Modal Shift in Travelers and an Evaluation of Feeder Services System Modal Shift in Travelers: A Case Study in Yangon

Hnin Nwe Nwe Soe[a], Kyaing[b], Yin Min Han[c]

[a,b] *Yangon Technological University, Insein Road, Gyogone, Insein 11011, Yangon, Myanmar.*
[a] *Email: hninnwenwesoe1@gmail.com*
[,c] *Technological University, Toungoo ,Bago, Myanmar.*
[b] *Email: kyaingkyaing@ytu.edu.mm*
[c] *Email: pokay4@gmail.com*

Abstract: The main objective of this study is to be convenience the travelers for transportation from one place to another and to minimize transportation cost and time in Hlaingtharya Township, Yangon. The proposed roads for feeder service are two routes. Among the different types of routes, a circular route is selected for feeder service system. Binary logit model was use to predict the probability of changing from motorcycle user to feeder transit, trishaw user to feeder transit and walking user to feeder transit. Vehicle operating analysis and economic analysis are evaluated. In vehicle operating cost, cost (investment, licensed and insurance), vehicles operational cost (fuel cost, engine oil cost, tire cost, maintenance cost depreciation cost, driver cost, garage cost and mechanic cost) are estimated for feeder transit. Maximum revenue potential is considered for benefits. This case study helps to get a good transportation which will be safe and efficient for travelers in suburban.

Keywords: Feeder Service System, Modal Shift, Binary Logit model, Vehicle Operating Cost, Economic Analysis

1. INTRODUCTION

The modal shift means replacing a saturated means of transport with another to make the first less congested. Modal transfer, therefore, makes it possible to reduce road-only high-volume cargo shipping and replace it with rail or barge transport. Traffic congestion is when vehicles travel slower because there is too much traffic on road. People use the public bus transportation system to reach their destination; however, some people to get to the bus station using private transport such as motorcycles, bicycles, trishaw and so on. Traffic congestions are taking place everywhere in the inner city from time to time. The frequent occurrences of traffic congestion resulted from careless drivers, those who are not crossing zebra crossing systematically, and undisciplined roadside hawkers. The traffic congestion is still occurring in all parts of Yangon. Especially, the suburban areas are always over crowed due to the high percentage of ordinary people who are working every day as staff such as government staff, private company staff, education staff, students, and workers earning a bare living life. Consequently, public transportation was faced with loads of difficulties to run as public transportation because of the above-mentioned problems in some places. Since the citizens around there have no chance to apply the private transportation system, therefore they are own small vehicles such as motorcycles, trishaws, and even walking on the road to their destination. Some studies suggest that using their transportation systems increases travel time, travel cost. Moreover, it is not safe to go out alone at night.

Congestion may be solved with one big idea, such as: widen roads, narrow road, add bus line, remove bus lanes and build a new ring. The names of different types of bus services vary according to local tradition or marketing, although services can be classified into basic types based on route length, frequency, the purpose of use, and type of bus used. Feeder services system is an important travel mode in the urban transportation system. It plays a critical role to meet travel needs within urban areas. To reduce other travel modes, feeder system is very convenient, comfortable, and fast and is considered a competitive service to satisfy the intra-city distance trips. Urban or suburban services are the most common type of public transport bus service and is used to transport the large number of people in urban areas, or to and from the suburbs to the population centre. Feeder bus services are designed to pick up in a certain locality and take them to a transfer point where they make an onward journal on the trunk road. The main focus of this research is to reduce the impact of motorcycles and trishaw on traffic congestion in Yangon City. However, this research could not study the whole city, and only the selected area in Hlaingtharya Township is chosen as the study area to analyze Feeder Services operation. From questionnaire survey, socio-economic, travel mode, mode fare, trip purposes are useful for the logit regression model. The main objective of the research is to specify the feeder services routes. Feeder transit services generally transport within residential services areas to and from a transfer point that joins to a major fixed route. Finally, the results obtained from the analysis are employed in the development process. The results will be drawn carefully from the valuable information obtained from each analysis. Thus, the commuters' consideration of the feeder services system will be supported. After data collection, SPSS software is used for logit regression analysis. An economic evaluation of the feeder service system was conducted in terms of Net Present Value (NPV), Benefit-Cost Ratio (BCR) and Inter Rate of Return (IRR). In-vehicle operating cost, cost (investment, licensed and insurance), vehicle operational cost (fuel cost, engine oil cost, tire cost, maintenance cost, depreciation cost, driver cost, garage cost, and mechanic cost) are estimated for feeder transit. The maximum revenue potential is considered for benefits in this study. From questionnaire survey, socio-economic, travel mode, mode fare, trips purposes are useful for the logit regression model.

Therefore, this study concentrates to identify existing modes users to the feeder service system and to analyze economic cost in feeder service.

The structure of this paper is organized as follows: related relevant study backgrounds are presented in Section 2. Section 3 states why the study area is selected as a case study. Section 4 briefly describes data to be used in this study and how to identify the various variable that influences the modal shift in travelers, model interpretation of the outputs, and an algorithm for vehicle schedule. Analysis of modal shift to feeder services system of the study area is discussed in Section 5. Finally, conclusions and future works are presented in Section 6.

