport providers to increase its service demand and for the Bangkok people to increase the conveniences and decrease cost of travelling in their daily life.

Field of Study:	Engineering Management	Student's Signature .....
Academic Year:	2019	Advisor's Signature .....

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Chapter 1 Introduction

This chapter illustrates the current situation of the transportation in Bangkok, especially on the First Mile Last Mile for Bangkok metro. Together with the objectives, scope, expected output and expected benefit of this research.

1.1 Background

Transportation becomes the key factor for sustainable development within societies. It provides opportunities for the movement of people and goods. Over the centuries, transport technologies have developed for improving these mobilities in many modes such as shipping, aircraft, bicycles, motor vehicles, railway, etc. These changes have significantly impacted the economy, social and overall living of people. Scoping down to the urban transportation, the mass transit, including subway, elevated rail systems, light rail system, commuter rail, and bus services, which efficiently commute millions of people each day, in most cities over the world. Even modern societies have rapidly invented and evolved in the automobile technologies which provide the individual freedom and convenient movement of people within the cities. Unfortunately, it has caused the big pollution, congestion that effect on the environment, societies, for more than decades.

Under the reason above, most cities are looking back to support the use and development of the mass transit, instead of automobile uses. These mass transit modals offer several significant benefits, which are increasing overall mobilities, energy-efficient, environment-friendly, economic and financial benefit, etc. However, one of their major drawbacks is the accessibility and connecting of the users from their origins to the transit nodes or even to their desired destination, which is also known as the First and Last Mile (FLM) problem.

Since today, there are three main metro transit systems in Bangkok. The first system is Bangkok Transit System (BTS) which operate the Light Green Line and Dark Green Line metro system from the centre of Bangkok with a total length of 54 kilometres, connecting 48 stations. The second system is the Mass Rapid Transit (MRT) which currently operate the MRT Blue Line in the city centre of Bangkok total of 38 kilometres with 38 stations and MRT Purple line connecting to the suburban area, a total of 23 kilometres with 16 stations. The Last Bangkok metro system is the Airport Rail Link(ARL) which operate connecting from the city centre to Suvarnabhumi Airport, a total of 29 kilometres, with 8 stations. All current Bangkok metro systems are shown in Figure 1 below. In order to develop the sustainability of Bangkok mobility, these urban railway transit or metro which are believed to be the main urban transportation, have to be maximized the uses

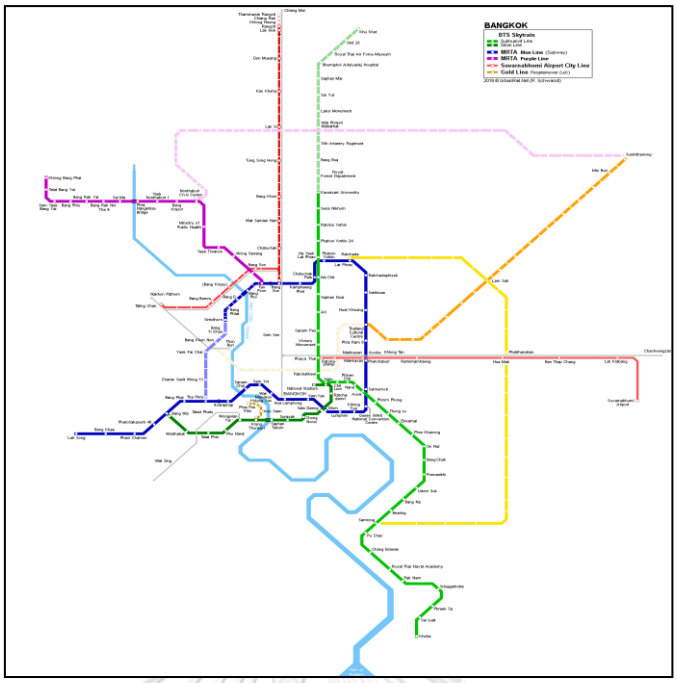


Figure 1 Current Bangkok Metro system

Source: (Schwandl, 2019)

1.2 Statement of Problems

The First and Last mile that is defined as the abilities and convenience of connecting between the transit nodes with the origin and destination of the journey as shown in Figure 2, which is the significant factor to influence the uses of public transit.

The problem of Bangkok's public transportation especially metro or train transit which has been faced more than decades started from the metro infrastructure projects which have been developed and implemented as stand-alone projects. There is no integrated plan to support the people or commuters to conveniently travel from the origin to their desired destinations. In other words, it is poor linkages within the transportation system and between the residential area with the activities centre which significantly reduce mobilities and quality of life. Moreover, Bangkok metro transit fare is claimed to be too expensive for the average city residents and unaffordable for those of low incomes, that comparing to the cost of living and the minimum wages in Bangkok. (BangkokPost, 2019)

According to (Prasertsubpakij & Nitivattananon, 2012), the major feeder mode of the metro in Bangkok is bus transit, with 40%, and van (23%), following by motorcycle taxi and taxi. Many of the metro users have long journey by using multi-modes transit to their destinations, for instance starting from walking to get the van to access metro, then connect another motorcycle taxi to their working place. The estimated travel time of Bangkok people are about 40-60 minutes which is reported as poor accessibility level. In other words, the Bangkok metro users waste time waiting, many modes paying, and transferring to get through many transit modes in order to reach their destination.

Figure 2 First and Last Mile

Source: (King, 2016)

1.3 Research Objectives

This research focuses on the price elasticity of demand for Bangkok metro transit and its acceptable fare range based on users' opinion. In order to apply for the First Mile/Last Mile service collaboration between mass transit and ride sharing providers. The project aims to achieve the main objectives as follows:

1. Analyse the price elasticity of demand for the Bangkok metro transit and its range of the acceptable Bangkok metro fare base on people opinion, in order to find the feasibility and approach for providing incentives for users.
2. Analyse the feasibility and the initial approach of the collaboration between metro transit and ride sharing service.

1.4 Scope of Research

This research focuses on the price elasticity of demand for Bangkok metro transit and its range of acceptable fare. The opinion of Bangkok metro transit is collected through the Qualtrics online survey platform. Three high-demand Bangkok metro routes which are Siam station – Asok station route, Siam station to Mo Chit station route, and Sukhumvit station to Silom station route are focused for collecting their fare opinion in the survey. The collected data are the users' opinions of each focused metro transit route's fare at 4 level prices, which are reasonable price, expensive price, too expensive price, and too cheap price. The focused respondents are the Bangkok metro users with at least 400 responses are collected per specific metro routes.

Moreover, the interview is conducted, by focusing on 2 main parties, who are the ride sharing providers in Bangkok, and Bangkok metro operators. The information and perspectives from these transport providers and metro fare strategy analysis from the survey are the main input to analyse for the feasibility and approach of the collaboration between transport providers in order to improve first and last mile problem of Bangkok metro transit.

1.5 Expected Output

From the research approach, the expected outcomes which are aimed to achieve as follows:

a) The range of acceptable fare and the price elasticity of demand for Bangkok metro transit which is based on the metro user's opinion and demand. These factors are analysed for the fare strategies of Bangkok metro transit based on users' demand.
b) The mutual benefit and approach of the collaboration between metro transit and ride sharing services in Bangkok.

1.6 Expected Benefits

The research is conducted with two main expected benefits as follows:

a) The fare strategies of Bangkok metro which achieve the users' demand in order to decrease the travelling cost for users and also influence more metro users or increase the metro services ridership that will benefit for metro transit operators.

b) The initial approach of the collaboration between Bangkok metro transit and ride sharing service providers in order to provide more convenience for metro users by improving metro First Mile/Last Mile. These will benefit to the Bangkok metro users and also the transport providers that their service demand is increased.

Chapter 2 Review of Literature

2.1 Urban Mobility

As more than half of the population around the world are living in urban areas that cause pressure on many businesses leading cities, for instance, London, New York, Hong Kong, etc. These population rising result in the higher cost of living and congestion which people have suffered for the long commuting from the suburban or outskirt of the cities into the centre. According to (TheEconomistIntelligenceUnit, 2017), the urban congestion effect to the people's quality life, economic growth. Around the world. Travelling by road and rail had been increased by 40% from 2000 to 2010 and are expected to be double by 2050. Especially in the extremely congested cities such as Moscow, Istanbul and Bangkok, the transporting time during peak hour can be more than double which is more than 100 extra hours in traffic every year. Moreover, these congestions are also major causes of pollution. The transportation account for 23% of global CO2 emissions which result in the health condition into 180,000 deaths annually. These number is not including another 1.25 million deaths and 50 million injuries from road accidents each year. (TheWorldBank, 2018)

In order to improve the urban transportation, refer to (Abdallah, 2017), mass transit is the solution for the cities with less pollution, less congestion comparing to the city with dominant the use of automobile transport. Mass transit network makes the cities more sustainable in term of reducing the use of cars into the more energy-efficient method, reduce the pollution level and improve the quality of people's life.

2.2 Metro First and Last mile

First and Last Mile is the connection which links people from transit with their origins and destination. This includes all journey purposes, whether going to work, home, shopping etc. The transit nodes or stops are rarely at the starting doors or destination doors of the passengers which is one of the major drawbacks of transits. Therefore, transit also relies on other methods to get to and from transit, for instances walking, bicycling, and other feeders. These types of connection are referred to as First and Last Mile.

According to (Smith, 2016),In general, walking and bicycling are the most popular and sustainable method for accessing transits, in the reason of it is healthy and free of charge. Most people are willing to walk with a maximum of approximately 0.25 miles and ride the bicycle with 1-3 miles in order to reach transits. However, it depends on the supportive of infrastructures such as the sidewalk, bicycle lanes, and weather condition in individual locations. Another transit connection is the personal vehicles which associate with the park and rides facilities and road condition. Apart from these transit connections, refer to (Chandra, et al., 2013), there are another 2 types of feeder transit services, which are Fixed routed Transit (FRT), and Demand Responsive Transit (DRT). FRT involves with the fixed stop along the fixed routes which is appropriated in the high demand areas, while DRT serves passengers from the individual passengers' locations which operate in the low demand area. These feeder transit services are the improvement of first and last mile problem in term of safety, cost-effective, reliable and connectivity as they are designed for specific demand in the individual community that provide integrated door-to-door services for passengers.

Moreover, apart from the feeder and connecting methods, according to (RiversideTransitAgency, 2017), there are the strategies and best practices to encourage people to use public transit by maximizing the accessibility. First, facilitate the infrastructure for walking and biking such as lighting, sidewalk, crossing, bicycle lane, bike parking, and signage. Together with the auto access facilities such as park and ride. Moreover, Land-use improvement such as Transit-Oriented Development is also the way to influence people for using transit. The transportation demand management is also applied for supporting the access to transit such as ride-sharing, car sharing and ride hailing services.

2.3 Price Elasticity of Demand

2.3.1 What is Price Elasticity of demand?

Most customers in the market are sensitive to the price of the products. It is a simple assumption that when the products or services price is increased, people will lose their willingness to buy, on the other hand, when the products or services are cheaper, more people will buy it. However, in reality, it is more quantifiable than that. The price elasticity is the economic measurement of the change in the quantity of demand, in the specific products or services which is related to their price change. (Kenton, 2018)

The marketers in the business need to understand how the demand has responded to the products or services' price, which is how it is elastic or inelastic, in order to know how to set or change the price. The elasticity of each product or service is different. Some products or services have a big and quick response to the price changes, which normally are defined as non-essential products and services or there are some substitutes available in the market. While some products or services have slightly response to the price change even there is a big change in price that simply means that these products or services are essential which people need to buy it with no choice. (Gallo, 2015)

2.3.2 Elasticity Calculation

According to (Guo, 2019), there is the formula for price elasticity of demand:

Equation 1 price elasticity formula

$$price\ elasticity\ of\ demand\ (e) = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ price}$$

Since the change in quantity demanded usually moving in the opposite way to the change in price, if the price is rising, the demand is usually dropped, or if the price is lower, the demand will rise. With this reason, the price elasticity coefficient is usually negative.

When the absolute value of price elasticity coefficient is less than 1, it is defined as inelastic to demand which mean in 1 unit change in price, resulting in less than 1 unit change in demand. On the other hand, if it is more than 1, this product or service is elastic to demand which mean in 1 unit change in price will cause a bigger change in demand.

2.3.3 Level of Elasticity

The price elasticity coefficient which is the result of the calculation in Equation 1 has described how sensitive the customer demand is to the price of product change. Or we can say that the higher the absolute value of the price elasticity coefficient, the more sensitive of the customer to the price change. According to (Gallo, 2015), there are five levels of price elasticity which the product or service can be:

a) Perfectly elastic
   The perfectly elastic product or service is when there is a small change in price of them, but causes the major change in their demand. In this elastic level, the calculation has assumed that when the small change in price even almost down to zero, cause the big change to the demand. According to Equation 1: the formula would be

$$price\ elasticity\ of\ demand\ (perfectly\ elastic) = \frac{\infty}{0} = \infty$$

b) Relatively elastic
The relatively elastic product or service is when the change in product or service price, cause a greater change in their demand. So, the price elasticity coefficient is more than 1 (e >1).

c) Unitary elastic
The Unitary elastic is when the change in product or service price, cause the same change in their demand. So that the price elasticity coefficient would be 1.

$$price\ elasticity\ of\ demand\ (unitary\ elastic) = 1$$

d) Relatively inelastic
The relatively elastic product or service is when the change in product or service price, cause a smaller change in their demand. So, the price elasticity coefficient is less than 1 (e <1). This type of product and service are the things most people need and also has a strong brand such as gasoline. So that even its price has changed, most people still pay for it.

e) Perfectly inelastic
This perfectly inelastic is when there is no change of the demand when the product or service price has changed. So the price elasticity coefficient of the perfectly inelastic is zero (e=0) This type of product or service are the things which consumers absolutely need with no choice, In other words, even the price has changed, the consumers still need to buy it anyway.

2.3.4 Total Revenue Test

Total revenue test is the concept which approximates the price elasticity of demand by measuring the change in total revenue. This concept will be used in the pricing strategy of the business, in order to have a better aspect on how to maximize the total revenue in specific products or services. In other words, the small change in prices may affect the big change in demand and therefore the total revenue. (Kenton, 2020)

In the total revenue test concept, the change in the price of products or services which are elastic and inelastic to demand will result in a different trend of the total revenue.

- For the products or services which are elastic to demand, increasing in price will only yield big decreasing in the quantity demanded. So, the total revenue would be dropped. On the other hand, if the price is discounted, it is likely to result in increasing the large demand, that would increase the total revenue.
- For the products or services which are inelastic to demand, if its price has increased, the demand is expected to be a small change or even unchanged, So the increasing price would lead into increasing total revenue. In the same way as discounting the price, the demand would not be affected, that the total revenue would be dropped as well.

2.3.5 Application of Price Elasticity

Price elasticity is one of the key concepts for the Marketing of the business. It reflects how unique, value-adding or necessary for customers. If the products or service which the business offer is highly elastic, that means these products or services is defined as the unnecessary or commodity by customers. On the other hand, if the products or services are highly inelastic, that means they are value-adding or essential for the customers which they still willing to buy even its price have risen.

As the marketing goal for the business is to shift its product or service to be more inelastic because that means its products or services are sustainable, differentiated and meaningful for customers. The price elasticity is not only the concept to increase the customers' demand to buy with the price strategy, but also the crucial concept for analysing the market and competitors. If the competitors or substitutes play more role to the market, the products or services of the business may become more elastic which customers are more sensitive to the price because they have more choices available in the market. (Gallo, 2015)

2.4 Development of Kishi's Logit PSM

2.4.1 Price Sensitivity Measurement (PSM)

According to (Kishi & Satoh, 2005), price sensitivity measurement (PSM) is the method that measures the customer's perspective on the price of the product or service that for this study would be the transit fare. This model evaluates the perspective of the customer in four price level of the specified product which are the 'reasonable price", "expensive price", "too expensive price" and "too cheap price". PSM has been developed to find the solution through the psychological approach to find the acceptable product price in the customer's opinion, together with the customer's price sensitivity and acceptability.

In the PSM model, the customers are asked to give the opinion of the product price at 4 different levels. First, "reasonable" price, in this question the customers are asked what is the most appropriated price of the certain product that they are willing to pay. Secondly, "expensive" price that the customers are asked what the expensive level price is, to purchase a certain product. Thirdly, "too expensive" price that the customers are asked what is the maximum price that they are willing to pay for the certain product. Finally, "too cheap" price, in this level, the customers are asked what is the minimum price that they would pay for the products but keeping in mind about the quality of the product when the price is too low. Figure 3 summarize the four level of the price.

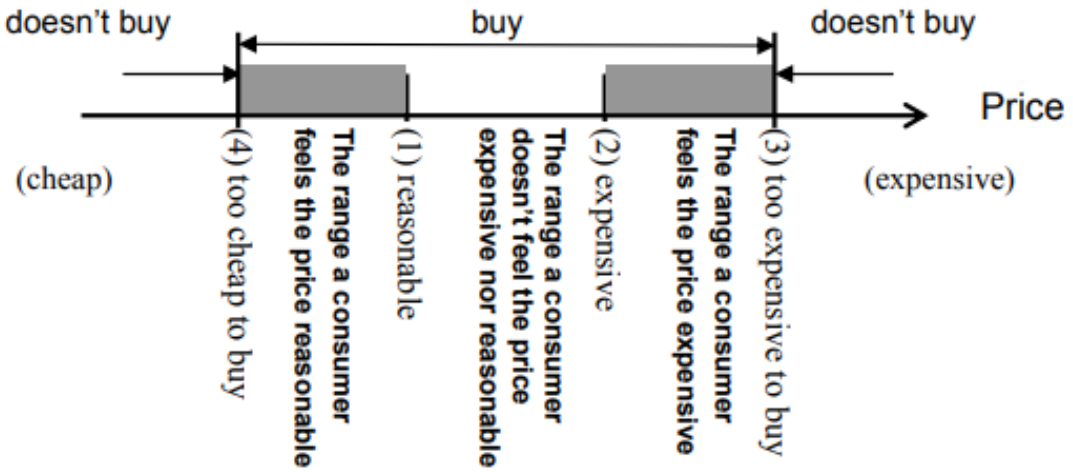


Figure 3 Consumers' Price Sensitivity and Willingness to Buy

(Source: (Kishi & Satoh, 2005))

Base on the collected price data, the cumulative frequency of each price level is plotted into graphs as shown in Figure 4 below. The "reasonable" and "too cheap to be willing to buy" are plotted in the decreased curves. While the "expensive" and "too expensive to be willing to buy" are plotted in increasing curves. KIshi and Satoh have defined the curves and intersections of the graph as an example in Figure 5:

1. The intersection between Reasonable curve and Expensive curve is called "Indifference Price" which is the point that the number of people who think this price is reasonable and the number of people who think this price is expensive are the same.
2. The intersection between "Too expensive to be willing to buy" curve and "Too cheap to be willing to buy" curve is called Optimum price, which is the point that has the lowest demand and it is the point where the number of people who think this price is too expensive to buy and the number of people who think this price is too cheap to buy, is the same.
3. The area between Indifference price and Optimum price is the Range of Acceptable Price.

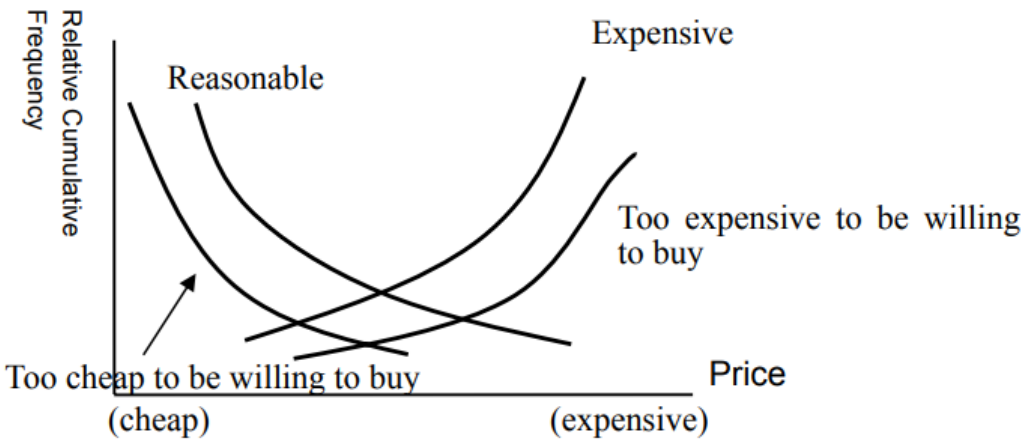


Figure 4 Relative cumulative frequency of four price level

Source: (Kishi & Satoh, 2005)

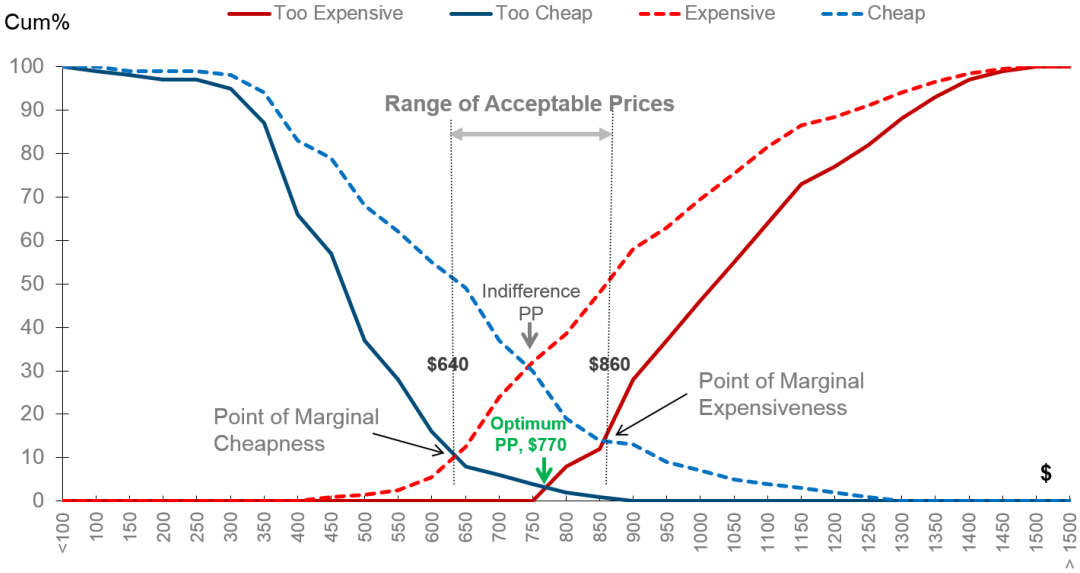


Figure 5 Range of Acceptable Price

Source: (NationalUniversityOfSingapore, 2013)

The complementary event of the reasonable price and the expensive price is “should be less expensive” and the complementary event of the reasonable expensive price is “Should be more expensive” as are shown in Figure 6 and Figure 7

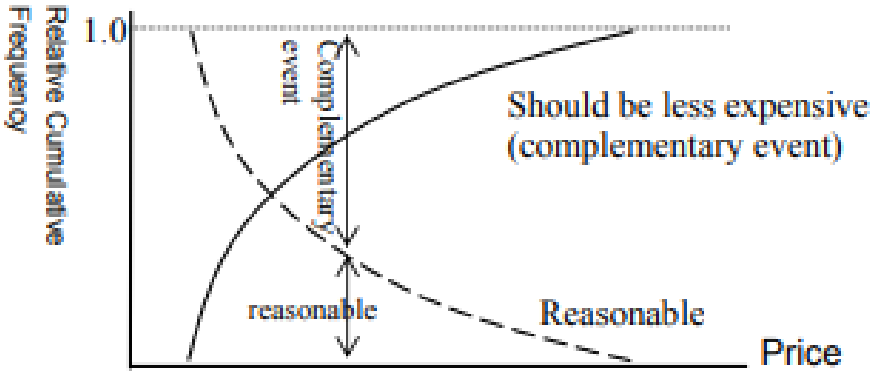


Figure 6 Complementary event of "Reasonable"

Source: (Kishi & Satoh, 2005)

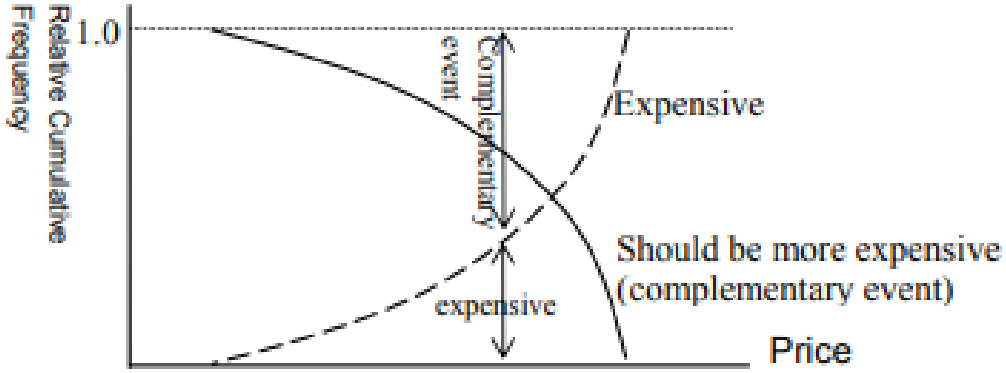


Figure 7 Complementary event of "Expensive"

Source: (Kishi & Satoh, 2005)

2.4.2 Kishi's Logit PSM (KLP)

In the Price Sensitivity Measurement (PSM) analysis, the Relative cumulative frequencies of "should be less expensive", "should be more expensive", "too cheap to be willing to buy" and "too expensive to be willing to buy" are used as indicators of the analysis. Kishi's Logit PSM (KLP) has developed the Equation 2 and Equation 3 in order to analyze the customer's evaluated prices. The resulting curves are shown in Figure 8.

Equation 2

$$T = \frac{1}{1 + \exp F(x)}$$

Equation 3

$$F(x) = ax + b$$

Where
T: relative cumulative frequency
x: price
T_1, F_1: should be less expensive
T_2, F_2: should be more expensive
T_3, F_3: too expensive to be willing to buy
T_4, F_4: too cheap to be willing to buy

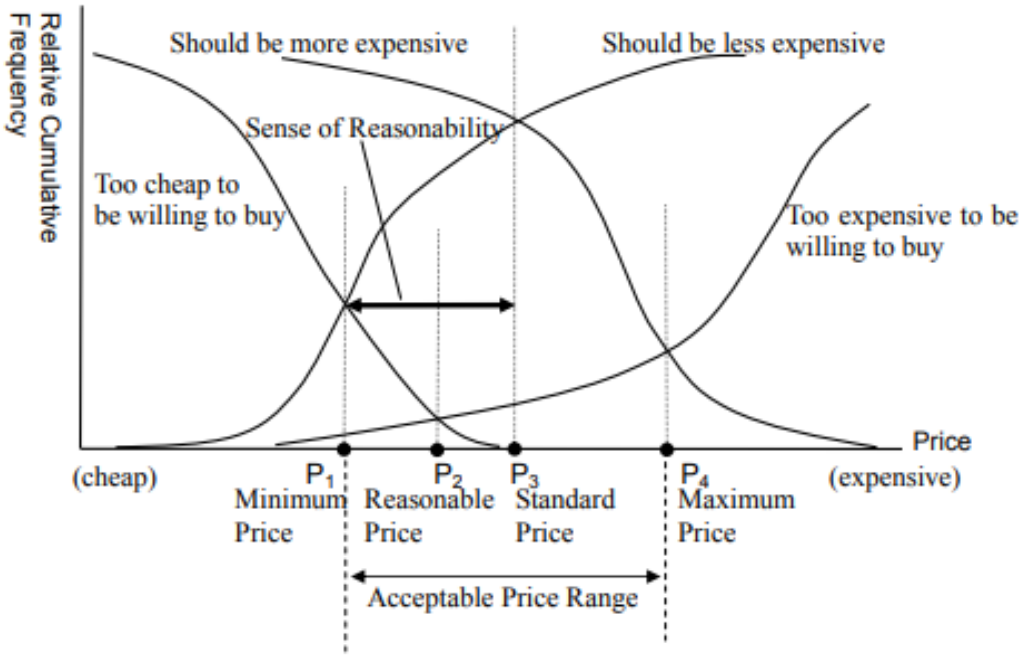


Figure 8 KLP Reference Price Indicators

(Source: (Kishi & Satoh, 2005))

According to Figure 8, there are reference price indicators as follows :

a) P_1 (Minimum Price)
P_1 is the intersection between the curves “Should be less expensive” and “Too cheap to be willing to buy”. Between these two curves, the price should be discounted less than the “should be less expensive” level otherwise customers would think it is expensive even they buy it. However the price should not be decreased to less than the P_1 level, otherwise, the customer would feel it is too cheap to be willing to buy because they doubt the product or service quality. Therefore, P1 is the minimum price it should not be lower than.

b) P_2 (Reasonable Price)
P_2 is the intersection of “Too expensive to be willing to buy” and “Too cheap to be willing to buy” This price indicates the border level that customer is not willing to buy the product. In two way, if the price is higher than this indicator, more customers think it is too expensive to be willing to buy. On the other hand, if the price is lower than this indicator, more customers think it is too cheap to be willing to buy. Therefore, this price can be defined as the price which customer perceive reasonable considering the quality.

c) P_3 (Standard Price)
P_3 is the intersection of “Should be more expensive” and “Should be more expensive” curves. At this point, the same number of customers think the price is reasonable or expensive from a complementary viewpoint. In other words, the price is reasonable that the entire population think the price is neither expensive nor cheap. This standard price represents the price which the product quality and price are well balanced.

d) P_4 (Maximum Price)
P_4 is the intersection of “Should be more expensive” and “Too expensive to be willing to buy” curves that represent the maximum price. If the price is higher than this point, more customers think that the price is too expensive to buy the product. This maximum price is determined on the price-conscious basis.

e) P_1 to P_4 (Acceptable Price Range)
The price range is between the maximum price and minimum price. The price should be set within this range that is acceptable for the entire consumer population.

f) Sense of Reasonability
Within the Acceptable Price Range(P_1 to P_4), the entire consumer population feels that the price is more reasonable when it is set between Standard Price(P_3) and Minimum Price(P_1)

2.4.3 Application of KLP

Kishi’s Logit PSM (KLP) is used to set the price standard base on the consumer’s demand. Consumers always weigh the product quality and benefit against the price when they purchase the products. If they think the price is too expensive, they would not buy the product. On the other hand, if they feel that the price is too cheap, they suspect the product’s quality would be low. KLP is applied to set the product price as it will be acceptable for the target consumers.

Moreover, KLP model indicates the price from the different views which can show the market segment where the product belongs. It is possible to analyse how the product is evaluated in the market segment as shown in Figure 9.

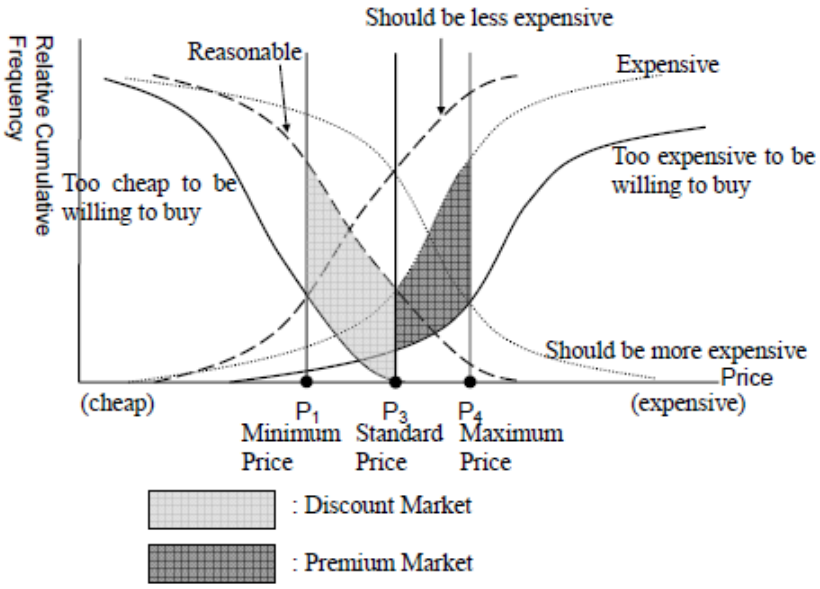


Figure 9 Estimation of Market Size by KLP

(Source: (Kishi & Satoh, 2005))

According to Figure 9, the market is segmentalized into Discount Market and Premium Market. The discount market is the group of consumers who feel a product price within the range between Standard Price and Minimum Price is too cheap to buy are removed from those who feel it is reasonable. This discount market is the group of potential consumers who will buy the product when they feel the price is reasonable. For the Premium market, this market is the group of consumers who will buy the product despite feeling it is expensive, for instance, the brand-name goods market. These two markets have potential sales volume in their market.

2.5 The Impact of metro fare on Riders

Price can affect the customers' purchase decisions, for instance by discounting some of products or services prices, may influence more customers. On the other hand, by increasing the price, may motivate customers to use products or services less or even shift to another brand.

According to (Litman, 2004), there are many factors can affect how transit fare affect its consumption decisions as are summarized below:

a) User type: The transit-dependent riders are normally less price-sensitive than the riders who have alternative choices such as the people who own the cars. The certain groups, including the low-income people, non-drivers, disabilities, students and elderly people are more likely to be more transit dependent.

b) Trip type: Elasticity of the off-peak transit trips are typically 1.5 to 2 times higher than elasticities of the peak-period trip because the peak-period trips are more consist of commute trips or the trip which people travel regularly. In other words, people are more necessary or depend on the peak period trips than the trip in the off-peak period

c) Geography: Large cities and developed cities tend to have lower price elasticity than suburb area and smaller cities. In the reason of, they have a bigger portion of transit-dependent users which transit ridership tends to increase with city size.

d) Type of price change: Transit fare, transit service quality and parking pricing tend to have a great impact on transit ridership. Price elasticity tends to increase when the fare levels increase. In other words, there will be more elasticity when the fare level is high.

e) The direction of price change: Both fare increases and reductions affect transit ridership. However, fare increase appears to result in a greater reduction in ridership than the size which fare reduction will increase ridership.

f) Time period: The period of time which the transit price has impacted have different elasticities. The elasticities are higher when the customers take price change in consideration in a longer-term decision such as where to live or work which may affect by the transit fare in long term decision.

g) Transit type: Different modes of transportation such as bus and rail often have different elasticities because they have different rider groups in the different market segment.

2.6 Integrated Transport System

In most cities, it is common that the individual mode of transportation such as road, rail, airway and other infrastructures are developed by different agencies of public and private companies which operate with a different set of objectives. In theory, the transportation system should operate as an integrated network including rail, highway, roads, walkways, bike paths, rivers, air corridors with other coordinated transportation services. Travellers and logistics providers make the journey to transport to their desired destination by using multiple parts of the system and expect the integrated experiences. The integration or intermodal of transportation create the flexibility with many options in one trip for travellers which provide the convenience, resilience and the mobility even in the unnormal incident such as the metro or airline strike, traffic jam, etc. (Gudmundsson, et al., 2016)

2.7 Integrating of Ride Hailing services and Public transit

In Bangkok, Grab is the most use ride hailing service. The significant relative statistic of Grab and metro of Bangkok are shown that in the morning peak hours, 69% of grab rides which start in residential area, end at the public transit nodes, and with 34% of Grab rides which start at Public transit nodes, end at educational areas and Job areas. In the same way of the evening peak hours, 59% of Grab rides which start in the job and educational area, end at the transit nodes and 45% of grab ride which start at the transit stations will end in the residential area. These statistics reflect that significant numbers of Grab rides in Bangkok are used for first and last mile of public transit. (Grab, 2018)

Since today, several transit agencies have started the opportunities to partner or integrate with the ride hailing services. For instances, bike sharing, car sharing, and private shuttle or feeder services, etc. These integrations are the alternative to the traditional transit in low density area or even extending the reach of transit that are addressed to fix first and last mile problems, and also on-demand transportation especially for seniors and disables. (Blodgett, et al., 2017)

As the growth of the integration or partnership between the transportation network companies and the public transit, According to (Schwieterman & Livingston, 2018), there are 5 basic categories of partnership/integration as follows:

1) Encourage the connection between the ride hailing services and the transit through the discount or other financial incentives. For instances in San Francisco Bay area, Dublin, offers 50% discount, up to 5 dollars, on all Lyft trips within its municipal boundaries and include the trip to its BART rapid-transit stations.
2) Develop smartphone trip planning application to combine ride hailing services and public transit in a single trip. For instances GoPass mobile application which allows the travellers to buy their transit tickets and connect to Lyft application, in Dallas. (DallasAreaRapidTransit, 2019). Ridetap system which allows the real-time information of both public transit and Lyft transportation that able to combine these transports in the same trip. (moovelUS, 2016). And other application which combines the ride sharing services and transit in the single trip such as “Go LA” in Los Angeles, CA, shown in Figure 10.
3) Mitigating shortage of parking shortages especially in crucial or centre locations. For instances the program in Summit, New Jersey, USA, which provide the $ 2-weekday rideshares to/from the rail stations for the residents who have paid for the rail stations’ parking permit.
4) Promoting mobility for seniors and/or traveller with impairments. For instances, the Massachusetts Bay Transportation Authority (MBTA) pilots the program with Lyft and Uber to provide the limited number of subsidized ridesharing for seniors and disabled. (MassachusettsBayTransportationAuthority, 2019)
5) Indirectly promoted transit use or improvement. For instances in Cincinnati, Ohio that partnership with Uber and transit agencies, established “Cincinnati Mobility Lab” to promote data sharing, transportation planning with the Transportation Network Companies in the longer term. (Salzberg, 2018)

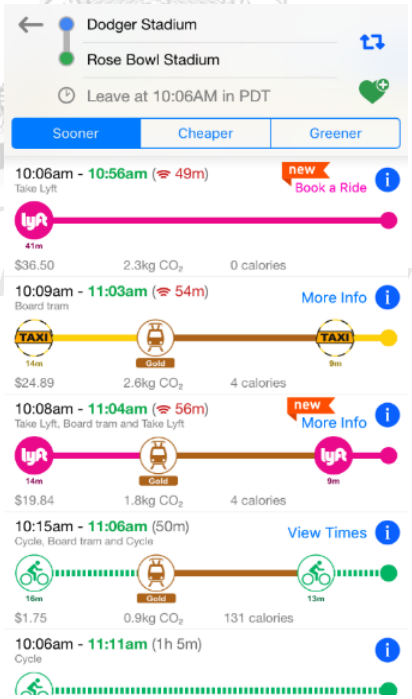


Figure 10 “Go LA” combining ridesharing and transit on a single trip.

