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"Study on Efficiency and Satisfaction level of Public Transportation within Kathmandu Inner Ring Road"

by

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ABSTRACT

Increasing private vehicle ownership and lack of systematic public transportation led to the various traffic problems within Kathmandu Inner Ring Road. This study aims to evaluate the efficiency and satisfaction level of public transportation which is the one of the issues in present public transportation system in inner ring road. The average travel time, waiting time, running speed, and average passenger patronage in the study area have been accessed by using moving observer method. Later, these parameters were used for analysis of public transportation efficiency using DEA model.

The result of analysis shows that the efficiency of the bus is 24.5% more than that of the micro-bus. With reference to Mahanagar Yatayat, other bus services are found 86.6% efficient whereas microbuses are found 56.5% efficient.

Taking waiting time, travel time, running speed and passenger in and out as independent parameters, the efficiency assessment model has been calibrated by regression analysis. Similarly, satisfaction level of the various modes of public transportation has been assessed with on revealed questionnaire survey. SPSS have been used to check the statistical significance of questionnaire. The satisfaction level of services is evaluated with 10 parameters viz. comfort, cleanliness, frequency and reliability, access for various disable people, availability of timetable and route information, seating arrangement and space for standing, seat availability, speeding, conductor behavior and easiness on using service. The result obtained from pair sample statistics shows that passengers were not satisfied with both bus and micro-bus services in overall aspects. From two tail pair t-test, bus provides better performance in respect to six indicators, whereas there is no any difference in the significance level for remaining four indicators. Overall, the bus proves to be a better mode of public transportation in perspective of both efficiency and satisfaction level. This study identifies the major service indicator for the improvement of public transportation.

Key Words: Public Transportation, Efficiency, Satisfaction level, Satisfaction, DEA model

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Bishnu Bhattarai

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LIST OF ABBREVIATION

BCC:	Banker, Charles and Cooper
BLR:	Binary Logistic Regression
CDO:	Chief District Officer
CEN:	Clean Energy Nepal
DDC:	District Development Community
DEA:	Data Envelopment Analysis
DMU:	Decision Making Unit
DOR:	Department of Road
DOTM:	Department of Transport Management
GA:	Genetic Algorithm
KSUTP:	Kathmandu Sustainable Urban Transport Project
LRN:	Local Road Network
PIP:	Priority Investment Plan
SFA:	Stochastic Frontier Analysis
SP:	Stated Performance
SPSS	Statistical Package of Social Sciences
SRN:	Strategic Road Network
TMC:	Transport Management Committee
VRS:	Variable Return to Scale

CHAPTER ONE: INTRODUCTION

1.1 Background

The increase in population and derived demand for transportation has added the load in the public transportation system. The population has increased by 4.32 % per year and motorization has increased by 12% per year (CBS 2011; DoTM, 2013) while the modal share of public transport has remained inactive (MoPIT/JICA, 2012) in Kathmandu Valley. The purpose behind the construction of Kathmandu inner ring road was to join the incoming radial roads towards the central business district of Kathmandu. The inner ring road was constructed as access controlled high speed arterial road.

The present public transportation system prevalent in the Kathmandu valley is unsystematic, unreliable, polluting and uncomfortable. With evidence of more frequent traffic congestion problems in Kathmandu valley, it has become a necessity to attract more public towards public transport. A good regional level policy and good quality service have become essential to improve public transportation sector in Kathmandu valley. Beside congestion, over crowdedness, long waiting time, long and inconsistent travel time, poor and unreliable services have also become the part of public transportation system. Not to mention their own internal problems. As such, the need to improve the operational performance and standard of the public transport is urgently required. The level of service technique and performance indicator analysis technique can be applied as diagnostic tools to identify operational inefficiency and dissatisfaction level at the route level and network level. However, no attempts have been made so far to utilize these analyses in Nepal.

Now, more than ever, public transport operators should emphasize on the monitoring and improvement of the services provided, or else shall more worsen the present traffic condition with increased car and bike ownership. Quality of service in public transit reflects the passengers' perception of transit performance. There are a number of approaches and techniques used to define and assess quality of service, such as

- Customer satisfaction in public transit can be defined as the overall level of achievement of a customer's expectations and measured in the percentage of the customer expectations, which have actually been fulfilled.

- Customer loyalty is reflected by a combination of attitudes and behavior. It is usually driven by customer satisfaction. It involves a commitment on the part of the customer to make a continued investment in an ongoing relationship with transit service.
- Benchmarks can also be used for comparing quality either in different time or at the same time among different routes or even among different public transport operators.

Among the various routes within Kathmandu valley the radial routes from Koteshwor, Kalanki, Satdobato and Maharajgunj has high public transport demand along with Ring Road (H016). Previous studies suggested that more than 1 lakh passenger per day travelled through public transportation within Ring Road (Hemant, 2015) which shows the high public transportation usage in this corridor. But again, the level of satisfaction is getting worse day by day and people have to face extreme congestion at major nodes along this selected corridor.

1.2 Problem Formulation

High passenger patronage and being the major linkage, Inner Ring Road (H016) serves as a major public transportation corridor and hence need to be improved. For the improvement of public transport, improvement in journey speed and running speed is essential. These two parameters are used to calculate average speed of the vehicle. The decrease in average speed of vehicles is due to high level of congestion at intersections with high traffic volume.

As the public transportation is not reliable, the private vehicle ownership is increasing. Introduction of better mode of public transport with good service and more reliable public transport service have become a necessity to reduce the alarming rate of private vehicle ownership. Passenger’s perception towards public transportation must be assessed to evaluate the existing status. It also helps to recommend the improvement measures. Similarly, efficiency of buses and micro-buses at present scenario has to be evaluated. Action has to be taken to introduce higher efficiency public transportation mode that would better serve passenger while lower efficiency mode of transport usage has to be discouraged with effective policy.

1.3 Research Objective

The overall objective of this study is to investigate the efficiency and satisfaction level of various modes of public transportation within Kathmandu inner ring road. Also, the study tries to provide the satisfaction level of passenger towards different operating characteristics.

The specific objectives are:

- To find out the efficiency of different mode of public transportation along inner ring road.
- To find out the passenger satisfaction level towards various means of public transportation.