2. RELEVANT STUDY BACKGROUND

The mode choice model is the third of the four-step model in travel demand forecasting. Mode choice is developed based on the theory of utility maximization which mean that an individual making a particular choice from a set of different alternatives depend upon the maximum benefit they gain (Qrtuzar and Willumsen, 2001). There are two approaches to model the transportation mode choice, which are known as aggregate and disaggregate approach (or discrete choice method, or discrete choice analysis). The advantages and disadvantages of disaggregate and aggregate model have also been studied (Watson, 1972, 1974) and briefly, owing to the pros of overcoming the shortcomings facing the aggregate approach like extensive confidence limits and large errors in predicting, disaggregate approach have been widely utilized in many fields of research, especially in transportation (Banai-Kashani, 1984; Wilson *et al.*, 1990; Al-Ahmadi, 2006; Praveen and Mallikarjuna, 2011). Mode choice is influenced by many factors including characteristics of trip maker, characteristics of journey, and characteristics of transport facility (Qrtuzar and Willusen, 2001). Equally importantly, it should be noticed that in the field of transportation and tourism, travel mode choice is closely related to the choice of tourism destination. A number of researchers studied the various topics of mode shift using binary logit model in SPSS. A binary logit model for estimation of mode shift (Chauhan *et al.*, 2016), was formulated to predict whether existing mode users have shifted from buses or are new to public transport shifting from PMVs. transportation mode choice binary logit model (O. C. Puan *et al.*, 2019) has been derived and attributes of age, income, vehicle ownership, the comfort of the car, reliability of bus service, affective motives, and instrumental motives were found statically correlated to the mode choice of transport in Johor Bahru. Logit regression analysis of factors effecting travel mode choice (Thana wan *et al.*, 2019) was found that the relationships were analyzed among the factors affecting the travel mode choice between government vehicles, and privately used for the evacuation of people in areas experiencing floods and landslides.

In this study, the binary logit model was used to predict the probability of changing from motorcycle users to feeder transit, trishaw users to feeder transit, and walking users to feeder transit for the suburban areas of Yangon City.

3. STUDY AREA

There are 45 townships in Yangon Region which are classified as a central business district (CBD), inner-city, outer city, old suburbs, new suburbs, and periphery Area. Among all of these townships, Hlaingtharya township of the suburban area has been selected as the study area. Hlaingtharya township has an area of 67.37 km^2 with a population of over seven hundred thousand. It is one of the biggest townships in Yangon and it is also a populated township.

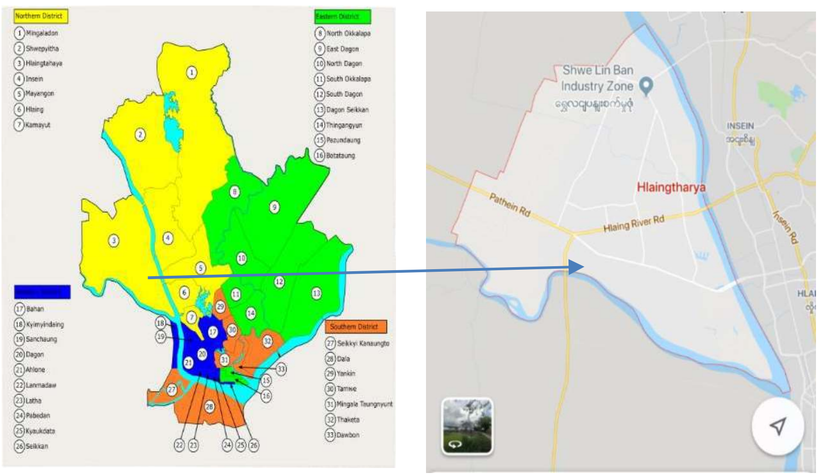

Figure 1. Location of the study area

The township comprises 20 wards and nine village tracts and shares borders with Htantabin township in the north and west, Insein township, Mayangon township, and Hlaing township in the east across the Yangon River and Twante township in the south. Traffic congestion is taking place everywhere in this township from time to time. Traffic congestions, long travel times, low travel speed, and traffic accidents are subjected in most parts of the day. Therefore, the suburban area of Yangon was selected as a case study. The location of the study area is shown in Figure 1.

4. METHODOLOGY

4.1 Method

The respondents are needed to collect the data by interviewing and making a questionnaire survey in Hlaingtharya Township. These have been selected represent of the suburban area of developing countries that satisfy the criteria and scope of the research.

From the questionnaire survey, gender, age, socio-economic, travel mode, travel time, travel cost, vehicle ownership, origin, and destination are included. Among them, socio-economic, travel mode, mode fare, and vehicle ownership are useful for the logit regression model. The main objective of the research is to specify the feeder services routes. Feeder services generally operate within residential services areas and move customers to and from a transfer point that connects to a major fixed-route transit network. Finally, the results obtained from the analysis are employed in the development process. The results will be drawn carefully from the valuable information obtained from each analysis. After data collection, SPSS software is used for logit regression analysis. An economic evaluation of the feeder service system was conducted in terms of Net Present Value (NPV), Benefit-Cost Ratio (BCR), and Inter Rate of Return (IRR). In-vehicle operating cost, cost (investment, licensed and insurance), vehicle operational cost (fuel cost, engine oil cost, tire cost, maintenance cost, depreciation cost, driver cost, garage cost, and mechanic cost) are estimated for feeder service system. The maximum revenue potential is considered for benefits in this study.