(Source: (Schwieterman & Livingston, 2018))

Chapter 3 Research Methodology

This chapter aims to summarise the approach and methods which are used in the research in order to achieve the objectives. The overall outline of the research methodology is shown in Figure 11. The methodology of the research begins with (1) conducting the survey to get the opinion from metro users on Bangkok metro fare. Following by (2) interview the transport providers for the business perspective for improving first mile last mile by integration or collaboration of metro transit and ride hailing services and also the approach for providing discount and financial incentives in order to influence more users. After getting all data from metro users and transport providers, (3) the discussion is focusing on the Bangkok metro price elasticity and approach for providing discount and promotion that will benefit for users and the transport providers. Together with the approach for the collaboration between metro transit and ride hailing services. These analyses and discussion aim for the main objectives of this research which are studying the service fare strategies on users' demand and the approach for improving first mile last mile of Bangkok metro transit.

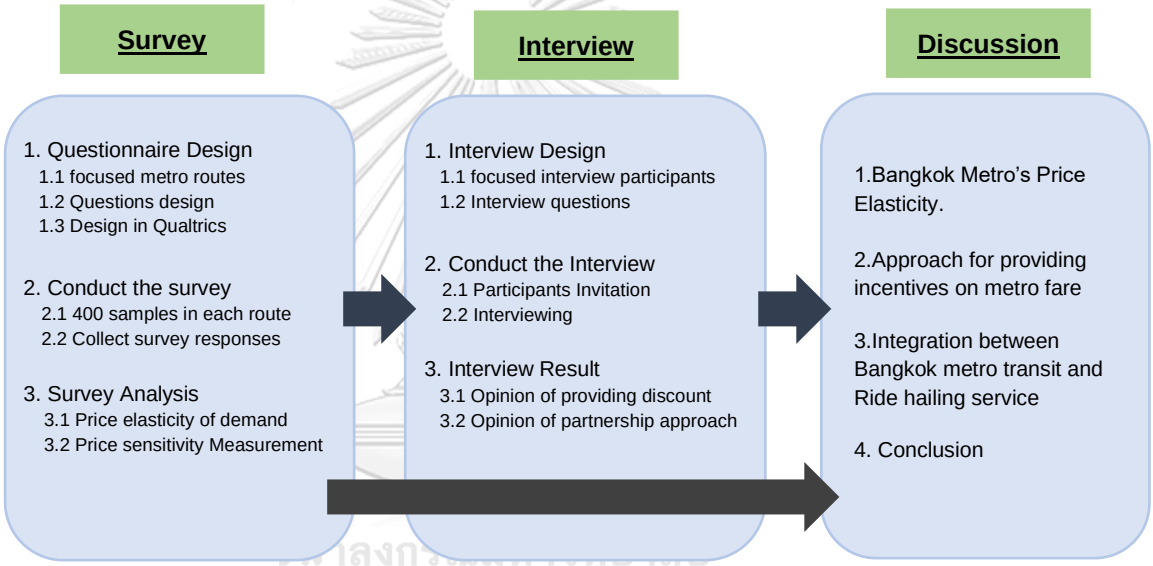


Figure 11 Overall Research Methodology Outline

3.1 Questionnaire Survey Design

The purpose of the survey is analysing for the metro price elasticity and its range of the acceptable metro fares in Bangkok, based on the opinion and demand of the Bangkok metro users.

3.1.1 Three specific Bangkok metro routes for the survey

The survey is focusing on three specific routes of Bangkok metro which are Siam station to Asok station, Siam station to Mo-chit station and Sukhumvit station to Silom station. The background of these three specific routes are as follows:

a) Siam Station to Asok Station

This route is a part of the Bangkok Dark Green metro Line or Sukhumvit Line which is operated by Bangkok Mass Transit System Public Company Limited (BTSC). The route

between Siam Station to Asok Station pass through four intermediate stations as shown in Figure 12. According to (BTSC, 2019), this route takes time to travel around 7 minutes and the current fare with the single journey ticket is 30 Thai Baht.

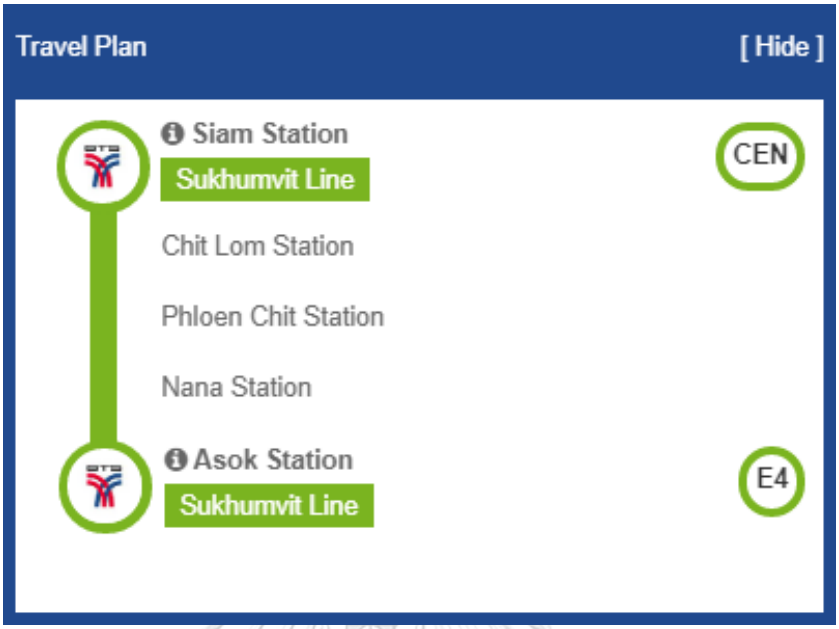


Figure 12 Siam Station to Asok Station Route

Source: (BTSC, 2019)

The reason that Siam station and Asok Station are chosen to focus on this research is, according to (Prachachat, 2018), Siam Station has the highest passenger with 148,000 trips per day, following to Asok Station where has the second-highest passengers with 135,000 trips per day. With this reason, this research tends to focus on the most travelling or having the highest demand stations to conduct the survey in order to get the most realistic opinion and information of this routes between Siam Station and Asok Station.

b) Siam Station to Mo-chit Station

This is also the high demand route where is also the part of Dark Green Line of Bangkok which starts from Siam station where is the big interchanged station, riding pass through six intermediated stations into the north of Bangkok, before arriving at Mo-chit station as shown in Figure 13. This route is operated by Bangkok Mass Transit System Public Company Limited. Refer to (BTSC, 2019), This route takes time around 14 minutes and cost 44 Thai Baht with the single journey ticket.

This route is one of the highest demand routes in Bangkok, due to Siam station is the central station where is the interchange between many metro line and it is also located in the central Bangkok, together with Mo-chit station where is one of the biggest stations in north Bangkok area with the third highest passengers around 118,000 trips per day, and it is also the transportation hub interchange with other transport modes such as van, bus, etc. With these reasons, this route is chosen to focus on the survey of this research.

Figure 13 Siam Station to MoChit station Route

Source: (BTSC, 2019)

c) Sukhumvit Station to Silom Station

This route is a part of MRT Blue Line of Bangkok which is operated by Bangkok Expressway and Metro Public Company Limited. This route starts at Sukhumvit station which is in the city centre of Bangkok with the highest passengers in MRT Blue line around 35 million passengers per year (MGRonline, 2019) and also be the interchange station with Asok station of the Dark Green Line. From Sukhumvit Station, riding through three intermediated stations as shown in Figure 14 then arrive at Silom station where located in the main job area of Bangkok. Silom Station is also the interchange station with the Light Green Line. According to (BEM, 2018), the trip from Sukhumvit Station to Silom Station takes around 7 minutes and its fare is 23 Thai Baht for the single journey ticket.

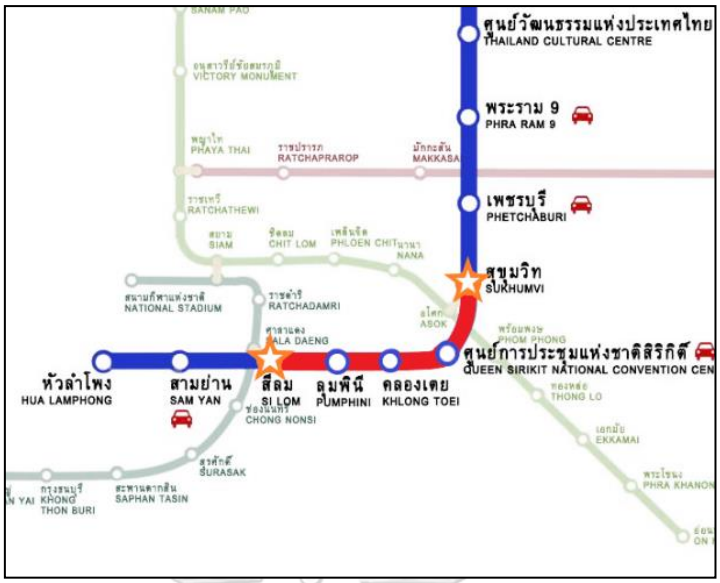


Figure 14 Sukhumvit Station to Silom Station Route

3.1.2 Survey Questions

a) Consent for the survey

First of all, participants for this survey will be informed about this survey approach for instances, why is this survey is conducted? What you have to do if you participate? the participant's right, etc. This information will be described in Participant Information Leaflet (PIL) as shown in Appendix C Appendix C.

After the participants have read the information in Participant Information Leaflet (PIL), If they consent to participate the survey in order to give the information for this research purpose, they have to tick in the Consent box in the Participant Consent Form as in Appendix C, before going to the survey questions. Otherwise, they are able to close down or leave the survey at any time without any consequences.

b) Main questions

The questionnaire is designed following the Kishi's Logit PSM Analysis which have described in Clause 2.4. In order to analyse for the appropriated metro fare in Bangkok, four input factors are needed which are as follows:

- The metro fare which users think it is reasonable.
- The metro fare which users think it is expensive, but still able to purchase it.
- The metro fare which users think it is highest to purchase (to analyse for the too expensive fare level).
- The metro fare which users think it is too cheap which may not purchase by doubt to its service quality.

In the survey, the respondents who are the Bangkok metro users will be asked for the opinion of four levels fare of each of three focused metro routes. These factors will be analysed for the price elasticity and range of acceptable price of three specific routes which are Siam Station to Asok Station, Siam Station to Mo-Chit Station, and Sukhumvit Station to Silom Station.

Moreover, some general detail of respondents which related to the behaviour of transport in daily life are needed in this survey, which are the sex, age, range of income, occupation and is they own the car or not. This information will be used for analysing for the behaviour or environment and personal factor which may affect the opinion and behaviour of using the metro transit.

Therefore, in this survey, the main questions outline is shown in Figure 15.

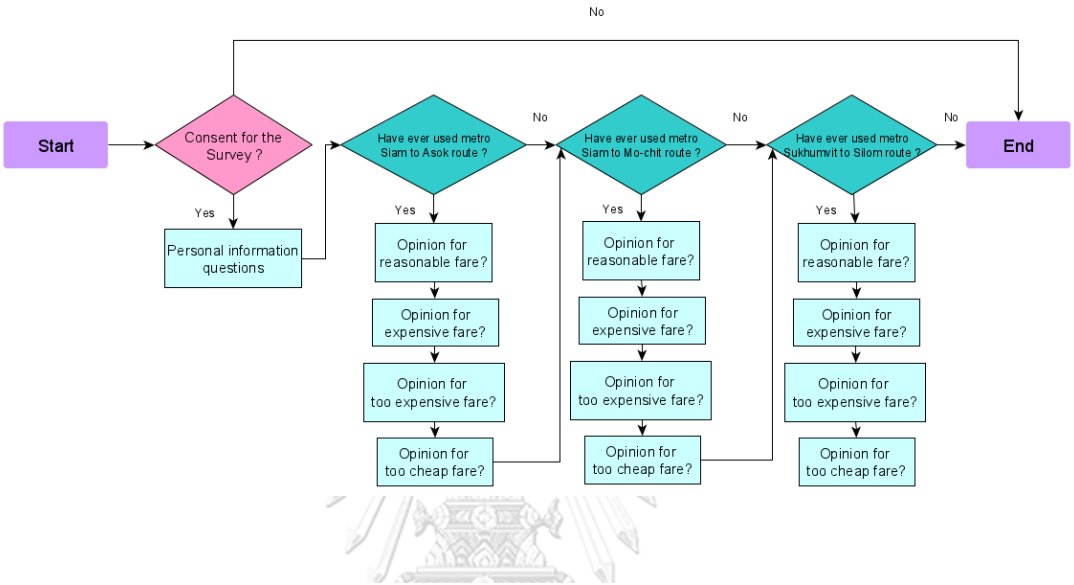


Figure 15 Survey Question Outline

3.1.3 Survey Platform

This survey will be conducted through the Qualtrics online platform. This Qualtrics online survey platform allows the users to design and conduct the survey through the provided platform and able to share to the targeted participants to take part in this survey through the internet. This survey will not offer participants cash payment or any other kind of incentives or compensation for participating in this survey.

The survey is structured with the all consent form, main questions and other decoration to allow easier understanding for the respondents. All structures are designed in the Qualtrics online survey platform as follows:

a) Participant Information Leaflet and Consent Form

According to Figure 16, this first part of the survey will show the link for the participants to go to the participant Information Leaflet (PIL) which allows participants to read or download, together with the Consent Form. The participants who consent to participate in this survey have to select the Consent box then will follow to the next question part.

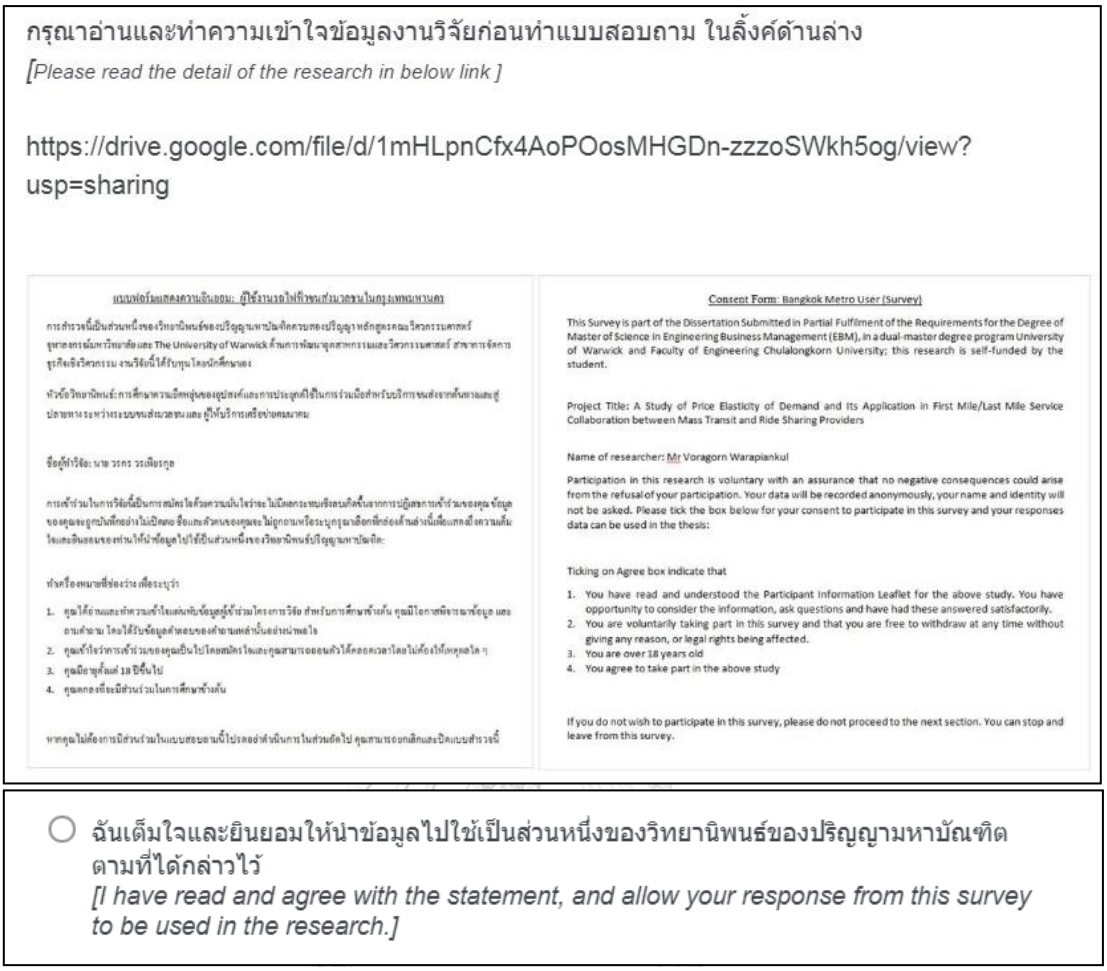


Figure 16 Survey Design - PIL and Consent form

b) General information question part

This questioning part will ask the participants about the personal information related to transport behaviour. The main questions are about the sex, age, range of income, occupation and as if they own the car. As the functions of Qualtrics Survey Platform, the participants are allowed to change the language of Survey's context between Thai and English as preferable. The designs of this Survey part both in Thai and English are shown in Figure 17 and Figure 18.

The main questions in this part are as follows

- What is your sex?
- What is your age?
- What is your range of income (Baht) ?
- What is your occupation?
- Do you own the car?

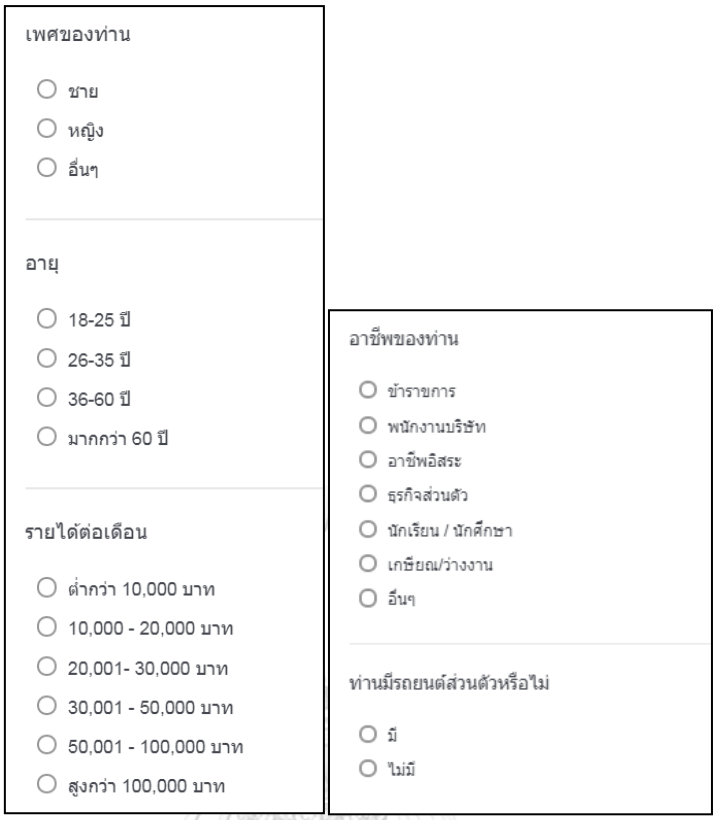


Figure 17 Survey Design - Personal Information Questions (Thai)

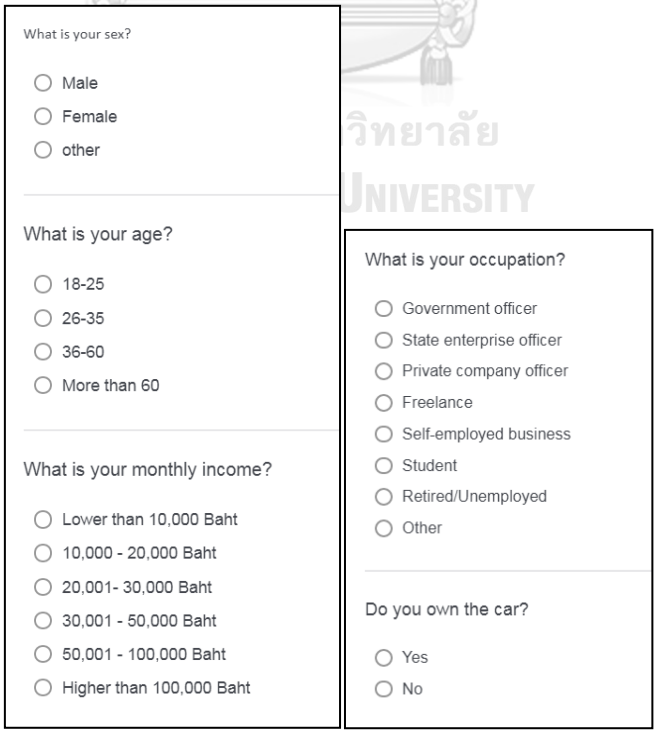


Figure 18 Survey Design - Personal Information Questions (English)

c) Bangkok metro – Siam Station to Asok Station route Question part

As the functions of Qualtrics Survey Platform, the participants are allowed to change the language of Survey's context between Thai and English as preferable.

In this question part of Siam station to Asok Station route, the participants will be asked first as if they have ever been travelled by this route as in Figure 19 and Figure 20. If yes, they will be asked for the opinion of four levels of fare for this route which are the reasonable fare, expensive fare, the highest fare to be willing to buy and too cheap fare as in Figure 21 and Figure 22 before going to the next question part. But if the participants have not been travelled by this route, they will go to the next question part without asking any following questions in this part.

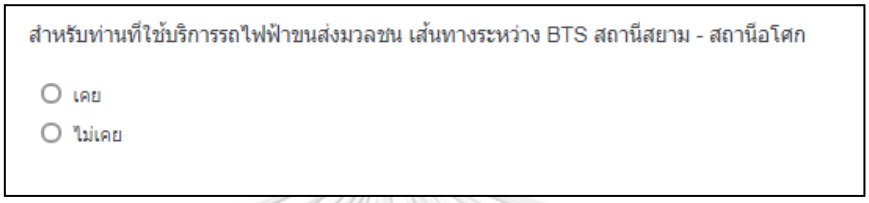


Figure 19 Survey Design - Siam Station to Asok Station Route First Page (Thai)

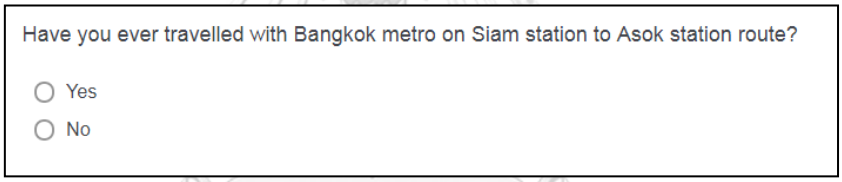


Figure 20 Survey Design - Siam Station to Asok Station Route First Page (English)

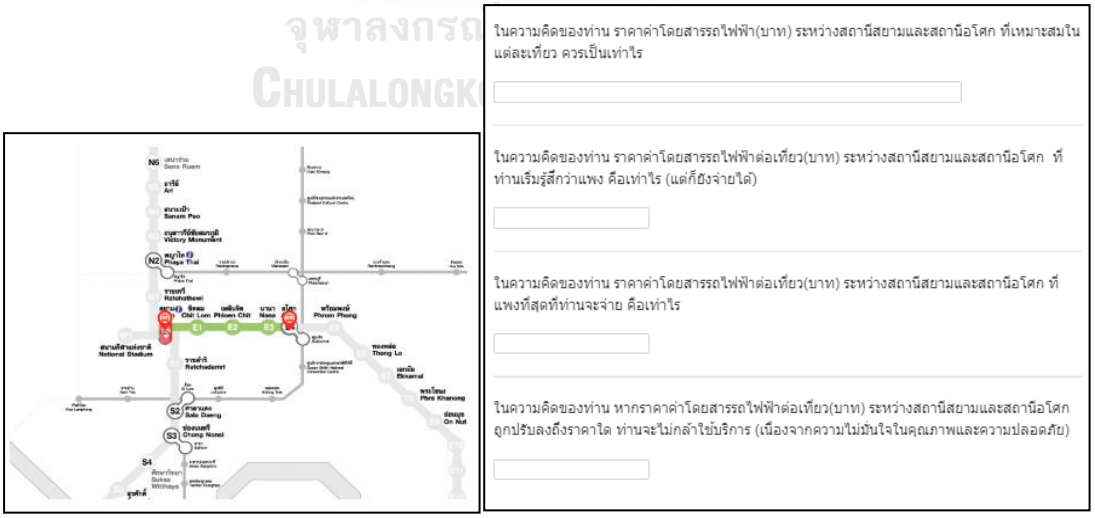


Figure 21 Survey Design - Siam Station to Asok Station Main questions (Thai)

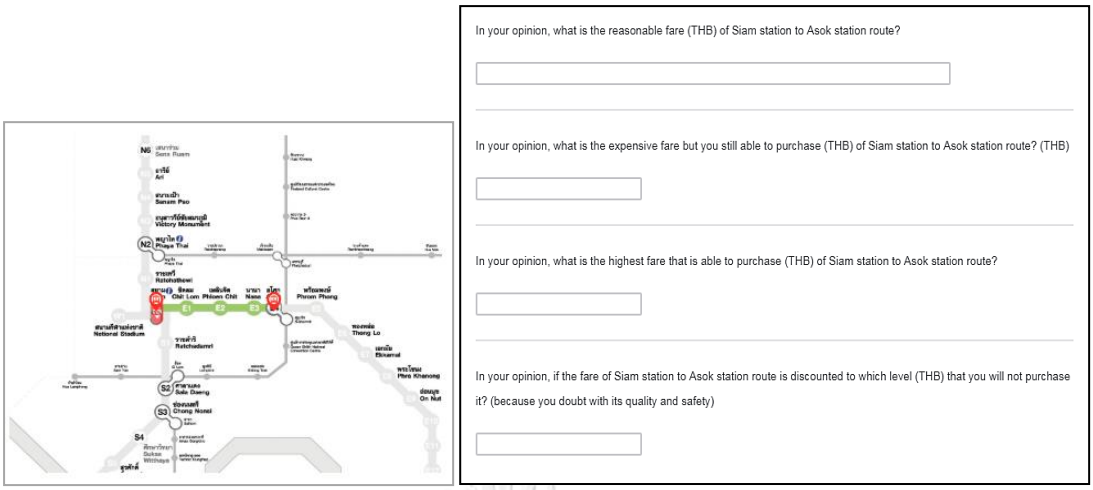


Figure 22 Survey Design - Siam Station to Asok Station Main questions (English)

According to Figure 21 and Figure 22, the participants are informed with the Siam station to Asok station route map, and are asked the 4 questions as follows:

- In your opinion, what is the reasonable fare (THB) of Siam station to Asok station route?
- In your opinion, what is the expensive fare but you still able to purchase (THB) of Siam station to Asok station route?
- In your opinion, what is the highest fare that is willing to purchase (THB) of Siam station to Asok station route?
- In your opinion, if the fare of Siam station to Asok station route is discounted to which level (THB) that you will not purchase it? (because you doubt with its quality and safety)

d) Bangkok metro – Siam Station to Mo-Chit Station route Question part

As the functions of Qualtrics Survey Platform, the participants are allowed to change the language of Survey's context between Thai and English as preferable.

This question of this part follows the same step of the previous part. The participants will be asked first as if they have ever been travelled by this Siam Station to Mo-Chit Station route as in Figure 23 and Figure 24. If yes, they will be asked for the opinion of four levels of fare for this route which are the reasonable fare, expensive fare, the highest fare to be willing to buy and too cheap fare as in Figure 25 and Figure 26 before going to the next question part. But if the participants have not been travelled by this route, they will go to the next question part without asking any following question of this part.

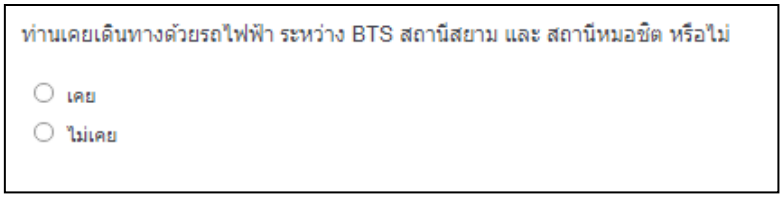


Figure 23 Survey Design - Siam Station to Mochit Station First page (Thai)

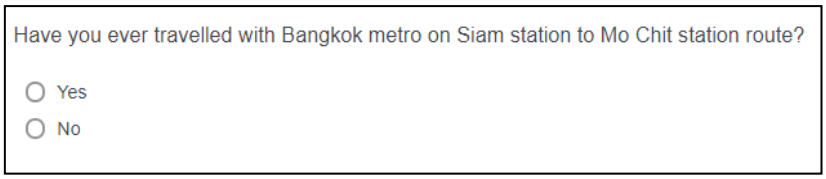


Figure 24 Survey Design - Siam Station to Mochit Station First page (English)

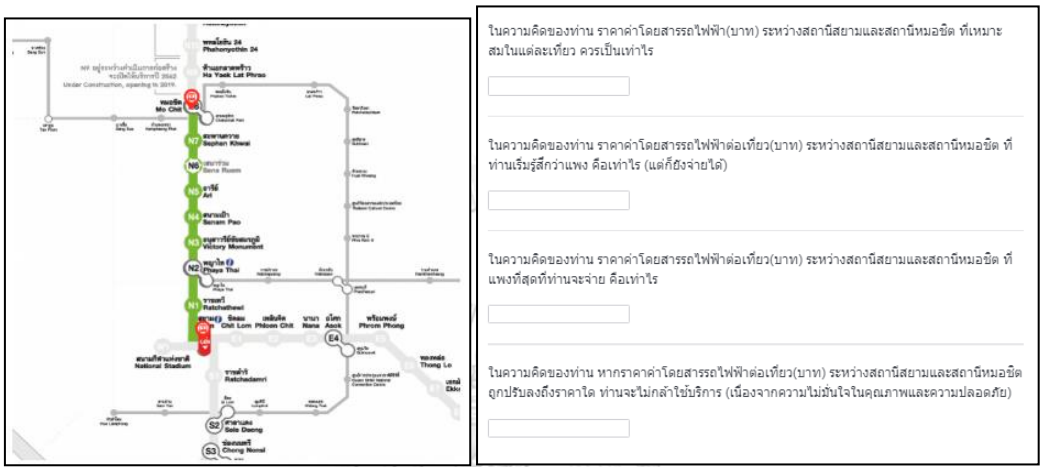


Figure 25 Survey Design - Siam Station to Morchit Station Route Main questions (Thai)

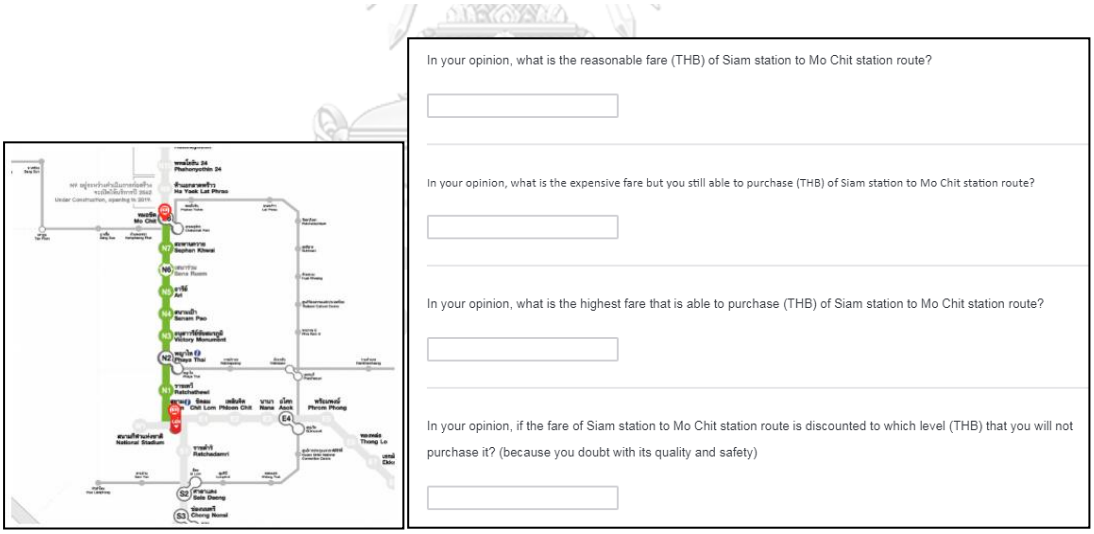


Figure 26 Survey Design - Siam Station to Mo chit Station Route Main questions (English)

According to Figure 25 and Figure 26, the participants are informed with the Siam station to Mo Chit station route map, and are asked the 4 questions as follows:

- In your opinion, what is the reasonable fare (THB) of Siam station to Mo Chit station route?
- In your opinion, what is the expensive fare but you still able to purchase (THB) of Siam station to Mo Chit station route?
- In your opinion, what is the highest fare that is willing to purchase (THB) of Siam station to Mo Chit station route?
- In your opinion, if the fare of Siam station to Mo Chit station route is discounted to which level (THB) that you will not purchase it? (because you doubt with its quality and safety)

e) Bangkok metro – Sukhumvit Station to Silom Station route Question part

As the functions of Qualtrics Survey Platform, the participants are allowed to change the language of Survey's context between Thai and English as preferable.

This part is the last part of this survey, it has the same step of the last two previous question parts. The participants will be asked first as if they have ever been travelled by Sukhumvit Station to Silom Station route as in Figure 27 and Figure 28. If yes, they will be asked for the opinion of four levels of fare for this route which are the reasonable fare, expensive fare, the highest fare to be willing to buy and too cheap fare as in Figure 29 and Figure 30 before end of this survey. But if the participants have not been travelled by this route, they will end of this survey without asking any following questions of this part.

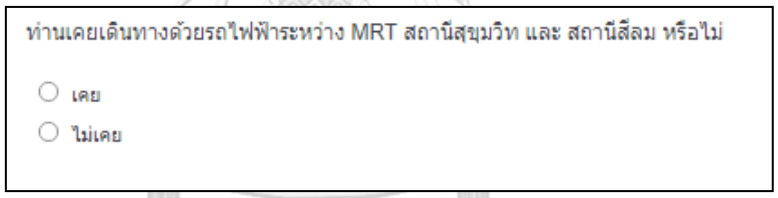


Figure 27 Survey Design - Sukhumvit Station to Silom Station First page (Thai)

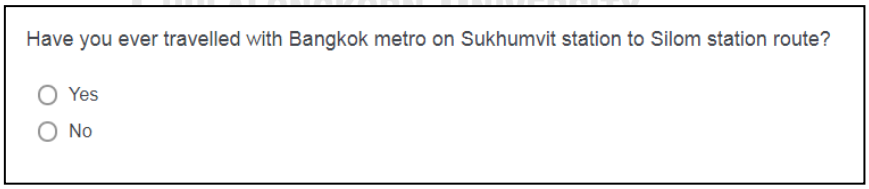


Figure 28 Survey Design - Sukhumvit Station to Silom Station First page (English)

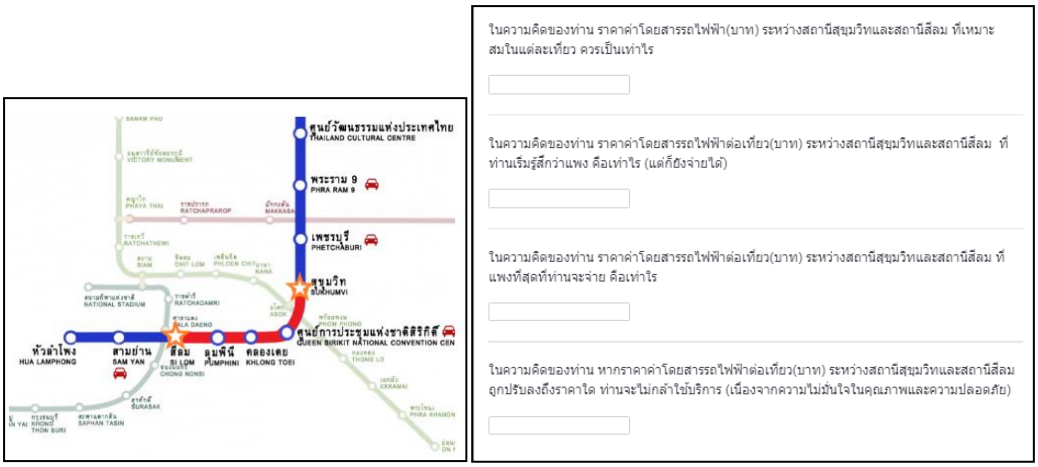


Figure 29 Survey Design - Sukhumvit Station to Silom Station Main questions (Thai)

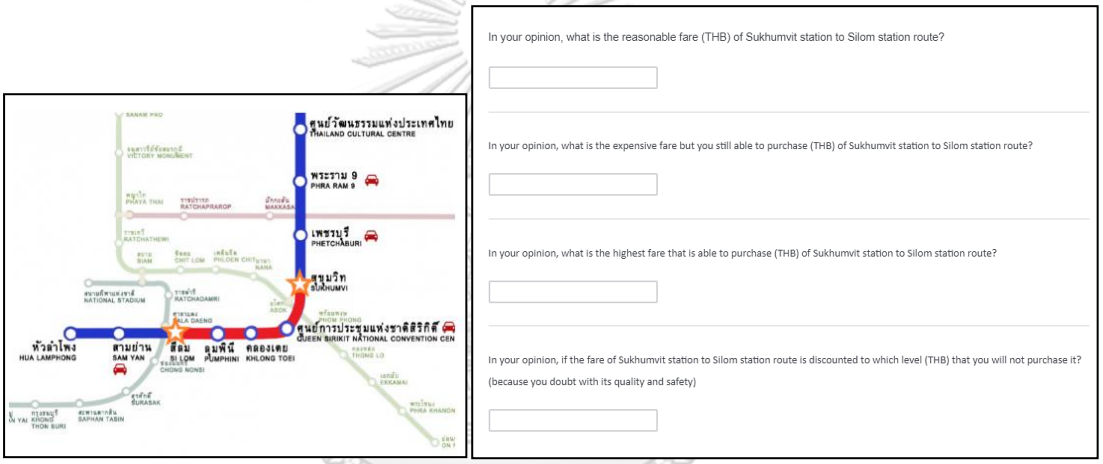


Figure 30 Survey Design - Sukhumvit Station to Silom Station Main questions (English)

According to Figure 29 and Figure 30, the participants are informed with the Sukhumvit station to Silom station route map, and are asked the 4 questions as follows:

- In your opinion, what is the reasonable fare (THB) of Sukhumvit station to Silom station route?
- In your opinion, what is the expensive fare but you still able to purchase (THB) of Sukhumvit station to Silom station route?
- In your opinion, what is the highest fare that is willing to purchase (THB) of Sukhumvit station to Silom station route?
- In your opinion, if the fare of Sukhumvit station to Silom station route is discounted to which level (THB) that you will not purchase it? (because you doubt with its quality and safety)

3.2 Conduct the survey

3.2.1 Survey Samples

This research focuses on surveying Bangkok Metropolitan people, while the survey will adopt with the precision rate or sampling error of ±5% and normally, approximately 95% of confidence level will be applied. According to (KREJCIE & MORGAN, 1970), these factors with the Bangkok Metropolitan population in 2019 is more than 10 million (WorldPopulationReview, 2020), the sampling size of 384 is needed. Therefore, this research will take the number of 400 samples of people who have ever been travel by Bangkok metro in each specific route.