1.4 Scope of Work

The scope of work which is carried out in this study are as follows:

a) Moving Observer method has been used as the method for finding travel time, waiting time, passenger in and out time, running speed and average passenger in and out. These are the main parameters from which efficiency was calculated.

b) The efficiency of bus and microbuses has been calculated by using the Data Envelopment Assessment (DEA) model. Regression analysis along with outcome of DEA model, efficiency of transportation mode, model calibration and validation has been carried out.

c) Passenger satisfaction survey has been used to find out user perception towards different modes of public transportation. The survey has been carried out with the help of questionnaire targeting various satisfaction level indicators as: comfort, speed, reliability, behavior for various means of public transportation.

1.5 Limitation

a) Lack of adequate public transportation patronage data of vehicle plying in Kathmandu ring road.

b) Physical characteristics of the vehicle like length, breadth and height, and lane width of the road has not been incorporated for analysis and calculating efficiency of that particular vehicle.

1.6 Organization of Report

The research is organized in five chapters. Chapter 1 deals with basic aspects of research work which includes background, study area, rationales of study, objective and scope of work. Chapter 2 is all about the literature review which includes all the theory and literatures that are somehow linked to the project work. Chapter 3 includes the methods that were accommodated in conduction of research work. It talks about the way of collection of primary and secondary data and the method of processing raw data collected from field and other related organization into useful output. It talks about the process of data analysis that is used. Chapter 4 deals with the data analysis and the brief description of the result obtained from the data analysis. Last and chapter 5 concludes stating conclusion and recommendations of the research work.

CHAPTER TWO: LITERATURE REVIEW

2.1 Mass Transit System

Mass Transit System also known as public transport or public transit is a system which provides travel services locally in the set of fix routes. The people travelling in it should pay fare on the basis of travel kilometer to their destination. The fare paid to the public transport is less than that of other services because of the mass transit system where many people travel through at same time. The public transport mode includes buses, mini buses, micro-bus, train, taxi etc. The use of mass transit modes reduces congestion and air pollution due to which many countries are now opting for high occupancy vehicle. A good public transport system makes efficient use of urban space, provide efficient and affordable mobility, and access to work, school/colleges, social, recreation and economic activities.

It is well understood that the modernization and urbanization processes accelerate, the importance of this sector in providing easy of use and mobility reaches higher levels. Transport is an integral part of human life. Proper transport link enables efficient frequency of services, flow of passengers and product on mode of travel. This gives every individual the right to choose the services that he/she desires.

The urbanization process increases significantly and the demand for urban services should be increased in which the efficiency and the availability of the transport depend. It has played a great role in the transformation of the society and facilities modernization. By doing so, it has changed the lifestyle of society from traditional to modern. The level of motorization and cost of its accommodation directly correlates with trends in per capita income. The demand for urban transport is affected by the city size and population. The urban transport system should be modified and structured to contribute and operate within the principles and limitations of urban development. (Jamet, 1998)

Public transport system was first introduced in United States in 1920 AD. After that year, United States upgraded the public transport by studying and knowing its importance. They become more common after wards. With the increase in number of the people in the world and their need for comfort, public transport facilities started to grow. However, with the increase in the number of buses and other modes of transportation, increasing congestion and pollution started inflicting cities. Thus, other modes of transportation as; rails, metro trains, rapid train, mass transit buses were introduced. (Albert, 2009)

Public transport modes in our country include mini/micro buses, buses, three-wheeler, taxi etc.). In other countries like Japan, United States of America, public transport is dominated by coaches, and intercity rail. High-speed rail networks are being developed in many parts of the world. Most public transport runs to a scheduled timetable with the most frequent services running to headway. Share taxi offers on-demand services in many parts of the world and some services will wait until the vehicle is full before it starts. Para transit is sometimes used in areas of low-demand and for people who need door-to-door service.

2.2 History of public transportation in Nepal

The Department of Roads was established in Nepal in 1960. From this year, the road network has been expanding according to the priority of our country among all the mode of transports. Development of the Strategic Road Network (SRN) has been rapidly increasing in the country. By using both external and internal resources, it has expanded from 376 km in 1951 to 8,323 km in 1997 and 9,400km in 2007 and going on. If all roads area included the total length exceeds 22,000 km. Road density is increasing significantly from 0.3 km/100sq. km. in 1951 to 5.7km/sq. km. in 1997(www. dor.gov.np/table). The strategic road network is managed under Public Road Act 1971 and development and maintenance is being developed as per National Transport Policy 2002. Before 2003, all types of roads were planned, constructed and maintained by DOR. In 2003, the Government decentralized management of roads keeping strategic road network (highways, feeder roads and strategic urban roads) within DOR, district and rural roads within DDC and urban roads within municipalities (Local Self Government Act 1999 and National Transport Policy 2002). DOR has prepared a Priority Investment Plan (PIP 2007) for 10 years and 20 years Road Master Plan. The objective of these plans is to provide reliable and safe road access to within 4 hours walking distance of settlements in hills and 2 hours in Terai. This is complemented by the Local Road Network (LRN) developed and managed by the DDCs and Municipalities. (PROJECT, 2010). The American Heritage Dictionary Fourth Edition defines “accessibility” as “easily approached or entered” (Picket et al. 2000). The Oxford English Dictionary defines “accessibility” as “the quality of being accessible, or of admitting approach” (OED 2002). Mobility, the potential for movement, is related to the impedance component of accessibility, in other words, how difficult it is to reach a destination. Accessibility refers to the access to the facilities, whether it be road network or public transportation, whereas Mobility refer to the service in afforadble cost and reasonable time. Urban transport service providers are basically concerned with the mobility of the user. (Handy, 2002)

2.3 Quality of Public Transport Services in Kathmandu Valley

The public transport service provided for the Kathmandu Valley is so poor and insufficient. No well-defined schedules, poorly maintained vehicles, poor cleanliness, overcrowded, comfortless are some of the unacceptable facts of public transportation services in Kathmandu. The riding behavior and speeding characteristics of the driver of public transportation make passengers feel more unsafe to travel. Vehicles wait for a long time to get passenger and do not move even they have passengers to their capacity. These are the causes for mode shift of the travel through private vehicles ultimately leading to congestion problems. The major findings of the survey conducted by CEN/CANN (2011) about the public transport of Kathmandu valley are:

- About 61.7% of female respondents said that they feel uncomfortable with the space in public transport because of overcrowding.
- About 57.7% of passenger was not happy with the travel time in public transport.
- About 69.1% of passenger perceived that the public transport drivers practice reckless driving making travel uncomfortable and unsafe.
- About 24.9% of passenger perceived public transport services to be unreliable.
- About 30.5% of people said that they have to wait for more than 10 minutes during morning peak hour to get a ride.