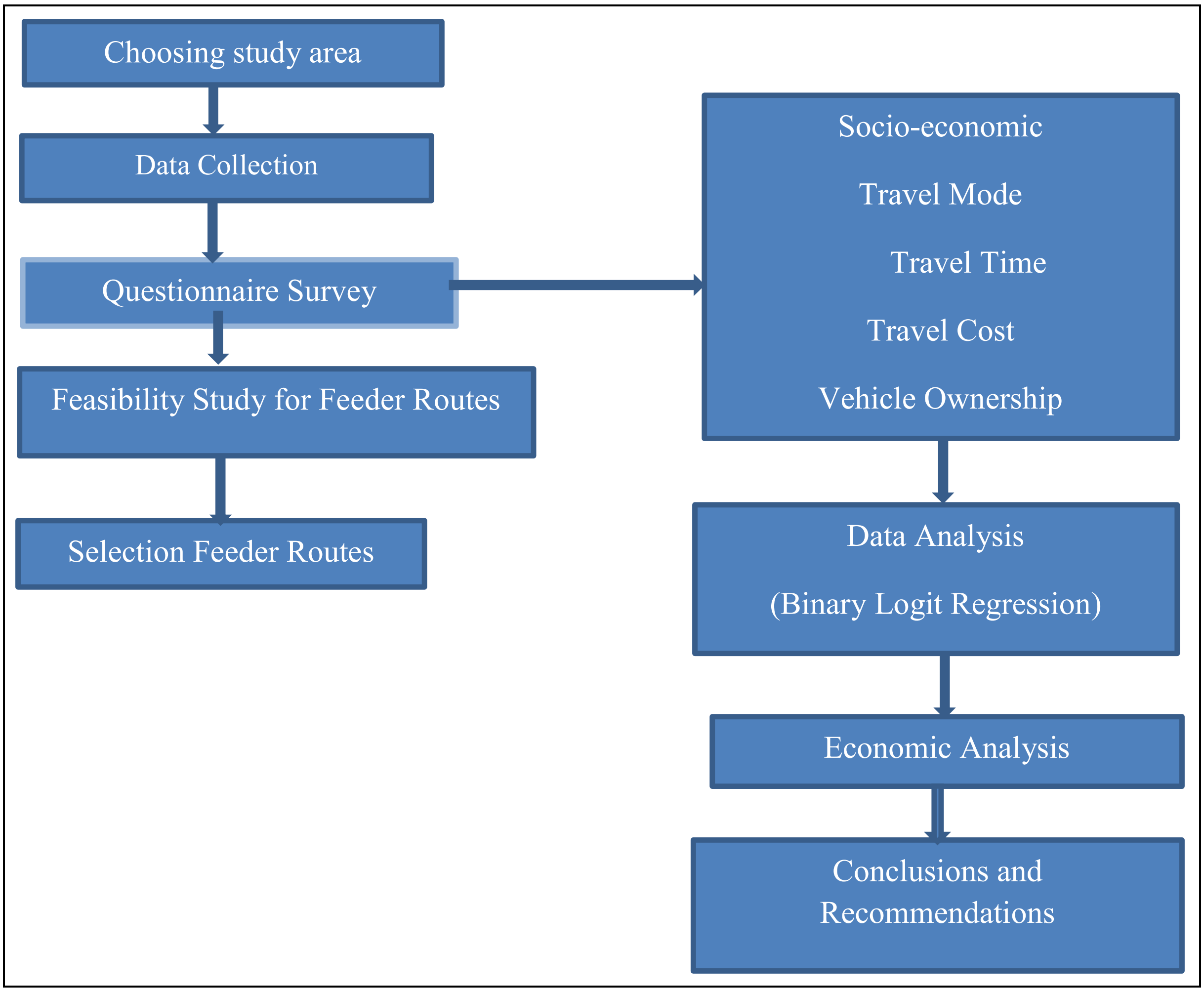

Figure 2. Overview of Research Work Flow

4.2 Survey

Along the main road corridors of Hlaingtharya Township, papered-based questionnaire surveys were performed using the methodologies of check-point survey and site survey. For the pilot survey, the survey staff visited 100 sheets were asked for co-operation and explained the questionnaire details. The check-point survey was conducted near the station's areas in the morning (7:00 AM- 11:00 AM) and (3:00 PM-6:00 PM) during their access trips and return trips to earn the ease of participation and gather the commuters living in specific areas. The respondents were interviewed individually by a trained people who the bachelor engineering students in Technological University (Pathein). Travel mode and travel cost of travelers were collected during October 3-5, 2018 (7:00 AM- 6:00 PM), and maximum useable routes in selected areas were collected during December 23-25, 2018 (7:00 AM-6:00 PM). The location of bus stops for proposed feeder routes was explored.

4.3 Questionnaire Data

The surveys mainly focused on the short trips connecting between transit stations and residences or trips destinations which are access trips from home and their destinations. The data obtained will be applied in the two main objectives analyses; (1) present travel mode, and (2) encourage using the feeder transit system. The modal split was classified into three main modes. There are motorcycles, trishaws, and walking. The respondents were asked about their socio-economics, travel mode, travel time, and travel cost. And, respondents were asked their attitudes on access trips as feeder service to stations and intra-city services and also their affordable price for feeder transit. Therefore, 500 sample sizes were collected for data collection. This research conducted 500 respondents which are used in the analysis process.

4.4 Data Analysis

After collecting the data by designing the questionnaire and face interviewing, it is necessary to analyze the collected data by using appropriate statistical tools. Data analysis is a critical study by which extract information from the collected data. The methods of data analysis used in this study are both descriptive and inferential statistics.