3.2.2 Collect survey responses

This approach is to conduct the survey or questionnaire in order to collect the responses or answers from the respondents through the Qualtrics online platform. For recruiting the survey participants, the Qualtrics link of this survey will be shared in the open sourced social media such as Facebook, the Facebook communities which will be shared with the survey link will be the public communities related to the Bangkok metro or transportation in order to recruit the right targeted participants. This survey is not intended to provide any incentives to the participants.

The responded data will be collected with the number of at least 400 samples of the people who use to travel in each of three specific metro routes which are focused. These number of at least 400 samples is sufficient to be analysed for achieving the survey's objectives.

In the survey, there is a variation in the responses which is an uncontrollable factor. Since this survey of the research tend to ask for the opinion of the metro fare, and due to it has been conducted through the online platform which has no direct interaction with respondents and this survey have no intention to offer any money or incentives to the respondents. There are some unintentional and unrealistic responses which are not able to be used in the analysis. Therefore, these responses have to be cut off from the database and need to reconduct the survey for more responses in order to fulfil the number of sample requirement. This limitation results in the delay in the survey timeline.

3.3 Survey Analysis

After collecting all the data of at least 400 samples of each three focused metro route, the main responded data are analysed as follows:

3.3.1 Price Elasticity of Demand of focused Bangkok metro routes

The survey data of each focused Bangkok metro route will be analysed for the price elasticity of each route. In order to reflect how sensitive the people demand to the Bangkok metro fare. The price elasticity will be calculated as the formula:

$$Price\ elasticity\ of\ demand\ (e) = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ price}$$

3.3.2 Price Sensitivity Measurement of focused Bangkok metro routes

This part of the analysis will follow the Kishi's Logit PSM (KLP). From the opinion on four levels of metro fare of each specific route which are collected during the survey, the KLP enable to develop the price and marketing strategy by the result of this analysis.

The steps of finding the appropriated metro fare base on KLP concept are as follows:

a) The relative accumulated frequency of each focused Bangkok metro route will be plotted into four graphs which are:
   - The graph of the relative accumulated frequency of the fare which respondents think it is reasonable.
   - The graph of the relative accumulated frequency of the fare which respondents think it is expensive.
   - The graph of the relative accumulated frequency of the fare which respondents think it is too expensive to be willing to buy.
   - The graph of the relative accumulated frequency of the fare which respondents think it is too cheap to be willing to buy

b) From the four graphs of each focused metro route, The intersection of each graph as shown in Figure 31. are
   - The intersection between Reasonable graph and Expensive graph is called Indifference Price
   - The Intersection between Too cheap to be willing to buy and Too expensive to be willing to buy graphs is called Optimum price.
   - The Intersection between Too cheap to be willing to buy graph and Expensive graph is the minimum price that customers still confident of the quality of the service and willing to pay for it.
   - The Intersection between Reasonable graph and Too expensive to be willing to buy graphs is the maximum price that the customers still willing to pay for it.

c) The range between the minimum price that customers still confident of the quality of the service and willing to pay for it and the maximum price that the customers still willing to pay for it is the "Range of acceptable price" base on customers' perspective.

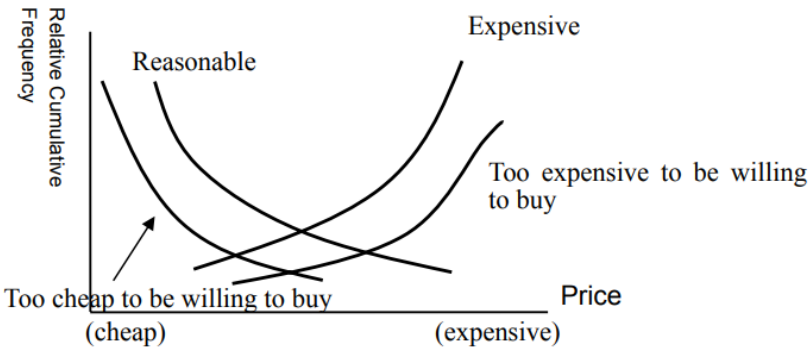


Figure 31 Relative cumulative frequency of four price level

(Source: (Kishi & Satoh, 2005))

The range of acceptable fare of the Bangkok metro fare from the Kishi's Logit PSM (KLP), with the price elasticity of demand for the Bangkok metro fare, are the main factors to analyse for the feasibility to discount or provide the promotion in the appropriated level in order to increase the metro users' demand. Moreover, these are one of the main input for Analysing the business benefit-sharing for the approach of an integrated transport system which integrates and partnership among transport providing companies as the research objectives.

3.4 Interview Design

3.4.1 Interview participants

Due to the purpose of this interview is collecting and understand the business perspective of the metro transit operators and the ride hailing service companies or Transportation Network Companies (TNC) Therefore, the main focused participants are the representative of the metro transit operators and ride hailing service companies in Bangkok.

a) Bangkok Expressway and Metro Public Company Limited (BEM)

Bangkok Expressway and metro PLC (BEM) is one of the metro operators in Bangkok. It operates two main metro transit line which are MRT Blue Line that includes 38 stations total of 38 kilometres in the city centre of Bangkok and MRT Purple Line that connects to the suburban area, includes 16 stations total of 21 kilometres (BEM, 2018).All two MRT system which are operated by BEM are shown in Figure 32. From these reasons, Bangkok Expressway and Metro Public Company Limited is one of the targeted interview participants in this research.

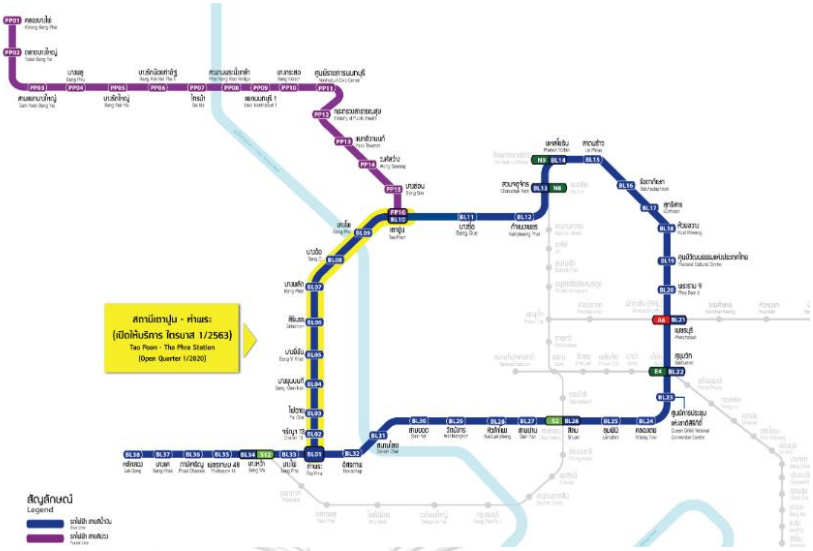


Figure 32 MRT system, operated by BEM

Source: (BEM, 2018)

b) Bangkok Mass Transit System Public Company Limited

Bangkok Mass Transit System Public Company Limited is also one of the biggest metro operators in Bangkok. It operates two main metro line which are the Light Green Line and Dark Green line which connects the city centre of Bangkok to the suburban area. They combine total length of more than 54 kilometres, connecting 48 stations (BTSC, 2018). This company are other Bangkok metro operators who is the target in this interview.

c) Grab Thailand

Grab is Southeast Asia's leading ride hailing service or Transport Network Company (TNC) who is established in Malaysia. It is the largest mobile technology company who connects millions of consumers to millions of drivers, merchants and businesses in the 21 cities across 6 countries in South East Asia. Grab provide transportation service, food delivery service, financial service, etc. Grab Thailand has been established since 2013, nowadays Grab Thailand has provided service for more than 1.2 million kilometres. (Grab, 2019). Therefore, Grab is one of the main rides hailing service in Bangkok and with this reason, Grab Thailand is one of the main focus of this interview in this research.

d) Get Thailand

Get Thailand is the ride hailing service or Transport Network Company, it is established in February 2019 from Thai funding team with Go-Jek who is the big ride hailing service from Indonesia. It provides a range of services starting from the transportation services, food and parcel delivery services in Bangkok area and expanding the service to other cities in Thailand. With these reasons, Get Thailand Company is another focus in this interview of this research.

3.4.2 Interview questions

In order to achieve the research objectives, this interview aims to get the response from the transport providers into main topics, which are the service fare strategy including the promotion or discount which will be provided to the customers, and the business collaboration perspective between metro transit and ride-hailing service that focus on the cooperation and benefit-sharing between businesses. Therefore, the main questions of this interview are as follows:

a) Service fare perspective
   - What do you think about the price elasticity of demand for your services?
   - What is the approach or strategy of providing discount or promotion in order to influence more customers in the long term?

b) Integration between metro transit and ride hailing services
   - What do you think about the First Mile Last Mile problems or the Bangkok transit? And do you have any approach for improving the accessibility for Bangkok transit?
   - What do you think about the collaboration and integration among transportation modes for the integrated transportation network?
   - What do you think about the approach for partnership between ride hailing service and metro transit in Bangkok? In order to improve the First Mile Last Mile of metro transit.
   - In case of collaboration between ride hailing service and metro transit, what type of co-promotion should be provided for the customers?
   - In case of collaboration between ride hailing service and metro transit, do you think it would be mutual benefits for the businesses?

3.5 Conduct the interview

3.5.1 Participants invitation

The main focused companies in this interview are Bangkok Expressway and Metro Public Company Limited, Bangkok Mass Transit System Public Company Limited, Grab Thailand, and Get Thailand. The researcher submitted the official invitation letter from Chulalongkorn University to these four companies in order to invite for the interview. The invitation letters inform about the information or the research, request for the participation and also inform the main questions of the interview. The four official letters are shown in Appendix B.

In the interview of this research, the participants of the interview are the management level of the main Bangkok metro operators and Ride hailing services companies in Bangkok. The researcher starts submitting the official letter from the university to invite 4 participants from 4 companies for the interview with no intention to offer any incentives to participants. However, there are only 2 responses from 2 companies, that were willing to participate in this research. Even the researcher followed up contact with another 2 companies, they were not available for giving the interview within the thesis timeline. Therefore, this research has been analysed the information and perspectives from 1 Bangkok metro operator and 1 ride hailing service company who are Bangkok Expressway and Metro public company limited and Get Thailand company, respectively.

3.5.2 Interviewing

Before the interview, all participants are informed with the Participant Information Leaflet (PIL) and if they understand and accept to take part in the interview, they are required to sign on the consent form in order to give consent for giving information in this interview to use for the research purpose. During the interview. The interview with each participant takes about 30 minutes.

3.6 Discussion

After collecting data of the opinion of the metro transit operators and ride hailing service companies from the interviews. The result and analysis which would be analysed in to achieve the research objectives are as follows:

3.6.1 Bangkok Metro's Price Elasticity.

The price elasticity of demand of Bangkok metro will be discussed whether how elastic they are, which following the discussion of the factors which affect the elasticity of metro fare in Bangkok.

3.6.2 Feasibility for providing incentives on metro transit fare

Following from the survey result, the price elasticity of demand and range of acceptable price of Bangkok metro transit, with the transport provider's perspective from the interview will be discussed. These results and analysis will be discussed whether how benefit and feasibility for providing the promotion or financial incentives on transit fare for customers.

3.6.3 Integration between Bangkok metro transit and Ride hailing service

All results from the survey and interview in this research are used to discuss for the feasibility and approach for integrating or partnership between Bangkok metro transit and ride hailing service companies. The discussion emphasizes on the approach and benefit-sharing of the integration between transport providers, together with the benefit for the Bangkok metro users from the improved first mile last mile of metro transit and seamless mobility which are able to influence people using Bangkok metro transit as the main transport mode.

Chapter 4 Results and Analysis

4.1 Number of Surveys

The researcher collected the survey data from March 2020 until May 2020, the researcher has filtered the incompleted results out and has the completed survey results left of 616 responses. However, as this survey focus on the people who used to commute with the specific Bangkok metro specific routes. After sorting the data from respondents who use to commute in each specific routes, the number of survey results which are used to analyse in each routes are as follows

- 500 responses of people who use to commute with Siam Station to Asok Station Route
- 449 responses of people who use to commute with Siam Station to Mo Chit Station Route
- 400 responses of people who use to commute with Sukhumvit Station to Silom Station Route

Each metro route gets the number of survey responses more than 400 responses, more than the number according to (KREJCIE & MORGAN, 1970) which define the needed sample of 384 samples.

4.2 General Information of survey respondents

According to the survey, the respondents are asked about their general information which are sex, age, monthly income, occupation and if they own the car or not. The results are as follows:

4.2.1 sex and age of the respondents

Table 1 Sex and Age of survey participants

Sex	Age	Number	Ratio (%)	Total Number	Total Ratio
Male	18-25	100	16.2	350	56.8
	26-35	158	25.6		
	36-60	85	13.8		
	over 60	7	1.1		
Female	18-25	76	12.3	266	43.2
	26-35	115	18.7		
	36-60	70	11.4		
	over 60	5	0.8		
Other	-	0	0	0	0
Grand Total				**616**	**100**

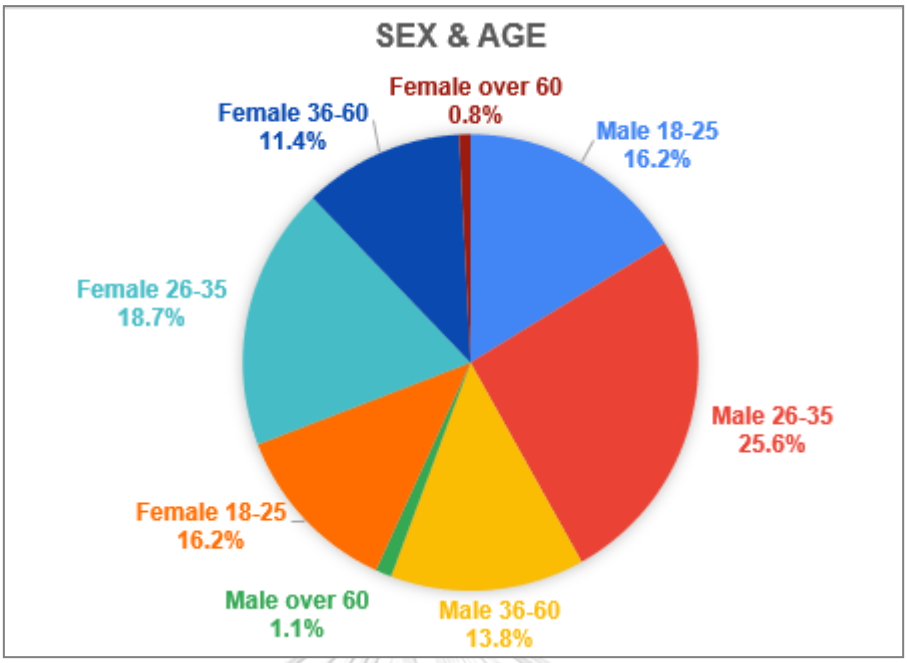


Figure 33 Sex and Age proportion of survey participants

According to Table 1 and Figure 33, there are slightly different between the proportion of participants who are male and female about 56.8 and 43.2 percent respectively. Most of the participants are in adult age between 26-35 years, both in male and female. While the number of the metro users in senior age or over 60 years old is only 12 people which are about 1.9% of all participants.

It seems that the number of Bangkok metro users of male and female have similar trends if we compare at the same range of age. In other words, the Bangkok metro users are mostly in the working-age especially in the age between 26-35 years, with a similar ratio between male and female.

4.2.2 Occupation and Monthly Income

Table 2 Occupation of Survey participants

Occupation	No.	Ratio (%)
Student	114	18.5
Government officer	68	11.0
State enterprise officer	7	1.1
Private company officer	297	48.2
Self-employed business	37	6.0
Freelance	54	8.8
Retired/Unemployed	17	2.8
Other	22	3.6
Grand Total	**616**	**100**

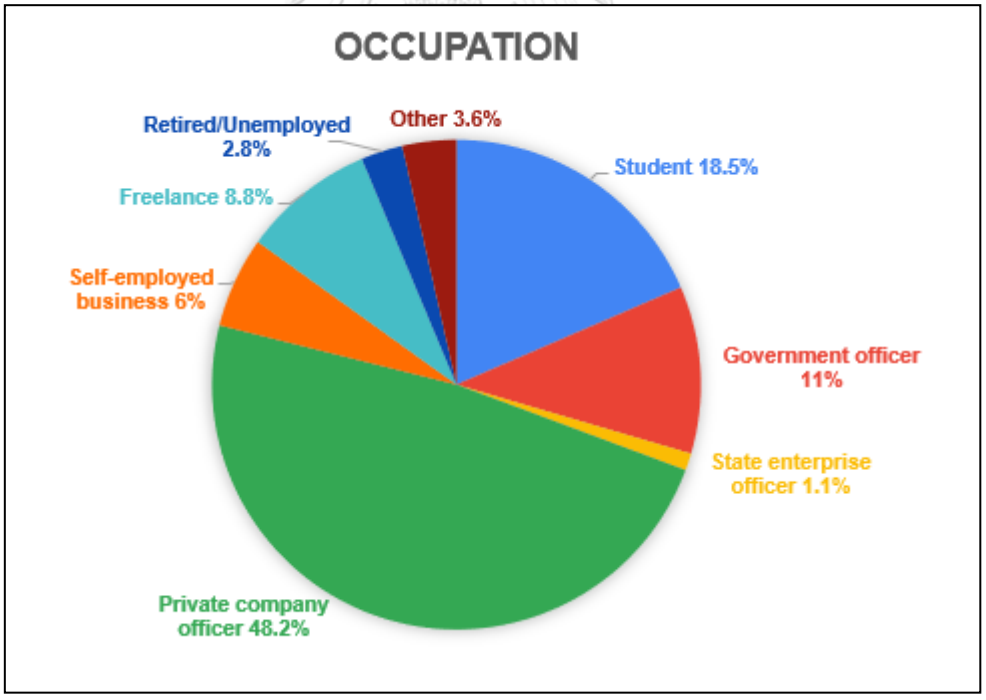


Figure 34 Occupation proportion of Survey participants

According to Table 2 and Figure 34, the most three occupations of Bangkok metro users are private company officer, student and Government officer with the proportion of 48.2%, 18.5%, and 11% respectively. These three groups have a total ratio at 77.7% of all participants.

Table 3 Monthly income of survey participants

Monthly Income (Baht)	Number	Ratio (%)
lower than 10,000	71	11.5
10,000 - 20,000	128	20.8
20,001- 30,000	148	24.0
30,001 - 50,000	136	22.1
50,001 - 100,000	77	12.5
over 100,000	56	9.1
Grand Total	**616**	**100.0**

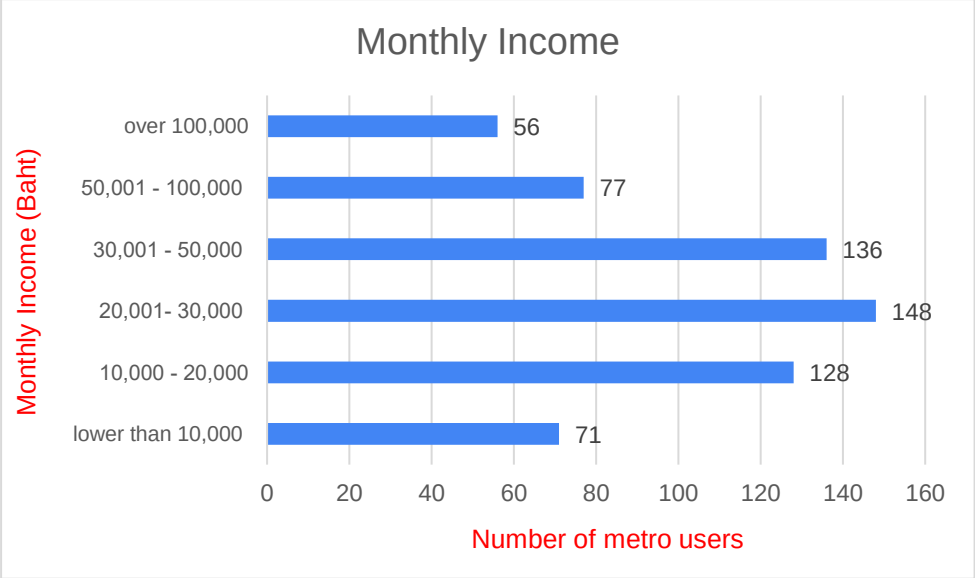


Figure 35 Monthly income proportion of survey participants

According to Table 3 and Figure 35, there is 24%% of metro users who have income between 20,001-30,000 Thai Baht per month, slightly more than the users who have income between 10,000 to 20,000 baht and 30,000 to 50,000 baht which are the ratio of 20.8% and 22.1% respectively. In other words, most of the Bangkok metro users are the low to medium income people who have monthly income between 10,000 to 50,000 baht. While only 11.5% and 9.1% of Bangkok metro users are low and high-income people with lower than 10,000 baht and over 100,000 baht per month, respectively.

These numbers significantly show that trend of commuting with Bangkok metro which is most travelling by the medium-income people.

Table 4 Occupation with Income of survey participants

Occupation	Monthly Income (Baht)	Number	Ratio (%)	Total Number	Total Ratio (%)
Student	lower than 10,000	60	52.6	114	18.5
	10,000 - 20,000	43	37.7		
	20,001- 30,000	7	6.1		
	30,001 - 50,000	3	2.6		
	over 100,000	1	0.9		
Government officer	10,000 - 20,000	17	25.0	68	11.0
	20,001- 30,000	21	30.9		
	30,001 - 50,000	16	23.5		
	50,001 - 100,000	11	16.2		
	over 100,000	3	4.4		
State enterprise officer	20,001- 30,000	4	57.1	7	1.1
	50,001 - 100,000	3	42.9		
Private company officer	lower than 10,000	2	0.7	297	48.2
	10,000 - 20,000	57	19.2		
	20,001- 30,000	88	29.6		
	30,001 - 50,000	86	29.0		
	50,001 - 100,000	35	11.8		
	over 100,000	29	9.8		
Self-employed business	lower than 10,000	1	2.7	37	6.0
	10,000 - 20,000	1	2.7		
	20,001- 30,000	6	16.2		
	30,001 - 50,000	10	27.0		
	50,001 - 100,000	7	18.9		
	over 100,000	12	32.4		
Freelance	lower than 10,000	2	3.7	54	8.8
	10,000 - 20,000	8	14.8		
	20,001- 30,000	13	24.1		
	30,001 - 50,000	14	25.9		
	50,001 - 100,000	12	22.2		
	over 100,000	5	9.3		
Retired/Unemployed	lower than 10,000	6	35.3	17	2.8
	10,000 - 20,000	2	11.8		
	20,001- 30,000	3	17.6		
	30,001 - 50,000	2	11.8		
	50,001 - 100,000	3	17.6		
	over 100,000	1	5.9		
Other	20,001- 30,000	6	27.3	22	3.6
	30,001 - 50,000	5	22.7		
	50,001 - 100,000	6	27.3		
	over 100,000	5	22.7		
Grand Total				**616**	**100**

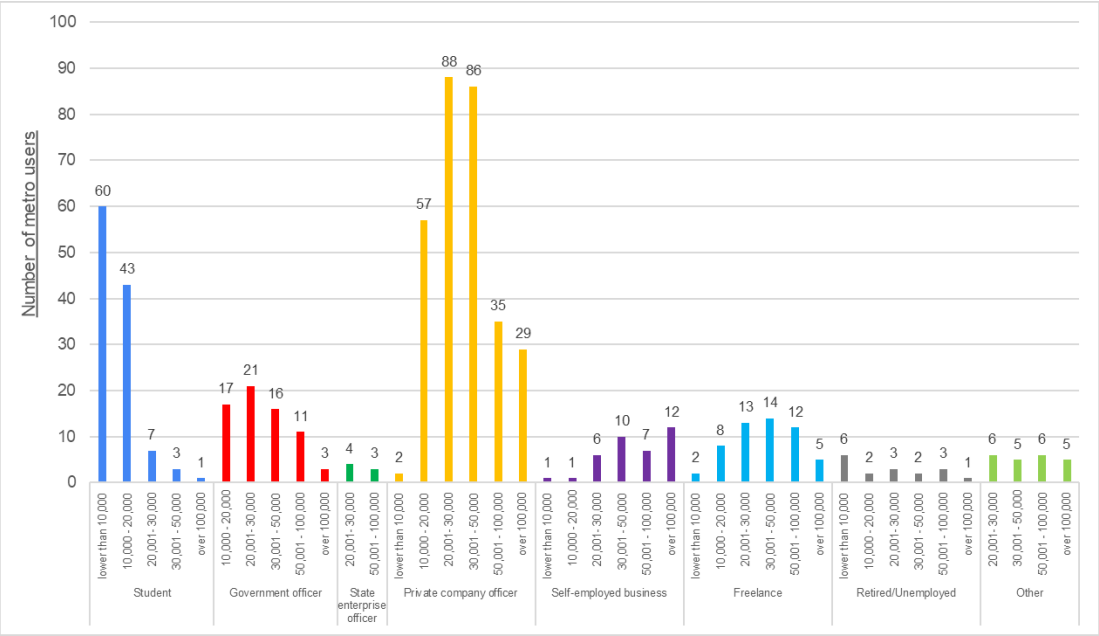


Figure 36 Occupation with Income proportion of survey participants

According to Table 4 and Figure 36, the group of occupation and income which most commute with Bangkok metro is the Private company officers who have medium-income between 10,000 to 50,000 baht. The second highest is the student who has low income, lower than 10,000 baht. The third highest number is the Government officer who has medium-income between 10,000 to 50,000 baht. These numbers illustrate that most of the Bangkok metro users are the office employee who needs to commute with the metro transit for going to work or even the students who need to take the metro for the schools or universities.

4.2.3 Car Owning

Table 5 Car owning rate of survey participants

Car Owning	Number	Ratio (%)
Yes	331	54
No	285	46
Total	**616**	**100**

Refer to Table 5, it is interesting that, the number of the Bangkok metro users who own the cars, at 54%, is slightly more than who do not own the car which is 46%. In other words, more than half of the Bangkok metro users actually own the cars

4.3 Opinion of Bangkok Metro fare

According to the survey, three routes of Bangkok metro routes are focused as follows:

- Siam station to Asok station route which its current fare is 30 Baht
- Siam station to Mo chit station route which its current fare is 44 Baht
- Sukhumvit station to Silom station route which its current fare is 23 Baht

In each of the routes, the participants who use to commute with each specific route are asked for the opinion of its fare in 4 levels which are:

- The fare which users think it is reasonable.
- The fare which users think it is expensive, but still able to purchase it.
- The fare which users think it is the highest fare to be willing to purchase.
- The fare which users think it is too cheap which may not purchase by doubt to its service quality.

The result of each focused Bangkok metro route is as follows:

4.3.1 Opinion of Siam station to Asok station route fare

The current fare of Bangkok metro in Siam station to Asok station route is 30 Baht. The number of 500 people who use to commute in this route are asked for the opinion of four levels of fare for this route.

a) The reasonable fare of Siam station to Asok station route

Table 6 The reasonable fare of Siam station to Asok station route in users' opinion

Fare (baht)	No.	Percentage
5	12	2.4
6	1	0.2
7	3	0.6
8	10	2
9	6	1.2
10	60	12
11	1	0.2
12	7	1.4
13	1	0.2
14	1	0.2
15	94	18.8
16	2	0.4
17	1	0.2
18	4	0.8
19	2	0.4
20	163	32.6
21	3	0.6
22	2	0.4
23	3	0.6
24	6	1.2
25	69	13.8
26	2	0.4
28	2	0.4
29	1	0.2
30	34	6.8
35	7	1.4
37	1	0.2
40	2	0.4
Total	**500**	**100**

Refer to Table 6 and Figure 37, there are 6.8% of the users who think that the current fare of 30 Baht is already reasonable. While there are 91.2% of users who think the fare of this route should be discounted and there are only 2% of users who think the reasonable fare of this route is more than 30 baht.

Most of the users, at 32.6%, think that the fare of this route should be 20 Baht. There are about 13.8% who think that the reasonable fare should be 25 baht and another 18.8% of users think that the reasonable fare for this route is 15 baht.

The highest fare which there are 2 users or 0.4% of all users think it is reasonable for this route is 40 baht and there are 12 users or 2.4% of all users think that the reasonable fare is 5 baht which is the lowest fare.

It is significantly shown that most of the Bangkok metro users who use to commute with this route think in the same direction that the fare of this route should be less than the current fare (30 baht) which the reasonable fare of most users opinion is 20 baht.

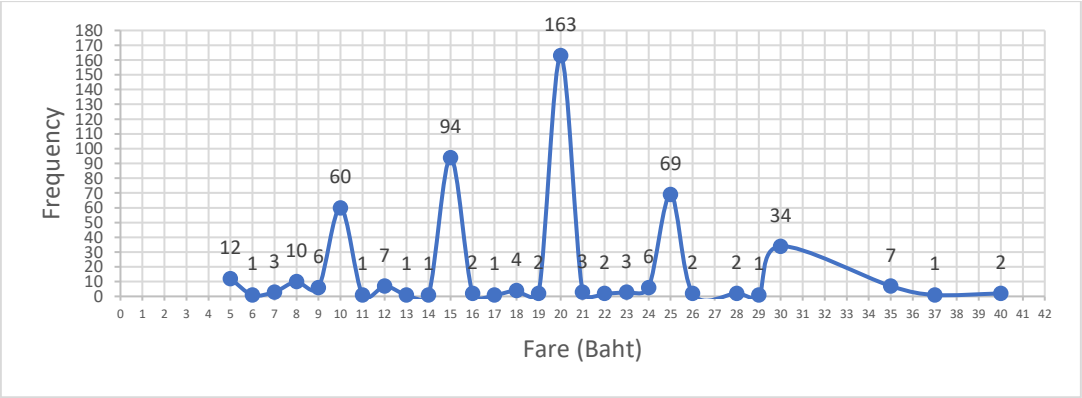


Figure 37 Frequency of reasonable fare of Siam station to Asok station route in users' opinion

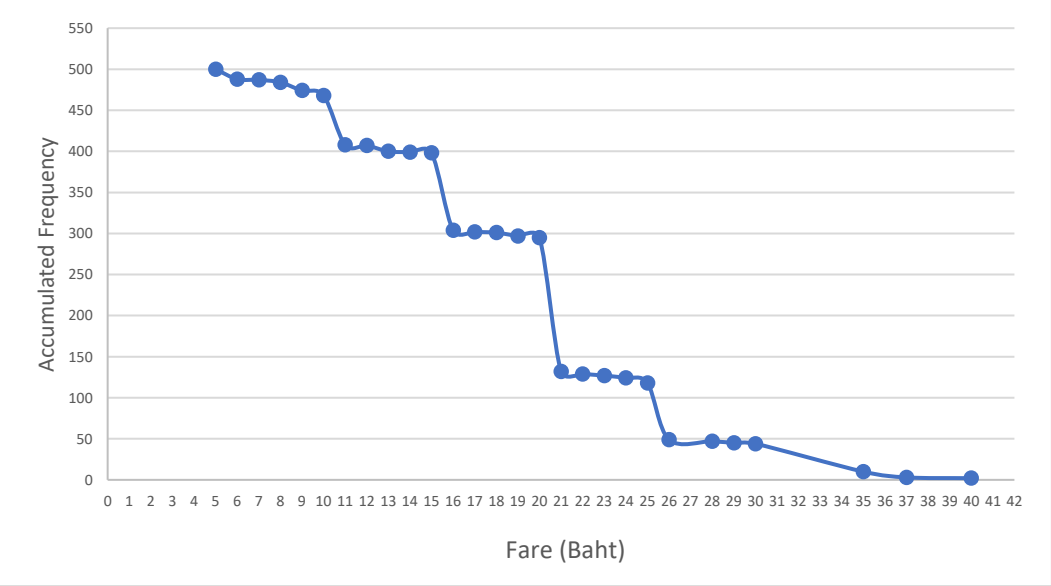


Figure 38 Accumulated frequency of reasonable fare of Siam station to Asok station route in users' opinion

a) The expensive fare, but still able to purchase of Siam station to Asok station route

Table 7 The expensive fare of Siam station to Asok station route in users' opinion

Fare (baht)	No.	Percentage
6	1	0.2
10	1	0.2
12	3	0.6
14	2	0.4
15	17	3.4
16	12	2.4
18	4	0.8
19	19	3.8
20	46	9.2
21	6	1.2
22	7	1.4
23	7	1.4
24	5	1
25	72	14.4
26	9	1.8
27	7	1.4
28	5	1
29	14	2.8
30	139	27.8
31	1	0.2
32	1	0.2
35	43	8.6
38	1	0.2
40	41	8.2
42	1	0.2
43	1	0.2
44	1	0.2
45	13	2.6
49	1	0.2
50	18	3.6
55	2	0.4
Total	**500**	**100**

Even there are 6.8% of users think that the current fare of this route(30 baht) is reasonable, according to Table 7 and Figure 39, 27.8% of users think that the current fare is expensive, following to 14.4% of users feel that it would be expensive at the fare of 25 baht.

However, there is 8.6% and 8.2% of users think that the fare of this route is expensive if it is increased to 35 baht and 40 baht, respectively. In overall, the fare of this route which most users think it is expensive are in the range of 20-30 baht. It results in Figure 40 which the accumulated frequency graph has a high slope in fare range of 20-30 baht.

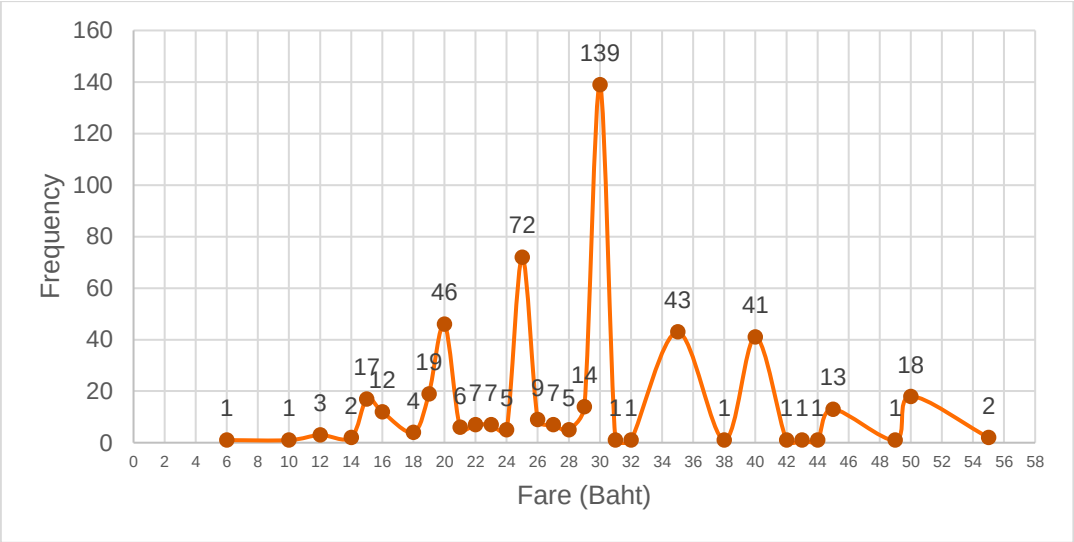


Figure 39 Frequency of expensive fare of Siam station to Asok station route in users' opinion

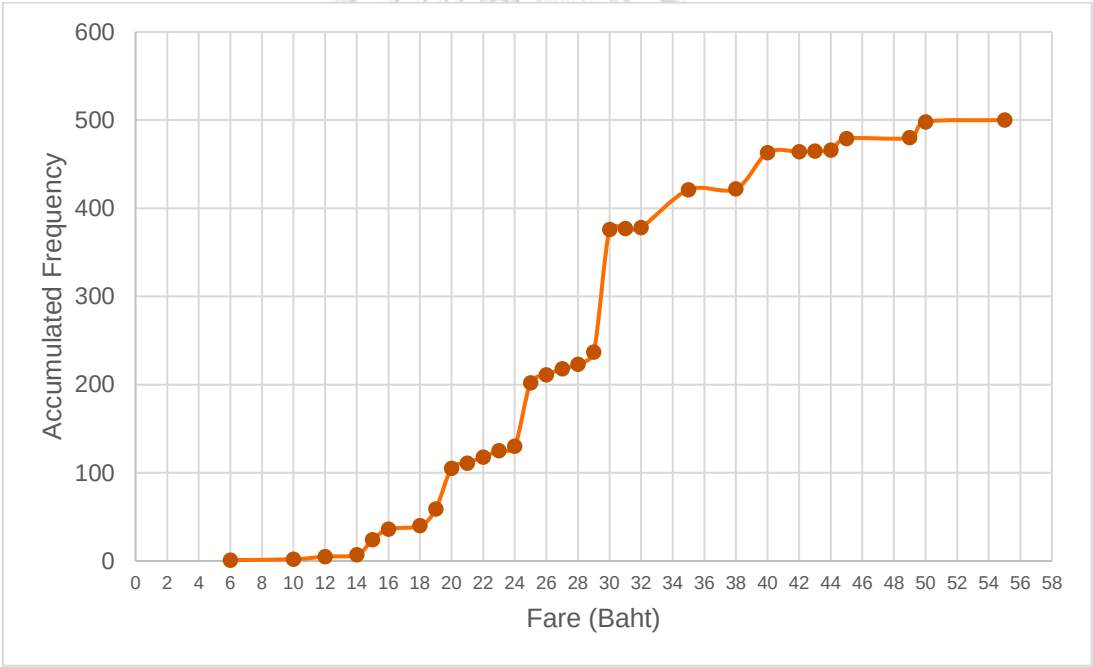


Figure 40 Accumulated frequency of expensive fare of Siam station to Asok station route in users' opinion

b) The highest fare to purchase of Siam station to Asok station route

Table 8 The highest fare of Siam station to Asok station route in users' opinion

Fare (baht)	No.	Percentage
10	1	0.2
12	1	0.2
14	1	0.2
15	8	1.6
16	5	1
18	3	0.6
19	10	2
20	34	6.8
21	6	1.2
22	5	1
23	9	1.8
24	2	0.4
25	55	11
26	5	1
27	3	0.6
28	5	1
29	15	3
30	118	23.6
31	4	0.8
32	2	0.4
33	3	0.6
35	43	8.6
36	1	0.2
38	1	0.2
40	65	13
41	1	0.2
42	2	0.4
44	1	0.2
45	14	2.8
50	40	8
52	1	0.2
55	7	1.4
60	23	4.6
65	3	0.6
70	1	0.2
80	1	0.2
100	1	0.2
Total	**500**	**100**

According to Table 8 and Figure 41, most of the users at 23.6% think that they are not willing to commute with this metro route if the fare is more than 30 baht, following to 13% and 8.6% of users will not commute with this routes if its fare is increased to more than 40 baht and 35 baht, respectively. However, there are 11% of users are not willing to commute in this route even its fare is discounted to 25 baht.