Survey conducted by the World Bank in 2013 in Kathmandu valley found out some facts regarding dissatisfaction of passengers towards public transportation service. Overcrowding (75%), personal insecurity (26%) and reckless driving and fear of accidents (17%) were sought as major problems in the service. The study also found that 26% of women of age group 19-35 had to experience inappropriate touching on public transport.

A study conducted by Kathmandu Sustainable Urban Transport Project (KSUTP) has identified the following problems associated with the public transport operation and existing route structures:

- Overlapping or duplication of routes
- Inefficient vehicle
- Concentration of route terminals in the city center
- Poor passenger services at terminals
- Poor service quality (Nepal, Public Transportation in Kathmandu Valley, 2014)

Figure 1: Passenger riding way in micro-bus at Kathmandu City

2.4 Speed, Journey Time and Delay Survey

Speed is the one of the most important characteristics of traffic and its measurement is a frequent necessity in traffic engineering studies. Speed is the rate of movement of traffic or of specified components of traffic and is commonly expressed in kilometer per hour.

Spot speed is the instantaneous speed of traffic at a specified location.

Running speed is the average speed maintained by traffic over a given course while the traffic is in motion.

Journey speed, also known as overall travel speed, is the effective speed of traffic between two points, and is the distance between two points divided by the total time taken by the vehicle to complete the journey, including delay.

Delays are the time lost during the travel by the vehicle, which is divided into two categories as explained below:

A. Fixed delay

Delays that occur mostly at road way intersections, traffic signals, stop signs, railway crossing etc. that is as a result of some fixed roadway conditions and does not depend upon the traffic density.

B. Operational delay

Operational delays are primarily a reflection of interacting effects of traffic on a road. These delays can be caused by parking of vehicles, by pedestrians, crossing and turning vehicles in uncontrolled intersections and vehicles stalling in the middle of traffic stream. Internal friction caused within the traffic stream may be another reason for this type of delay. E.g. vehicle volume in excess of capacity will cause traffic congestion and result in considerable delays in traffic. Uncontrolled intersections adjacent to each other and carrying heavy turning movements can be cause of considerable amount of weaving with the stream as vehicles attempts to enter and leave the main roadway.

The time obtained by deducting Delays from Total journey time is called Running Time of vehicle, which represents the actual time the vehicle was in motion. Based on these times, the speeds are named accordingly. The speed calculated by use of Total Journey time is called Journey Speed and the speed calculated using Running time is called Running Speed. Running speed can be used as the measure of Level of Service offered by the highway section over a long period of time, and thus can be of use to a highway planner. But, the main interest of both driver and passenger goes to Average journey speed.

Speed and delay study can be obtained by various methods, such as Registration number plate, Elevated observer method as well as floating car method. ***Moving Observer Method (Floating Car Method)*** is mostly adopted method for finding all forms of delays and thus provides both running and journey speed. In this method, the observation travel in moving car and notes the delays and running speed of certain vehicle (even his vehicle).

2.5 Public Transport Efficiency

The concept of public transport efficiency was first practiced in Slovak Republic. For the purpose of calculating public transport efficiency, two methods namely Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) are used. DEA model uses input oriented slack base model as variable. The validity of DEA results is performed by stability analysis where recalculation of DEA under different combination of inputs and outputs is done. A SFA is based on Cobb Douglas function type, which assumes normally distributed errors and half normally distributed errors. Here, the models can be negatively affected by the insufficient number of decision making units and by the presence of outliers in available data set. (Bystrica, 2006)

The type of model orientation to be used depends on the objective of the decision maker. If the objective is to minimize the cost of service, the input-oriented DEA model is chosen. On the other hand, if the objective is to maximize the output level, the output-oriented model is chosen. In this study, the output-oriented Banker Charnels and Cooper (BCC) model was chosen to maximize ridership (number of passengers). Reason to choose the BCC model is that it employs a Variable Return to Scale (VRS) assumption. The model assumes that efficiency may increase or decrease with a change in size in input or output. Mathematically, VRS suggests that the estimated production frontier can pass anywhere relative to the origin in input-output space.

Mathematically, the BCC model (Banker et al. 1984) can be written as follows:

$$Max_{u,v}\theta = \frac{\sum_{m=1}^{M} UmYmk}{\sum_{n=1}^{N} VnXnk} \qquad \text{Equation 1}$$

$$\text{Subject to } \frac{\sum_{m=1}^{M} UmYmj}{\sum_{n=1}^{N} VnXnj} \leq 1 \quad \text{for all j} \qquad \text{Equation 2}$$

$$\sum_{n=1}^{N} Vn * nk = 1 \qquad \text{Equation 3}$$

$$U_m, V_n, Y_{mj}, X_{nj} > 0 \text{ for all m, n, j} \qquad \text{Equation 4}$$

Where,

j: Index of decision making unit (DMU), j=1…, J

n: Index of input, n=1…, N

m: Index of output, m=1…, M

x_{nj}: The n^{th} input for the j^{th} DMU

y_{mj}: The m^{th} output for the j^{th} DMU

u_m, v_n: Non-negative scalars (weights) for the m^{th} output and the nth input

θ_k: Efficiency/Satisfaction level ratio of DMUk

The targeted Decision Making Unit (DMU) (of a given evaluation) is designated as DMU_k. The Banker Charnels and Cooper (BCC) model (Eq. 1) maximizes the ratio of weighted outputs to the weighted inputs. The weights U_m and V_n are the decision variables. These weights are changed until the ratio (of the weighted outputs to the weighted inputs) is maximized for the target DMU_k, while same weights are applied to all DMUs. The value of the ratio, θ, in (1) is referred to as the efficiency/satisfaction level score of DMU_k, where $0 \leq \theta \leq 1$. For a fully efficient DMU, the value of θ is 1. It is to be noted that the weights are the decision variables and that the values of inputs and outputs are the actual observed values. Constraint (3) ensures the DEA model's Variable Returns to Scale (VRS). Constraint (4) imposes non-negativity restrictions for the weights. (Lao, 2009)