4.4.1 Binary logit model

The users' response data related with modal shift to feeder services system was analyzed by using binary logit model. Dependent variables were respondents change present modal to feeder services system or not. They are motorcycle to feeder transit, trishaw to feeder transit, walking to feeder transit.

$$\ln(Odds) = \ln\frac{P(Y=1)}{1-P(Y=1)} = \alpha + X\beta$$

Where P(Y=1) was the probability that the individual traveller chose to travel by feeder transit, 1- P(Y=1) was the probability that the traveller decided to travel by trishaw, motorcycle and walking. *Odds* was the ratio of the probability that the traveller chose to travel by feeder transit and the probability that the traveller decided to travel by trishaw, motorcycle and walking and $Odds = \ln\frac{P(Y=1)}{1-P(Y=1)}$ or $Odds = e^{\alpha + X\beta}$; α and β were the intercept and a vector of slope coefficient respectively; X was a vector of explanatory variables.

Table 1. Independent Variables in equation

Sr No	Independent Variable		Symbols
1	X_1	Gender	G
2	X_2	Age	A
3	X_3	Monthly income	I
4	X_4	Ownership	Owner
5	X_5	Travel time	TT
6	X_6	Travel cost	TC

4.4.2 Model interpretation of the output

The first one to take note is the Classification tables in Block 0 Beginning Block. In Block 0: Beginning Block, Block 0 presents the results with only the constant included before any coefficients (that is those relating to change mode or not) are entered into the equation. Logits regression compares this model with a model including all the predictors (Agree or Disagree) to determine whether the latter model is more appropriate. The table suggests that if researchers knew nothing about our variables and guessed that a person would not take the offer, they would be correct percentage of the time. The equation table without variables shows whether each independent variable improves the model. If they had not been significant and able to contribute to the prediction, then termination of the analysis would obviously occur at this point.

In Block 1 Method Enter, this presents the results when the predictors 'Agree' or 'Disagree' are included. Later SPSS prints a classification table which shows how the classification error rate has changed from the original percentage. By adding the variables, they can now predict with percentage accuracy (see Classification Table). The model appears good, but it needs to evaluate model fit and significance as well. SPSS will offer a variety of statistical tests for model fit and whether each of the independent variables included make a significant contribution to the model. The Hosmer-Lemeshow statistic indicates a poor fit is the significance value is less than 0.05.

In Model Summary, although there is no close analogous statistics in logit regression to the coefficient of determination R^2 the Model Summary Table provides some approximations. Cox and Snell's R-Square attempts to initiate multiple R-Square based on 'likelihood', but its maximum can be (and usually is) less than 1.0, making it difficult to interpret. The Nagelkerke modification that does range from 0 to 1 is a more reliable measure of the relationship. Nagelkerke's R2 will normally be higher than the Cox and Snell measure. Nagelkerke's R^2 is part of SPSS output in the 'Model Summary' table and is the most-reported of the R-squared estimates. HL test is a goodness of fit test for logit regression, especially for risk prediction models. The test is only use for binary respond variable (a variable with two outcomes like "yes or no".

In Classification Table, rather than using a goodness-of-fit statistic, researchers often want to look at the proportion of cases which have managed to classify correctly. For these researchers need to look at the classification table printed out by SPSS, which show how many of the cases where the observed values of the dependent variable were 1 or 0 respectively have been correctly predicted. In the Classification table, the columns are the two predicted values of the dependent, while the rows are the two observed (actual) values of the dependent. In a perfect model, all cases will be on the diagonal and the overall percent correct will be 100%.

In Variables in the Equation, the Variables in the Equation table has several important elements. The Wald statistic and associated probabilities provide an index of the significance of each predictor in the equation. The Wald statistic has a chi-square distribution. The simplest way to assess Wald is to take the significance values and if less than 0.05 reject the null hypothesis as the variable makes a significant contribution. The Exp(B) column in the table presents the extent to which raising the corresponding measure by one unit influences the odds ratio. The researchers can interpret Exp (B) in terms of the change in odds. If the value exceeds 1 then the odds of an outcome occurring increase; if the figure is less than 1, any increase in the predictor leads to a drop in the odds of the outcome occurring. The 'B' values are the logit coefficients that can be used to create a predictive equation.

For more details, each of significant variables were defined as following. In model 1, Travel time (TT) (1= between 20-30 min), Travel cost (TC) (1= over500 kyats), Low income (1= under100000-200000), and Motorcycle ownership were impacted on the motorcycle to feeder services system. In model 2, Travel time (TT) (1= between 20-30 min), Travel cost (TC) (1= over500 kyats), Low income (1= under100000-200000), Medium income (2= under 210000-500000) and Motorcycle ownership were impacted on the trishaw to feeder services system. In model 3, Travel time (TT) (1= between 20-30 min), Low income (1= under100000-200000), Medium income (2= under 210000-500000) and High income (3= over 500000) were impacted on the walking to feeder services system.

4.5 Basic Schedule Relationship

To develop an algorithm for generating vehicle schedules a number of basic relationships governing headway, cycle time and number of fleets are as follow;

Cycle time = Travel time + Layover/Recovery time + Typical Boarding Service Time (Prepayment) + Typical Alighting Service Time (1)

The rate or percentage at which the value of asset is depreciated using any method is called depreciation rate. The rate of car depreciation varies depending on the year, make and model of the car. The first year, the greatest depreciation value is 12.5 percentage of original value. The loss continues onward there, with car shedding about 60 percentage of their original purchase price within the first five years on average. This estimate is considered good enough when the rate value is 0.7. Sale value of vehicle is taken 30% purchase of vehicle. The capacity of Daihatsu Hijet is 11 passengers. The number of feeder transit is eight vehicles for operating and two vehicles for reserve in two routes.