Refer to Table 7, most users of this route think the expensive fare is between 20 baht to 30 baht which is consistent to Table 8 and Figure 42 that most users will not commute in this route if its fare is increased to more than the level between 25 baht to 40 baht. And if the fare is increased to more than 60 baht, there will be only 6 users or 1.2% who are willing to pay for it.

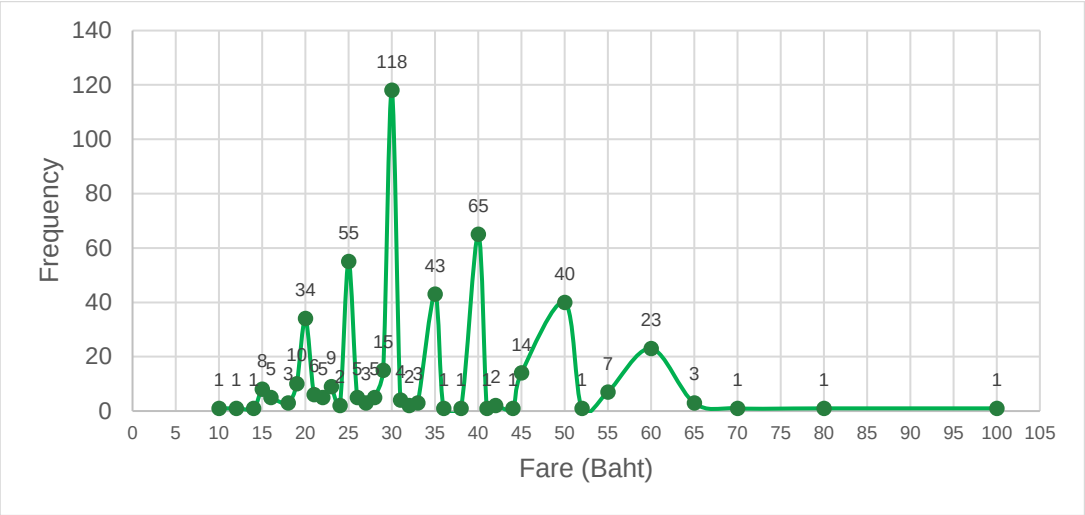


Figure 41 Frequency of the highest fare fare of Siam station to Asok station route in users' opinion

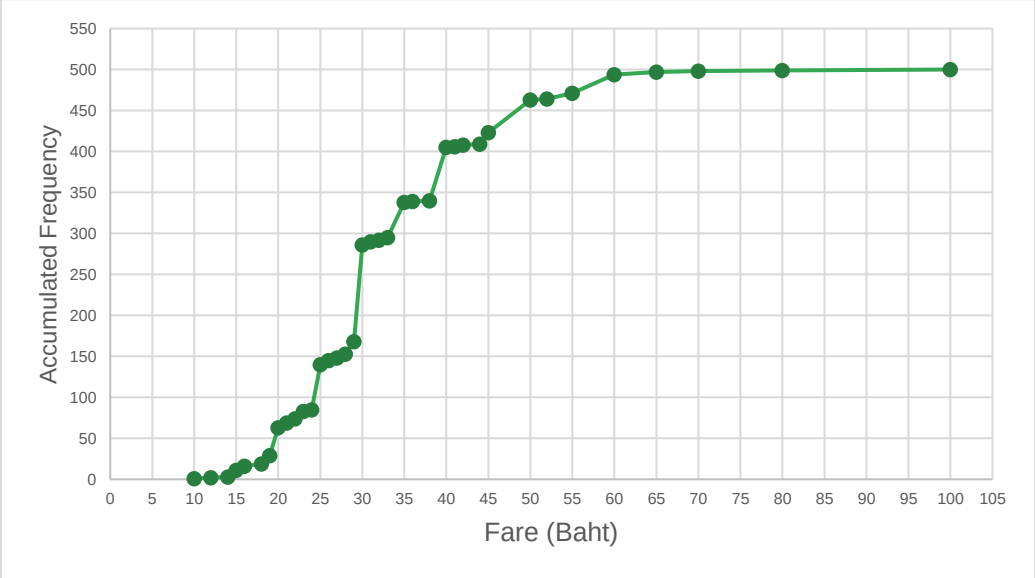


Figure 42 Accumulated frequency of the highest fare of Siam station to Asok station route in users' opinion

b) too cheap fare which may not purchase by doubt its service quality of Siam station to Asok station route

Table 9 The too cheap fare of Siam station to Asok station route in users' opinion

Fare (baht)	No.	Percentage
0	70	14
1	24	4.8
2	13	2.6
3	22	4.4
4	7	1.4
5	122	24.4
6	2	0.4
7	6	1.2
8	8	1.6
9	2	0.4
10	136	27.2
12	7	1.4
13	4	0.8
15	50	10
16	2	0.4
18	3	0.6
19	1	0.2
20	18	3.6
22	1	0.2
25	2	0.4
Total	**500**	**100**

According to Table 9 and Figure 43 , it seems that by discounting the fare to too low level is not result to increasing the demand, but on the other hand, it also affect to the confidence of users on the safety and quality of service. In reason of the metro is the mass transit which people rely on it every day, so users are really concern on the safety and reliability while commuting with metro.

Therefore, this is why there are 224 users or 44.8% will not commute with this metro route if its current fare is discounted around 66%, to 10 baht. And another 28% of users will not commute with this route if its fare down to 5 baht. Moreover, there are 70 users or 14% who are not willing to commute with this route if it is zero or free of charge.

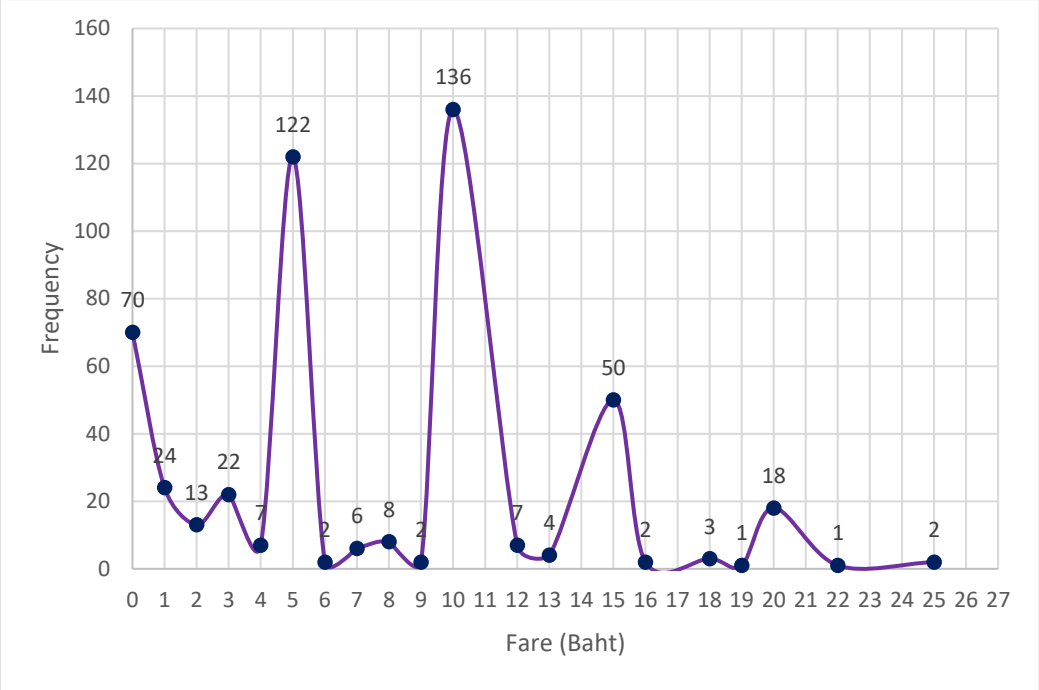


Figure 43 Frequency of too cheap fare of Siam station to Asok station route in users' opinion

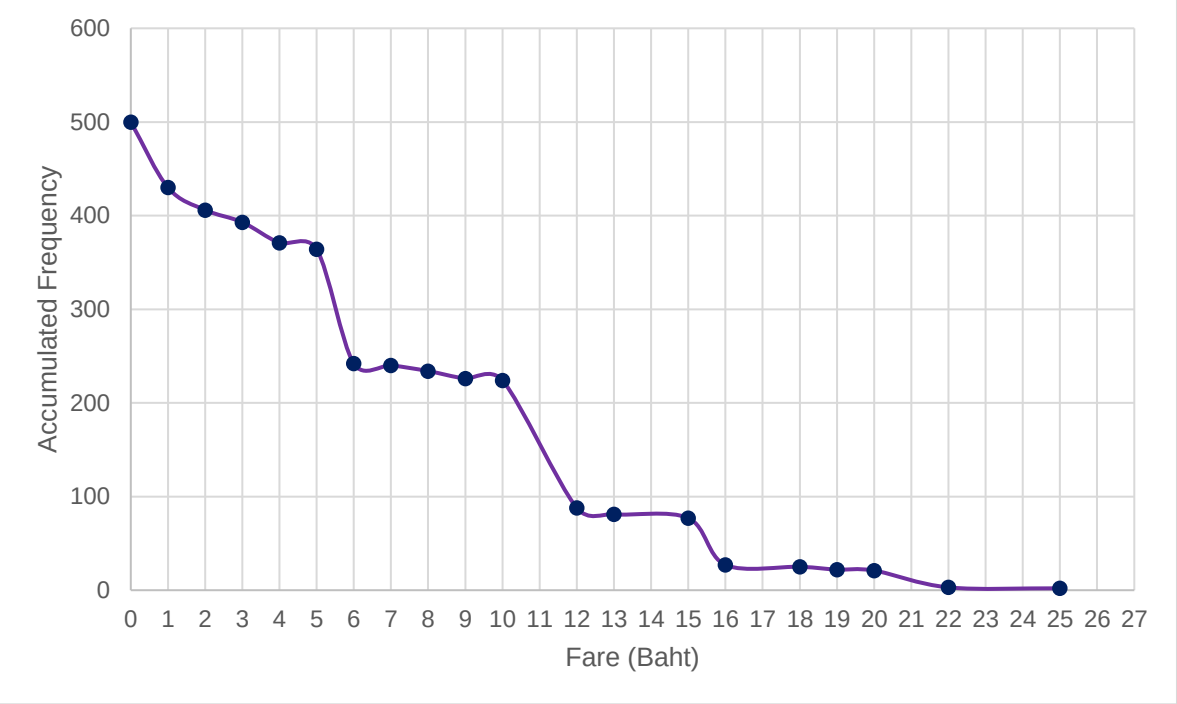


Figure 44 Accumulated frequency of too cheap fare of Siam station to Asok station route in users' opinion

4.3.2 Opinion of Siam station to Mo chit station route fare

The current fare of Bangkok metro in Siam station to Mo Chit station route is 44 Baht. The people who use to commute in this route are asked for the opinion of four levels of fare for this route.

a) The reasonable fare of Siam station to Mo chit station route

Table 10 The reasonable fare of Siam station to Mo chit station route in users' opinion

Fare (baht)	No.	Percentage
5	3	0.7
9	1	0.2
10	23	5.1
11	1	0.2
12	4	0.9
14	3	0.7
15	27	6.0
16	1	0.2
18	3	0.7
20	59	13.1
22	1	0.2
24	5	1.1
25	62	13.8
26	1	0.2
27	1	0.2
28	4	0.9
29	1	0.2
30	125	27.8
32	1	0.2
34	1	0.2
35	49	10.9
36	3	0.7
40	52	11.6
45	9	2.0
50	4	0.9
55	2	0.4
60	2	0.4
70	1	0.2
Total	**449**	**100**

According to Table 10 and Figure 45, there are only 2% of users who think that 45 baht which is close to the current fare of 44 baht is reasonable. However, most users, about 27.8%, think that 30 baht is the reasonable fare and following to 13.8% and 13.1% of users think that 25 baht and 20 baht is reasonable, respectively. However, there are only 9 users or 1.9% who think that the reasonable fare of this route is higher than 45 baht.

In overall, most users of Siam station to Mo chit station route think that the reasonable fare should be cheaper than the current fare (44 baht) that the reasonable fare in the majority of users' opinion are between 20 to 40 baht.

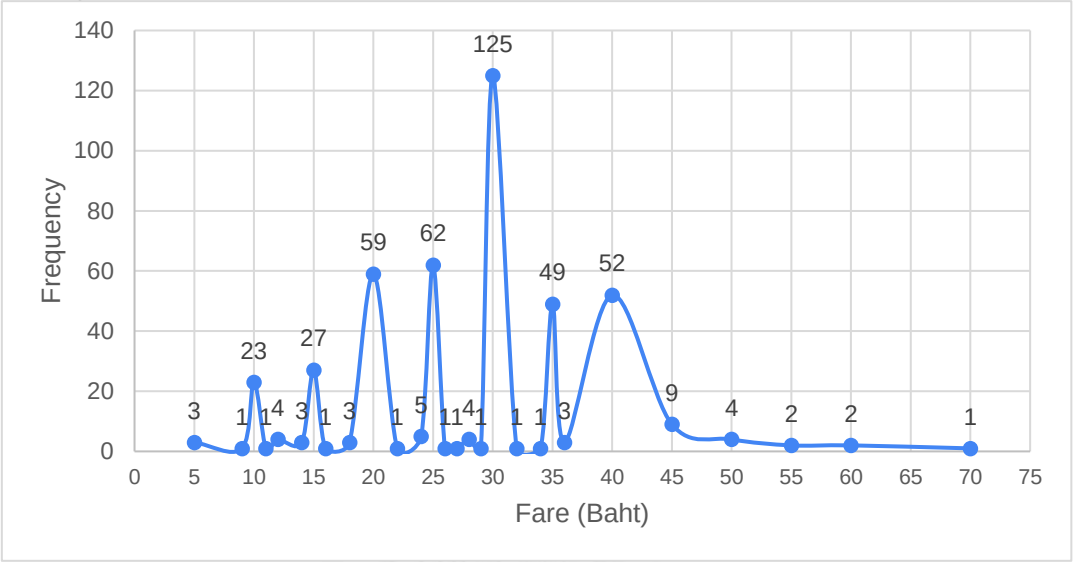


Figure 45 Frequency of reasonable fare of Siam station to Mo chit station route in users' opinion

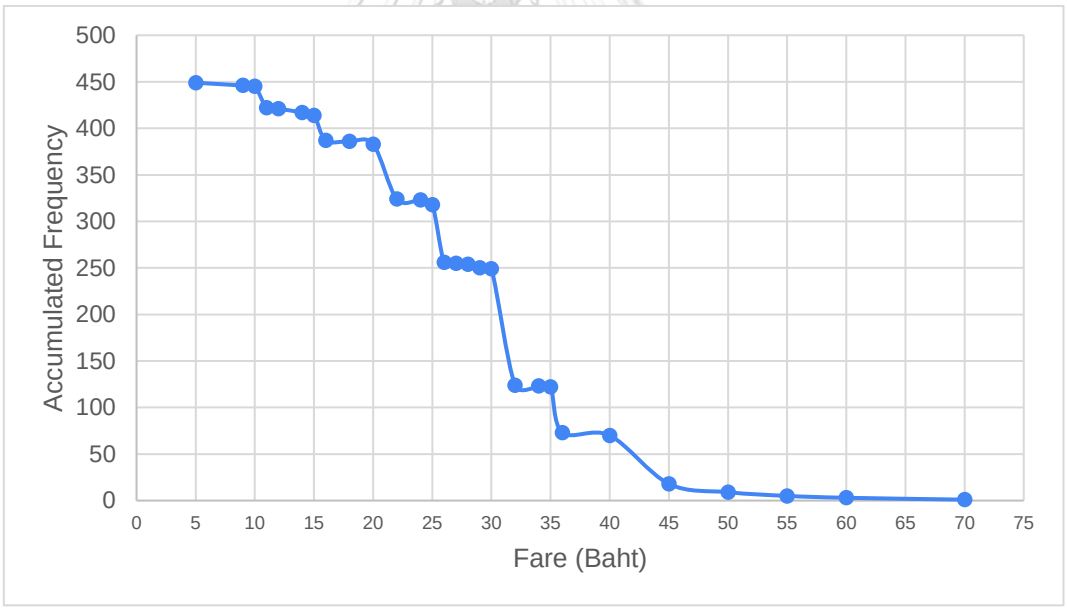


Figure 46 Accumulated frequency of reasonable fare of Siam station to Mo chit station route in users' opinion

Refer to Figure 46, most users think that the reasonable fare are between 20 baht to 40 baht, which illustrate that this accumulated frequency graph has high slope between fare length of 20-40 baht.

b) The expensive fare, but still able to purchase of Siam station to Mo chit station route

Table 11 The expensive fare of Siam station to Mo chit station route in users' opinion

Fare (baht)	No.	Percentage
15	5	1.1
16	6	1.3
17	1	0.2
18	1	0.2
19	4	0.9
20	13	2.9
21	4	0.9
22	2	0.4
23	2	0.4
24	4	0.9
25	28	6.2
26	4	0.9
27	1	0.2
28	1	0.2
29	2	0.4
30	47	10.5
31	2	0.4
32	4	0.9
33	2	0.4
34	2	0.4
35	55	12.2
37	1	0.2
38	5	1.1
39	1	0.2
40	89	19.8
41	3	0.7
42	3	0.7
43	3	0.7
44	14	3.1
45	41	9.1
48	1	0.2
50	56	12.5
55	13	2.9
59	1	0.2
60	18	4.0
65	2	0.4
70	2	0.4
80	3	0.7
90	1	0.2
100	2	0.4
Total	**449**	**100**

According to Table 11 and Figure 47, there are 14 users or 3.1% think that the current fare (44 baht) is expensive. However, most of the users,at 19.8% think that 40 baht is expensive following to 12.5%, 12.2% and another 10.5% of users think that 50 baht, 35 baht and 30 baht is the expensive fare for this route, respectively. However, there are 140 users or 31.2% think that the it would be expensive if the fare of this route increase to more than 44 baht, up to 100 baht.

In overall, for the Bangkok metro - Siam station to Mo chit station route, most users think that the expensive fare are between 35-50 baht which seem that the current fare (44 baht) is in expensive level for them.

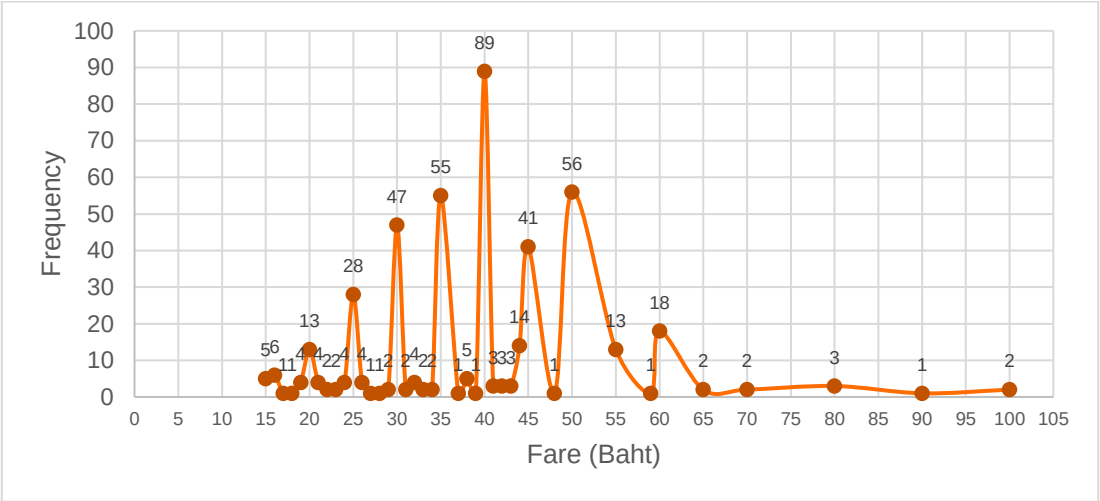


Figure 47 Frequency of expensive fare of Siam station to Mo chit station route in users' opinion

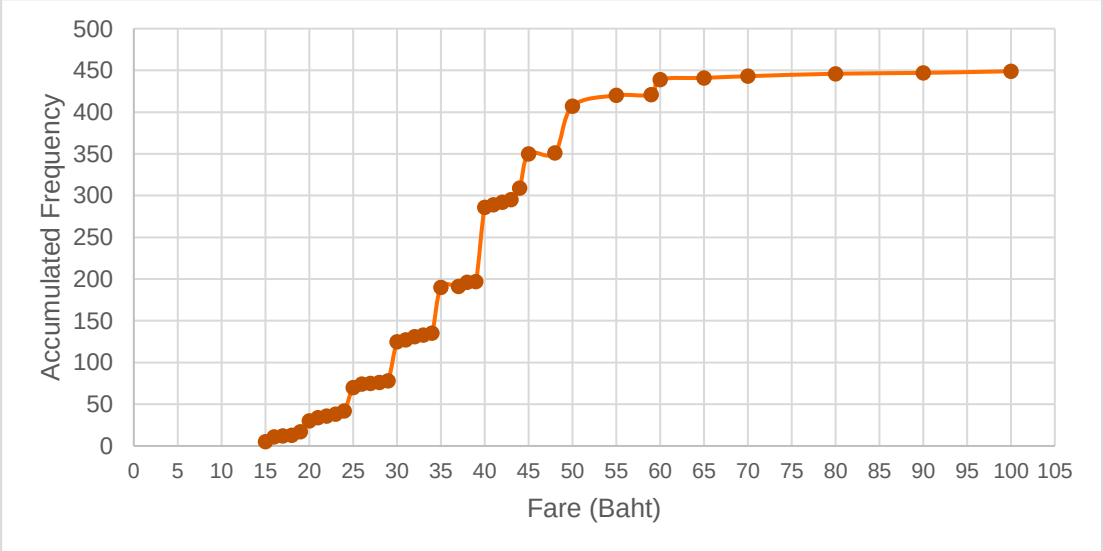


Figure 48 Accumulated frequency of expensive fare of Siam station to Mo chit station route in users' opinion

c) The highest fare to purchase of Siam station to Mo chit station route

Table 12 The highest fare of Siam station to Mo chit station route in users' opinion

Fare (baht)	No.	Percentage
15	2	0.4
18	1	0.2
19	2	0.4
20	5	1.1
21	4	0.9
23	1	0.2
24	2	0.4
25	21	4.7
26	1	0.2
28	1	0.2
29	3	0.7
30	39	8.7
31	4	0.9
32	2	0.4
33	1	0.2
34	1	0.2
35	26	5.8
36	3	0.7
37	2	0.4
38	1	0.2
39	1	0.2
40	67	14.9
41	2	0.4
42	6	1.3
43	5	1.1
44	23	5.1
45	46	10.2
46	1	0.2
48	1	0.2
49	1	0.2
50	71	15.8
51	1	0.2
53	2	0.4
55	19	4.2
60	40	8.9
65	6	1.3
69	1	0.2
70	16	3.6
80	10	2.2
90	1	0.2
95	2	0.4
100	2	0.4
120	2	0.4
130	1	0.2
Total	**449**	**100**

Refer to Table 12 and Figure 49, 5.1% of users think that the current fare or 44 baht is the highest fare to pay for commuting in this route, following to 14.9%, 15.8% and 8.9% of users think that 40 baht, 50 baht and 60 baht are the highest fare they are willing to pay for this route, respectively. In other words, If the fare of this route is increased to 50 baht, 61.2% of users will not commute with this route because they think it is too expensive.

Moreover, if its fare is increased to 100 baht, there will be only 5 users or 1% who still pay for commuting with this metro route. However, the highest fare which is accepted is 130 baht which there is only 1 user accept this fare.

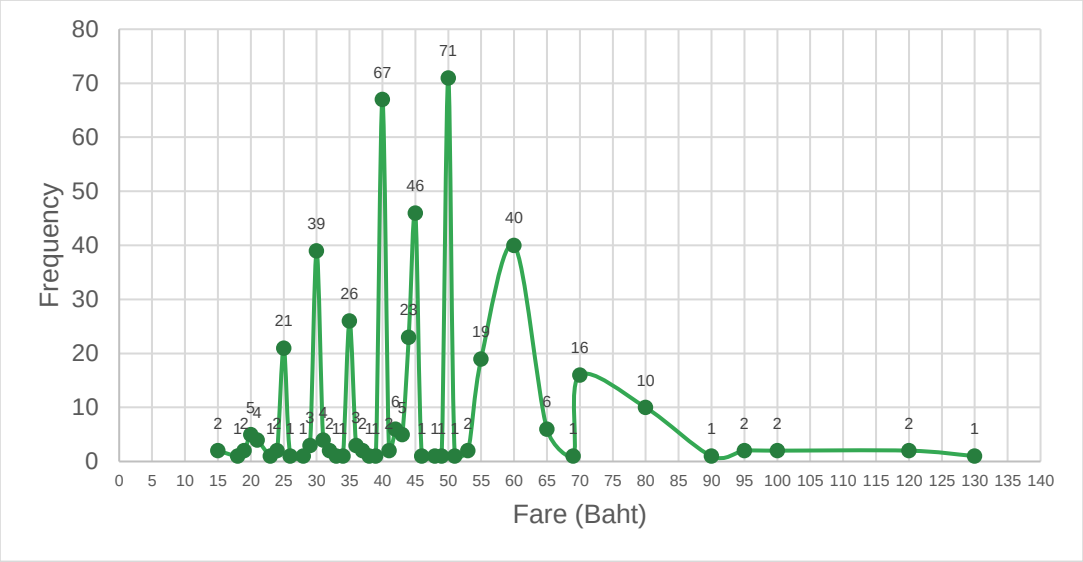


Figure 49 Frequency of the highest fare of Siam station to Mo chit station route in users' opinion

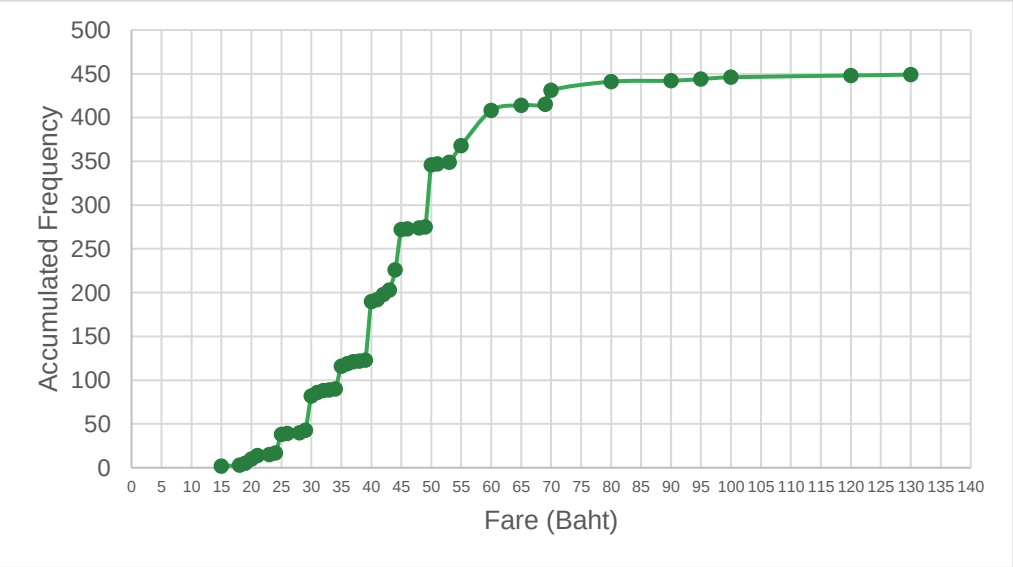


Figure 50 Accumulated frequency of the highest fare of Siam station to Mo chit station route in users' opinion

According to Figure 50, In overall, most users of Siam station to Mo Chit station route think that the fare which is too expensive to pay for is between 40 – 60 baht, that is high slope in this price range of the accumulated frequency graph.

d) too cheap fare which may not purchase by doubt to its service quality of Siam station to Mo chit station route

Table 13 The too cheap fare of Siam station to Mo chit station route in users' opinion

Fare (baht)	No.	Percentage
0	59	13.1
1	7	1.6
2	11	2.4
3	7	1.6
4	8	1.8
5	60	13.4
6	5	1.1
7	3	0.7
8	6	1.3
9	3	0.7
10	111	24.7
12	3	0.7
13	1	0.2
14	1	0.2
15	70	15.6
16	2	0.4
18	1	0.2
19	3	0.7
20	67	14.9
22	2	0.4
23	1	0.2
25	8	1.8
29	1	0.2
30	5	1.1
35	2	0.4
40	2	0.4
Total	**449**	**100**

According to Table 13 and Figure 51, there are 111 users or 24.7% who think that if the fare is discounted to 10 baht, they will not travel with this metro route, following to another 15.6%, 14.9%, who think the too-cheap fare of this metro route are 15 baht and 20 baht, respectively. Moreover, 59 users or 13.1% of users think that zero or free of charge is the too-cheap fare level of this route and will deny travelling in this route because they think it is too cheap and doubt with its service quality and safety.

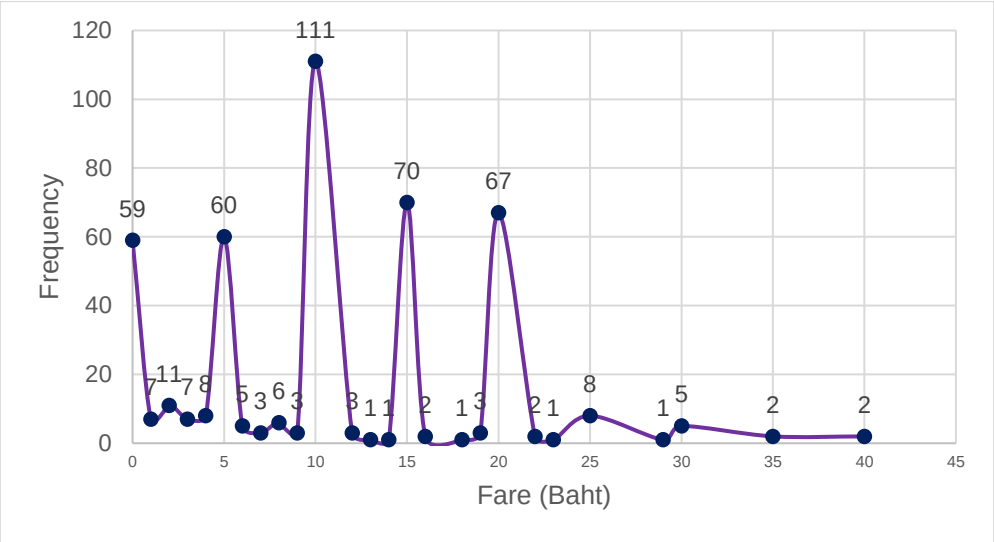


Figure 51 Frequency of too cheap fare of Siam station to Mo chit station route in users' opinion

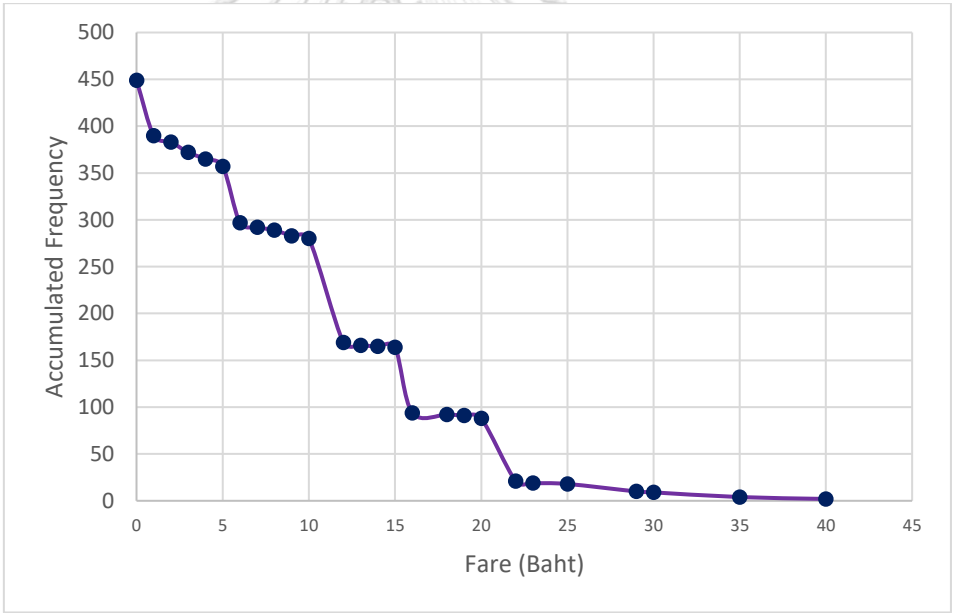


Figure 52 Accumulated frequency of too cheap fare of Siam station to Mo chit station route in users' opinion

Refer to Figure 52, there are high slope in the accumulated frequency graph between fare length of 0 baht to 20 baht, which mean that the fare that is too cheap for this route in their opinion are between free of charge to 20 baht.

4.3.3 Opinion of Sukhumvit station to Silom station route fare

The current fare of Bangkok metro in Sukhumvit station to Silom station route is 23 Baht. The people who use to commute in this route are asked for the opinion of four levels of fare for this route.

a) The reasonable fare of Sukhumvit station to Silom station route

Table 14 The reasonable fare of Sukhumvit station to Silom station route in users' opinion

Fare (baht)	No.	Percentage
5	17	4.3
7	6	1.5
8	7	1.8
9	5	1.3
10	42	10.5
12	5	1.3
14	3	0.8
15	63	15.8
16	1	0.3
17	1	0.3
18	7	1.8
19	1	0.3
20	122	30.5
21	1	0.3
22	4	1.0
23	8	2.0
24	5	1.3
25	50	12.5
28	1	0.3
29	1	0.3
30	33	8.3
35	11	2.8
40	6	1.5
Total	**400**	**100**

According to Table 14 and Figure 53, for Sukhumvit station to Silom station route, 30.5% of the users think that 20 baht is the reasonable fare of this route. Following to 15.8% and 10.5% of users think that the current fare of this route (23 baht) should be discounted to 15 baht and 10 baht respectively. On the other hand, 12.5% and 8.3% of users think that the reasonable fare for this route can be increased to 25 baht and 30 baht, respectively.

In overall, refer to Figure 54, the accumulated frequency graph of the reasonable fare has high slope between the fare range of 15 baht to 25 baht, which mean that most users think that between 15 baht to 25 baht is the reasonable fare for Sukhumvit station to Silom station route.