DEA is a non-parametric approach and linear programming technique to measure relative efficiencies of a set of peer units called Decision Making Units (DMUs). The major advantage of DEA is its capability to handle multiple inputs and outputs, implicit specification of the production function, and the ability to identify the source of inefficiency. This is based on the original work of Farrel (1957) and was later popularized by Charnels et al. (1978) as the CCR model. The CCR model is fairly inflexible in the sense that it assumes constant returns to scale in its production possibility set (Karlaftis 2004). Later, Banker et al. (1984) developed an efficiency frontier structured by both constant and decrease returns to scale. The underlying assumption is that each DMU requires certain resources or inputs to produce its goods or services (outputs). It is used to empirically measure productive efficiency of DMUs by comparing it to the best practice of a DMU or combination of DMUs (Lao and Liu 2009). This model is called the BCC model.

2.6 Research work on operational efficiency of public transit

A number of studies were conducted to identify the key performance indicators of public transit services based on the goals and objectives of the authorities (Tomazinis 1977; Gilbert and Dajani 1975; Fielding et al. 1978; Meyer and Gomez-Ibanez 1981; Forkenbrock and Dueker 1979; Bly and Oldfield 1986; Cervero 1984). These studies used relatively variant performance indicators. As such, these studies cannot be used to reach a generalized conclusion (Benjamin and Obeng 1990; Karlaftis 2004). This has led some researchers to conclude that it may be necessary to use a more concise yet reliable set of indicators to describe the public transit system performance (Karlaftis 2004).

Anderson and Fielding (1982) and Fielding et al. (1985), in an effort to reduce the number of indicators, used factor analysis to reduce 48 performance indicators to 7 measures. Benn (1995) selected a number of inputs and categorized these into five broad groups to determine the evaluation standards: route design, schedule design, economics and productivity, service delivery and monitoring, and passenger comfort and safety. The study concluded that service quality and operating cost were the most two important factors for the users to evaluate the overall service satisfaction level.

In general, in transit systems, labor, capital and energy are used as inputs, while efficiency measures such as vehicle kilometers, seat kilometers, or passenger kilometers are used as outputs (Fielding et al. 1985; De Borger et al. 2002). Sanchez (2009) used a number of output variables such as vehicle kilometers, seating capacity, service hours, number of passengers, and average age of the fleets to evaluate bus service performance of Spanish transport systems.

There are two approaches to assess the performance of the transit system: either by comparing to standards or by measuring and assessing the relative efficiencies if no standards are available. As there are no standards available to benchmark service in our country, the second approach was chosen to assess bus service performance. There are several methods to measure and assess performance. The methods can be classified as parametric and non-parametric tests. Pucher (1982) used correlation coefficients to measure performance. Karlaftis et al. (1997) applied a t-test technique to measure whether there was a significant change in the performance of transit system of two models. Boschken (2000) and Obeng and Azam (1995) used the ordinary least square methods (OLS) to calculate the production and cost functions, respectively. All of these are parametric techniques to measure the performance of a transit system.

These parametric techniques entail assumptions on the functional forms of the production or cost functions. (Sanchez 2009). The non-parametric technique known as Data Envelopment Analysis (DEA) has been widely used to measure the efficiencies and satisfaction level of public transit systems (Zhu 2003). DEA was used in many studies to evaluate the public transit service performance (Cowie and Asenova 1999; Pina and Torres 2001; Kerstens 1999; Odeck 2001; Boil'e 2001 and Nakanishi and Norsworthy 2000). Chu et al. (1992) developed a single index for measuring service efficiency as well as service satisfaction level of public transit agencies using DEA. Barnum et al. (2008) evaluated the performances of 46 bus routes of U.S. transit systems using the DEA method.

Jorgensen et al. (1997) estimated stochastic cost frontier model for the Norwegian bus industry but found no significant differences in the efficiency between privately and publicly owned operators. On the other hand, Alexanderson et.al (1998), Mizutani and Nakamura (1997), Karlaftis and Sinha (1997) and Karlaftis and McCarthy (1999), using a variety of data and methodologies, found the result of privatization to be positive for the efficiency and productivity of transit systems. Yehet al. (2000) using multi criteria analysis obtained an overall performance index for each of the alternatives considered to assess bus system performance in Taiwan.

The existing literature points to ratio analysis and non-parametric techniques as the means to evaluate the performance of public transport systems. According to Nissam and Penman (2001), ratio analysis compares ratios for individual firms against comparable firms in the past and the present to get a sense of what is normal and what is abnormal. Alter (1976) used the perspective of the consumer to select six items for a composite index that included basic accessibility, travel time, reliability, directness of service, frequency of service, and passenger density for evaluation of mass transport service quality using levels of service. Feng and Wang (2001) used financial ratios for the performance evaluation of buses, with number of employees, number of maintenance employees, number of drivers, number of vehicles, fuel current assets, fixed assets, total assets, stock capital and stockholder equity as inputs and frequencies, vehicle-km, current liabilities, long-term liabilities, total liabilities, operation cost, and interest expense as product outputs. This approach typically considers one performance indicator at a time in evaluating an organization's performance and setting up benchmarks in a peer group. The non-parametric approach provides the capability for a holistic perspective of an organization's performance. DEA model has been used evaluate the efficiencies and effectiveness of various routes of Sajha Yatayat. The performance is evaluated from a productive efficiency point of view. Efficiency is measured using deterministic non-parametric Data Envelopment Analysis (DEA) based on selected input (travel time per trip, total number of stops, and total number of buses) and output (daily ridership and vehicle kilometre) variables. This approach enables the decision maker to determine the performance of bus route according to the diesel consumption. Beside the three route, only one route provide the serviceability and efficient which is verify be the DEA Model. Thus the DEA help to rate the route according to Output and Input provided Parameter. (Pragya, 2016)

2.7 Satisfaction Survey

The main function of public transport is to provide accessibility. Customer satisfaction is very important to transport services. Customer satisfaction with public transport is defined as the degree to which an individual positively evaluates the overall quality of a public transport service. Satisfied customers could become loyal customers. Thus, customer loyalty is important for the operator, because loyal customers use the service more frequently and recommend the service to others by telling them about their positive experiences. Therefore, demand and revenues of transport services are highly dependent on customer satisfaction.