Maximum Revenue Potential = number of trips × number of passengers × fare (2)

Table 2. Typical bus passenger boarding and alighting service time for selected bus types and door configurations

Bus Type	Available Doors or Channels		Typical Boarding Service Time (s/p)		Typical Alighting Service Times (s/p)
	Number	Location	Prepayment	Single Coin Fare	
Conventional (rigid body)	1	Front	2.0	2.6 to 3.0	1.7 to 2.0
	1	Rear	2.0	NA	1.7 to 2.0
	2	Front	1.2	1.8 to 2.0	1.0 to 1.2
	2	Rear	1.2	NA	1.0 to 1.2
	2	Front, rear	1.2	NA	0.9
	4	Front, rear	0.7	NA	0.6

Table 3. summarizes different types of variable costs. Fixed Costs include vehicle purchase and insurance. Variable costs consist of fuel costs, tire cost, engine oil cost, maintenance cost and repair cost in this study. Vehicle Operating Costs, depreciation costs and garage costs can be varied.

Table 3. Potential cost savings from reduced driving

Category	Description	Typical Values
Vehicle Operating Costs	Fuel, oil and tire wear	Varies
Long-Term Mileage-Related Costs	Mileage-related depreciation	Varies
Special cost savings	Garage cost, insurance	Varies

5. RESULTS AND DISCUSSION

5.1 Model Validation

Dependent Variable: The commuters who agree to use feeder service system are denoted by 1 and not agree to use is denoted by 0.
Explanatory Variables: The explanatory variables that are consider in the study that predict the response variables are travel mode, travel time, travel cost, income and vehicle ownership.

5.1.1 The preliminary analysis of questionnaire in motorcycle user

This Table 4 represents descriptive statistic on the profile of travelers which is 209 shown that females are greater than males in little amount females are 52.6% and males are 47.4%. The travelers who age (under 20 years) are significant than others age. Travel time (between 20-30 min) is three times the travel time (between 10-20 min). Travel cost (below 500 kyats) is double more than over 500 kyats pay. In case of income level, no income is 28.2%, low income is 60.3%, medium income is 9.1% and higher income is 2.4%. Motorcycle ownership is 58.9%.

Table 4. Descriptive statistic on the profile of travelers

Name	Label	Category	Frequency	Percent
Gender	0	Male	99	47.4
	1	Female	110	52.6
Age	0	Under 20 years	87	41.6
	1	Between 20-30 years	81	38.8
	2	Between 30-40 years	11	5.3
	3	Between 40-50 years	17	8.1
	4	Over 60 years	13	6.2
Travel time	0	Between (10-20 min)	49	23.4
	1	Between (20-30 min)	160	76.6
Travel cost	0	Below 500	68	32.5
	1	Over 500	141	67.5
Income	0	No income	59	28.2
	1	Low (under100000-200000)	126	60.3
	2	Medium (210000-500000)	19	9.1
	3	High (over 500000)	5	2.4
Motorcycle ownership	0	No	86	41.1
	1	Yes	123	58.9

5.1.2 The calibration of the model 1

The following Table 5 presents about the factors of socio-demographic for motorcycle users to feeder transit users. Four independent variables were included in the model. These variables were found to be significant in the dependent variables. In model 1, Chi-square omnibus tests of coefficient showed the value of 104.694 on 6 df, significant beyond 0.000 confirmed that the test of the full model against a constant only model was statically significant. The -2 Log likelihood reflected the prediction deviation by the model. The -2 Log likelihood statistic of model 1 was 158.998. Model 1 had Cox and Snell's $R^2 = 0.394$ and a Nagelkerke $R^2 = 0.550$, which explained 55.0% of the variation in the dependent variables. With regard to the interpretation of the parameters sign, parameters with significant negative coefficients are interpreted to result in a decrease the likelihood of that response category with respect to the reference category. On the other hand, the parameters with positive coefficients were considered to result in increase the likelihood of that response category.

Table 5. Estimation from the binary logit model

Model 1 Travel Mode - Motorcycle				
Variable	B	Standard Error	Sig.	Exp(B)
Travel time (20-30 min)	1.541	.485	.001	0.467
Travel cost (over500 kyats)	1.055	.470	.025	2.871
Income (Low)	1.003	.471	.033	2.727
Motorcycle ownership	-5.531	1.312	.000	0.004
Constant	2.834	1.387	.041	17.007
-2 Loglikelihood	158.998			
Model Chi-square	104.694, df = 6, p < 0.001			
Cox & Snell R2	0.394			
Nagelkerke R2	0.550			
N	209			

In this study, there are motorcycle ownerships, travel cost (over 500), travel time (between 20-30 min), low income (between 100000-200000 kyats) are defined as 1 and others are 0 to calculate verification. These variables are the most in questionnaire result.

Y motorcycle to feeder = β0 + β1 (TT 20-30 min) + β2 (TC Over 500 kyats) + β3 (Low Income) - β4 (Motorcycle Ownership)
= 2.834 + 1.541(TT 20-30min) + 1.055(TC Over 500 kyats) + 1.003
(Low Income) - 5.531(Motorcycle Ownership)
= 2.834 + 1.541 ×1 + 1.055×1 + 1.003×1 - 5.531×1 = 0.902

P motorcycle to feeder $= \frac{e^{0.902}}{1+e^{0.902}} = 0.711 \approx 71.1\%$

5.1.3 The preliminary analysis of questionnaire in trishaw user

Table 6 represents descriptive statistic on the profile of travelers which is 141. From this result, gender is almost portion of male and female participated in this study. The respondents who age (between 20-30 years) are significant than others age. Travel time (between 10-20 min) is 23.4% and the travel time (between 20-30 min) is 76.6%. Travel cost (over 500 kyats) is double more than below 500 kyats pay. In case of income level, no income is 26.2%, low income is 34.0%, medium income is 38.3% and higher income is 1.4%. Trishaw ownership is 43.3%.