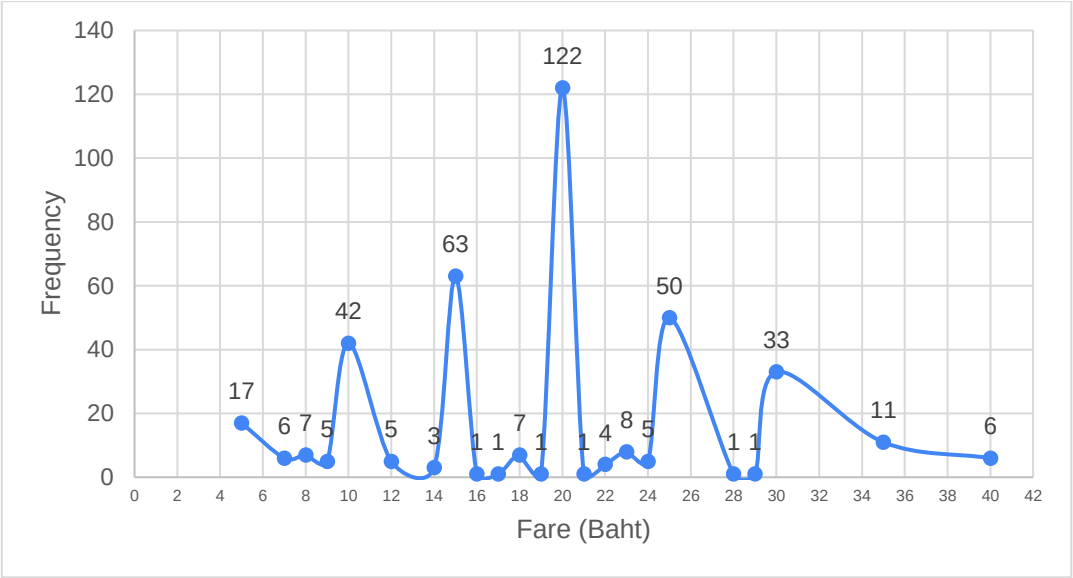


Figure 53 Frequency of reasonable fare of Sukhumvit station to Silom station route in users' opinion

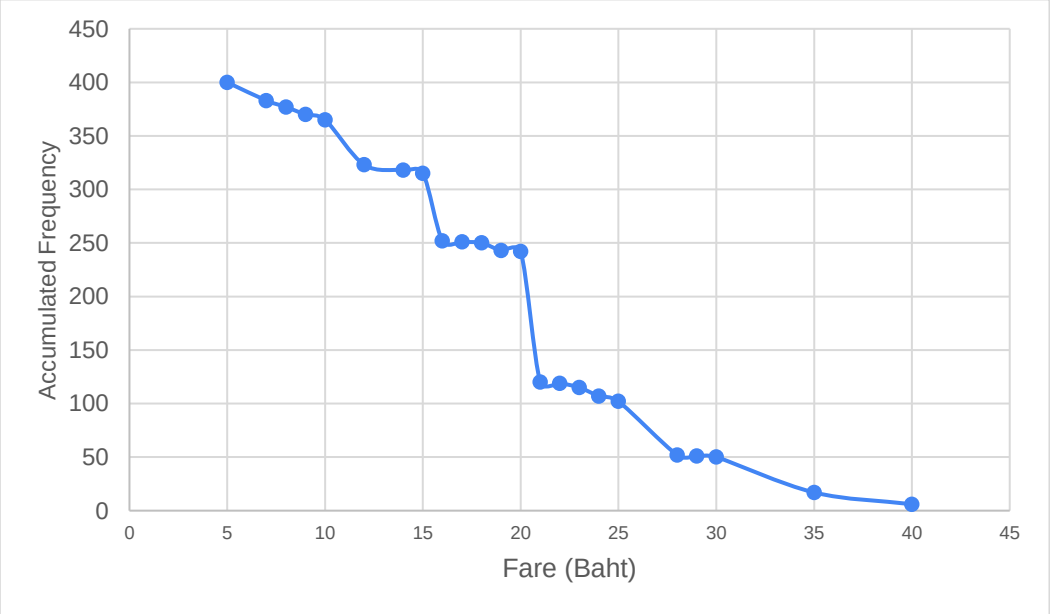


Figure 54 Accumulated frequency of reasonable fare of Sukhumvit station to Silom station route in users' opinion

b) The expensive fare, but still able to purchase of Sukhumvit station to Silom station route

Table 15 The expensive fare of Sukhumvit station to Silom station route in users' opinion

Fare (baht)	No.	Percentage
10	2	0.5
11	1	0.3
12	1	0.3
13	1	0.3
14	5	1.3
15	2	0.5
16	27	6.8
17	3	0.8
18	5	1.3
19	20	5.0
20	30	7.5
21	7	1.8
22	2	0.5
23	22	5.5
24	2	0.5
25	75	18.8
26	3	0.8
27	2	0.5
28	6	1.5
30	61	15.3
33	2	0.5
35	43	10.8
36	3	0.8
38	1	0.3
40	37	9.3
45	16	4.0
50	17	4.3
55	1	0.3
60	2	0.5
75	1	0.3
Total	**400**	**100**

According to Table 15 and Figure 55, there are 75 users or 18.8% of users think that 25 baht is the expensive fare of this route, following to another 15.3%, 10.8% and 9.3% of users think that 30 baht, 35 baht and 40 baht are the expensive fare, respectively. In overall, as in Figure 56, most of the users think that the expensive fare of this route is between 25 baht to 40 baht which the accumulated frequency graph has a high slope between this fare range.

It is consistent that most users of Sukhumvit station to Silom station route think that the reasonable fare is 15 baht to 25 baht and following to think that 25 baht to 40 baht are the expensive fare level of this route.

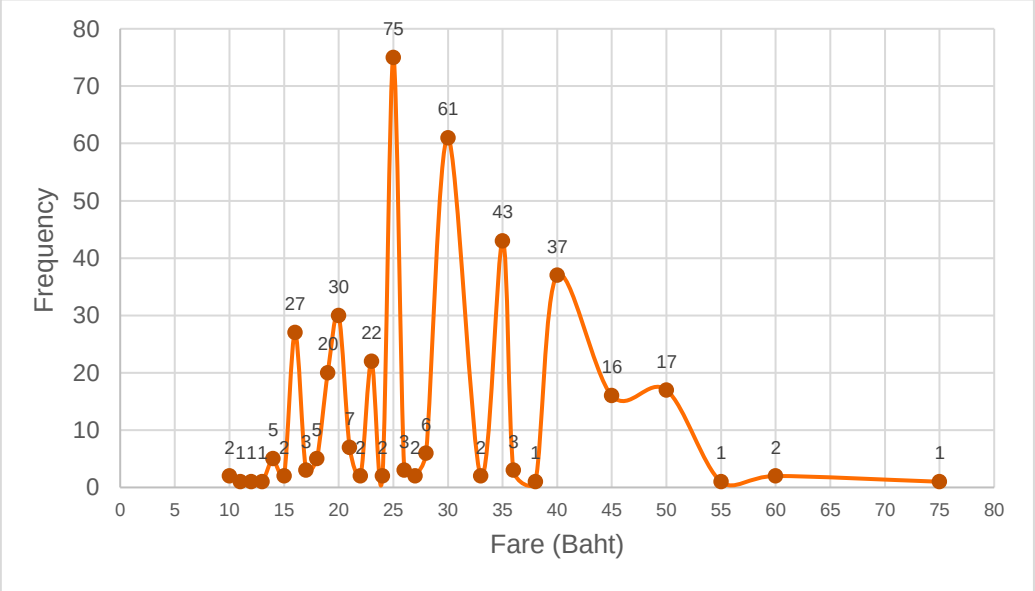


Figure 55 Frequency of expensive fare of Sukhumvit station to Silom station route in users' opinion

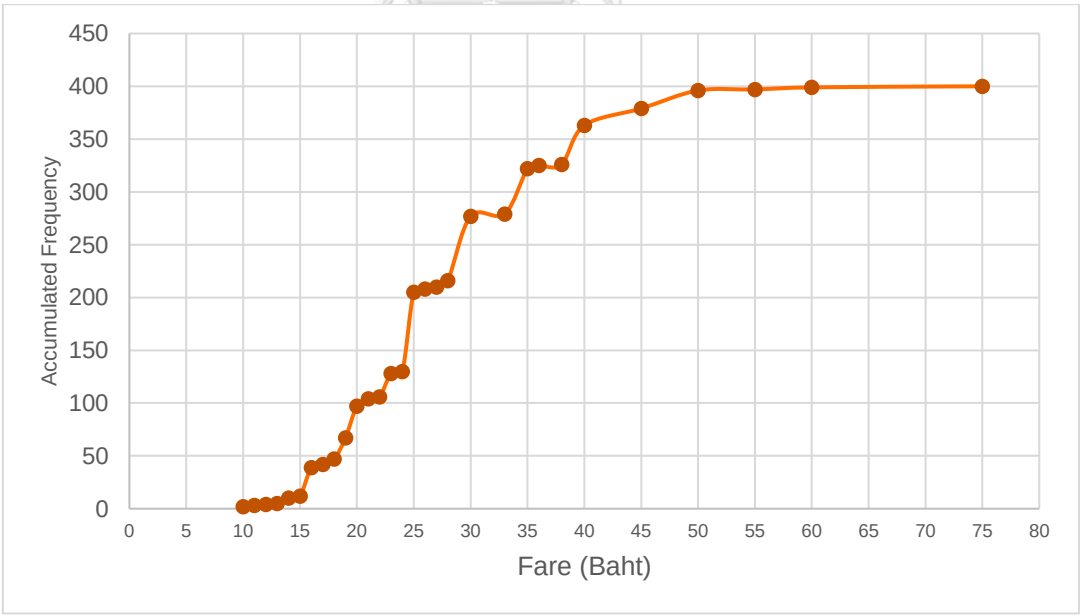


Figure 56 Accumulated frequency of expensive fare of Sukhumvit station to Silom station route in users' opinion

c) The highest fare to purchase of Sukhumvit station to Silom station route

Table 16 The highest fare of Sukhumvit station to Silom station route in users' opinion

Fare (baht)	No.	Percentage
10	1	0.3
15	1	0.3
16	7	1.8
17	1	0.3
18	1	0.3
19	8	2.0
20	11	2.8
21	8	2.0
23	39	9.8
24	8	2.0
25	56	14.0
26	6	1.5
28	4	1.0
29	4	1.0
30	63	15.8
32	4	1.0
33	1	0.3
35	25	6.3
36	1	0.3
38	1	0.3
39	1	0.3
40	54	13.5
42	2	0.5
44	2	0.5
45	18	4.5
46	1	0.3
48	1	0.3
50	27	6.8
52	1	0.3
55	9	2.3
60	23	5.8
65	2	0.5
68	1	0.3
70	4	1.0
80	2	0.5
85	1	0.3
130	1	0.3
Total	**400**	**100**

According to Table 16 and Figure 57, the fare range which users think it is highest fare they are willing to pay for this route are between 25 baht to 40 baht and higher. There are 39 users or 9.8% who think that the current fare (23 baht) is the highest fare to pay for this route. While most users or 15.8% think that if the fare is increased to more than 30 baht, they will deny to

commute with this metro routes, following to 6.3%, 13.5%, 6.8% of users will deny to pay for commuting with this route if its fare is increased to more than 35 baht, 40 baht, and 50 baht, respectively.

Moreover, if the fare is increased to 100 baht, there are only 1 user or 0.3% who will still pay for commuting with this metro route. The highest fare which is accepted is 130 baht.

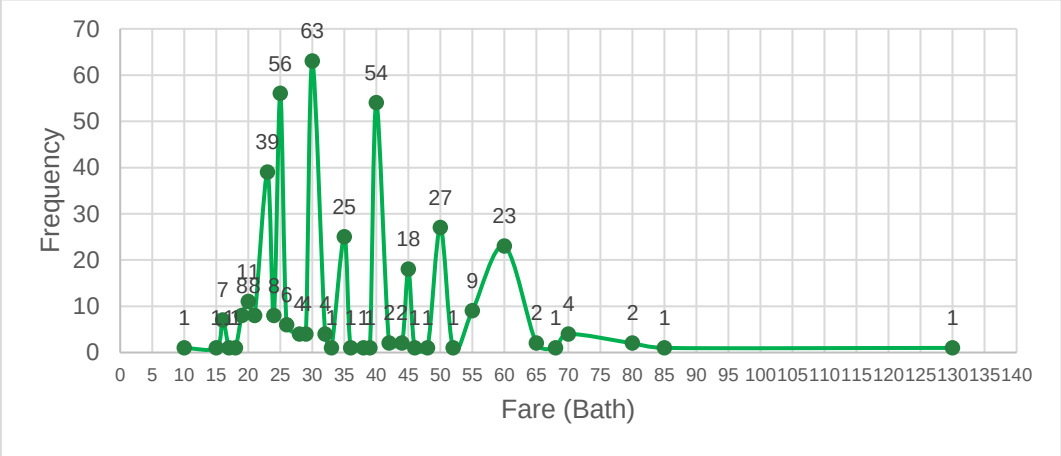


Figure 57 Frequency of the highest fare of Sukhumvit station to Silom station route in users' opinion

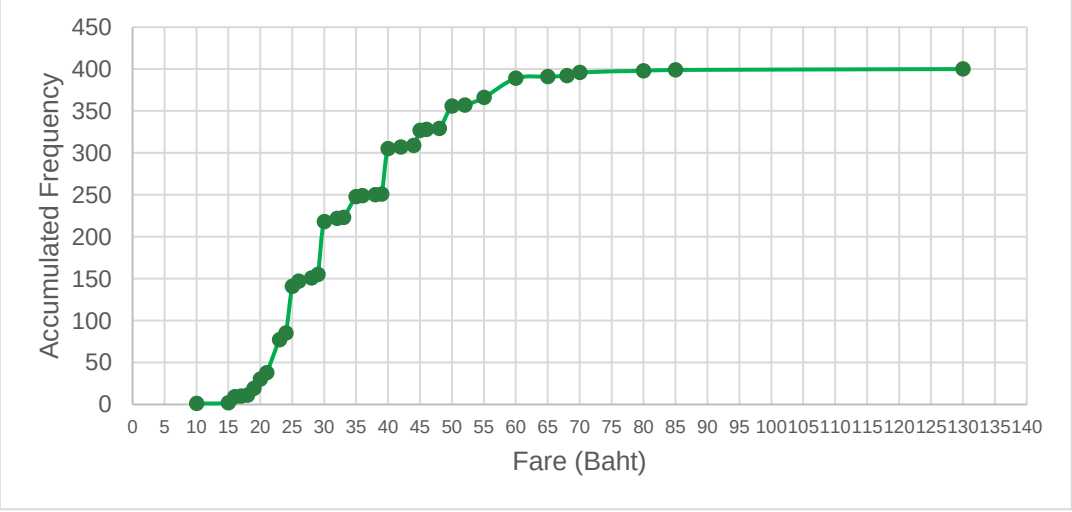


Figure 58 Accumulated frequency of the highest fare of Sukhumvit station to Silom station route in users' opinion

d) too cheap fare which may not purchase by doubt to its service quality of Sukhumvit station to Silom station route

Table 17 The too cheap fare of Sukhumvit station to Silom station route in users' opinion

Fare (baht)	No.	Percentage
0	63	15.8
1	16	4.0
2	15	3.8
3	24	6.0
4	3	0.8
5	83	20.8
6	1	0.3
7	3	0.8
8	3	0.8
9	2	0.5
10	107	26.8
11	1	0.3
12	4	1.0
13	4	1.0
14	1	0.3
15	46	11.5
16	3	0.8
17	1	0.3
18	4	1.0
19	1	0.3
20	13	3.3
25	2	0.5
Total	**400**	**100**

According to Table 17 and Figure 59, for Bangkok metro - Sukhumvit station to Silom station route, 107 users or 26.8% think that 10 baht is too cheap fare level because they doubt its service quality. Following to 20.8%, 15.8% and 11.5% of users think that the fare which is too cheap are 5 baht, free of charge and 15 baht, respectively. In other words, if the fare of this route is discounted to 10 baht, 46.8% of users will deny commuting with this metro route because they doubt with the service quality.

In overall, the fare level which users think they are too cheap for this route are between free of charge to 10 baht as shown in Figure 60 which there is high slope between these fare range.

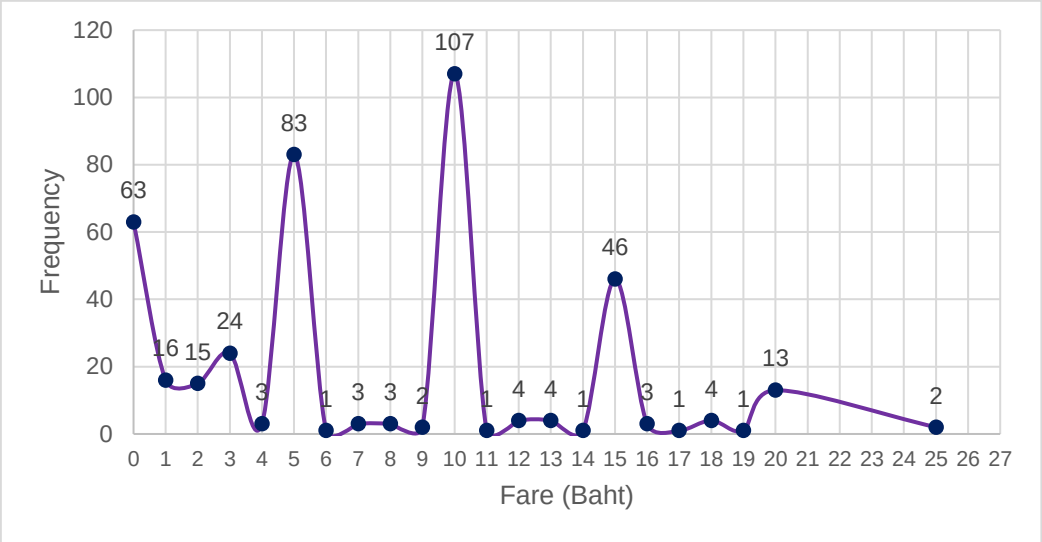


Figure 59 Frequency of too cheap fare of Sukhumvit station to Silom station route in users' opinion

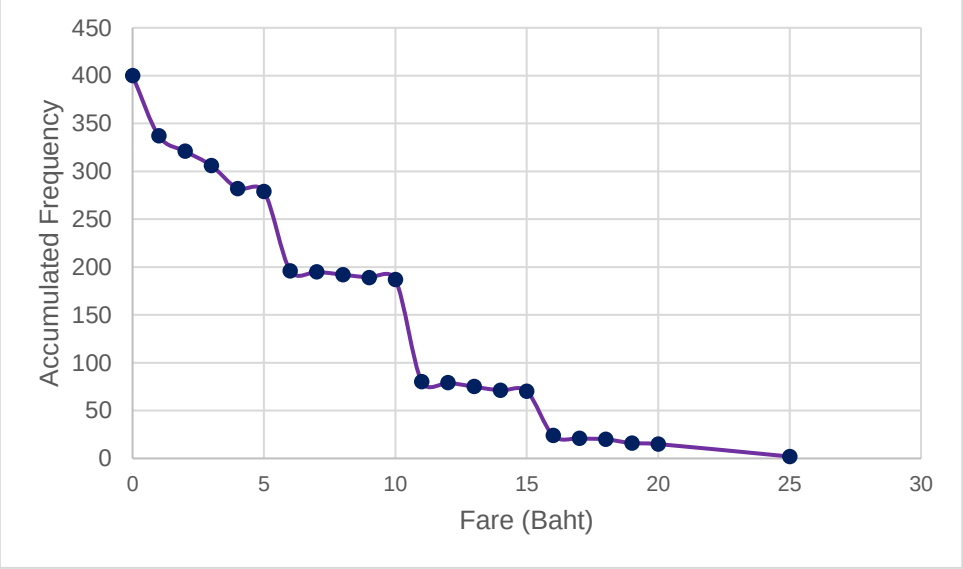


Figure 60 Accumulated frequency of too cheap fare of Sukhumvit station to Silom station route in users' opinion

4.4 Price Elasticity of Demand and Total Revenue Test

For analysing the price elasticity of demand and total revenue test of the survey result, there are 3 analysis are used as follows:

- Price elasticity from the Demand curve (Point Elasticity)
  Price elasticity of demand for each focused Bangkok metro route is used to analyse how the change of the metro commuting demand to the change of its fare. First, the demand curve which is the relation between the number of metro users and the reasonable fare on their opinion with its trend graph is plotted with the Trendline Function of Microsoft Excel Software. According to the price elasticity of demand formula, the price elasticity of demand coefficient is calculated from the demand curve's formula as below:

$$price\ elasticity\ of\ demand\ coefficient\ (E_d) = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ price}$$

$$E_d = \frac{\Delta Q_i / Q_i}{\Delta P_i / P_i} = \frac{\Delta Q_i}{\Delta P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial Q_i}{\partial P_i} \times \frac{P_i}{Q_i}$$

When E_d = price elasticity of demand coefficient

$\frac{\partial Q_i}{\partial P_i}$ = differentiation of the demand curve with respect to the price.

Q_i = the demand for product or service i

P_i = the price of product or service i

- Price elasticity from the formula (Average Elasticity)

  Another way to analyse the price elasticity of demand coefficient is calculating from the formula below with input from the survey results.

$$E_d = \frac{\Delta Q_i / Q_i}{\Delta P_i / P_i} = \frac{\Delta Q_i}{\Delta P_i} \times \frac{P_{i-avg}}{Q_{i-avg}}$$

When E_d = price elasticity of demand coefficient

Δ = the change

$Q_{i\text{-}avg}$ = the average demand for product or service i

$P_{i\text{-}avg}$ = the average price of product or service i

- Total revenue Test

  Moreover, after analysing the price elasticity of demand coefficient, the total revenue test are conducted.

  In case the metro fare is inelastic to demand, the price and total revenue are direct to each other as follows:
  If the price is increased → the total revenue is increased
  If the price is discounted → the total revenue is decreased

  On the other hand, in case the metro fare is elastic to demand, the price and total revenue are inverse to each other as follows:
  If the price is increased → the total revenue is decreased
  If the price is discounted → the total revenue is increased

  The example of the estimation of total revenue base on the different fare rate of Bangkok metro operation on a weekday is shown. According to (AirportRailLink, 2018), the passenger density on Bangkok metro system in different time of the day on weekday are specified, together with (NationalAcademiesofSciences, 2013), the estimated density of passenger load for the normal load is 3 standing passenger per sq.m. , the high-density passenger load is 5 standing passenger per sq.m. and the crushing load is 6 standing passenger per sq.m, while the sparse passenger load is assumed to have only the seated passengers as are shown in Figure 61.

  According to Table 18, refer to (BTSC, 2018), the number of trips per day of Bangkok metro operation is set by the different period of the day which has been operated in different trip frequency. The number of 252 trips per day has been estimated to be operated on weekday.

  These passenger densities and number of trips per day on a weekday are used to calculate the average passengers per day on a weekday of each focused metro route and calculating their demand and daily total revenue of each route.

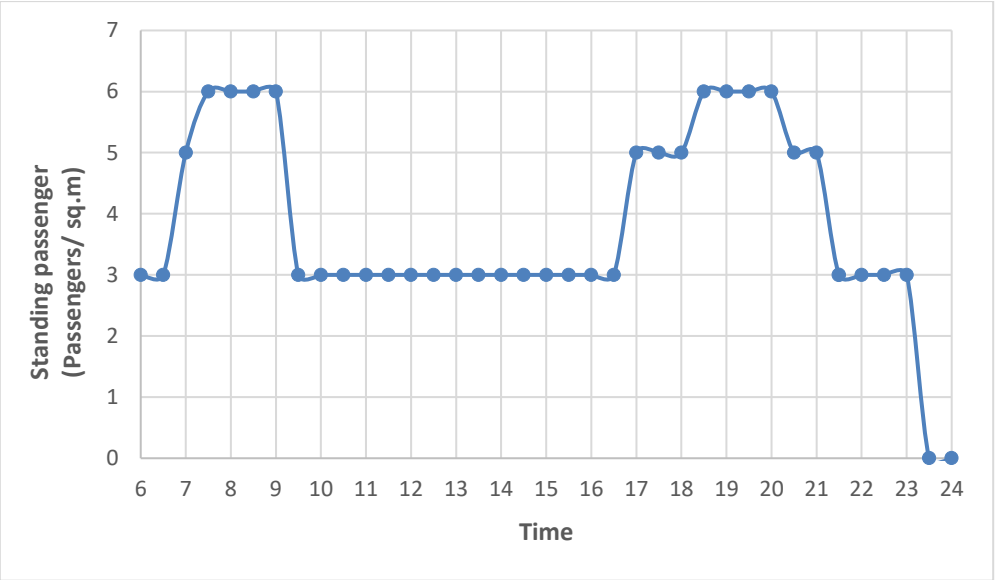


Figure 61 Pessenger Density on Bangkok metro system on weekday

Table 18 number of trips per day of metro operation on weekday

Time	Time duration between trips (mins:sec)	Number of trips
6:00 - 7:00	5:00	12
7:00-9:00	2:40	45
9:00 - 9:30	3:35	9
9:30 - 16:00	6:30	60
16:00-16:30	4:25	7
16:30-17:00	2:40	12
17:00-20:00	2:40	68
20:00-21:00	4:25	14
21:00-22:00	6:00	10
22:00-24:00	8:00	15
Total		**252**

4.4.1 Survey Analysis of Siam station to Asok station route

a) Point elasticity from Demand curve of Siam station to Asok station route

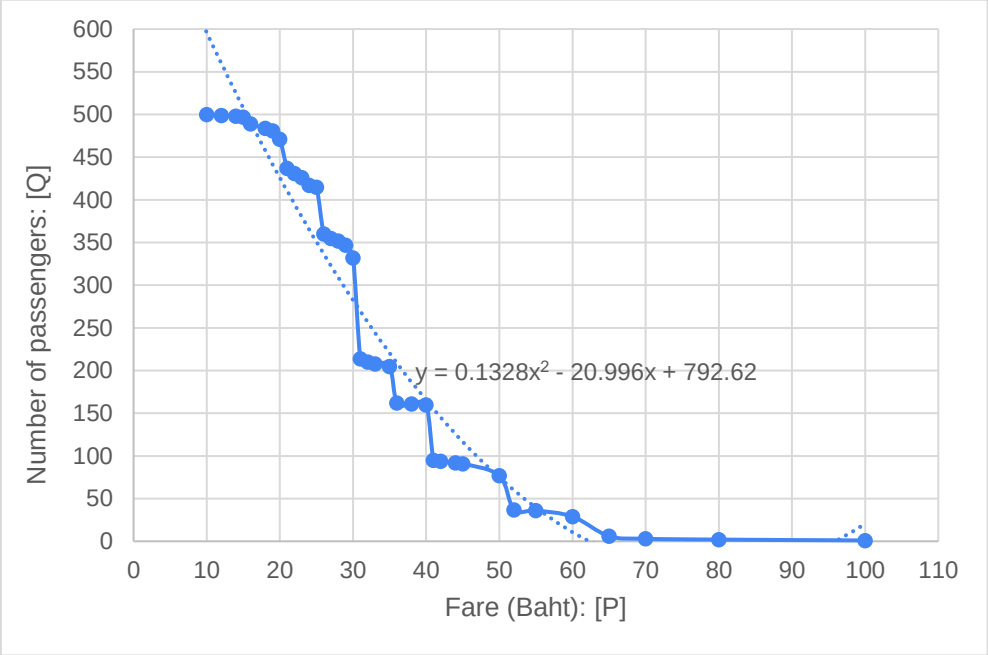


Figure 62 Demand Curve of Siam station to Asok station route

According to Figure 62, the Demand curve of Siam station to Asok station route are shown which is plotted from the too expensive fare opinion data. The trend curve of demand graph is plotted by the Trendline Function of Microsoft Excel Software. The formula for trend curved line of the demand graph of Siam station to Asok station route is

$Q = 0.1328P^2 - 20.996P + 792.62$

The price elasticity of demand coefficient of Bangkok metro Siam station to Asok station route is calculated from the formula for trend curved line of its reasonable fare graph as follow:

When P_i is the current fare of Siam station to Asok station route is 30 Baht

Q_i is the demand at the current fare of this route is 332 users (refer to Table 8)

$$E_d = \frac{\Delta Q_i}{\Delta P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial Q_i}{\partial P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial \left(0.1328P^2 - 20.996P + 792.62\right)}{\partial P} \times \frac{30}{332}$$

$$E_d = [0.2656P - 20.996] \times \frac{30}{332}$$

In case of the fare of Siam station to Asok station route is discounted from current fare of 30 Baht to 25 Baht, the price elasticity of demand coefficient of this route can be calculated as below:

P = 25: $$E_d = [0.2656(25) - 20.996] \times \frac{30}{332}$$

$$E_d = -1.3$$

Therefore, the price elasticity of demand coefficient of Siam station to Asok station route is -1.3, that its absolute value of price elasticity is more than 1 which means this metro route is relatively elastic to demand.

b) Average Elasticity of Siam station to Asok station route

As the current fare of metro Siam station to Asok station route is 30 baht.

According to Table 8, In case that its fare is discounted from the current fare(30 baht) to 25 baht, the demand of this route will increase by 83 users.

- ΔQ_i: The demand will change from 332 people to 415 people which is increased by 83 people
- ΔP_i: The fare is discounted for 5 baht
- $P_{i\text{-}avg}$: The average fare between current fare and changed fare are used for calculating which is
$$\frac{30 + 25}{2} = 27.5$$
- $Q_{i\text{-}avg}$: The average demand between current fare demand and changed fare demand are used for calculating which is
$$\frac{332 + 415}{2} = 373.5$$

The price elasticity of demand for Siam station to Asok station route from the formula is:

$$E_d = \frac{83}{-5} \times \frac{27.5}{373.5} \approx -1.22$$

Due to the metro fare and demand of the users are inverse relation, therefore the price elasticity of demand is always negative value. The symbol of minus which shows the negative value are only using to define the direction of the relation. In order to consider how much price elasticity of demand, the absolute value of the elasticity coefficient is used to consider.

According to the calculation of the price elasticity of demand of Bangkok metro - Siam station to Asok station route which is -1.22. It means that if the fare has discounted for 1%, the demand will be increased for 1.22%, On the other hand, If the fare has been increased for 1%, there will be 1.22% of users who deny commuting in this route.

As the absolute value of price elasticity is 1.22 which is more than 1. The price elasticity is more than 1, which is this metro route is relatively elastic to the demand. In other words, the change in this metro route's fare, cause a greater change in its demand.

c) Total Revenue Test of Siam station to Asok station route

Moreover, as the price elasticity of demand coefficient of this route is relatively elastic to demand. According to the Total revenue test, as the price is elastic to the demand, the price and total revenue are inverse to each other.

According to (BTSC, 2018), the train which operates for Siam station to Asok station route has a maximum capacity of 1490 passenger base on standing passenger density of 8 passengers per sq.m. and including 168 seated passengers per train. Therefore From this information, The different passenger density in the Siam station to Asok station metro route in the different period of time of the day on weekday are calculated and the average number of passenger per trip of this metro route on weekday is 802 passengers per trip as are shown in Table 19.

Therefore, According to Table 20 and Figure 63, as the Point Elasticity coefficient from demand curve of this metro route is -1.3 and the average elasticity coefficient is -1.22, in each day, the number of users of this route would be increased as the fare has been discounted, that result in the increasing of the total revenue for this route.

Table 19 Passenger load and Number of passengers/trip for Siam station to Asok station route

Time	**Duration (hr.)**	**Standing Passenger Load (passenger / sq.m.)**	**Passengers/Trip (Standing + seated)**
6:00-7:00	1	3	664
7:00-7:30	0.5	5	995
7:30-9:30	2	6	1159
9:30-17:00	7.5	3	664
17:00-18:30	1.5	5	995
18:30-20:30	2	6	1159
20:30-21:30	1	5	995
21:30- 23:00	1.5	3	664
23:00-24:00	1	0	168
			Average = 802

Table 20 Total revenue of Bangkok metro Siam station to Asok station route in different fare

	E_d =-1.22 (average elasticity)		E_d = -1.3 (point elasticity)	
Fare (baht)	**No. of users per trip**	**Total Revenue (baht)**	**No. of users per trip**	**Total Revenue (baht)**
30	802	6,063,120	802	6,063,120
29	835	6,099,364	837	6,114,993
28	867	6,119,170	872	6,149,351
27	900	6,122,539	906	6,166,193
26	932	6,109,469	941	6,165,519
25	965	6,079,962	976	6,147,330
24	998	6,034,017	1011	6,111,625
23	1030	5,971,634	1045	6,058,404
22	1063	5,892,814	1080	5,987,668
21	1096	5,797,555	1115	5,899,416
20	1128	5,685,859	1150	5,793,648

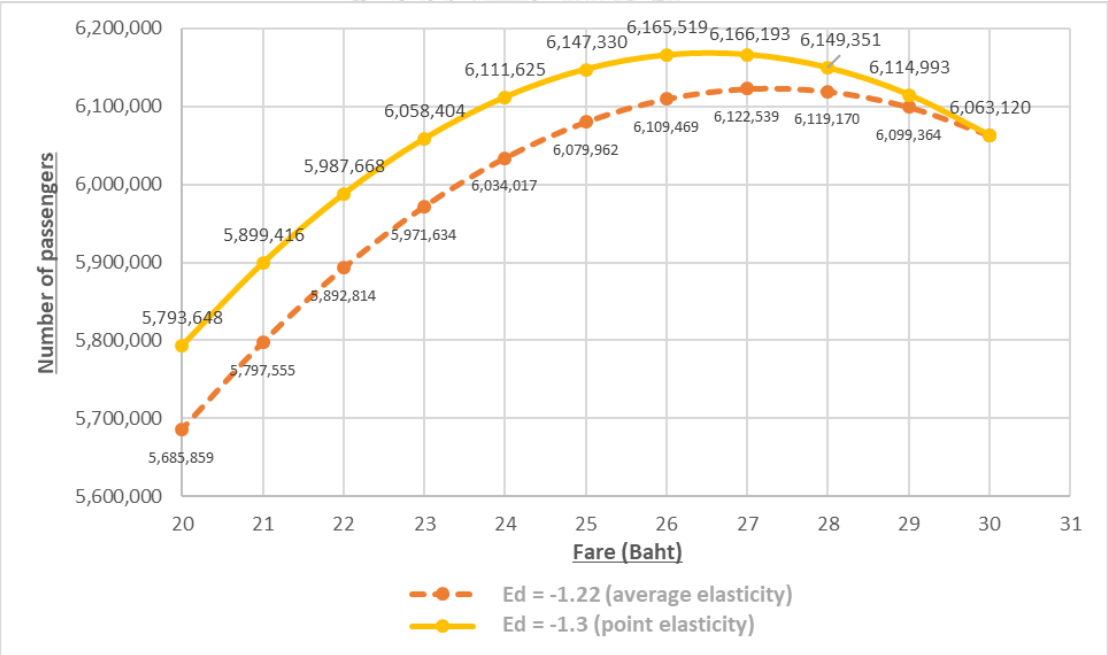


Figure 63 Total revenue of Bangkok metro Siam station to Asok station route in different fare

According to Table 20 and Figure 63, in case applying the average elasticity coefficient of this metro route (-1.22), the total revenue would be increased if the fare is discounted from the current fare (30 baht) until 25 baht because there is the greater increasing in its demand. However, if its fare is discounted to lower than 25 baht, the total revenue of this route are dropped. While applying the point elasticity coefficient of this metro route (-1.3), the total revenue will be increased if the fare is discounted until 24 baht as the demand are greater increased, and if discount the fare lower than 24 baht, the total revenue is decreased. Therefore, these are the minimum fare level that the total revenue is increased when discounting the fare.

4.4.2 Survey Analysis of Siam station to Mo chit station route

a) Point elasticity from Demand curve of Siam station to Mo chit station route

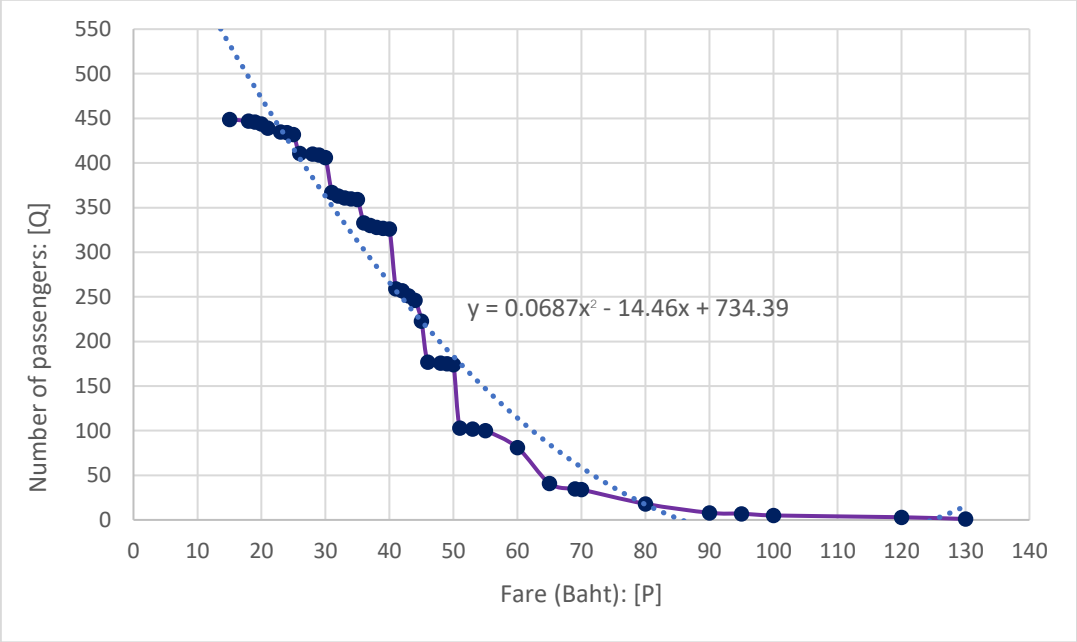


Figure 64 Demand Curve of Siam station to Mo Chit station route

According to Figure 64, the reasonable fare graph and expensive fare graph of Siam station to Mo Chit station route are shown which the trend curve of reasonable fare graph is plotted by the Trendline Function of Microsoft Excel Software. The formula for trend curved line of the reasonable fare graph is

$Q = 0.0687P^2 - 14.46P + 734.39$

The price elasticity of demand coefficient of Bangkok metro Siam station to Mo Chit station route is calculated from the formula for trend curved line of its reasonable fare graph as follow:

When P_i is the current fare of Siam station to Mo Chit station route is 44 Baht

Q_i is the demand at the current fare of this route is 246 users (refer to Table 12)

$$E_d = \frac{\Delta Q_i}{\Delta P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial Q_i}{\partial P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial \left(0.0687P^2 - 14.46P + 734.39\right)}{\partial P} \times \frac{44}{246}$$

$$E_d = (0.1374P - 14.46) \times \frac{44}{246}$$

In case of the fare of Siam station to Mo Chit station route is discounted from current fare of 44 Baht to 40 Baht, the price elasticity of demand coefficient of this route can be calculated as below:

P = 40: $$E_d = (0.1374(40) - 14.46) \times \frac{44}{246}$$

$$E_d = -1.6$$

Therefore, the price elasticity of demand coefficient of Siam station to Mo Chit station route is -1.6, that its absolute value of price elasticity is more than 1 which means this metro route is relatively elastic to demand.

b) Average Price Elasticity of Siam station to Mo Chit station route

As the current fare of metro Siam station to Mo chit station route is 44 baht.