Revealed preference models are the most common tolls of satisfaction survey, which is used to identify the behavour response by the traveller. This model is a way of identifying the importance of service quality, passanger satisfaction aad calculating Service Quality Index. This provides an insight to satisfaction level of current public transport service. (Hensher, 07 January 1993)

A lot of research has been done regarding costs and travel time, but less about person characteristics and image aspects influencing customer satisfaction with public transport. The goal of public transport operators and authorities is increasing customer satisfaction cost efficiency. However, there is a lack of knowledge on how to do this. Most customer satisfaction researches are descriptive; no relations are investigated. The KPVV Klantenbarometer model measures overall satisfaction with the trip, appreciations of sub aspects, travel and traveler’s characteristics in vehicles, in all urban, agglomeration and regional concession areas yearly.

The model is built in a way that it analyses the contributions of supply, travel and traveler’s characteristics to customer satisfaction and the four needs. The model is prepared by clustering of needs, supply characteristics, trip purposes and day parts. First, the needs are clustered by sub aspects based on a factor analysis. In order of importance, the most important factors are speed, comfort, ease and safety. (Hart, August 24th, 2012)

The Binary Logistic Regression (BLR) model is one of the most commonly used statistical techniques for the analysis of binary categorical response variables. This type of model is known as generalized linear model. This model predicts the probability of a passenger to rate the overall service quality to be good and condition on the level of satisfaction of the individual service components provided by public transport operators. The model assumes a binomial distribution for the binary dependent variable and a logit link function. If binary values 1 and 0 are used to represent passengers overall good and not-good respectively, then the binary logistic regression model which is commonly known as binary logit model is defined as:

$$\text{Logit it (Y)} = \frac{P(Y=1)}{1-P(Y=1)} = \alpha + X\beta \quad \text{Equation 5}$$

where P(Y=1) describe the probability of a passenger rating the overall service as being good whiles [1-P(Y=1)] represent the probability of a passenger rating the overall service as not-good given the satisfaction level of the individual service components. This probability falls between 0 and 1 ($0 \leq \pi \leq 1$) for all possible independent variables. Also, π and β represent the intercept and a vector of slope coefficients respectively. Whiles X is a vector of explanatory variables representing the satisfaction level for individual service component. The parameters in the model can be estimated using maximum likelihood estimation method. The estimated model can be evaluated as done in any other generalized linear model. That is, by testing the significant difference between the null model (restricted model) and the fitted model (unrestricted model) for the data. In addition, the fitted model can be checked for the problem of over/under dispersion. The estimated value of the parameter β describes the effect of the explanatory variable X on the log odds of response Y=1. In this work, all computerizations were performed using R and STATA software. (Aidoo E. N., May 2013)

CHAPTER THREE: METHODOLOGY

3.1 Methodological Framework

The methodological framework adopted during the study is been summed up in the form of following flow chart. (Refer Figure 2)