Table 6. Descriptive statistic on the profile of travelers

Name	Label	Category	Frequency	Percent
Gender	0	Male	70	49.6
	1	Female	71	50.4

Age	0	Under 20 years	9	6.4
	1	Between 20-30 years	86	61.0
	2	Between 30-40 years	40	28.4
	3	Between 40-50 years	4	2.8
	4	Over 50 years	2	1.4
Travel time	0	Between (10-20 min)	33	23.4
	1	Between (20-30 min)	108	76.6
Travel cost	0	Below 500 kyats	43	30.5
	1	Over 500 kyats	98	69.5
Income	0	No Income	37	26.2
	1	Low (under100000-200000)	48	34.0
	2	Medium (210000-500000)	54	38.3
	3	High (over 500000)	2	1.4
Trishaw ownership	0	No	80	56.7
	1	Yes	61	43.3

5.1.4 The calibration of the model 2

The Table 7 presents about the factors of socio-demographic for trishaw users to feeder transit users. Four independent variables were included in the model. These variables were found to be significant in the dependent variables. In model 2, Chi-square omnibus tests of coefficient showed the value of 140.333 on 6 df, significant beyond 0.000 confirmed that the test of the full model against a constant only model was statically significant. The -2 Loglikelihood reflected the prediction deviation by the model. The -2 Loglikelihood statistic of model 2 was 43.039. Model 2 had Cox and Snell's $R^2 = 0.630$ and a Nagelkerke $R^2 = 0.866$, which explained 86.6% of the variation in the dependent variables.

Table 7. The maximum likelihood estimates of the binary logit model

Model 2 Travel Mode - Trishaw				
Variable	B	Standard Error	Sig.	Exp(B)
Travel time (20-30 min)	2.524	1.007	0.012	12.479
Travel cost (over500 kyats)	3.039	1.022	0.003	20.877
Income (Low)	4.409	1.349	0.001	82.165
Income (Medium)	3.750	1.109	0.001	42.522
Motorcycle ownership	-3.125	1.087	0.004	0.044
Constant	-4.135	1.769	5.465	0.016
-2 Loglikelihood	43.039			
Model Chi-square	140.333, df = 6, p < 0.001			
Cox & Snell R2	0.630			
Nagelkerke R2	0.866			
N	141			

In this study, there are motorcycle ownerships, female, travel cost (over 500), travel time (between 20-30 min), income (low, between 100000-200000) are defined as 1 and others are 0 to calculate verification. These variables are the most in questionnaire result.

$$
\begin{aligned}
Y_{\text{trishaw to feeder}} &= \beta 0 + \beta 1 \text{ (TT 20-30 min)} + \beta 2 \text{ (TC Over 500 kyats)} + \beta 3 \text{ (Low Income)} \\
&\quad + \beta 4 \text{ (Medium Income)} - \beta 5 \text{ (Trishaw Ownership)} \\
&= -4.135 + 2.524 \text{ (TT 20-30min)} + 3.039 \text{ (TC Over 500kyats)} + 4.409 \\
&\quad \text{(Low Income)} + 3.750 \text{(Medium Income)} - 3.125 \text{(Trishaw Ownership)} \\
&= -4.135 + 2.524\times1 + 3.039\times1 + 4.409\times1 + 3.750\times0 - 3.125\times1 = 2.712
\end{aligned}
$$

$$
P_{\text{trishaw to feeder}} = \frac{e^{2.712}}{1+e^{2.712}} = 0.938 \approx 93.8\%
$$

5.1.5 The preliminary analysis of questionnaire in walking

The following Table 8 represents descriptive statistic on the profile of travelers which is 141. From this result, female 78.7% participated in this study. The respondents who age (under 20 years) are more significant than others age. Travel time (between 10-20 min) is 18.7% and the travel time (between 20-30 min) is 81.3%. In case of income level, no income is 19.3%, low income is 49.3%, medium income is 26.0% and high income is 5.3%. Motorcycle ownership is 34.7%.

Table 8. Descriptive statistic on the profile of travelers

Name	Label	Category	Frequency	Percent
Gender	0	Male	32	21.3
	1	Female	118	78.7
Age	0	Under 20 years	85	56.7
	1	Between 20-30 years	14	9.3
	2	Between 30-40 years	6	4.0
	3	Between 40-50 years	27	18.0
	4	Over 50 years	18	12.0
Travel time	0	Between (10-20 min)	28	18.7
	1	Between (20-30 min)	122	81.3
Travel cost	0	Below 500 kyats	-	-
	1	Over 500 kyats	-	-
Income	0	No Income	29	19.3
	1	Low (under100000-200000)	74	49.3
	2	Medium (210000-500000)	39	26.0
	3	High (over500000)	8	5.3
Motorcycle ownership	0	No	98	65.3
	1	Yes	52	34.7

5.1.6 The calibration of the model 3

The following Table 9 presents about the factors of socio-demographic for trishaw users to feeder transit users. two independent variables were included in the model. These variables were found to be significant in the dependent variables. In model 3, Chi-square omnibus tests of coefficient showed the value of 56.560 on 4 df, significant beyond 0.000 confirmed that the test of the full model against a constant only model was statically significant. The -2 Loglikelihood reflected the prediction deviation by the model. The -2 Loglikelihood statistic of model 3 was

75.341. Model 3 had Cox and Snell's $R^2 = 0.314$ and a Nagelkerke $R^2 = 0.537$, which explained 53.7% of the variation in the dependent variables.