According to Table 12, In case that its fare is discounted from the current fare(44 baht) to 40 baht, its demand will increase by 80 users.

- ΔQ_i: The demand will increase from 246 people to 326 people which is increased by 80 people
- ΔP_i: The fare is discounted for 4 baht
- P_i: The average fare between current fare and changed fare are used for calculating which is

$$\frac{44 + 40}{2} = 42$$

- Q_i: The average demand between current fare demand and changed fare demand are used for calculating which is

$$\frac{246 + 326}{2} = 286$$

The price elasticity of demand for Siam station to Mo chit station route is:

$$E_d = \frac{80}{-4} \times \frac{42}{286} \approx -2.94$$

This price elasticity coefficient Is the negative value because the fare and its demand have an inverse relation. According to the calculation of the price elasticity of demand of Bangkok metro - Siam station to Mo chit station route which is -2.94. It means that if the fare has discounted for 1%, the demand will increase for 2.94%, On the other hand, If the fare has been increased for 1%, there will be 2.94% of users who deny commuting in this route.

As the absolute value of price elasticity is 2.94 which is more than 1. The price elasticity is more than 1, which mean this metro route is relatively elastic to the demand. In other words, the change in this metro route's fare, cause a greater change in its demand.

c) Total Revenue Test of Siam station to Mo Chit station route

Moreover, as the price elasticity of demand coefficient of this route is relatively elastic to demand. According to the Total revenue test, as the price is elastic to the demand, the price and total revenue are inverse to each other. In other words, If the fare of this route is discounted, the total revenue for this route will increase, because the demand for commuting with this route is also increased.

Here is the example of the estimation of total revenue when the fare of this metro route is discounted. According to Table 18, the estimated number of trips per day of Bangkok metro operation on weekday is 252. And the metro Siam station to Mo chit station route are operated with the same operator as the Siam station to Asok station route, therefore the average passengers per trip of Siam station to Mo chit station route is calculated and estimated as the same as Siam station to Asok station route which are 802 passengers per trip, as are shown in Table 21.

Then as the average price elasticity coefficient of Siam station to Mo chit station route is -2.94 and its point elasticity coefficient of this metro route is -1.6, together with the estimated passenger per trip of this route on weekday is 802 passengers per trip, the total revenue for Bangkok metro – Siam station to Mo Chit station route would be increased as its fare has been discounted, that are shown in Table 22 and Figure 65.

Table 21 Passenger load and Number of passengers/trip for Siam station to Mo Chit station route

Time	**Duration (hr.)**	**Standing Passenger Load (passenger / sq.m.)**	**Passengers/Trip (Standing + seated)**
6:00-7:00	1	3	664
7:00-7:30	0.5	5	995
7:30-9:30	2	6	1159
9:30-17:00	7.5	3	664
17:00-18:30	1.5	5	995
18:30-20:30	2	6	1159
20:30-21:30	1	5	995
21:30- 23:00	1.5	3	664
23:00-24:00	1	0	168
			Average = 802

Table 22 Total revenue of Bangkok metro Siam station to Mo Chit station route in different fare

	E_d =-2.94 (average elasticity)		E_d = -1.6 (point elasticity)	
Fare (baht)	**No. of users per trip**	**Total Revenue (baht)**	**No. of users per trip**	**Total Revenue (baht)**
44	802	8,892,576	802	8,892,576
42	909	9,622,723	860	9,105,704
40	1016	10,244,835	919	9,260,038
39	1070	10,515,379	948	9,315,157
38	1124	10,758,915	977	9,355,578
35	1284	11,327,470	1064	9,388,649
33	1391	11,571,465	1123	9,337,205
32	1445	11,652,949	1152	9,289,435
31	1499	11,707,425	1181	9,226,966
30	1552	11,734,893	1210	9,149,799

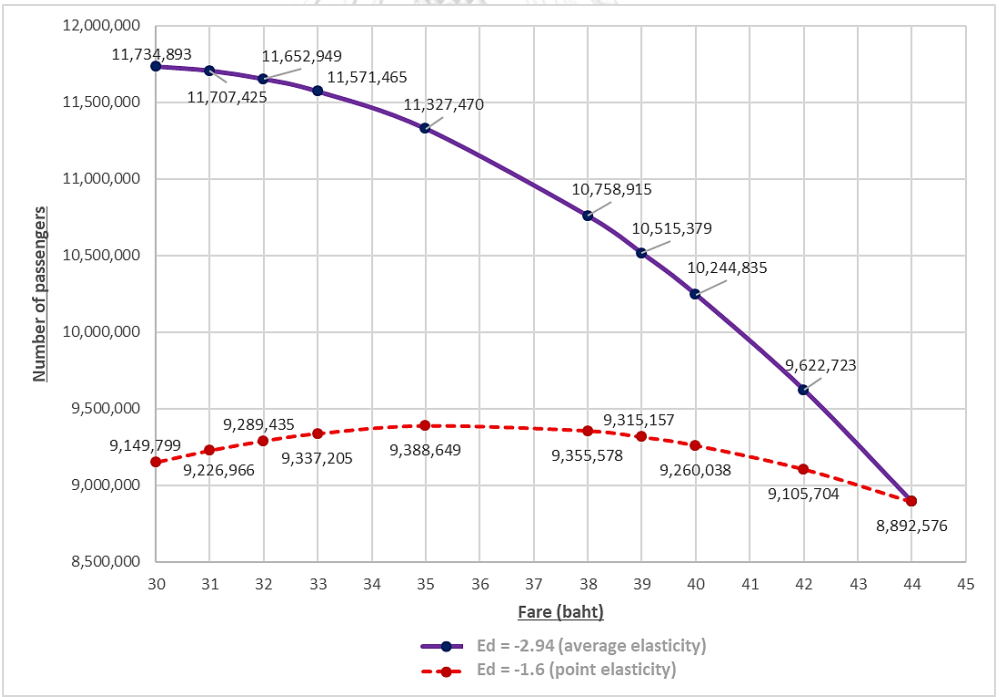


Figure 65 Total revenue of Bangkok metro Siam station to Mo Chit station route in different fare

According to Table 22 and Figure 65, in case using the average price elasticity coefficient of Siam station to Mo Chit station route (-2.94), the total revenue would increase if the fare is discounted from the current fare (44 baht). While applying the point elasticity coefficient of this route (-1.6), the total revenue will also be increased if its fare is discounted.

However, according to BTSC (2018) the train which operates for Siam station to Mo Chit station route has maximum capacity of 1490 passenger per train, refer to Table 22, if the fare of this route is discounted to 31 Baht in case applying the average price elasticity coefficient of -2.94, the demand for this route would be increased to 1499 users per trip which is over the maximum capacity of the train. Therefore, if the fare of this route is discounted to 31 Baht and lower level, the operators may need to invest for increasing the system capacity to support these higher demands.

4.4.3 Survey Analysis of Sukhumvit station to Silom station route

a) Point elasticity from Demand Curve of Sukhumvit station to Silom station route

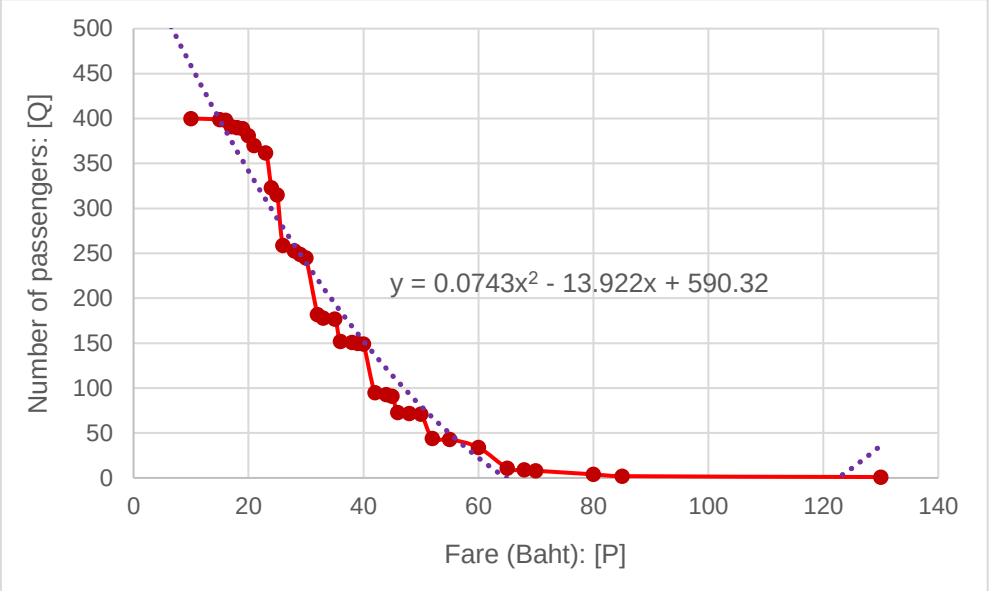


Figure 66 Demand Curve of Sukhumvit station to Silom station route

According to Figure 66, the reasonable fare graph and expensive fare graph of Sukhumvit station to Silom station route are shown which the trend curve of reasonable fare graph is plotted. The formula for trend curved line of the reasonable fare graph is

$$\underline{Q = 0.0743P^2 - 13.922P + 590.32}$$

The price elasticity of demand coefficient of Bangkok metro Sukhumvit station to Silom station route is calculated from the formula for trend curved line of its reasonable fare graph as follow:

When P_i is the current fare of Sukhumvit station to Silom station route is 23 Baht

Q_i is the demand at the current fare of this route is 362 users (refer to Table 16)

$$E_d = \frac{\Delta Q_i}{\Delta P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial Q_i}{\partial P_i} \times \frac{P_i}{Q_i}$$

$$E_d = \frac{\partial \left(\mathbf{0.0743P^2 - 13.922P + 590.32}\right)}{\partial P} \times \frac{23}{362}$$

$$\boldsymbol{E_d = \left(0.1486P - 13.922\right) \times \frac{23}{362}}$$

In case of the fare of Sukhumvit station to Silom station route is discounted from current fare of 23 Baht to 20 Baht, the price elasticity of demand coefficient of this route can be calculated as below:

P = 20: $\boldsymbol{E_d = \left(0.1486\left(20\right) - 13.922\right) \times \frac{23}{362}}$

$$\boldsymbol{E_d} \textbf{ = -0.69}$$

Therefore, the price elasticity of demand coefficient of Sukhumvit station to Silom station route is -0.69, that its absolute value of price elasticity is less than 1 which means this metro route is relatively inelastic to demand.

b) Average price elasticity of Sukhumvit station to Silom station route

As the current fare of metro Sukhumvit station to Silom station route is 23 baht.

According to Table 16, In case that its fare is discounted from the current fare(23 baht) to 20 baht, the demand will be increased by 19 users.

- ΔQ_i: The demand will decrease from 362 people to 381 people which is increased by 19 people
- ΔP_i: The fare is discounted for 3 baht
- P_i: The average fare between current fare and changed fare are used for calculating which is

$$\frac{23 + 20}{2} = 21.5$$

- Q_i: The average demand between current fare demand and changed fare demand are used for calculating which is

$$\frac{362 + 381}{2} = 371.5$$

The price elasticity of demand for Sukhumvit station to Silom station route is

$$E_d = \frac{19}{-3} \times \frac{21.5}{371.5} \approx -0.37$$

The price elasticity of demand has negative value because the metro fare and its demand have an inverse relation. According to the calculation of the average price elasticity of demand of Bangkok metro - Sukhumvit station to Silom station route which is -0.37. It means that if the fare has discounted for 1%, the demand will change for 0.37%, On the other hand, If the fare has been increased for 1%, there will be 0.37% of users who deny commuting in this route.

As the absolute value of average price elasticity is 0.37 which is less than 1. The price elasticity is less than 1, which mean this metro route is relatively inelastic to the demand. In other words, the change in this metro route's fare, cause a smaller change in its demand.

c) Total Revenue Test of Sukhumvit station to Silom station route

Moreover, as the price elasticity of demand coefficient of this route is relatively inelastic to demand that is different from another two focused routes. According to the Total revenue test, on the other hand of the previous route, if the fare of this route is discounted, the total revenue for this route will also drop, because the demand for commuting with this route has smaller increasing.

Here is the example of the estimation of total revenue when the fare of this metro route is discounted. According to Table 18, that the estimated number of trips per day of Bangkok metro operation on weekday is 252.

Moreover, according to (Siemens, 2018), the train which operates for Sukhumvit station to Silom station route has a maximum capacity of 1139 passengers base on standing passenger density of 8 passengers per sq.m. and including 126 seated passengers per train. Therefore From this information, The different passenger density in the Sukhumvit station to Silom station metro route in the different period of time of the day on weekday are calculated and the average number of passenger per trip of this metro route on weekday is 609 passengers per trip as are shown in Table 23.

Following to Table 24 and Figure 67, as the average price elasticity of demand coefficient of Sukhumvit station to Silom station route is -0.37 and the point elasticity coefficient of this route is -0.69. With the estimated passenger per trip of this route on weekday is 609 passengers per trip, the total revenue for Bangkok metro – Sukhumvit station to Silom station route would be dropped as its fare has been discounted.

Table 23 Passenger load and Number of passengers/trip for Sukhumvit station to Silom station route

Time	Duration (hr.)	Standing Passenger Load (passenger / sq.m.)	Passengers/Trip (Standing + seated)
6:00-7:00	1	3	504
7:00-7:30	0.5	5	756
7:30-9:30	2	6	882
9:30-17:00	7.5	3	504
17:00-18:30	1.5	5	756
18:30-20:30	2	6	882
20:30-21:30	1	5	756
21:30- 23:00	1.5	3	504
23:00-24:00	1	0	126
			Average = 609

Table 24 Total revenue of Bangkok metro Sukhumvit station to Silom station route in different fare

	E_d =-0.37 (average elasticity)		E_d = -0.69 (point elasticity)	
Fare (baht)	**No. of users per trip**	**Total Revenue**	**No. of users per trip**	**Total Revenue (baht)**
23	609	3,599,799	609	3,599,799
21	629	3,392,521	646	3,483,979
20	638	3,281,329	664	3,411,983
18	658	3,043,838	700	3,239,819
17	668	2,917,538	719	3,139,651
16	678	2,786,204	737	3,030,092
15	687	2,649,833	755	2,911,142

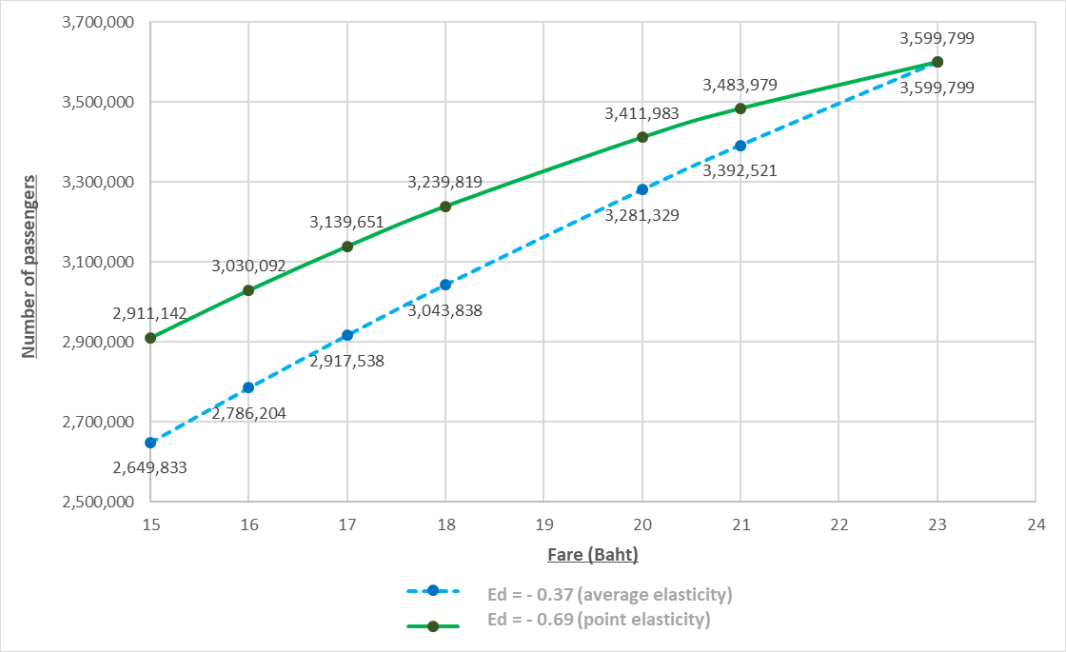


Figure 67 Total revenue of Bangkok metro Sukhumvit station to Silom station route in different fare

According to Table 24 and Figure 67, in case applying the average price elasticity coefficient of Sukhumvit station to Silom station route (-0.37), the total revenue drop if the fare is discounted from the current fare (23 baht). In the same way, in case applying the point elasticity coefficient (-0.69), the total revenue is also dropped if the fare is discounted.

4.5 Kishi's Logit PSM (KLP)

After the price elasticity of demand has been calculated and found that the Bangkok metro in three focused routes are relatively elastic to demand. According to (Kishi & Satoh, 2005), Kishi's Logit PSM (KLP) is able to find the range of acceptable fare of these metro routes.

The method of finding the range of acceptable fare of each focused Bangkok metro route, In each route, the Relative Cumulative Frequency of 4 graphs are plotted as follows:

- The accumulated frequency of the fare which is reasonable
- The accumulated frequency of the fare, which is expensive, but still able to purchase
- The accumulated frequency of the fare, which is too expensive to be willing to buy
- The accumulated frequency of the fare, which is too cheap to be willing to buy, due to doubt with the service quality and safety.

4.5.1 Range of acceptable fare – Siam station to Asok station route

a) Relative Cumulative Frequencies of Four Prices

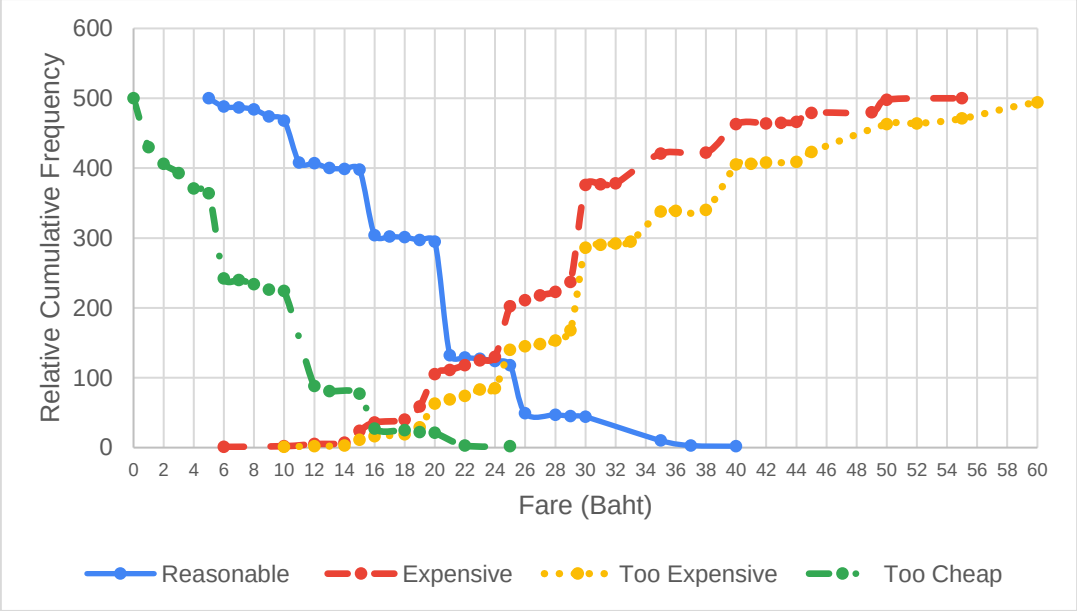


Figure 68 Relative Cumulative Frequencies of Four Prices - Siam station to Asok station route

The first line from the left is the relative cumulative frequency of the fare which user think it is too cheap and deny to take service of this metro route or "Too cheap to be willing to buy". This graph starts from the right at fare level of 25 baht, and if the fare level has decreased, the accumulated frequencies have increased because there will be more users who deny taking the service. Until the fare is decreased to 10 baht and 5 baht which the number of users who will deny for taking the service is 224 users and 364 users, respectively.

The second line from the left is the relative cumulative frequency of the reasonable fare in users' opinion of metro Siam station to Asok station route. The graph slopes down from the left to right because when the fare is increased, the frequency of users who think it is reasonable is decreased. This relative cumulative frequency graph starts from fare level of 5 baht to 40 baht.

The third line from the left is the relative cumulative frequency of the expensive fare in users' opinion, but they still take the service of this metro route. This graph starts from the left at fare level of 6 baht and slopes up to the right to fare level of 55 baht. When the fare has increased, the users who think that rising fare is expensive will be increased.

The last line from the left is the cumulative frequency of the fare which is too expensive to buy. This graph has the same trend as the third graph. As the fare has risen, the frequency of users who think it is too expensive will increase.

b) The Area between the intersection of four graphs

This area between the intersection of 4 graphs is the Range of Acceptable price or the appropriated price in customers' opinion. If the price has changed within this range, the demand will not change. This range is from the intersection between "Too cheap to be willing to buy" and "Expensive" graph to the intersection between the "Reasonable" graph and "Too expensive to be willing to buy" graph.

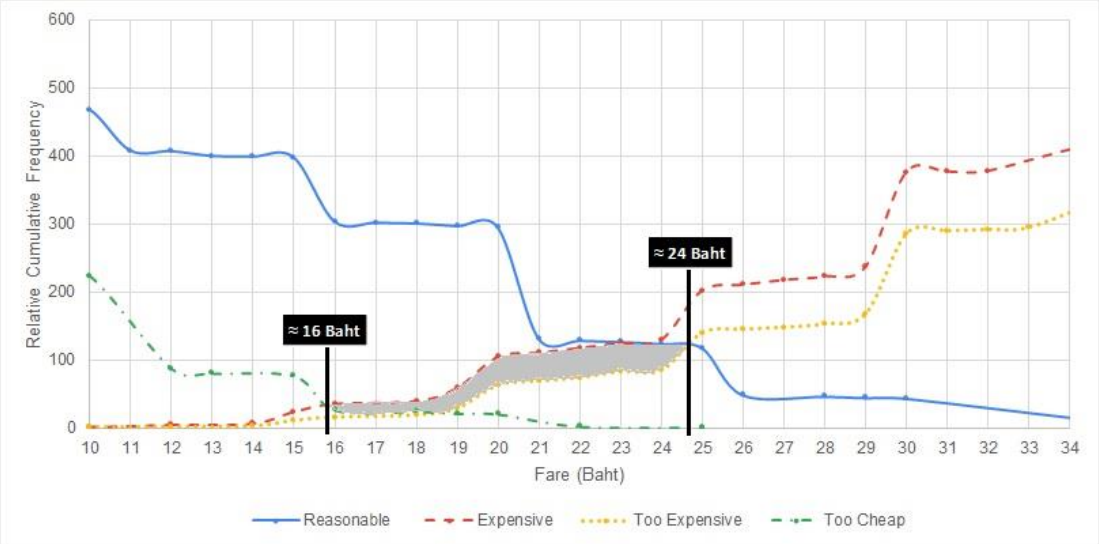


Figure 69 Range of Acceptable price - Siam station to Asok station route

According to Figure 69, the Range of Acceptable price of the Bangkok metro – Siam station to Asok station route is the fare between 16 baht to 24 baht. If the fare is discounted to lower than the intersection between "Too cheap to be willing to buy" graph and "Expensive" graph or 16 baht, the users will doubt to the service quality and safety that cause some users deny to take the services of this route and may change to use other modes which they think it is more safety. In the same way, if the fare is increased to higher than the intersection between "Reasonable" graph and "Too expensive to be willing to buy" graph or 24 baht, most users will think it is too expensive and may change to use other modes which is cheaper.

4.5.2 Range of acceptable fare – Siam station to Mo Chit station route

a) Relative Cumulative Frequencies of Four Prices

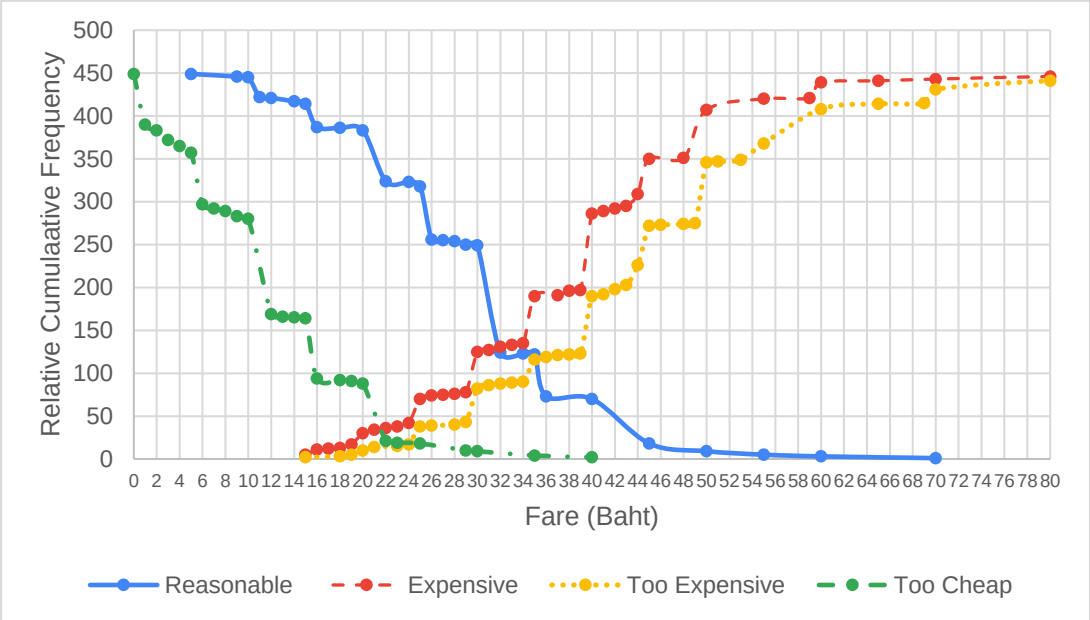


Figure 70 Relative Cumulative Frequencies of Four Prices - Siam station to Mo Chit station route

According to Figure 70,

The first line from the left is the Relative Cumulative Frequencies of the price which users think it is too cheap to be willing to buy, for the Bangkok metro Siam station to Mo Chit station route. This graph starts from the fare level of 40 baht and the frequency has increased as the fare level has decreased.

The second line from the left is the relative cumulative frequency of the reasonable fare in users' opinion of metro Siam station to Mo Chit station route. The graph slopes down from the left to right because when the fare is increased, the frequency of users who think it is reasonable is decreased. This relative cumulative frequency graph starts from fare level of 5 baht to 70 baht.

The third line from the left is the relative cumulative frequency of the expensive fare in users' opinion, but they still take the service of this metro route. This graph starts from the left at fare level of 15 baht and slopes up to the right to fare level of 100 baht. When the fare has increased, the users who think that rising fare is expensive will be increased.

The last line from the left is the cumulative frequency of the fare which is too expensive to buy. This graph has the same trend as the third graph. As the fare has risen, the frequency of users who think it is too expensive will increase.

b) The Area between the intersection of four graphs

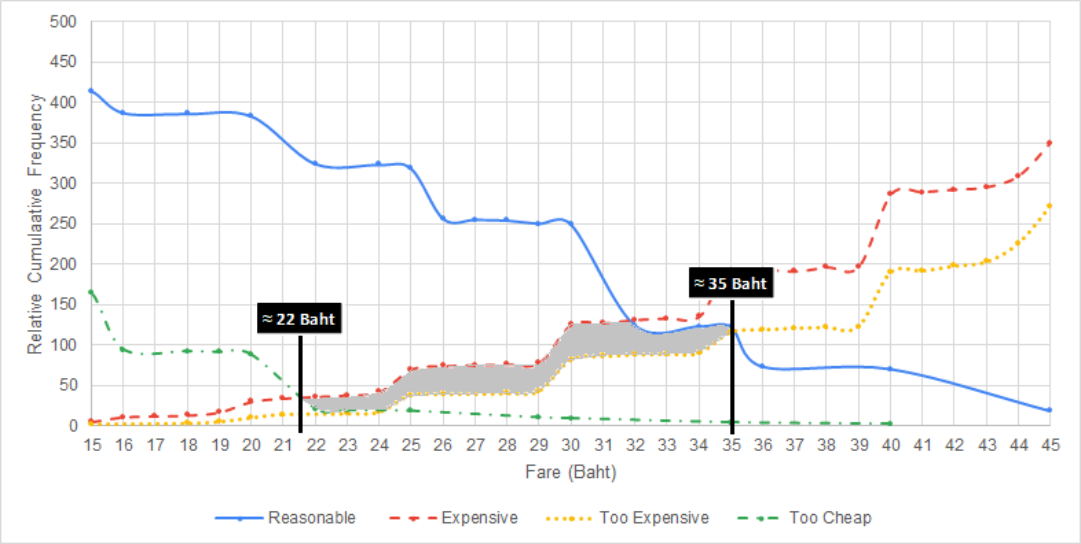


Figure 71 Range of Acceptable price - Siam station to Mo Chit station route

According to Figure 71, the Range of Acceptable price of the Bangkok metro – Siam station to Mo chit station route is the fare between 22 baht to 35 baht. If the fare is discounted to lower than the intersection between “Too cheap to be willing to buy” graph and “Expensive” graph or 22 baht, the users will doubt to the service quality and safety that cause some users deny to take the services of this route and may change to use other modes which they think it is more safety. In the same way, if the fare is increased to higher than the intersection between “Reasonable” graph and “Too expensive to be willing to buy” graph or 35 baht, most users will think it is too expensive and may change to use other modes which is cheaper.

4.5.3 Range of acceptable fare – Sukhumvit station to Silom station route

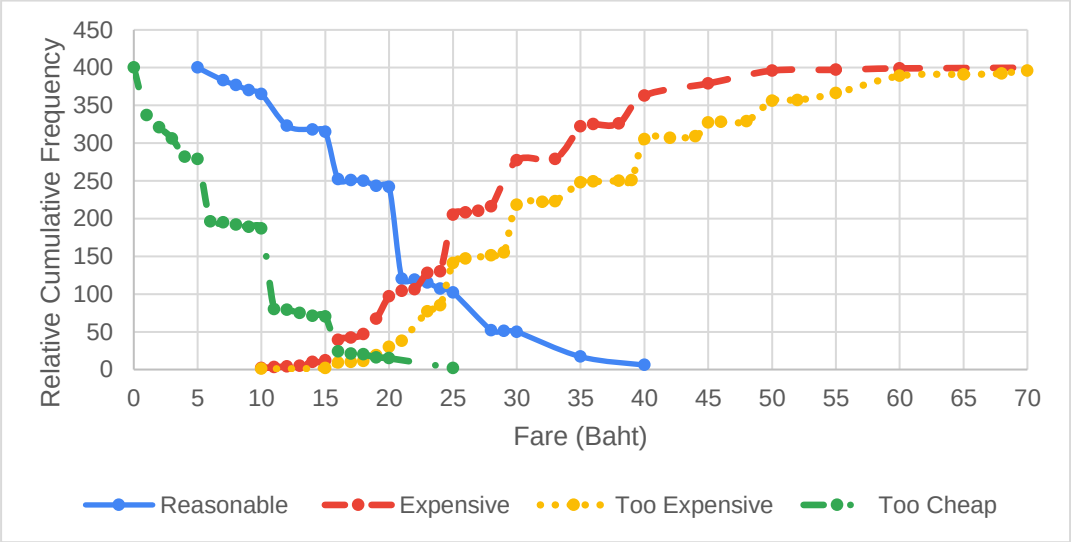


Figure 72 Relative Cumulative Frequencies of Four Prices - Sukhumvit station to Silom station route

According to Figure 72,

The first line from the left is the Relative Cumulative Frequencies of the price which users think it is too cheap to be willing to buy, for the Bangkok metro Sukhumvit station to Silom station route. This graph starts from the fare level of 25 baht and the frequency has increased as the fare level has decreased until the fare level of 0 baht or free of charge.

The second line from the left is the relative cumulative frequency of the reasonable fare in users' opinion of metro Sukhumvit station to Silom station route. The graph slopes down from the left to right because when the fare is increased, the frequency of users who think it is reasonable is decreased. This relative cumulative frequency graph starts from fare level of 5 baht to 40 baht.

The third line from the left is the relative cumulative frequency of the expensive fare in users' opinion, but they still take the service of this metro route. This graph starts from the left at fare level of 10 baht and slopes up to the right to fare level of 75 baht. When the fare has increased, the users who think that rising fare is expensive will be increased.

The last line from the left is the cumulative frequency of the fare which is too expensive to buy. This graph has the same trend as the third graph. It starts from the fare level of 10 baht until 130 baht which as the fare has risen, the frequency of users who think it is too expensive will increase.

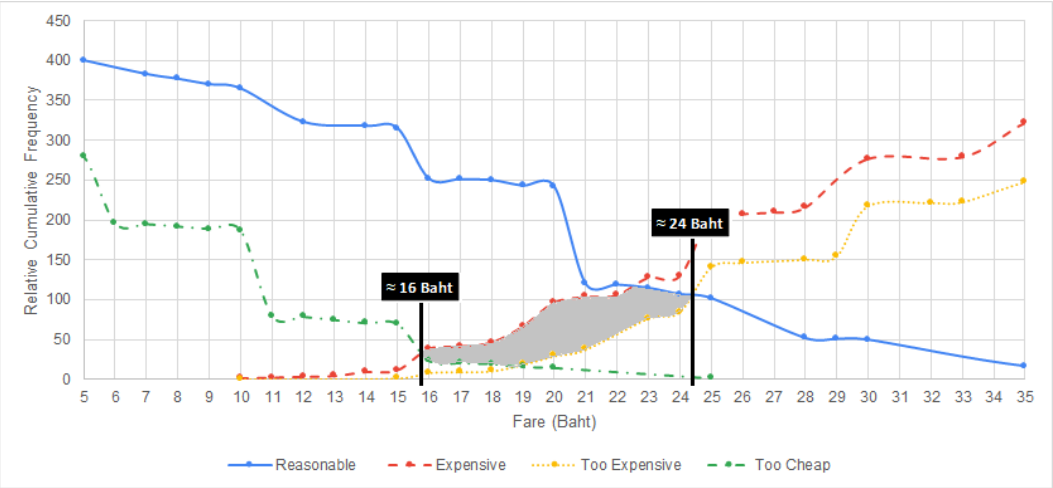


Figure 73 Range of Acceptable price - Sukhumvit station to Silom station route

According to Figure 73, the Range of Acceptable price of the Bangkok metro – Sukhumvit station to Silom station route is the fare between 16 baht to 23 baht. If the fare is discounted to lower than the intersection between "Too cheap to be willing to buy" graph and "Expensive" graph or 16 baht, the users will doubt to the service quality and safety that cause some users deny to take the services of this route and may change to use other modes which they think it is more safety. In the same way, if the fare is increased to higher than the intersection between "Reasonable" graph and "Too expensive to be willing to buy" graph or 23 baht, most users will think it is too expensive and may change to use other modes which is cheaper.

4.5.4 Range of Acceptable fare of Student users

However, According to (BEM, 2018), the Student who commute in Sukhumvit station to Silom station route of the MRT Blue Line which is operated by Bangkok Expressway and Metro Public Company Limited, will be received the 10% discount with the Student card ticket. As the questionnaire in this research has asked for the fare base on the purchasing opinion of respondents, the responses of this route from the students are assumed to be the fare which is discounted for 10%. Therefore, students' fare responses are analysed whether there is any significant difference with the overall results. 64 students use to commute in Sukhumvit station to Silom station route. The result of students' responses in four fare opinion is shown in Table 25.

According to Table 25, The first column shows the responses of the students from the survey which is assumed to be the fare after the student discount, while the second column shows the fare before the student discount, by dividing the students 'responses in the first column by 0.9. Then the further columns show the frequencies of students' responses of individual fare in each fare level.