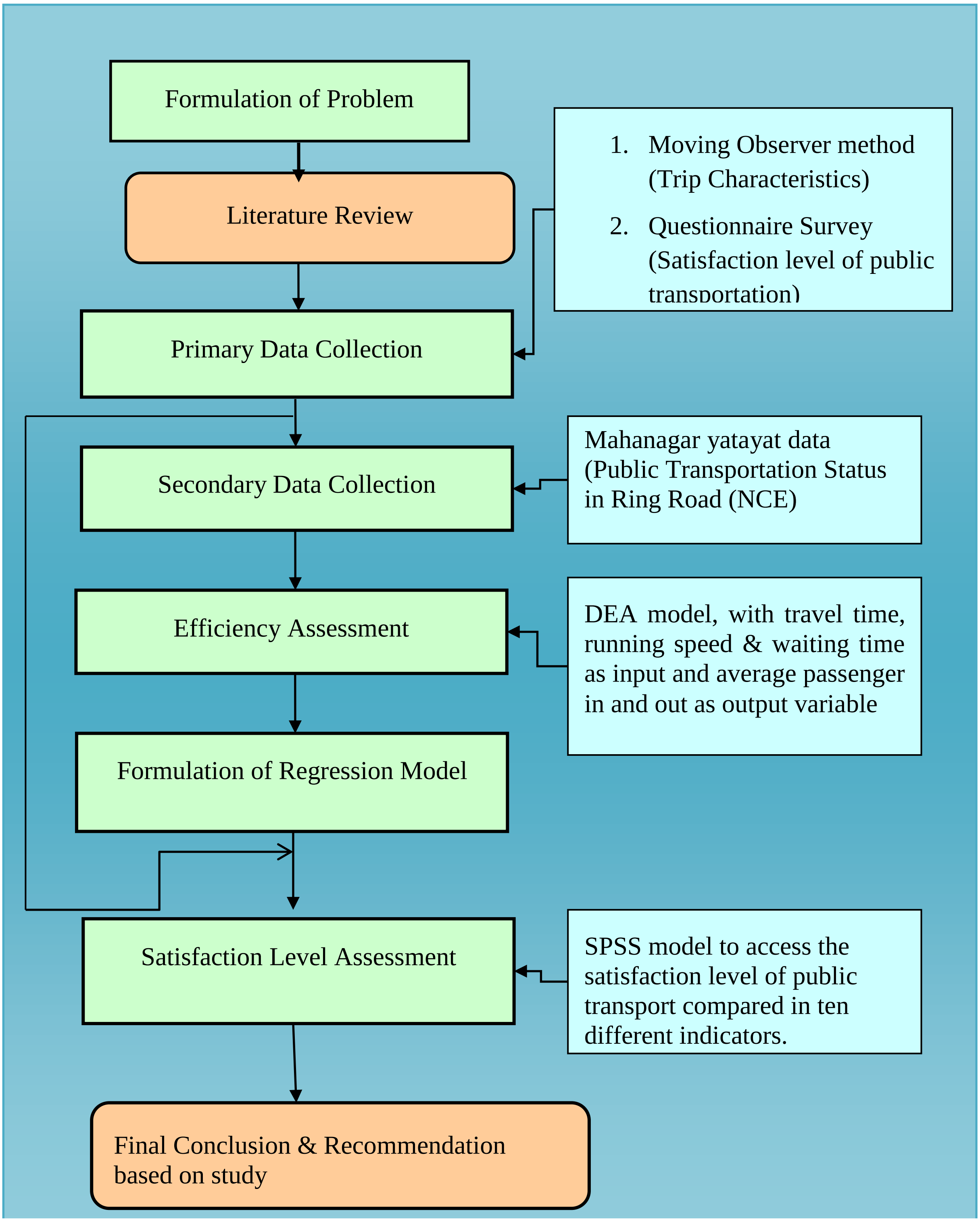

Figure 2: Methodological Framework of Study

3.2 Study Area

There are various major public transportation routes within Kathmandu Valley, among them Kathmandu inner ring road is one of the major route corridor. Because of large patronage and large number of public transportation plying in ring road, the ring road is selected as the study area for the research work. The major entry to Kathmandu Central Business District (CBD), viz. Koteshwor, Kalanki, Maharajgunj, Gausala lies in the Ring road, which further supports the selection of ring road as our study area.

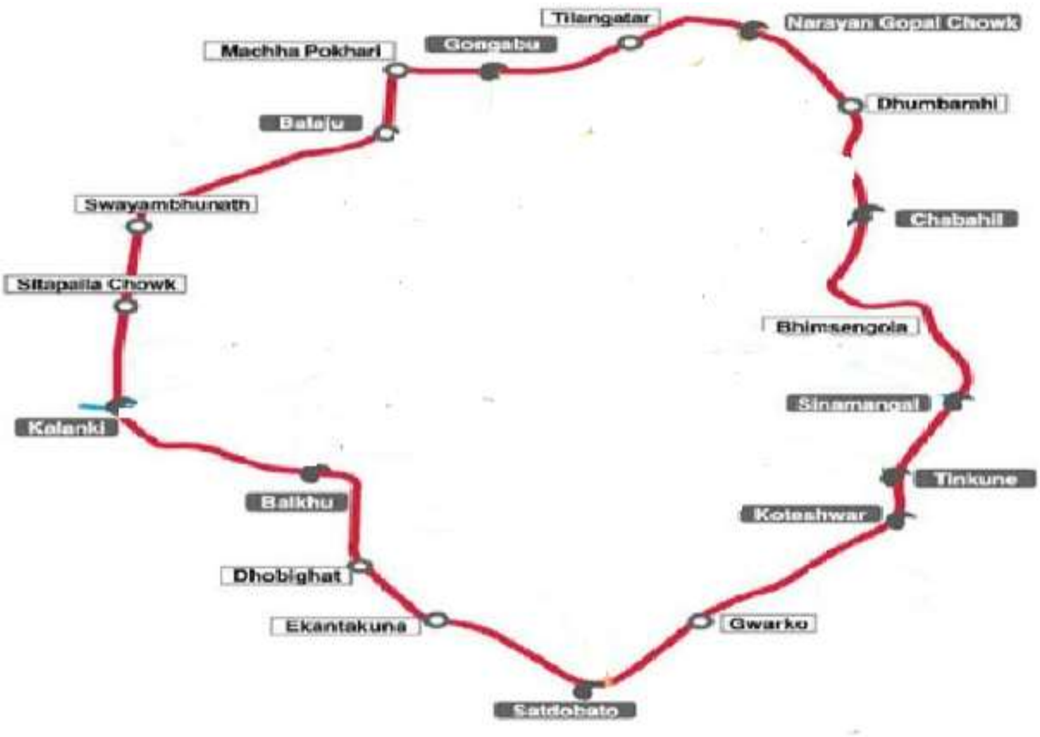

Figure 3: Study Area (Inner ring road of Kathmandu valley)

3.3 Data collection

After selection of study area, the next task is the collection of the data required for analysis during the study. The data have been categorized in two types: Primary Data and Secondary Data, which have been further discussed in the later subheading.

3.3.1 Primary data collection

Primary data are the backbone of this research which are used to assess efficiency and satisfaction level of the public transportation within Ring Road. The major primary data collected during the study involves the trip characteristics of public transportation (speed, delay, passenger in and out) and people perception towards public transportation services. The methods adopted during the collection of primary data were:

(a) Moving Observer Method

(b) Questionnaire based Satisfaction Survey

a) Moving Observer Method

This method is adopted to identify the various trip characteristics of public transportation within Kathmandu Valley. A public transportation is randomly chosen and is travelled through the route in the same vehicle. While traversing all the stopped stations, number of passengers getting in or out of the bus at respective station, time of various types of delay (fixed and operational), time elapsed between two stopping station and total time elapsed to cover the whole ring road is noted down.

The trips were made at different course of time in each direction. Thirty set of data from five bus service providers (15 clockwise and 15 anti-clockwise), covering morning peak, evening peak and off peak had been collected during the study. Similarly, total of 18 data were also collected from 3 micro-bus service providers (9 clockwise and 9 anti-clockwise). All these data have been summarized in ***Appendix A***.

Based on the total length of H016, the raw data are then processed to evaluate average travel time, average waiting time, average no. of station, average passenger arriving and boarding time, average passenger, average journey speed and average running speed have been summarized in tabulated as below.