Table 9. The maximum likelihood estimates of the binary logit model

Model 3 Travel Mode - Walking				
Variable	B	Standard Error	Sig.	Exp(B)
Travel time (20-30 min)	4.235	0.818	0.000	69.043
Income (Low)	2.931	0.911	0.001	18.751
Income (Medium)	2.346	0.944	0.013	10.448
Income (High)	3.706	1.490	0.013	40.676
Constant	-2.961	0.911	0.001	0.052
-2 Loglikelihood	75.341			
Model Chi-square	56.560, df = 4, p < 0.001			
Cox & Snell R2	0.314			
Nagelkerke R2	0.537			
N	150			

In this study, there are travel time (between 20-30 min) and low income are defined as 1 and others are 0 to calculate verification. These variables are the most in questionnaire result.

$$Y_{\text{walking to feeder}} = \beta 0 + \beta 1\,(\text{TT 20-30 min}) + \beta 2\,(\text{Low Income}) + \beta 3\,(\text{Medium Income}) + \beta 4\,(\text{High Income})$$

$$= -2.961 + 4.235\,(\text{TT 20-30 min}) + 2.931\,(\text{Low Income}) + 2.346\,(\text{Medium Income}) + 3.706\,(\text{High Income})$$

$$= -2.961 + 4.235\times1 + 2.931\times1 + 2.346\times0 + 3.706\times0 = 4.205$$

$$P_{\text{walking to feeder}} = \frac{e^{4.205}}{1+e^{4.205}} = 0.985 \approx 98.5\%$$

5.2 Feeder Routes in Hlaingtharya Township

Figure 3 shown that the Feeder Routes in Hlaingtharya Township. The type of route is considered in loop. Thus, service analysis is based on two routes. The distance of each route is 6.65 km long, start and end from Tadar Phyu bus stop in route 1. The numbers of eight bus stops are located in route 1. For route 2 start and end bus stop is Nawaday bus stop. The numbers of eight bus stops are located in route 2. These two routes are mostly used in this region.

Figure 3. Feeder Routes in Hlaingtharya Township

5.3 Analysis of Feeder Services System

In this case, the following two points are assumed:
(i). The private operator will pay 1.7% of the bus cost as insurance to the city agency.
(ii). The private operator will take 17% in discount rate.

Variables costs are costs that relate to the usage of the vehicle, such as fuel, engine oil, tire and driver costs. Fixed costs include depreciation, insurance. Revenue is income that the payment received from passengers for the journey.

The distances of the route 1and 2 are 6.65 that each has eight bus stops. Layover time is assumed 10% of the travel time and time headway is assumed 7 minutes. Boarding passengers are assumed 11 passengers in starting bus stop 1. Boarding and alighting passengers are assumed 3 passengers in other bus stops. Boarding time is taken 2 second per passenger and alighting time is 1.7 second per passenger. Layover / recovery time at bus stop = 10% of travel time.

Cycle time = Travel time + Layover/Recovery time + Typical Boarding Service Time (Prepayment) + Typical Alighting Service Time = 19.95 +19.95(10%) + ($\frac{2}{60}\times 11\times 1$) + ($\frac{2}{60}$x3x7) + ($\frac{1.7}{60}$x 3x7) + ($\frac{1.7}{60}$ x11x1)
= 23.918 min

Take Cycle time = 24 min

Number of cars = Cycle time/Headway

Number of cars needed in the route 1 and 2 (6:00am-8:00pm) = 8 vehicles

Take one bus is needed to reserve in each route. The following Table 10 shows the initial cost of investment, vehicle operating cost and maximum potential revenue of feeder transit. In the vehicle operating cost, direct cost and indirect cost are considered. There are 28 trips per day, number of bus is 4 buses and one bus is needed to reserve in each route. The feeder transit fare is 200 MMK in prepayment.

Table 10. Fixed costs and variable costs in feeder services

Items	Particulars	No.	Unit	Cost/Unit MMK	Cost MMK/Year	Benefit MMK/Year
1	Cost of Car	10	Nos	10,400,000	104,000,000	
	Insurance (per year)	10	Nos	176,800	1,768,000	
	Licensed Cost (per year)	10	Nos	100,000	1,000,000	
2	Vehicle Operating Cost					
	Fuel Cost	8	Nos	5,364,903.500	42,919,228	

	Engine oil Cost	8	Nos	334,080	2,672,640	
	Tire Cost	8	Nos	140,000	1,120,000	
	Driver cost	16	Nos	3,360,000	53,760,000	
	Annual Depreciation	10	Nos	1,456,000	14,560,000	
	Maintenance & Repaired	8	Nos	1,800,000	14,400,000	
	Bell	8	Nos	14,000	112,000	
	Garage	10	Nos	480,000	4,800,000	
3	Maximum Revenue	28	Trips	42,435,420.857		118,819,200.000

The Table 11 shows that the net present value of all future cash flow over the entire life of the investment discounted to the present. The result is that the value of investment is worth 106,768,000 MMK in year 0. It means that the investor would be willing to pay the cost 196,230,629 MMK for the vehicle operating and to receive about 237,638,400 MMK every year. By paying this price, the investor would receive the discount rate of 17%. After four years, the investor would receive net present value is 6,823,248 MMK.