Table 25 Students' fare opinion of Sukhumvit station to Silom station route

Student's Fare responses (Baht)	Student's Fare responses /0.9 (Baht)	Frequency			
		Reasonable	Expensive	Too expensive	Too cheap
0	0				14
2	2				4
3	3				2
5	5	5			17
8	8				1
9	10	2			
10	11	9			10
11	12		1		1
12	13	3	1		1
13	14				3
14	15		5		
15	16	11		1	8
16	17	1	5	1	1
17	18		2		
18	20	2		1	1
19	21		2	3	
20	22	16	3	2	1
21	23		1		
22	24	1			
23	25	3	6	6	
24	26		1	6	
25	27	6	15	6	
26	28		1	1	
27	30		1		
28	31	1		2	
29	32			2	
30	33	2	7	12	
32	35			2	
33	36		1	1	
35	38	2	6	4	
40	44		3	5	
42	46			1	
44	48			1	
45	50		1		
48	53			1	
50	55		2	2	
55	61			1	
60	66			1	
65	72			1	
68	75			1	

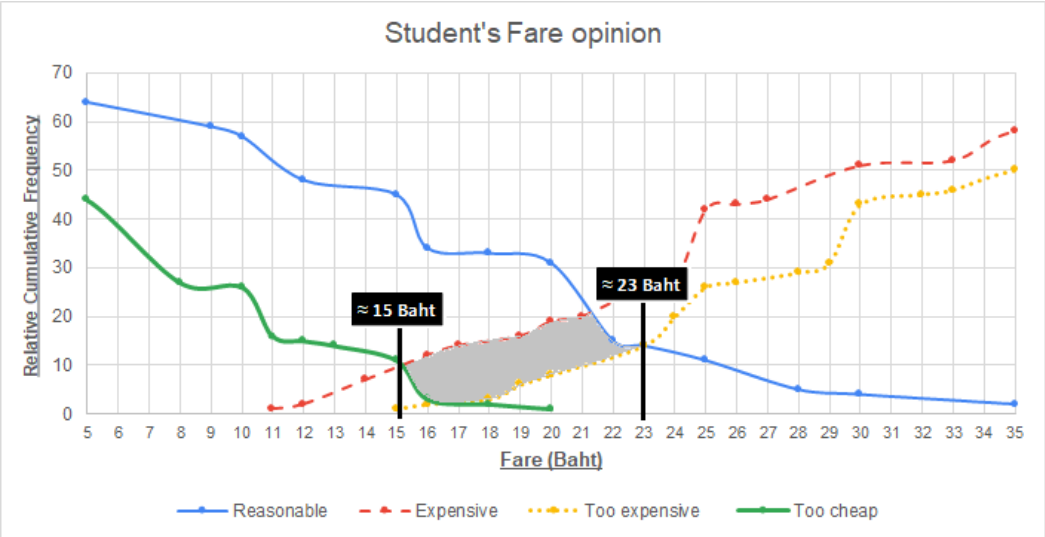


Figure 74 Range of Acceptable price of students - Sukhumvit station to Silom station route

According to Figure 74, the Range of Acceptable price of students in Bangkok metro – Sukhumvit station to Silom station route is the fare between 15 baht to 23 baht. However, this range of acceptable price is assumed to be the fare after student discount and this fare range are divided by 0.9 in order to calculate for the normal fare range in students' opinion. Therefore, the normal fare range which is acceptable for student users is 16 baht to 25 baht which is the similar range as the overall range of acceptable price for Sukhumvit station to Silom station route.

4.5.5 Range of Acceptable Fare of all focused metro routes

Table 26 Range of Acceptable Fare of focused Bangkok metro routes

Bangkok metro Route	Current fare (baht)	Range of Acceptable fare (baht)
Siam station to Asok station	30	16 - 24
Siam station to Mo Chit station	44	22 - 35
Sukhumvit station to Silom station	23	16 - 24
Sukhumvit station to Silom station (Student users)	23	15 - 23

According to Table 26, it seems that the current fare of all focused metro routes should be discounted to its range of acceptable fare, except the Sukhumvit station to Silom station of overall users that its current fare is already in its range of acceptable fare. Therefore, there is the area for the Bangkok metro transit to discount the current fare to the acceptable level, in order to increase the demand.

4.6 Interview Results

In order to get the direction and business strategies of the Bangkok metro transit and ride hailing service, the representative of Bangkok metro operators and ride hailing service companies are interviewed. Unfortunately, the representative of Bangkok Mass Transit System Public Company Limited and Grab Thailand company were not available for the interview within the thesis timeline. Therefore, only participant from Bangkok Expressway and Metro Public Limited Company and Get Thailand Company were interviewed and asked about the Fare strategy and feasibility for providing the discount and promotion for the users in order to influence more passengers in the long term. Together with the approach and opinion about partnership or integration between metro transit and ride hailing services or Transportation Network Companies (TNC) for improving the first mile last mile problem. The Interview results of each participant are as follows:

4.6.1 Bangkok Expressway and Metro Public Limited Company's interview result

In order to interview for the information and opinion of Bangkok Expressway and Metro Public Limited Company in these specific topics, Deputy Managing Director – Business Development Group of the company had been interviewed. Before starting the interview, the participant was informed about the purpose and steps of the interview through Participant Information Leaflet (PIL). Together with allow the participant to give the consent by ticking in the consent box and sign on in the Interview Consent Form as in Appendix C, which means the participant has understood the interview purpose and steps and allowed the researcher to use the given information during the interview for the research purpose.

a) Fare and incentives

According to an interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, for the fare rate of the metro system which is operated by the company, it has already been defined from the concession contract with the government authority who is the owner of the metro system. The concession contract had defined the maximum fare rate of each route of this metro system, together with the revenue sharing rate for the government in each year. In this reason, the company is not able to set the fare rate over the maximum rate in the contract. On the other hand, if the company intend to provide the discount or other financial incentives to the users, it must be approved by the government authority before implementing. In reason of discounting the fare and providing other financial incentives will effect to the company's revenue which means it also affects the revenue sharing with the government authority.

The participants also mentioned that the present pricing strategy of the company does not intend to provide the financial incentives by direct discounting the fare for all users in specific routes. Instead, the company provide the various type of travel cards which are appropriate for individual users' travel behaviours for instance monthly pass, one-day pass, student pass, and senior pass. However, the company may willing to provide the discount on a specific route in order to influence more users in the long term, if there are the obvious studies and evidence that it will significantly influence more users and benefit for the company.

b) Price elasticity of demand – Bangkok metro transit fare

Then, during an interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, the participant was explained about the price elasticity of demand of Bangkok metro fare, together with the Bangkok metro fare survey in this research which results that the metro fare is relatively elastic to demand. The participant had mentioned that this metro fare survey in this research is a good initiative of the

evidence that the demand would be significantly increased when the fare is discounted. However, the participant was concerned that for the price elasticity of demand of Bangkok metro fare, there is another factor that would affect to people opinion for instances the fare of other modes of transportation which are the substitution of metro transit. This other factor should be addressed for future research.

c) First Mile Last Mile problem

According to an interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, the participants have agreed that First Mile Last Mile is the big problem of Bangkok metro and the metro line worldwide. In order to improve this problem, there are some specific restriction and requirement in individual area in Bangkok, for instance, In Silom area which is one of the busy job areas in Bangkok, first-mile last mile may not be the problems because the offices are located within walking distances from the metro stations, In Huai Kwang area where is the big residential area, first mile last mile is the significant problems but there are some local private companies provide the short transportation in the area.

Moreover, due to nowadays, the metro lines in Bangkok are not cover all of the important areas, which in some area the first mile last mile of metro to job area or residential areas are in long distance, this may be on of the restriction for people to use the first mile last mile services. In the future, if all metro line in government master plan are all in operation, this restriction may be solved.

d) Integrate with Ride hailing service

According to an interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, the participant has agreed that ride hailing service may be one of the solutions of improving fist mile last mile problem due to it provided on-demand door-to-door services which are able to fill the gap of first mile last mile.

The participant concerned that, in order to collaborate or integrate with ride hailing service companies, there are some restrictions that depend on travelling behaviour and operation strategy of the ride hailing service companies which are as follows:

- The behaviour and pattern of ride hailing service users that usually use the service in short-distance routes or in long-distance routes. If users usually take the ride hailing services in short distance, there is a tendency that the trip is the first mile last mile of metro transit. On the other hand, if users always take the ride hailing service in long-distance and door-to-door trip, that means people prefer taking only one mode in a trip that means they may not use the ride hailing services for first mile last mile of metro transit.

- The strategy of the ride hailing service companies whether prefer to provide the long-distance travelling service which provides door-to-door service, or providing the short distance services in a specific area. If the ride hailing service company prefer providing the service in short distance trip, that may consistent with the integrated transportation concept which ride hailing services are the feeder for metro transit. On the other hand, if the ride hailing service companies prefer providing the service in long-distance, or providing door-to-door services, that would be the substitution of metro transit instead.

However, the participant has mentioned that the company is willing to collaborate, together with providing the co-promotion with ride hailing service companies if there are the reliable

studies and evidence that this collaboration or integration are able to increase the significant number of metro users.

4.6.2 Get Thailand company's interview result

In order to interview for the detail and opinion of Get Thailand Company in these specific topics, Corporate Strategy Director of the company had been interviewed. Before starting the interview, the participant was informed about the purpose and steps of the interview through Participant Information Leaflet (PIL) as shown in Appendix C. Together with allow the participant to give the consent by ticking in the consent box and sign on in the Interview Consent Form, which means the participant has understood the interview purpose and steps and allowed the researcher to use the given information during the interview for the research purpose.

a) Fare and incentives

According to an interview with Corporate Strategy Director of Get Thailand Company, the participant had explained that the strategy of Get Thailand is to allow the legal motorbike taxi to apply with the company in order to provide the ride hailing service in the company's online application.

For the pricing strategy of the company, the participant had mentioned that the company set the fare level according to the motorbike taxis' income as the first priority. For other factors such as operating cost and customer's demand are further priorities. For the level of service fare, the company has to balance to be not too high or low, in reason of if it is too high, the demand will be dropped. On the other hand, if the company's service fare is too low, this will affect the job and services of another legal motorbike taxi who have not applied for online service with the company.

b) Integrate with metro transit

According to an interview with Corporate Strategy Director of Get Thailand Company, the participant had explained that most of the company's service trip are short-distance trips, around 2 kilometres or shorter, where many of their picking up location or destination are metro stations. That means there is the demand of taking the ride hailing service as first mile last mile of metro transit. Moreover, the participant had also mentioned that in the company's operation strategy, the short distance services are preferred due to taking lower operating cost and take shorter aisle return distance for the motorbike taxi.

With these reasons, the participant has also told the researcher that the company is willing to integrate or collaborate with metro transit or being the metro's feeder. However, the integration approach are corporate in two levels as follow:

- The corporate for seamless services and payment: The company are able to support the technology by integrating the metro transit trip information in the trip planning process of GET's mobile application, which allows convenience for users to plan the integrated trip within the application.
- The accurate seamless transportation: In this level of integration, the timetable of metro and the availability of the GET's services have to be consistent. This will allow users to plan and estimate the trip duration and arrival time accurately since the origin to destination of the trip. However, this cooperate may have the restriction, in case there are some failure on metro transit or unexpected road traffic jam which effect the trip time planning.

c) Restriction of ride hailing service

Since today, Thailand law does not allow anyone to use private cars or private motorbikes for providing the transport services. This is why GET Thailand focus on acquiring only motorbike taxi with public vehicle driving licenses. So that the motorbike taxi who applying with GET are able to provide the service with GET legally. However, according to the interview with Corporate Strategy Director of Get Thailand Company, as motorbike taxi in Bangkok has their individual service zone in a specific location, which there is the culture that allows the motorbike taxi to pick up the passengers in only their own service zone. There are always be seen on the news that there is the violence or fight between motorbike taxi riders on the road just because some motorbike taxi picked up the passengers in others' service zone. The participant told the researcher that this issue must be addressed and solved by the government in order to allow more flexibility of the motorbike taxi services that will benefit for Bangkok people.

Chapter 5 Discussion and Conclusion

5.1 Discussion of Research Results

5.1.1 Bangkok Metro's Price Elasticity

According to the results of the research, the fare of metro Siam station to Asok station route and metro Siam station to Mo Chit station route are relatively elastic to demand, which mean when changing in Bangkok metro fare, cause the greater change in their demand for commuting in these metro routes. On the other hand, the fare of metro Sukhumvit station to Silom station route is relatively inelastic to demand which mean These are results from the reasons below:

a) There are alternative modes which allow people to commute. In Bangkok, there is the transformation of transportation over time which nowadays, there are many modes of transport modes servicing in Bangkok. Firstly, taxi is the most convenient and easy finding modes which starting fare is 35 Baht and increasing depending on the distance and traffic time of the trip. Together with the motorbike taxi which can be found in almost every street of Bangkok that is also convenient for travelling in peak hours. Another mode is the Bus which has the service routes across the city and its starting fare is only 8 baht. It illustrates that Bangkok people have many alternative modes to travel. Moreover, according to Table 5, a result shows that more than half or 55% of metro users actually own the private cars which mean they have the choice to drive their own car to destination that is more convenient and be door-to-door transport.

   Since the fare of metro Siam station to Asok station route and metro Siam station to Mo Chit station route are expensive in users' opinion that result in their fare are higher than their range of acceptable price, or the users think the current fare of these routes are expensive, that is the reason why these two Bangkok metro route are elastic to demand because the users have alternative modes which is more convenient and may be cheaper..

   While the fare of Bangkok metro Sukhumvit station to Silom station is relatively inelastic to demand, that is because its current fare is not expensive base on users' opinion, or its current fare is within its range of acceptable price. That means users of this route have already accepted the current fare, by discounting the fare of this route, it may not influence much more demand for this route.

b) As nowadays, in 2019, the Bangkok metro network routes master plan has not been implemented covering all main area in Bangkok. According to the interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, this may be one of the reasons that Bangkok metro transit is not convenient and has the accessibility problem or first mile last mile problem.

5.1.2 Feasibility for providing incentives on metro transit fare

As the Bangkok metro routes which are operated by Bangkok Mass Transit System Public Company Limited are relatively elastic to demand, which means the change in the metro fare, result in the bigger change on its demand. This is the opportunity for the metro transit operators to provide incentives for the customers that can increase the demand and result to increase the total revenue. However, by discounting the metro fare to increase the demand, if the fare is discounted to the limited level, the total revenue would increase, but if discount the fare to the too low level, the total revenue would be decreased even the demand has risen. Moreover, when discount the fare to the too low level, its demand may increase to the level over the metro system capacity that the metro operator may need to invest more to increase the system capacity to support the overdemand. Therefore, the metro operators need to consider for the trade-off between providing the social benefit which provides the incentives on the metro fare to influence more people commuting with metro transit or maximize the metro transit demand, that may take the loss of total revenue and investment to increase the system capacity or another option is emphasizing on the shareholder benefit that may provide the limited discount to increase the demand to the level which the total revenue is raised and the current system capacity can support the increasing demand.

For the Bangkok metro route which is operated by Bangkok Expressway and Metro Public Limited Company, the fare of this route is relatively inelastic of demand due to its current fare is in the range of acceptable price of user's opinion. Therefore, discounting the fare of this route is not recommended because it cannot increase the demand significantly that its total revenue will be dropped.

Therefore, the Bangkok metro routes which are operated by Bangkok Mass Transit System Public Company Limited (BTSC) is recommended to provide the incentives for users that will benefit both operators and users. While the metro routes which is operated by Bangkok Expressway and Metro Public Limited Company (BEM) is not recommended for providing the incentives. According to (BEM, 2018) and (BTSC, 2018), The annual report 2018 of both companies shows the average daily ridership in 2018 of BTSC is 660,335 trips per day, while the average daily ridership of BEM is 311,447 trips per day. It seems that the demand and ridership of the metro route of BTSC are double to the one of BEM. By providing the incentives on the metro routes of BTSC, it will benefit to more than 60% of all Bangkok metro market.

Since today Bangkok metro has already high demand during peak period but low demand during the off-peak period. While Bangkok metro fare rate has been set in a flat rate or same rate along all period of the day. In order to balance between the social benefit and shareholder benefit for the metro operators, the incentives for users may be provided only on the off-peak period which will increase the demand to the level which the current system capacity can support. While the on-peak period which the demand is already high in some routes, the incentives may not need to be provided because the system capacity is not able to support the much higher demand. This approach will influence more users to commute with metro transit on the low demand period, while the operators can increase the total revenue on the off-peak period services and may not need to invest to increase the system capacity in short investment term.

However, since today the Bangkok metro operator has no strategy to provide the direct discount or incentives on the metro fare, with reasons of the metro management structure of the high-demand Bangkok metro systems are taking the right of management and operation to the private companies under the concession period with the government authority that has specify the maximum fare rate in the concession agreement. So if there is the approach to discount the fare, it should be approved by the government before, because it may affect to the metro transit revenue which directly effects to concession fee or revenue sharing to the government authority. Therefore, these are the limitations to develop the system and provide

discounts to maximize and emphasize on the social benefit. Together with the private companies may emphasize on the companies' benefit and revenue as first priority.

5.1.3 Integration between Bangkok metro transit and Ride hailing service

The purpose of the integration between metro transit and ride hailing service is to improve the first mile last mile of Bangkok metro transit. In order to provide convenience and influence more people to commute with metro transit as the main transport modes.

a) Cooperate strategy

According to the interview with Deputy Managing Director Business Development of Bangkok Expressway and Metro Public Limited Company, the metro operator are willing to collaborate with the ride hailing service, if there is evidence that it would be benefit for the company such as there are significant increases of metro ridership.

This approach is consistent with the strategy of ride hailing service company, refer to an interview with Corporate Strategy Director of Get Thailand Company, Ride hailing service company's strategy prefer to provide the services in the short-distance trip up to 3 kilometer which is consistent for being the feeder for metro transit in order to support the metro transit's users. The collaboration between modes will allow convenience for metro users.

b) Co-promotion and Ticketing strategy

According to the interview, ride hailing service company is willing to provide the financial incentives for ride hailing services' users who transfer from metro transit or to metro transit. However, by discounting the fare of both metro transit and ride hailing service in order to influence more users, there are the statistics show the significant number of Bangkok metro users who use ride hailing service for first mile last mile and also the price elasticity of demand of Bangkok metro transit which shows that by discounting its fare on over 60% of Bangkok metro routes to the acceptable level, its demand will increase and result to increase of total revenue. Therefore, these mutual benefit of the approach for providing financial incentives for the cooperated services, are the great opportunities for the integration between metro transit and ride hailing service.

Moreover, in order to gain mutual benefits between businesses and Bangkok people, the ride hailing service company and metro transit operator should provide the temporary discount or incentives on the service fare and take it as the mutual cost between businesses which will not affect to the revenue and the approval from the government authority. This approach is flexible that is able to increase the metro transit demand and ride hailing service users and when the demand reaches the maximum capacity, the companies may stop providing the discount on the service fare at any time. Together with provide convenience and increase the quality of life for the Bangkok people to travelling in their daily life.

c) Sustainability benefits

According to the (UnitedNation, 2012), sustainable development has been adopted and conducted over time. Three dimensions of sustainable development should be balanced and integrated which are the economic, social and environmental. The approach of this research is able to achieve all of these three dimensions of the sustainable development framework.

Firstly, in the economic aspect, the approach of integrated between transport providers and providing incentives are benefits for reducing the commuting cost of the Bangkok people and gaining the mutual benefit between businesses that can increase users and total revenue.

Secondly, the approach for the integrated transport system is the main factor to gain social benefit. It provides convenience for people to travel in their daily life and increasing accessibility of transit that influence more people to commute with transit as the main modes.

Finally, this research's objective is to influence people and maximize users of transits, that is the main factor to reduce urban pollution and benefit to the environment in the long term.

5.2 Conclusion

As the main purpose of this research is studying the price elasticity of demand of Bangkok metro and approach for improving the first mile last mile of metro transit by collaboration between metro transit and ride hailing service, the methodology of the research is surveying the opinion of the metro transit fare from the users. Together with interviewing the Bangkok metro operator and ride hailing service company for the perspective of the collaboration and integration between modes.

The result shows that the Bangkok metro routes which are operated by Bangkok Mass Transit System Public Company Limited(BTSC) are relatively elastic to demand that means by discounting the fare to an acceptable level, the demand will increase that result in increasing total revenue and the price sensitivity study shows that the fare of these routes should be discounted base on users' opinion. However, discounting the fare to the too low-level result in increasing the demand to the level over current metro system capacity, that the trade-off between investing for increasing system capacity or limit the fare discounting should be considered. While the Bangkok metro route which is operated by Bangkok Expressway and Metro Public Limited Company (BEM) is relatively inelastic to demand, that is because the fare of this route is already in the range of acceptable price of users. So, its service fare is not recommended to be discounted because its total revenue will be decreased. Following to the metro transit operators and ride hailing service company have consistent strategies in order to fill the gap of first mile last mile of metro transit and willing to collaborate between transport providers, that the ride hailing service company are willing to be feeders for metro transit and willing to support the technologies for the services.

Therefore, the collaboration between ride hailing service companies and metro transit operators and providing incentives for users gain the mutual benefit for the business. However, not only transport providers who gain benefit from the integrated transport system but also the Bangkok people who get convenient travelling and reduce the commuting expenses in their daily life. Lastly, by influencing more people to commute with the metro transit, it is able to increase the urban mobility for the sustainable society.

5.3 Limitations of the study

There are two main limitations which should be addressed in this research. Firstly, this survey analysis purpose to analyse for the price elasticity of demand and price sensitivity, with the input of opinion of transit fare and the profiles of people who use to commute with metro transit. However, this survey does not question for the travel frequency of users such as travel regularly or just sometimes or rarely travel with metro transit and travel purpose such as travel to the office for work or to college for studying or travel to meet friends or for shopping, etc. Therefore, this research is not considering these factors.

Secondly, the analysis of the metro fare in this research is conducted base on the users' opinion from the survey. However, the operation cost and maintenance cost of the metro transit operators have not been analysed. That means the results of the range of acceptable price in the research have not concerned about the cost of the transit operators.

5.4 Suggestion for Future Study

There are further studies for improving transportation in Bangkok and also in other cities of Thailand in order to maximise the mobility of people, which includes:

a) Study the improvement and development of the metro transit which trade-off between the social benefit and shareholder benefit. The cost of investment to improve the system, in any case, shall be considered in the analysis whether are worth to invest for gaining the benefit for society in long term, or limiting the investment to the balance point in order to reduce the investment risk and saving the shareholder benefit.

b) Study the feasibility and approach of integration among all transport modes within the cities and between the cities. The integration is in three parts that are the physical integration, cooperate and ticketing integration. In other words, the future studies should focus on maximizing the convenience of people for seamless multimodal travelling in all aspects for instances convenience for people for transferring between modes, all transport modes' operation should be consistent and together with seamless ticketing system.

Appendix A. Ethical Approval Document

Appendix A shows a copy of the email from Warwick Overseas Programmes Course Office regarding this thesis's ethical approval reference number

From: <wmg-overseas@warwick.ac.uk>
Date: Tue, 17 Mar 2020 at 18:46
Subject: Ethical Approval Confirmation (Overseas Programmes)
To: <V.Warapiankul@warwick.ac.uk>
Cc: <manoj.l@chula.ac.th>, <cuse.chula@gmail.com>

Ethical Approval Confirmation

Dear Mr Warapiankul,

Warwick ID Number: 1736929

Thank you for submitting your Supervisor's Delegated Approval form to the Overseas Programmes Course Office for the project: A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers .

Your reference number is REGO-2020-WMGOS-0016 .

You now have the appropriate approval in place to begin your study.

Please ensure you insert a copy of this email into the appendices of your project.

Best Wishes

Harjinder K Kang
WMG Overseas Programmes Course Office
wmg-overseas@warwick.ac.uk
warwick.ac.uk/fac/sci/wmg/overseas/

Appendix B. Interview Invitation Letter

Appendix B shows four copies of interview invitation letter with the enclosed interview questions, sending to four targeted companies who are Bangkok Expressway and Metro Public Company Limited, Bangkok Mass Transit System Public Company Limited, Get Thailand Company and Grab Thailand company.

The content of the letter is to introduce the researcher and adviser, together with informing the thesis and its purpose of this research. Then kindly request for the interview that is one of the main methods in this research. Moreover, the questions for the interview is attached in order to inform the questions for the participants. The invitation letters are submitted in Thai language due to all focused companies are Thai companies

1. The interview invitation letter and attached interview questions for Bangkok Expressway and Metro Public Company Limited

ศวผ. 024/2563 7 พฤษภาคม 2563

เรื่อง ขอความอนุเคราะห์ข้อมูลและสัมภาษณ์

เรียน คุณอนวัช สุวรรณฤทธิ์
รองกรรมการผู้จัดการส่วนพัฒนาธุรกิจ
บริษัท ทางด่วนและรถไฟฟ้ากรุงเทพ จำกัด (มหาชน)

สิ่งที่แนบมาด้วย รายละเอียดของการสัมภาษณ์

เนื่องด้วย นายวรกร วรเพียรกุล นิสิตระดับปริญญาโท หลักสูตรวิศวกรรมศาสตรมหาบัณฑิต สาขาการจัดการทางวิศวกรรม ของศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ซึ่งมีอาจารย์ที่ปรึกษาวิทยานิพนธ์คือ รศ.ดร.มาโนช โลหเตปานนท์ มีความสนใจทำโครงงานวิทยานิพนธ์ในหัวข้อ การศึกษาความยืดหยุ่นขององุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม (A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers) ซึ่งมีวัตถุประสงค์ในการศึกษาความยืนหยุ่นขององุปสงค์ต่อราคาค่าโดยสาร และความเป็นไปได้ในการร่วมมือกันระหว่างผู้ให้บริการขนส่งระบบรางและทางบก ทั้งในแง่ของการให้บริการ และค่าโดยสาร เพื่อที่จะแก้ไขปัญหาความไม่ต่อเนื่องในการเดินทางของประชาชน โดยส่วนหนึ่งของการวิจัยเป็นการหาข้อมูลและแนวคิดในเชิงธุรกิจ จากบริษัทผู้ให้บริการขนส่งโดยตรง โดยสัมภาษณ์ตามรายละเอียดที่แนบมาด้วย เพื่อนำข้อมูลมาวิเคราะห์ความเป็นไปได้ และแนวทางของระบบขนส่งแบบบูรณาการ

ศูนย์ระดับภูมิภาคฯ จึงขอความอนุเคราะห์กับทางบริษัทฯ ในการให้ข้อมูลกับ นายวรกร วรเพียรกุล เพื่อนำข้อมูลมาประกอบการทำโครงงานวิทยานิพนธ์ และทางศูนย์ระดับภูมิภาคฯ ขอรับรองว่าจะไม่นำเอกสารและข้อมูลต่าง ๆ ที่ได้รับจากบริษัทฯ ไปเปิดเผยก่อนที่จะได้รับอนุญาตอย่างเป็นลายลักษณ์อักษรจากทางบริษัทฯ

จึงเรียนมาเพื่อพิจารณาอนุมัติ จักขอบพระคุณยิ่ง หากท่านมีข้อสงสัยประการใด สามารถติดต่อสอบถามได้ที่ นายวรกร วรเพียรกุล 092-502-5554 หรือ voragorn1@gmail.com

(ศาสตราจารย์ ดร.ปารเมศ ชุติมา)
ผู้อำนวยการ
ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต

รายละเอียดของการสัมภาษณ์

1. **ความยืดหยุ่นของราคาค่าโดยสาร ต่อความต้องการใช้บริการของผู้บริโภค**

   1.1) ทาง MRT ได้มีการศึกษา หรือ มีความคิดเห็นอย่างไรต่อ การเปลี่ยนแปลงของราคาค่าโดยสารการเดินทางด้วย MRT, ที่มีผลต่อความต้องการใช้บริการของผู้บริโภค

   1.2) ท่านคิดว่าราคาค่าโดยสารของ MRT ในปัจจุบันนั้น มีความเหมาะสมต่อผู้บริโภคมากน้อยอย่างไร

   1.3) ทาง MRT มีแนวทางหรือความคิดเห็นอย่างไร ต่อการลดราคาค่าโดยสารและบริการ หรือจัดโปรโมชั่น เพื่อดึงดูดผู้ใช้บริการให้มากขึ้น ในระยะยาว

2. **ระบบขนส่งแบบบูรณาการ (Integrated Transport System)**

   2.1) ท่านมีความคิดเห็นอย่างไรต่อปัญหาในการเข้าถึงยากเพื่อใช้บริการรถไฟฟ้า หรือ ที่เรียกว่า First Mile Last Mile Problem

   2.2) ท่านมีความคิดเห็นอย่างไรต่อการร่วมมือกันในให้บริการขนส่งหลายรูปแบบ เช่น รถไฟฟ้า, รถบัส, Grab เป็นต้น หรือ ระบบขนส่งแบบบูรณาการ เพื่อนำไปสู่การขนส่งแบบไร้รอยต่อ

   2.3) ทาง MRT ได้มีแนวทาง หรือความคิดเห็นอย่างไร ต่อการจัดส่วนลด โปรโมชั่น ร่วมกันกับบริษัทขนส่งรูปแบบอื่น (เช่น Grab) เพื่อดึงดูดให้ผู้ใช้บริการ หันมาใช้บริการขนส่งสาธารณะ ตั้งแต่ต้นทางสู่ปลายทาง

   2.4) ในกรณีที่ทางบริษัท MRT ได้จัดส่วนลด โปรโมชั่น ร่วมกันกับขนส่งมวลชนรูปแบบอื่น (เช่น Grab) ท่านคิดว่าประเภทส่วนลดที่เหมาะสมนั้นควรเป็น โปรโมชั่นประเภทไหน อย่างไร

นายวรกร วรเพียรกุล

2. The interview invitation letter and attached interview questions for Bangkok Mass Transit System Public Company Limited

ศวอ. 075/2563 7 พฤษภาคม 2563

เรื่อง ขอความอนุเคราะห์ข้อมูลและสัมภาษณ์

เรียน คุณสุรพงษ์ เลาหะอัญญา
กรรมการผู้อำนวยการใหญ่
บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน)

สิ่งที่แนบมาด้วย รายละเอียดของการสัมภาษณ์

เนื่องด้วย นายวรกร วรเพียรกุล นิสิตระดับปริญญาโท หลักสูตรวิศวกรรมศาสตรมหาบัณฑิต สาขาการจัดการทางวิศวกรรม ของศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ซึ่งมีอาจารย์ที่ปรึกษาวิทยานิพนธ์คือ รศ.ดร.มาโนช โลหเตปานนท์ มีความสนใจทำโครงงานวิทยานิพนธ์ในหัวข้อ การศึกษาความยืดหยุ่นขององุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม (A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers) ซึ่งมีวัตถุประสงค์ในการศึกษาความยืนหยุ่นขององุปสงค์ต่อราคาค่าโดยสาร และความเป็นไปได้ในการร่วมมือกันระหว่างผู้ให้บริการขนส่งระบบรางและทางบก ทั้งในแง่ของการให้บริการ และค่าโดยสาร เพื่อที่จะแก้ไขปัญหาความไม่ต่อเนื่องในการเดินทางของประชาชน โดยส่วนหนึ่งของการวิจัยเป็นการหาข้อมูลและแนวคิดในเชิงธุรกิจ จากบริษัทผู้ให้บริการขนส่งโดยตรง โดยสัมภาษณ์ตามรายละเอียดที่แนบมาด้วย เพื่อนำข้อมูลมาวิเคราะห์ความเป็นไปได้ และแนวทางของระบบขนส่งแบบบูรณาการ

ศูนย์ระดับภูมิภาคฯ จึงขอความอนุเคราะห์กับทางบริษัทฯ ในการให้ข้อมูลกับ นายวรกร วรเพียรกุล เพื่อนำข้อมูลมาประกอบการทำโครงงานวิทยานิพนธ์ และทางศูนย์ระดับภูมิภาคฯ ขอรับรองว่าจะไม่นำเอกสารและข้อมูลต่าง ๆ ที่ได้รับจากบริษัทฯ ไปเปิดเผยก่อนที่จะได้รับอนุญาตอย่างเป็นลายลักษณ์อักษรจากทางบริษัทฯ

จึงเรียนมาเพื่อพิจารณาอนุมัติ จักขอบพระคุณยิ่ง หากท่านมีข้อสงสัยประการใด สามารถติดต่อสอบถามได้ที่ นายวรกร วรเพียรกุล 092-502-5554 หรือ voragorn1@gmail.com

(ศาสตราจารย์ ดร.ปารเมศ ชุติมา)
ผู้อำนวยการ
ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต

รายละเอียดของการสัมภาษณ์

1. <u>ความยืดหยุ่นของราคาค่าโดยสาร ต่อความต้องการใช้บริการของผู้บริโภค</u>

   1.1) ทาง BTS ได้มีการศึกษา หรือ มีความคิดเห็นอย่างไรต่อ การเปลี่ยนแปลงของราคาค่าโดยสาร การเดินทางด้วย BTS, ที่มีผลต่อความต้องการใช้บริการของผู้บริโภค

   1.2) ท่านคิดว่าราคาค่าโดยสารของ BTS ในปัจจุบันนั้น มีความเหมาะสมต่อผู้บริโภคมากน้อยอย่างไร

   1.3) ทาง BTS มีแนวทางหรือความคิดเห็นอย่างไร ต่อการลดราคาค่าโดยสารและบริการ หรือจัดโปรโมชั่น เพื่อดึงดูดผู้ใช้บริการให้มากขึ้น ในระยะยาว

2. <u>ระบบขนส่งแบบบูรณาการ (Integrated Transport System)</u>

   2.1) ท่านมีความคิดเห็นอย่างไรต่อปัญหาในการเข้าถึงยากเพื่อใช้บริการรถไฟฟ้า หรือ ที่เรียกว่า First Mile Last Mile Problem

   2.2) ท่านมีความคิดเห็นอย่างไรต่อการร่วมมือกันในให้บริการขนส่งหลายรูปแบบ เช่น รถไฟฟ้า, รถบัส, Grab เป็นต้น หรือ ระบบขนส่งแบบบูรณาการ เพื่อนำไปสู่การขนส่งแบบไร้รอยต่อ

   2.3) ทาง BTS ได้มีแนวทาง หรือความคิดเห็นอย่างไร ต่อการจัดส่วนลด โปรโมชั่น ร่วมกันกับบริษัทขนส่งรูปแบบอื่น (เช่น Grab) เพื่อดึงดูดให้ผู้ใช้บริการ หันมาใช้บริการขนส่งสาธารณะตั้งแต่ต้นทางสู่ปลายทาง

   2.4) ในกรณีที่ทางบริษัท BTS ได้จัดส่วนลด โปรโมชั่น ร่วมกันกับขนส่งมวลชนรูปแบบอื่น (เช่น Grab) ท่านคิดว่าประเภทส่วนลดที่เหมาะสมนั้นควรเป็น โปรโมชั่นประเภทไหน อย่างไร

นายวรกร วรเพียรกุล

3. The interview invitation letter and attached interview questions for GET Thailand Company

ศวผ. 025/2563 7 พฤษภาคม 2563

เรื่อง ขอความอนุเคราะห์ข้อมูลและสัมภาษณ์

เรียน คุณกิญญา นิตยาเกษตรวัฒน์
ประธานเจ้าหน้าที่บริหาร
บริษัท เก็ท ประเทศไทย จำกัด

สิ่งที่แนบมาด้วย รายละเอียดของการสัมภาษณ์

เนื่องด้วย นายวรกร วรเพียรกุล นิสิตระดับบริญญาโท หลักสูตรวิศวกรรมศาสตรมหาบัณฑิต สาขาการจัดการทางวิศวกรรม ของศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ซึ่งมีอาจารย์ที่ปรึกษาวิทยานิพนธ์คือ รศ.ดร.มาโนช โลหเตปานนท์ มีความสนใจทำโครงงานวิทยานิพนธ์ในหัวข้อ การศึกษาความยืดหยุ่นของอุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม (A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers) ซึ่งมีวัตถุประสงค์ในการศึกษาความยืนหยุ่นของอุปสงค์ต่อราคาค่าโดยสาร และความเป็นไปได้ในการร่วมมือกันระหว่างผู้ให้บริการขนส่งระบบรางและทางบก ทั้งในแง่ของการให้บริการ และค่าโดยสาร เพื่อที่จะแก้ไขปัญหาความไม่ต่อเนื่องในการเดินทางของประชาชน โดยส่วนหนึ่งของการวิจัยเป็นการหาข้อมูลและแนวคิดในเชิงธุรกิจ จากบริษัทผู้ให้บริการขนส่งโดยตรง โดยสัมภาษณ์ตามรายละเอียดที่แนบมาด้วย เพื่อนำข้อมูลมาวิเคราะห์ความเป็นไปได้ และแนวทางของระบบขนส่งแบบบูรณาการ

ศูนย์ระดับภูมิภาคฯ จึงขอความอนุเคราะห์กับทางบริษัทฯ ในการให้ข้อมูลกับ นายวรกร วรเพียรกุล เพื่อนำข้อมูลมาประกอบการทำโครงงานวิทยานิพนธ์ และทางศูนย์ระดับภูมิภาคฯ ขอรับรองว่าจะไม่นำเอกสารและข้อมูลต่าง ๆ ที่ได้รับจากบริษัทฯ ไปเปิดเผยก่อนที่จะได้รับอนุญาตอย่างเป็นลายลักษณ์อักษรจากทางบริษัทฯ

จึงเรียนมาเพื่อพิจารณาอนุมัติ จักขอบพระคุณยิ่ง หากท่านมีข้อสงสัยประการใด สามารถติดต่อสอบถามได้ที่ นายวรกร วรเพียรกุล 092-502-5554 หรือ voragorn1@gmail.com

(ศาสตราจารย์ ดร.ปารเมศ ชุติมา)
ผู้อำนวยการ
ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต

รายละเอียดของการสัมภาษณ์

1. **ความยืดหยุ่นของราคาค่าโดยสาร ต่อความต้องการใช้บริการของผู้บริโภค**

   1.1) บริษัท GET ได้มีการศึกษา หรือ มีความคิดเห็นอย่างไรต่อ การเปลี่ยนแปลงของราคาค่าโดยสาร การเดินทางด้วย GET, ที่มีผลต่อความต้องการใช้บริการของผู้บริโภค

   1.2) ท่านคิดว่าราคาค่าโดยสารของ GET ในปัจจุบันนั้น มีความเหมาะสมต่อผู้บริโภคมากน้อยอย่างไร

   1.3) ทางบริษัท GET มีแนวทางหรือความคิดเห็นอย่างไร ต่อการลดราคาค่าโดยสารและบริการ หรือจัดโปรโมชั่น เพื่อดึงดูดผู้ใช้บริการ ให้มากขึ้น ในระยะยาว

2. **ระบบขนส่งแบบบูรณาการ (Integrated Transport System)**

   2.1) ท่านมีความคิดเห็นอย่างไรต่อการร่วมมือกันในให้บริการขนส่งหลายรูปแบบ เช่น รถไฟฟ้า, รถบัส, Grab, GET เป็นต้น หรือ ระบบขนส่งแบบบูรณาการ เพื่อนำไปสู่การขนส่งมวลชนแบบไร้รอยต่อ

   2.2) ทางบริษัท GET ได้มีแนวทาง หรือความคิดเห็นอย่างไร ต่อการจัดส่วนลด โปรโมชั่น ร่วมกันกับบริษัทขนส่งรูปแบบอื่น(เช่น รถไฟฟ้า) เพื่อดึงดูดให้ผู้ใช้บริการ หันมาใช้บริการขนส่งสาธารณะตั้งแต่ต้นทางสู่ปลายทาง

   2.3) ในกรณีที่ทางบริษัท GET ได้จัดส่วนลด โปรโมชั่น ร่วมกันกับขนส่งมวลชนรูปแบบอื่น (เช่น รถไฟฟ้า) ท่านคิดว่าประเภทส่วนลดที่เหมาะสมนั้นควรเป็น โปรโมชั่นประเภทไหน อย่างไร

นายวรกร วรเพียรกุล

4. The interview invitation letter and attached interview questions for Grab Thailand Company

ศวผ. 021/2563 7 พฤษภาคม 2563

เรื่อง ขอความอนุเคราะห์ข้อมูลและสัมภาษณ์

เรียน คุณธรินทร์ ธนียวัน
กรรมการผู้จัดการใหญ่
บริษัท แกร็บ (ประเทศไทย) จำกัด

สิ่งที่แนบมาด้วย รายละเอียดของการสัมภาษณ์

เนื่องด้วย นายวรกร วรเพียรกุล นิสิตระดับปริญญาโท หลักสูตรวิศวกรรมศาสตรมหาบัณฑิต สาขาการจัดการทางวิศวกรรม ของศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ซึ่งมีอาจารย์ที่ปรึกษาวิทยานิพนธ์คือ รศ.ดร.มาโนช โลหเตปานนท์ มีความสนใจทำโครงงานวิทยานิพนธ์ในหัวข้อ การศึกษาความยืดหยุ่นขององุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม (A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers) ซึ่งมีวัตถุประสงค์ในการศึกษาความยืนหยุ่นขององุปสงค์ต่อราคาค่าโดยสาร และความเป็นไปได้ในการร่วมมือกันระหว่างผู้ให้บริการขนส่งระบบรางและทางบก ทั้งในแง่ของการให้บริการ และค่าโดยสาร เพื่อที่จะแก้ไขปัญหาความไม่ต่อเนื่องในการเดินทางของประชาชน โดยส่วนหนึ่งของการวิจัยเป็นการหาข้อมูลและแนวคิดในเชิงธุรกิจ จากบริษัทผู้ให้บริการขนส่งโดยตรง โดยสัมภาษณ์ตามรายละเอียดที่แนบมาด้วย เพื่อนำข้อมูลมาวิเคราะห์ความเป็นไปได้ และแนวทางของระบบขนส่งแบบบูรณาการ

ศูนย์ระดับภูมิภาคฯ จึงขอความอนุเคราะห์กับทางบริษัทฯ ในการให้ข้อมูลกับ นายวรกร วรเพียรกุล เพื่อนำข้อมูลมาประกอบการทำโครงงานวิทยานิพนธ์ และทางศูนย์ระดับภูมิภาคฯ ขอรับรองว่าจะไม่นำเอกสารและข้อมูลต่าง ๆ ที่ได้รับจากบริษัทฯ ไปเปิดเผยก่อนที่จะได้รับอนุญาตอย่างเป็นลายลักษณ์อักษรจากทางบริษัทฯ

จึงเรียนมาเพื่อพิจารณาอนุมัติ จักขอบพระคุณยิ่ง หากท่านมีข้อสงสัยประการใด สามารถติดต่อสอบถามได้ที่ นายวรกร วรเพียรกุล 092-502-5554 หรือ voragorn1@gmail.com

(ศาสตราจารย์ ดร.บำรุงเมศ ชุติมา)
ผู้อำนวยการ
ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต

รายละเอียดของการสัมภาษณ์

1. **ความยืดหยุ่นของราคาค่าโดยสาร ต่อความต้องการใช้บริการของผู้บริโภค**

   1.1) บริษัท Grab ได้มีการศึกษา หรือ มีความคิดเห็นอย่างไรต่อ การเปลี่ยนแปลงของราคาค่าโดยสาร การเดินทางด้วย Grab, ที่มีผลต่อความต้องการใช้บริการของผู้บริโภค

   1.2) ท่านคิดว่าราคาค่าโดยสารของ Grab ในปัจจุบันนั้น มีความเหมาะสมต่อผู้บริโภคมากน้อยอย่างไร

   1.3) ทางบริษัท Grab มีแนวทางหรือความคิดเห็นอย่างไร ต่อการลดราคาค่าโดยสารและบริการ หรือจัดโปรโมชั่น เพื่อดึงดูดผู้ใช้บริการ ให้มากขึ้น ในระยะยาว

2. **ระบบขนส่งแบบบูรณาการ (Integrated Transport System)**

   2.1) ท่านมีความคิดเห็นอย่างไรต่อการร่วมมือกันในให้บริการขนส่งหลายรูปแบบ เช่น รถไฟฟ้า, รถบัส, Grab เป็นต้น หรือ ระบบขนส่งแบบบูรณาการ เพื่อนำไปสู่การขนส่งมวลชนแบบไร้รอยต่อ

   2.2) ทางบริษัท Grab ได้มีแนวทาง หรือความคิดเห็นอย่างไร ต่อการจัดส่วนลด โปรโมชั่น ร่วมกันกับบริษัทขนส่งรูปแบบอื่น (เช่น รถไฟฟ้า) เพื่อดึงดูดให้ผู้ใช้บริการ หันมาใช้บริการขนส่งสาธารณะตั้งแต่ต้นทางสู่ปลายทาง

   2.3) ในกรณีที่ทางบริษัท Grab ได้จัดส่วนลด โปรโมชั่น ร่วมกันกับขนส่งมวลชนรูปแบบอื่น (เช่น รถไฟฟ้า) ท่านคิดว่าประเภทส่วนลดที่เหมาะสมนั้นควรเป็น โปรโมชั่นประเภทไหน อย่างไร

นายวรกร วรเพียรกุล

Appendix C. Participant Information Leaflet and Participant Consent

Appendix C shows Participants Information Leaflet for survey participants and interview participants in both Thai and English. Together with the consent form of interview participants from Bangkok Expressway and Metro Public Company Limited and Get Thailand Company.