Table 1: Summary of the primary data and its values

Bus travelling data of Inner Ring Road								
SN.	**Transportation Agency**	**Travel Time(min)**	**Waiting Time(min)**	**PABT(min)**	**Passenger In(no.)**	**Passenger Out(no.)**	**Journey speed (kmph)**	**Running Speed (kmph)**
1	Swayambhu Transport service	165.17	41.55	10.78	106.00	109.67	10.26	27.18
2	City Transport service	173.40	40.18	10.62	103.00	109.40	8.244	18.288
3	Kare Binayak Mount Everest Transport service	184.00	46.71	10.79	102.67	106.50	9.252	24.804
4	Nepal Yatayat Mini Bus Transport service	193.83	49.19	11.14	109.67	112.00	8.712	24.804
5	Lalitpur Mini Bus Transport service	206.33	59.00	11.50	115.00	115.00	8.028	21.312
6	Mahanagar Transport service	121.00	37.50		137.00	137.00	14.22	20.628
	Average	173.96	45.69	10.97	112.22	114.93	9.792	22.824
Micro travelling data of Inner Ring Road								
SN.	**Transportation Agency**	**Travel Time(min)**	**Waiting Time(min)**	**PABT(min)**	**In(no.)**	**Out(no.)**	**Journey speed(m/sec)**	**Running Speed**
1	Mahaluxmi Transport service	174.17	51.10	5.73	58.33	56.33	9.432	16.452
2	Manakamana Micro Transportation service	190.17	55.68	6.15	62.67	60.33	8.64	15.048

3	Koteshwor Micro Transportation service	179.67	52.42	6.08	61.83	59.83	9.576	16.308
	Average	181.33	53.07	5.99	60.94	58.83	9.216	15.948
Bus and Microbus travelling data of Inner Ring Road								
SN.	**Transportation Mode**	**Travel Time(min)**	**Waiting Time(min)**	**PABT(min)**	**In(no.)**	**Out(no.)**	**Journey speed(Kmph)**	**Running Speed(Kmph)**
1	Bus	173.96	45.69	10.97	112.22	114.93	9.792	22.824
2	Microbus	181.33	53.07	5.99	60.94	58.83	9.216	15.948
Bus and Microbus travelling data of Inner Ring Road with Mahanagar								
SN.	**Transportation Mode**	**Travel Time(min)**	**Waiting Time(min)**	**PABT(min)**	**In(no.)**	**Out(no.)**	**Journey speed(kmph)**	**Running Speed (Kmph)**
1	Microbus	181.33	53.07	5.99	60.94	58.83	9.216	15.948
2	Bus	173.96	45.69	10.97	112.22	114.93	9.792	22.824
3	Mahanagar	121.00	37.50		137.00	137.00	14.22	20.628

***PABT = Passenger Alighting and Boarding Time**

b) Questionnaire based Satisfaction Survey

In order to visualize the people perception towards public transportation, structured questionnaire survey has been carried out to the public transportation user within the Kathmandu inner ring road. The questionnaire survey has been collected from the passenger using the public transportation services within inner ring road, either by collecting at station or during the trip.

For 95% confidence interval and infinite population, number of sample that need to be adopted for the study came out to be 384 samples. Hence, 384 samples were collected covering the passenger perception towards various satisfaction indicators as provided in ***Appendix-C.***

3.3.2 Secondary data collection

Secondary data like vehicular composition, public vehicle route and their frequency, passenger travel trip demand, vehicles operating cost, income per day of public vehicle were collected. The major sources of secondary data were Department of Transport Management (DoTM) and different bus and micro-bus committees of vehicle plying on Ring Road, different websites and buses. Beside this, the data for Mahanagar Yatayat was taken from report of "Public Transportation Status in Ring Road (A case study of Mahanagar Yatayat) NCE".

3.4 Data Analysis

The obtained data have been processed for two major objectives: Efficiency assessment and satisfaction level assessment. Moving observer method along with major primary data has been assessed for efficiency assessment, whereas questionnaire survey is used for satisfaction level assessment. DEA model has been used for assessment of efficiency and SPSS model has been used to materialize the people perception level towards public transportation.

3.4.1 DEA model analysis

DEA model have been used to find out efficiency of public transportation and three input variables and one output variables, summarized in the formed of table below. Based on the types of input and output variables, three approaches were identified in the literature to use DEA to measure the efficiency of a transit system.

Table 2: Input and the Output variable

Input variables	**Output variables**
1. Total travel time of vehicle in one round (minute)	1. Total number of passengers (ridership) per trip
2.Running Speed (m/s)	
3. Waiting time at station (minute)	

DEA method is used to measure efficiency via measuring passenger patronage on each means of public transportation. DEA model has two major parameter, as input and output parameter. There is empirical evidence to indicate a linear relationship between the inputs and output variable. This justifies the use of the DEA approach as a linear programming approach. An efficiency score equal to 1 means an efficient system.

The basic methodology adopted during the study is the setup of various input and output variables. Waiting Time, Running Speed and Travel Time per trip were selected as the input variables based on literature and the research objective; whereas the average passenger in and out per trip has been selected as output variables. The waiting time at station has a positive impact on the passenger in and out as higher waiting time may leads to high passenger. Similarly, higher high running speed leads to less number of average passenger patronages per trip and finally higher travel time means leads less satisfaction towards that mode and hence less efficiency.

The input variables and output variables have been accessed to find out the efficiency of bus and micro bus, later they have been further sub grouped into various bus and micro bus operator to access their respective efficiency.

3.4.2 Regression Model Analysis

Based on the four independent variables, travel time, running speed, waiting time and passenger in and out, and regression analysis is carried out with Efficiency obtained from DEA model as dependent variable. The model is then checked for its statistical significance based on goodness of fit (R^2 Value). The calibrated model is then checked for the efficiency of different buses operator for its validation. The regression model can be further used to analyze the efficiency of at changed scenario of public transportation or to check the efficiency of new transportation service provider.

3.4.3 SPSS Based Satisfaction Level Assessment

The questionnaire survey result has been materialized in the standard format and has been used in SPSS based model, so as to quantify the people perception for various performance based criteria or indicators. The analysis is carried out in SPSS with set up of null hypothesis and alternative hypothesis and has been checked for p value.

Null Hypothesis (H_0): There is not any difference between the satisfaction level of bus & micro bus for specified service/performance indicator.

Alternative Hypothesis (H_0): There is any difference between the satisfaction level of bus & micro bus for specified service/performance indicator.

The null hypothesis will be rejected if the p value is less than 0.05 (95% confidence interval). The ranking has been grouped in five levels 1 to 5, where 1 represents high satisfaction level and 5 represents worst satisfaction level. Similarly, the service of micro-bus and bus have been compared based on the mean, paired t test and finally the overall perception of public transportation as well as comparison of bus and micro-bus for various indicators have been provided.

CHAPTER FOUR: RESULT AND ANALYSIS

4.1 Status Quo Analysis

Micro-bus services and bus services plying in the inner ring road were introduced with the objective to fulfill the current travel demand inside the valley. However, due to lack of good efficient service from public transportation, people are more attracted in owning private cars and two wheelers which are eventually causing traffic problems in the road. More crashes, frequent congestion problems, pollution (both noise and emissions) and social exclusions are some of the traffic problems that are being observed inside the valley.