Table 11. Cost and benefits analysis in feeder services

year	cost	benefit	net benefit	pv factor	present value
0	106,768,000		-106,768,000	1	-106,68,000
1	196,230,629	237,638,400	41,407,771	0.8547009	35,391,257
2	196,230,629	237,638,400	41,407,771	0.7305136	30,248,938
3	196,230,629	237,638,400	41,407,771	0.6243706	25,853,793
4	196,230,629	237,648,400	41,407,771	0.5336500	22,097,259
5					6,823,248

Net Present Value (NPV) = 5,033,639 MMK, B/C Ratio = 1.066012

Table 12. Internal rate of return (IRR) for feeder services

year	cost	benefit	net benefit	pv factor	present value
0	106,768,000		-106,768,000	1	-106,768,000
1	196,230,629	237,638,400	41,407,77,	0.8318757	34,446,120
2	196,230,629	237,638,400	41,407,771	0.6920172	28,654,892
3	196,230,629	237,638,400	41,407,771	0.5756724	23,837,309
4	196,230,629	237,638,400	41,407,771	0.4788879	19,829,679
5					0

The internal rate for which NPV equal to zero. For the feeder services system, i = 20.2102616%

6. CONCLUSION

In this study, the modal shift analysis was used to consider into three main modes. Results from binary logit model stated that motorcycle users to feeder transit are 71.1%, trishaw users to feeder transit are 93.8% and walking users to feeder transit are 98.5%. Travel time taken (between 20-30 min), travel cost (over 500 kyats) and low income were important factors influencing the modal shift from motorcycle to feeder transit system. The motorcycle ownership has not been chosen feeder transit system. Motorcycle users change to feeder transits are 71.1%. There are 93.8% will change trishaw to feeder transit system. Travel time, income and travel cost are influencing factors for shifting to feeder transit. Walking time (between 20-30 min), low income, medium income and high income will shift 98.5%. In economic evaluation, the project net present value (NPV) was 5 million kyats, benefit cost ratio (B/R) 1.066 and internal rate of return (IRR) 20.2102616%. Therefore, the plan to introduce Feeder Bus Service System shall be safe, effective and efficient and this will hopefully benefit for commuters.

Future research is to create trip attraction model for industrial area as a basic to determine another feeder route, demand feeder route and evaluate different system.

ACKNOWLEDGEMENTS

The author would also like to extend her sincere appreciation to her supervisor, Associate Professor of the Department of Civil Engineering of the Yangon Technological University, for her skillful guidance, encouragement, and effort.

REFERENCES

Allan G. Bluman (2011). Elementary Statistics: A Step-by-Step Approach 8th Edition, published by McGraw-Hill.

Ben-Akiva and Bierlaire Michel,1999, Discrete Choice Methods and Their Application to Short Term Travel Decisions.

Buehler, (2011). Determinants of transport mode choice: a comparison of Germany and the USA Journal of Transport Geography19(4) pp644-657.

Chao-Ying, 2002, "An introduction to logit regression analysis and reporting", J. Educ. Res, vol. 96, no. 1, pp.3-14, 2002.

Chee, W. L., and Fernandez, J. L, 2013. Factors that Influence the Choice of Mode of Transport in Penang: A Preliminary Analysis Procedia -Social and Behavioural Sciences91,120-127.

Chiu Chuen, O., Karim, M. R., and Yusoff, S.2014. Mode choice between private and public

transport in Klang Valley, Malaysia The Scientific World Journal 2014.
D. Muley, J. Bunker, and L. Ferreira, "Investigation into travel modes of TOD users: Impacts of personal and transit characteristics", Queensland Univ. Technol. Brisbane Aust., vol. 7, no. 1, pp. 3-13, 2009.
Evans, H. K.2010. Traffic Engineering Handbook. Institute of Traffic Engineers, Memphis, Tenn: General Books.
Gleeson, B.2001. Eco socialisation or counter modernisation, Reviewing the shifting 'storylines' of transportation planning Int. J. Urban Reg. Res.25784-803.
H.A. Park, "An introduction to logit regression: from basic concepts to interpretation with particular attention to nursing domain", Korean Acad. Nurs., vol. 43, no. 2, pp. 154-164, 2013.
Loo, L. Y. L., Corcoran, J., Mateo-Babiano, D., and Zahnow, R.2015. Transport mode choice in South East Asia: Investigating the relationship between transport users' perception and travel behaviour in Johor Bahru, Malaysia Journal of Transport Geography 4699-111.
M.A.A Abuhamoud, R.A. Rahmat, and A. Ismail, "Modelling of transport mode in Libya: A binary Logit model for government transportation encouragement", Aust. J. Basic Appl. Sci., vol. 5, no. 5, pp. 1291-1296, 2011.
Nicholas J. Garber and Lester A. Hoel. 2009, Traffic and Highway Engineering Fourth Edition, Toronto, Canada.
O.A. Khan, "Modelling passenger mode choice behaviour using computer aided stated preference data", School of Urban Development, Queensland University of Technology, PhD Thesis, 2007, pp. 1-324.
O.A. Khan, L. Ferreira, and J.M. Bunker, "Modelling multimodal passenger choices with stated preference", In: Proceedings 26th Conference of the Australian Institutes of Transport Research, Melbourne, Australia, 2004, pp. 1-9.
O'Flaherty, C. (Ed.) (1997). Transport planning and traffic engineering.
Paul Dolan, Richard Edlin, 2002, "Is it really possible to build a bridge between cost-benefit analysis and cost-effective analysis?", Journal of Health Economic 21(5), pp 827-843, 2002.
S Damart, Bernard Roy, 2009. The use of cost-benefit in public transportation decision making in France. Transport policy 16(4), pp 200-212, 2009.
Todd Litman, 2009. "Transportation cost and benefit analysis". Victoria Transport policy Institute 31, 1-19, 2009.