1. Participants Information Leaflet for survey participants

Participant Information Leaflet (Survey)

Research Project Title

A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers

Invitation to participate in a survey

We would like to invite you to join our research survey as part of the requirement for the completion of the Master Degree of Chulalongkorn University and University of Warwick. Before starting the participation in this research, it is important to understand why this survey is carried out and what it will involve. Please take time to read through the following information carefully and feel free to ask for more information if there is anything not clear.

What is the purpose of this survey

The purpose of this survey is finding out the appropriate range of Bangkok metro fare base on the metro user's opinion or demand. The participants are asked as if they have ever used to take the Bangkok metro in three specific routes. If they use to commute in any route. Their opinion of four levels of fare in that specific routes which are the appropriated fare, the expensive fare, too expensive fare to purchase, and too cheap fare to purchase are the main factors to analyse for the range of appropriated fare in each specific routes, base on metro users' opinion and also the price elasticity on people demand.

Why have I been chosen

You have been chosen because you are one of the Bangkok metro users who is able to provide a realistic perspective in the metro fare in Bangkok. Moreover, this survey intends to recruit only the participants who are over 18 years old. If you are under 18 years old, please refuse or leave the survey.

Do I have to take part?

No, it is up to your judgement to decide whether you are willing to take part in this survey and if you start to take part in this survey, you can stop and leave at any time. A decision to withdraw or not to take part in the survey will not have any consequences. Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. Your data will be recorded anonymously and will only be used for academic purposes in this thesis.

How do I consent to take part in the survey?

The consent form will be given to you prior to the start of the survey. By ticking the consent box, we will assume that you have provided your consent for the submitted data or answers in the survey, to be used for the research purpose as stated above.

What will the survey involve if I take part?

Before asking for the opinion of the fare for specific routes of Bangkok metro, the participants are asked as if they use to commute in three specific routes, if yes, the participants are further asked for the opinions of the metro fare in that specific route. If not, it is not necessary for them to be asked any further questions about those specific routes. In each specific routes, participants are asked to define the opinion of the fare for that route in 4 levels which are the appropriate fare for that route, the fare that you think it is expensive for that route but you still able to buy it, the fare that you think it is too expensive for that route to buy, and the fare that you think is too cheap for that route because it may be doubt in the quality of the service. The process should take approximately 5 minutes to complete.

What are the possible risks of taking part in the survey?

Participating in the research is voluntary with an assurance that no negative consequences could arise from your participation. It is not anticipated to cause you any disadvantages or discomfort. Please feel free to stop or leave at any time based on your comfort.

Will my taking part in this survey be kept confidential?

Yes, first of all, participants are not asked for the name or any personal detail that can identify the participants . All individual collected data will be kept strictly confidential and will be stored in the form that is able to access only by the researcher and protected by passwords.

What will happen to the results of the survey?

At the end of the study, we will analyse all of the survey results for all participants' input. The research will be submitted to the University's examination committee for evaluation. We might then publish our findings in an academic journal and at relevant conferences. You will not be identified in any publication arising from this survey.

Who has ethically reviewed the research?

The research has been ethically approved by the Overseas Programmes Course Office, Warwick Manufacturing Group

Contacts for further information

Voragorn Warapiankul

Email: voragorn1@gmail.com

Thank you for participating in this research.

แผ่นพับข้อมูลผู้เข้าร่วมโครงการวิจัย (แบบสำรวจ)

ชื่อโครงการวิจัย

การศึกษาความยืดหยุ่นขององุปสงค์และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และผู้ให้บริการเครือข่ายคมนาคม

ขอเชิญเข้าร่วมการสำรวจและสัมภาษณ์

เราขอเชิญคุณเข้าร่วมแบบสำรวจการวิจัยและการสัมภาษณ์ซึ่งเป็นส่วนหนึ่งของข้อกำหนดในการสำเร็จการศึกษาระดับปริญญาโทจากจุฬาลงกรณ์มหาวิทยาลัยและ University of Warwick ก่อนที่จะทำการตัดสินใจ สิ่งสำคัญคือคุณต้องเข้าใจว่าทำไมการสำรวจแบบสอบถามถึงถูกดำเนินการ รวมทั้งสิ่งอื่นๆที่เกี่ยวข้อง โปรดสละเวลาอ่านข้อมูลต่อไปนี้อย่างละเอียด และโปรดถามคำถามหากมีสิ่งใดที่ไม่ชัดเจนหรือหากคุณต้องการข้อมูลเพิ่มเติม

วัตถุประสงค์ของการสำรวจคืออะไร?

การทำแบบสำรวจนี้ มีวัตถุประสงค์เพื่อวิเคราะห์หาช่วงราคาที่เหมาะสมของค่าโดยสารรถไฟฟ้าในกรุงเทพมหานคร อ้างอิงตามความคิดเห็นและอุปสงค์ของประชาชนผู้ใช้งานรถไฟฟ้า คุณจะได้รับคำถาม ว่าเคยเดินทางด้วยรถไฟฟ้า ใน 3 เส้นทางหรือไม่ ถ้าคุณเคยเดินทางด้วยเส้นทางดังกล่าว ความคิดเห็นของท่านในค่าโดยสาร 4 ระดับ สำหรับเส้นทางดังกล่าว นั่นคือ ราคาค่าโดยสารที่เหมาะสมสำหรับเส้นทางนี้, ราคาค่าโดยสารที่ท่านคิดว่าแพงสำหรับเส้นทางนี้, ราคาค่าโดยสารที่ท่านคิดว่าเพงเกินกว่าที่จะจ่ายสำหรับเส้นทางนี้ และ ราคาค่าโดยสารที่ท่านคิดว่าถูกเกินกว่าที่จะใช้บริการเนื่องจากไม่มั่นใจในคุณภาพ จะเป็นข้อมูลที่ใช้ในการวิเคราะห์เพื่อหาช่วงราคาที่เหมาะสมสำหรับแต่ละเส้นทางตามความคิดเห็นของผู้ใช้งาน และความยืดหยุ่นของค่าโดยสารรถไฟฟ้าต่อความต้องการใช้งานของประชาชน

ทำไมฉันถึงถูกเลือก?

คุณถูกเลือกเพราะคุณคือหนึ่งในผู้ใช้งานรถไฟฟ้าในกรุงเทพมหานคร ซึ่งสามารถที่จะให้ความคิดเห็นสำหรับค่าโดยสารรถไฟฟ้าได้อย่างแท้จริง นอกจากนั้นแบบสำรวจนี้ต้องการผู้เข้าร่วมที่อายุตั้งแต่ 18 ปีขึ้นไปเท่านั้น ดังนั้นหากท่านอายุต่ำกว่า 18 ปี กรุณาปฏิเสธหรือยกเลิกการทำแบบสอบถามนี้

ฉันจำเป็นต้องเข้าร่วมหรือไม่

ไม่จำเป็น ขึ้นอยู่กับดุลยพินิจของคุณในการตัดสินใจว่าคุณยินดีที่จะมีส่วนร่วมในการสำรวจและการสัมภาษณ์ครั้งนี้หรือไม่ หากคุณตัดสินใจที่จะไม่เข้าร่วมในการสำรวจนี้ คุณสามารถหยุดและปิดแบบสำรวจได้ตลอดเวลา การตัดสินใจที่จะถอนตัวหรือไม่เข้าร่วมในการทำแบบสอบถามนี้จะไม่มีผลกระทบใด การเข้าร่วมในการวิจัยนี้เป็นการสมัครใจของท่าน ด้วยความมั่นใจว่าจะไม่มีผลกระทบเชิงลบที่อาจเกิดขึ้นจากการปฏิเสธการเข้าร่วมของคุณ ข้อมูลของคุณจะถูกบันทึกโดยไม่ระบุชื่อและจะถูกนำมาใช้เพื่อวัตถุประสงค์ทางวิชาการในการทำวิทยานิพนธ์นี้เท่านั้น

ฉันจะยินยอมให้มีส่วนร่วมในแบบสำรวจนี้ได้อย่างไร?

แบบฟอร์มการยินยอมจะให้ถูกแสดงให้คุณอ่านและตอบก่อนเริ่มทำแบบสอบถาม โดยการกดที่ช่องว่างแสดงความยินยอมในแบบฟอร์มที่มีให้ จะถือว่าคุณได้ให้ความยินยอมของคุณสำหรับข้อมูลคำตอบที่ส่งมาเพื่อใช้ตามวัตถุประสงค์ที่ระบุไว้ข้างต้น

การสำรวจจะเกี่ยวข้องกับอะไรบ้าง หากฉันเข้าร่วม?

หากคุณยินดีเข้าร่วมในแบบสอบถามนี้ คุณจะได้รับคำถามถามข้อมูลเบื้องต้นของท่าน เช่น อายุ อาชีพ รายได้ และ มีรถส่วนตัวหรือไม่ หลังจากนั้นท่านจะได้รับคำถามว่าท่านเคยเดินทางด้วยรถไฟฟ้า ในลามเส้นทางที่กำหนดหรือไม่ ในแต่ละเส้นทาง ถ้าท่านเคยเดินทาง ท่านจะได้รับคำถามต่อเนื่อง ถึงความคิดเห็นในระดับค่าโดยสาร 4 ระดับสำหรับแต่ละเส้นทางดังกล่าว นั่นคือ ราคาค่าโดยสารที่เหมาะสมสำหรับเส้นทางนี้, ราคาค่าโดยสารที่ท่านคิดว่าแพงสำหรับเส้นทางนี้, ราคาค่าโดยสารที่ท่านคิดว่าเพงเกินกว่าที่จะจ่ายสำหรับเส้นทางนี้ และ ราคาค่าโดยสารที่ท่านคิดว่าถูกเกินกว่าที่จะใช้บริการเนื่องจากไม่มั่นใจในคุณภาพ แบบสอบถามนี้จะใช้เวลาไม่เกิน 5 นาทีจึงจะเสร็จสมบูรณ์

อะไรคือข้อเสียหรือความเสี่ยงที่อาจเกิดขึ้นจากการเข้าร่วมการสำรวจ

การเข้าร่วมในการวิจัยเป็นไปโดยความสมัครใจของท่าน ทางเรามีความมั่นใจว่าจะไม่มีผลกระทบเชิงลบเกิดขึ้นจากการเข้าร่วมของคุณ และคาดว่าจะไม่ทำให้คุณเสียเปรียบหรือรู้สึกไม่สบายใจ โปรดอย่าลังเลที่จะขอหยุดหรือออกเมื่อใดก็ได้ตามความต้องการของคุณ

การมีส่วนร่วมในแบบสำรวจนี้จะถูกเก็บเป็นความลับหรือไม่

ใช่ ก่อนอื่น ท่านจะไม่ถูกถามถึงชื่อหรือข้อมูลส่วนตัวที่สามารถระบุตัวท่านได้ ข้อมูลทั้งหมดที่ทางผู้วิจัยรวบรวม จะถูกเก็บไว้ในรูปแบบที่เข้าถึงได้โดยผู้วิจัยเท่านั้น และได้รับการป้องกันด้วยรหัสผ่าน เพื่อป้องกันไม่ให้บุคคลอื่นสามารถเข้าถึงข้อมูลนี้ได้ อย่างเคร่งครัด

จะเกิดอะไรขึ้นกับข้อมูลและผลลัพธ์ของแบบสอบถามนี้

ในตอนท้ายของงานวิจัยนี้ ทางผู้วิจัยจะรวบรวม และวิเคราะห์ผลในแบบสอบถามทั้งหมด ผลการวิเคราะห์หรืองานวิจัยนี้จะ ถูกส่งไปยังคณะกรรมการตรวจสอบของมหาวิทยาลัยเพื่อการประเมินผล จากนั้นเราอาจตีพิมพ์ผลการวิจัยของเราในวารสารวิชาการและการประชุมที่เกี่ยวข้อง คุณจะไม่ถูกระบุในสิ่งพิมพ์ใดๆ ที่เกิดขึ้นจากการทำแบบสอบถามนี้

ใครบ้างที่สามารถตรวจสอบงานวิจัยนี้อย่างมีจริยธรรม?

การวิจัยได้รับการอนุมัติทางจริยธรรมจากสำนักงานหลักสูตรต่างประเทศของกลุ่ม Warwick Manufacturing Group

ผู้ติดต่อสำหรับข้อมูลเพิ่มเติม

นาย วรกร วรเพียรกุล

อีเมล: voragorn1@gmail.com

ขอบคุณที่เข้าร่วมงานวิจัยในครั้งนี้

2. Participants Information Leaflet for Interview participants

Participant Information Leaflet (Interview)

Research Project Title

A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers

Invitation to participate in a survey

We would like to invite you to join our research interview as part of the requirement for the completion of the Master Degree of Chulalongkorn University and University of Warwick. Before starting the participation in this research, it is important to understand why this survey is carried out and what it will involve. Please take time to read through the following information carefully and feel free to ask for more information if there is anything not clear.

What is the purpose of this interview?

The purpose of this interview is to find the perspective of metro operators and Ride Hailing Service companies or Transportation network company (TNC). The expected finding in this interview is the opinion of the transport providers for the feasibility and approach for improving the accessibility problems of metro transit as are called "First Mile Last Mile problem". The approach of integrated transport system which partnership between metro transit and Ride Hailing Service will be addressed. This interview also tends to find the possible partnership approach in term of business benefit-sharing, cooperate strategies in Transport providers' point of view.

Why have I been chosen

You have been chosen because you are the representative of the metro operators or Transportation network company (TNC) who is able to provide the realistic perspective to achieve the main purpose of this research as are stated above.

Do I have to take part?

No, it is up to your judgement to decide whether you are willing to take part in this interview and if you start to take part in this survey, you can stop and leave at any time. A decision to withdraw or not to take part in the interview will not have any consequences. Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. Your data will be recorded anonymously and will only be used for academic purposes in this research.

How do I consent to take part in the interview?

The consent form in paper form and electronic form will be given to you prior to the start of the interview. By ticking the consent box, we will assume that you have provided your consent for the submitted data or answers in the survey, to be used for the research purpose as stated above.

What will the interview involve if I take part?

If you take part in the interview, you will be asked two series of questions about the service fares and the integrated transportation system. About the service fare, participants are asked for the opinion of the current services fare level and the elasticity to the customers' demand or the approach of providing discount or promotion in order to attract more customers. For the integrated transportation system topic, participants are asked for the opinion of the approach to partnership between metro transit and ride hailing service in order to increase the accessibility to metro transit and provide convenience to people. Moreover, the participants are also asked for the business point of view of this partnership approach, for instance the business sharing, cooperate strategies, etc.

What are the possible risks of taking part in the interview?

Participating in the research is voluntary with an assurance that no negative consequences could arise from your participation. It is not anticipated to cause you any disadvantages or discomfort. Please feel free to stop or leave at any time based on your comfort.

Will my taking part in this interview be kept confidential?

Yes, All individual collected data will be kept strictly confidential and will be stored in the form that is able to access only by the researcher and protected by passwords.

What will happen to the results of the survey?

At the end of the study, we will analyse all of the survey results for all participants' input. The research will be submitted to the University's examination committee for evaluation. We might then publish our findings in an academic journal and at relevant conferences. You will not be identified in any publication arising from this survey.

Will I be recorded, and how will the recorded media be used?

In this interview, the participants will be asking for permission to record the sound during the interview. The recorded sound will be used only for studying purpose during conducting the research.

Who has ethically reviewed the research?

The research has been ethically approved by the Overseas Programmes Course Office, Warwick Manufacturing Group

Contacts for further information

Voragorn Warapiankul

Email: voragorn1@gmail.com

Thank you for participating in this research.

แผ่นพับข้อมูลผู้เข้าร่วมโครงการวิจัย (การสัมภาษณ์)

ชื่อโครงการวิจัย

การศึกษาความยืดหยุ่นขององุปสงค์ และการประยุกต์ใช้ในการร่วมมือสำหรับบริการขนส่งจากต้นทางและสู่ปลายทาง ระหว่างระบบขนส่งมวลชน และ ผู้ให้บริการเครือข่ายคมนาคม

ขอเชิญเข้าร่วมการสัมภาษณ์

เราขอเชิญคุณเข้าร่วมการวิจัยและการสัมภาษณ์ซึ่งเป็นส่วนหนึ่งของข้อกำหนดในการสำเร็จการศึกษาระดับปริญญาโทจาก จุฬาลงกรณ์มหาวิทยาลัย และ University of Warwick ก่อนที่จะทำการตัดสินใจสิ่งสำคัญคือคุณต้องเข้าใจว่าทำไมการสำรวจถึงถูกดำเนินการ รวมทั้งสิ่งอื่นๆที่เกี่ยวข้อง โปรดสละเวลาอ่านข้อมูลต่อไปนี้อย่างละเอียด และโปรดถามคำถามหากมีสิ่งใดที่ไม่ชัดเจนหรือหากคุณต้องการข้อมูลเพิ่มเติม

วัตถุประสงค์ของการสัมภาษณ์คืออะไร?

วัตถุประสงค์ของการสัมภาษณ์ในงานวิจัยนี้ คือ ศึกษาความคิดเห็นของผู้ให้บริการขนส่งรถไฟฟ้า และ ผู้ให้บริการขนส่งทางบกอื่น ในกรุงเทพมหานคร โดยคาดว่าจะได้รับข้อคิดเห็นและมุมมองของผู้ให้บริการขนส่งดังกล่าว ถึงความเป็นไปได้และแนวทางให้การแก้ไขปัญหาการเข้าถึงยากของการใช้บริการรถไฟฟ้าขนส่งมวลชนในกรุงเทพมหานคร โดยระบบขนส่งแบบบูรณาการ ซึ่งร่วมมือทางธุรกิจระหว่างรถไฟฟ้าขนส่งมวลชนและบริษัทเครือข่ายคมนาคม เช่น Grab และ GET เป็นต้น จะถูกยกขึ้นมาเป็นหัวข้อหนึ่งในการสัมภาษณ์ โดยการสัมภาษณ์มีวัตถุประสงค์เพื่อหาความเป็นไปได้และแนวทางในการร่วมมือทางธุรกิจดังกล่าว ทั้งในมิติของการแบ่งปันผลประโยชน์ทางธุรกิจ, กลยุทธ์ในการให้บริการร่วมกัน เป็นต้น

ทำไมฉันถึงถูกเลือก?

คุณถูกเลือกเพราะคุณคือตัวแทนของ ผู้ให้บริการรถไฟฟ้าขนส่งมวลชน หรือ บริษัทเครือข่ายคมนาคม ในกรุงเทพมหานคร ซึ่งสามารถให้ความคิดเห็น ตามวัตถุประสงค์ของงานวิจัยที่ได้กล่าวไปข้างต้น

ฉันจำเป็นต้องเข้าร่วมหรือไม่

ไม่จำเป็น ขึ้นอยู่กับดุลยพินิจของคุณในการตัดสินใจว่าคุณยินดีที่จะมีส่วนร่วมในการสัมภาษณ์ครั้งนี้หรือไม่ หากคุณตัดสินใจที่จะไม่เข้าร่วมในการสำรวจนี้ คุณสามารถหยุดและปิดแบบสำรวจได้ตลอดเวลา การตัดสินใจที่จะถอนตัวหรือไม่เข้าร่วมในการทำแบบสอบถามนี้จะไม่มีผลกระทบใด การเข้าร่วมในการวิจัยนี้เป็นการสมัครใจของท่าน ด้วยความมั่นใจว่าจะไม่มีผลกระทบเชิงลบที่อาจเกิดขึ้นจากการปฏิเสธการเข้าร่วมของคุณ ข้อมูลของคุณจะถูกบันทึกโดยไม่ระบุชื่อและจะถูกนำมาใช้เพื่อวัตถุประสงค์ทางวิชาการในการทำวิทยานิพนธ์นี้เท่านั้น

ฉันจะยินยอมให้มีส่วนร่วมในแบบสำรวจนี้ได้อย่างไร?

แบบฟอร์มการยินยอมจะให้ถูกแสดงให้คุณอ่านและตอบก่อนเริ่มทำการสัมภาษณ์โดยการทำเครื่องหมายที่ช่องว่างแสดงความยินยอมในแบบฟอร์มที่มีให้ จะถือว่าคุณได้ให้ความยินยอมของคุณสำหรับข้อมูลคำตอบในการสัมภาษณ์เพื่อใช้ตามวัตถุประสงค์ที่ระบุไว้ข้างต้น

การสัมภาษณ์จะเกี่ยวข้องกับอะไรบ้าง หากฉันเข้าร่วม?

หากคุณยินดีเข้าร่วมในแบบสอบถามนี้ คุณจะได้รับคำถาม 2 หัวข้อ คือความคิดเห็นต่อราคาค่าโดยสารในมุมมองผู้ให้บริการ และระบบขนส่งแบบบูรณาการ ในหัวข้อความคิดเห็นต่อราคาค่าโดยสาร ผู้ให้สัมภาษณ์จะถูกถามถึงความคิดเห็นต่อราคาค่าโดยสารในปัจจุบัน และ ความยืดหยุ่นของราคาค่าโดยสารต่อความต้องการใช้บริการของผู้บริโภค รวมถึงแนวทางในการจัดส่วนลด หรือ โปรโมชั่น เพื่อดึงดูดผู้ใช้บริการให้มากขึ้น สำหรับหัวข้อระบบขนส่งแบบบูรณาการ ผู้ให้สัมภาษณ์จะถูกถามถึงความคิดเห็นและแนวทางในการร่วมมือทางธุรกิจระหว่างผู้ให้บริการรถไฟฟ้าขนส่งมวลชนและบริษัทเครือข่ายคมนาคม เช่น Grab และ GET เป็นต้น ในมิติของการแบ่งปันผลประโยชน์ทางธุรกิจ, กลยุทธ์ในการให้บริการร่วมกัน เป็นต้น

อะไรคือข้อเสียหรือความเสี่ยงที่อาจเกิดขึ้นจากการเข้าร่วมการสำรวจ

การเข้าร่วมในการวิจัยเป็นไปโดยความสมัครใจของท่าน ทางเรามีความมั่นใจว่าจะไม่มีผลกระทบเชิงลบเกิดขึ้นจากการเข้าร่วมของคุณ และคาดว่าจะไม่ทำให้คุณเสียเปรียบหรือรู้สึกไม่สบายใจ โปรดอย่าลังเลที่จะขอหยุดหรือออกเมื่อใดก็ได้ตามความต้องการของคุณ

การมีส่วนร่วมในแบบสำรวจนี้จะถูกเก็บเป็นความลับหรือไม่

ใช่ ข้อมูลทั้งหมดที่ทางผู้วิจัยรวบรวม จะถูกเก็บไว้ในรูปแบบที่เข้าถึงได้โดยผู้วิจัยเท่านั้น และได้รับการป้องกันด้วยรหัสผ่าน เพื่อป้องกันไม่ให้บุคคลอื่นสามารถเข้าถึงข้อมูลนี้ได้ อย่างเคร่งครัด

จะเกิดอะไรขึ้นกับข้อมูลและผลลัพธ์ของแบบสอบถามนี้

ในตอนท้ายของงานวิจัยนี้ ทางผู้วิจัยจะรวบรวม และวิเคราะห์ผลในแบบสอบถามทั้งหมด ผลการวิเคราะห์หรืองานวิจัยนี้จะ ถูกส่งไปยังคณะกรรมการตรวจสอบของมหาวิทยาลัยเพื่อการประเมินผล จากนั้นเราอาจตีพิมพ์ผลการวิจัยของเราในวารสารวิชาการและการประชุมที่เกี่ยวข้อง คุณจะไม่ถูกระบุตัวตนในสิ่งพิมพ์ใดๆ ที่เกิดขึ้นจากการทำแบบสอบถามนี้

ฉันจะถูกสื่อบันทึกหรือไม่ และจะนำข้อมูลสื่อที่บันทึกไปใช้อย่างไร?

ในการสัมภาษณ์ ผู้ให้สัมภาษณ์จะถูกขออนุญาต ในการบันทึกเสียงระหว่างการสัมภาษณ์ โดยเสียงที่ถูกบันทึกนั้นจะถูกใช้สำหรับศึกษาและวิเคราะห์เนื้อหาสำหรับงานวิจัยเท่านั้น โดยจะไม่ถูกเปิดเผยที่ใด

ใครบ้างที่สามารถตรวจสอบงานวิจัยนี้อย่างมีจริยธรรม?

การวิจัยได้รับการอนุมัติทางจริยธรรมจากสำนักงานหลักสูตรต่างประเทศของกลุ่ม Warwick Manufacturing Group

ผู้ติดต่อสำหรับข้อมูลเพิ่มเติม

นาย วรกร วรเฟียรกุล

อีเมล: voragorn1@gmail.com

ขอบคุณที่เข้าร่วมงานวิจัยในครั้งนี้

3. Consent Form of Interview participants

Consent Form: Bangkok Expressway and Metro Public Company Limited (Interview)

This Interview is part of the Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Engineering Business Management (EBM), in a dual-master degree program University of Warwick and Faculty of Engineering Chulalongkorn University; this research is self-funded by the student.

Project Title : A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers

Name of researcher Mr. Voragorn Warapiankul

Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. Your data will be recorded anonymously, only the name of the company and your role will be referred to. Your name and identity will be kept anonymous. Please tick the box below and sign on for your consent to participate in this Interview and your data can be used in the thesis:

☑ Agree, I give my consent for my data submitted in this interview to be used for the purpose stated above.

Ticking on Agree box indicate that

1. You have read and understood the Participant Information Leaflet for the above study. You have opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. You are voluntarily taking part in this interview and that you are free to withdraw at any time without giving any reason, or legal rights being affected.
3. You consent to be audio recorded during the interview.
4. You agree to take part in the above study

If you do not wish to participate in this interview, please do not proceed to the next section. You can inform the researcher of your intention to withdraw.

Initial of participant 

Initial of Researcher Vorag W.

Consent Form: GET Thailand Company (Interview)

This Interview is part of the Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Engineering Business Management (EBM), in a dual-master degree program University of Warwick and Faculty of Engineering Chulalongkorn University; this research is self-funded by the student.

Project Title : A Study of Price Elasticity of Demand and Its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers

Name of researcher Mr. Voragorn Warapiankul

Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. Your data will be recorded anonymously, only the name of the company and your role will be referred to. Your name and identity will be kept anonymous. Please tick the box below and sign on for your consent to participate in this Interview and your data can be used in the thesis:

☑ Agree, I give my consent for my data submitted in this interview to be used for the purpose stated above.

Ticking on Agree box indicate that

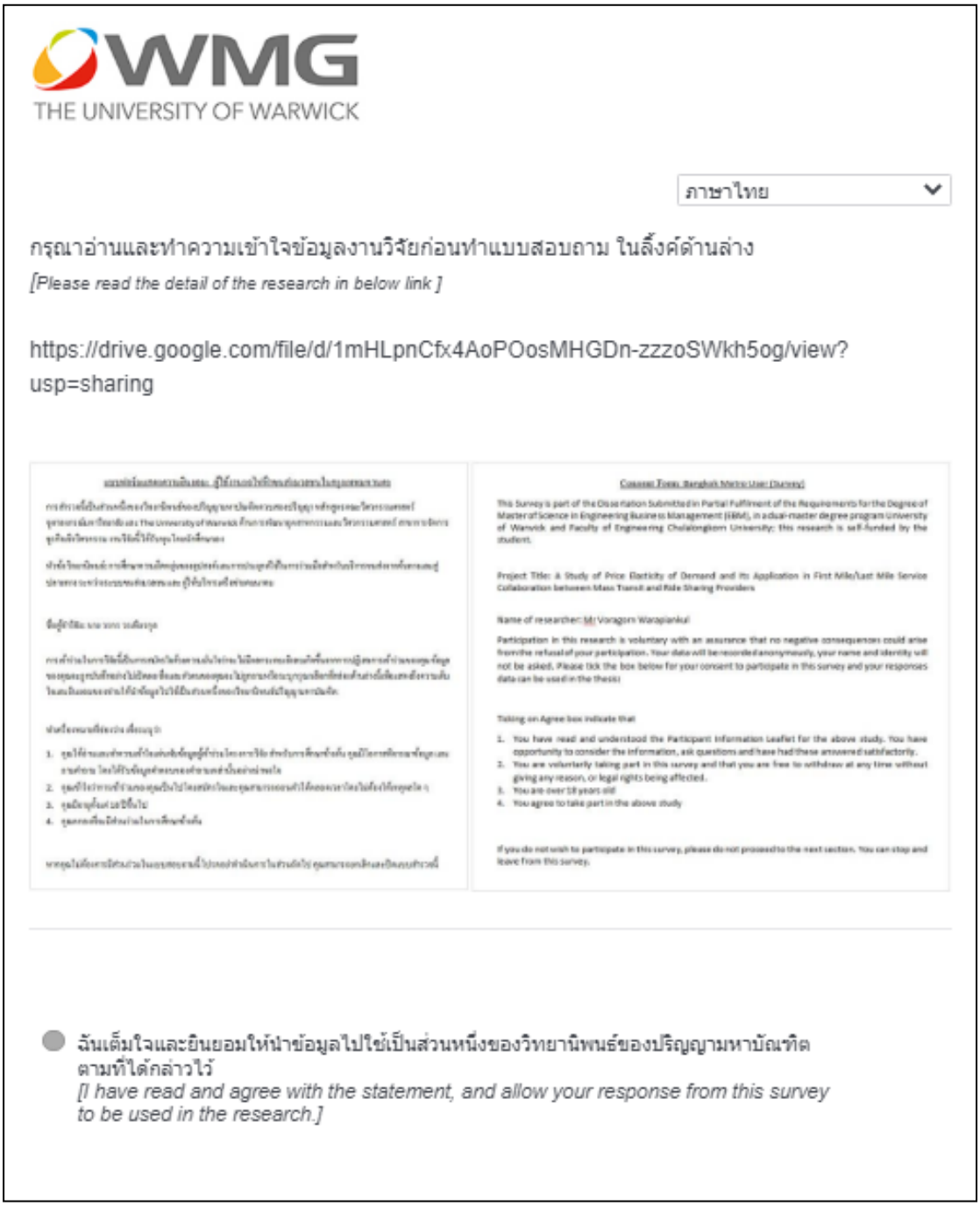
1. You have read and understood the Participant Information Leaflet for the above study. You have opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. You are voluntarily taking part in this interview and that you are free to withdraw at any time without giving any reason, or legal rights being affected.
3. You consent to be audio recorded during the interview.
4. You agree to take part in the above study

If you do not wish to participate in this interview, please do not proceed to the next section. You can inform the researcher of your intention to withdraw.

Initial of participant Pannatai J.

Initial of Researcher Voragorn W.

4. Example of the consent of survey participants



WMG
THE UNIVERSITY OF WARWICK

ภาษาไทย

กรุณาอ่านและทำความเข้าใจข้อมูลงานวิจัยก่อนทำแบบสอบถาม ในลิ้งค์ด้านล่าง

[Please read the detail of the research in below link]

https://drive.google.com/file/d/1mHLpnCfx4AoPOosMHGDn-zzzoSWkh5og/view?usp=sharing

Consent Form: Bangkok Metro User Survey

This Survey is part of the Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Engineering Business Management (EBM), in a dual-master degree program University of Warwick and Faculty of Engineering Chulalongkorn University; this research is self-funded by the student.

Project Title: A Study of Price Elasticity of Demand and its Application in First Mile/Last Mile Service Collaboration between Mass Transit and Ride Sharing Providers

Name of researcher: Mr Voragorn Warapiankul

Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. Your data will be recorded anonymously, your name and identity will not be asked. Please tick the box below for your consent to participate in this survey and your responses data can be used in the thesis

Taking on Agree box indicate that

1. You have read and understood the Participant Information Leaflet for the above study. You have opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. You are voluntarily taking part in this survey and that you are free to withdraw at any time without giving any reason, or legal rights being affected.
3. You are over 18 years old
4. You agree to take part in the above study

If you do not wish to participate in this survey, please do not proceed to the next section. You can stop and leave from this survey.

ฉันเต็มใจและยินยอมให้นำข้อมูลไปใช้เป็นส่วนหนึ่งของวิทยานิพนธ์ของปริญญามหาบัณฑิต ตามที่ได้กล่าวไว้

[I have read and agree with the statement, and allow your response from this survey to be used in the research.]

VITA

NAME	voragorn
DATE OF BIRTH	4 October 1993
PLACE OF BIRTH	Bangkok
INSTITUTIONS ATTENDED	Regional centre for manufacturing system engineering, Faculty of Engineering, Chulalongkorn University
HOME ADDRESS	15/3 Soi Meksawat SribumpenRoad, Yannawa District, Bangkok, Thailand 10120