4.2 Efficiency Assessment

Efficiency is calculated based on various output and input variables via DEA model. The output variables were taken as average passenger in and out, whereas input variables were travel time, waiting time and running speed, the data calculation from the DEA model and the regression analysis is shown in the ***Appendix-B.***

4.2.1 Comparison of Bus and Micro

The result obtained from DEA model showed that the bus services are 24.5% more efficient than the micro-bus services.

4.2.2 Comparison of buses of various transportation agencies

DEA model have been used to compare the efficiency of different bus operator. The analysis of various bus transport service provider provides the following efficiency, the operator with highest efficiency have been provided with 100% efficiency and the other have been evaluated based on that operator. In this case Mahanagar Yatayat has high efficiency and model take 100% value for it. Karya Binayak Mount Everest Transport Service and Nepal Yatayat Mini Bus Transport Service have the lowest efficiency among various operators. The lowest Table 3 gives the clear picture of the efficient bus transportation service among various service providers.

Table 3: Efficiency calculation of Buses

SN.	Transportation agency of Buses	Efficiency
1	Maha Nagar Transport service	100%
2	Lalitpur Mini Bus Transport service	96.8%
3	Nepal Yatayat Mini Bus Transport service	83.2%
4	Karye Binayak Mount Everest Transport service	83.2%
5	City Transport service	87.4%
6	Swayambhu Transport service	90.3%

4.2.3 Comparison between Mahanagar Yatayat, Buses and Micro-buses

Based on DEA model, the efficiency of various means of public transportation have been accessed, which gives higher efficiency of Mahanagar Yatayat (Refer Appendix B). The Mahanagar Yatayat is being taken as the improved version of the bus services and hence evaluated accordingly. Thus, comparison has been made among Mahanagar Yatayat, other bus service providers and micro-bus service provider.

The result obtained from the DEA model showed that bus services and micro-bus services are 88.6% and 56.5% efficient on average when compared to 100% efficiency of the Mahanagar Yatayat. So, among other transportation services Mahanagar Yatayat is found to be more efficient.

4.2.4 Comparison among Micro-bus transportation services

In this section, result of comparison between different micro-bus transportation service providers is presented. The DEA model showed that Manakamana and Koteshwor Micro-buses transportation services are more efficient than Mahalaxmi Bus Transportation Service. Manakamana & Koteshwor Micro Transportation service has high and equal efficiency and DEA model have used that as 100%.

Table 4: Efficiency calculation of Micro-buses

SN.	Transportation agency of Micro-buses	Efficiency
1	Mahaluxmi Transport service	97.2%
2	Manakamana Micro Transportation service	100%
3	Koteshwor Micro Transportation service	100%

4.3 Model Development

Model has been calibrated based on the efficiency obtained from DEA model as dependent variable and the output and input variables of DEA model as independent variables. It shows that four independent variables have significant impact on efficiency, which is further justified by high goodness of fit i.e. correlation coefficient (R^2 value) of 0.97.

Y= 6.04 - 0.00105* Travel Time + 0.48 * Waiting Time - 0.323 * Running Speed + 0.56 * Passenger In/Out (avg. passenger)

Here, Y = Efficiency value obtained from DEA Model

All the other independent variables have been obtained based on primary data collection (Moving Observer Methods)

Table 5: Efficiency based on Regression and DEA model

Efficiency	Micro	Bus	Mahalaxmi Microbus	Manakamana Micro Bus	Koteshwor Microbus	Mahanagar
Based on Regression	63.8	88.6	54.9	66.3	64.1	99.7
Based on DEA model	56.5	90.3	61.1	56.5	56.5	100

The R square value of 0.97 shows that the calibrated model is good enough to be used for generalization purpose.

Calibration of model shows that the efficiency increases with decrease in travel time and running speed whereas increases with increase in waiting time and passenger in and out volume. Higher the waiting time high will be the passenger and hence high will be the efficiency. Similarly, the decrease in travel time will increase the efficiency.

4.4 Satisfaction Level Assessment

384 data were collected for the satisfaction level assessment between bus service provider and micro-bus service provider. Questionnaires were prepared and passengers were asked to fill it during their ride in the respective public transport mode (either of bus or micro-bus) or in the stop station. The sample of questionnaires is shown in ***Appendix-C***. Thus, collected data obtained were checked for the statistical significance with 95 % level of confidence. SPSS model was used to analyze the satisfaction level based on the data collected of bus and micro-bus service. For higher satisfaction level, a value of 1 was given whereas for low satisfaction a value of 5 was given.

A value of 2.5 is taken as the average mean. When the value obtained for the particular types of service is lower than 2.5, the service provided is said to be satisfactory whereas if the mean is greater than 2.5, the service provided is said to be unsatisfactory. By the help of pair sample statistics, as shown in the Table 6, the satisfaction level is seen unsatisfactory for every criterion for both bus and micro-bus service.

Table 6: The Paired Samples Statistics table

Criteria		**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Comfort of bus	2.88	384.00	1.15	0.06
	Comfort of micro-bus	3.20	384.00	1.17	0.06
Pair 2	Cleanness of the Service of bus	3.26	384.00	1.12	0.06
	Cleanness of the Service of micro-bus	3.23	384.00	1.09	0.06
Pair 3	Frequency/reliability of services of bus	3.18	384.00	1.01	0.05
	Frequency/reliability of services micro-bus	3.27	384.00	1.14	0.06
Pair 4	Access for various disable person of bus	3.21	384.00	1.15	0.06
	Access for various disable	3.54	384.00	1.22	0.06

Criteria		Mean	N	Std. Deviation	Std. Error Mean
	person micro-bus				
Pair 5	Availability of timetable/route information of bus	3.39	384.00	1.14	0.06
	Availability of timetable/route information micro-bus	3.49	384.00	1.18	0.06
Pair 6	Seating Arrangement/Space for standing of bus	3.35	384.00	1.23	0.06
	Seating Arrangement/Space for standing micro-bus	3.70	384.00	1.23	0.06
Pair 7	Seat availability/over-crowding of bus	3.51	384.00	1.18	0.06
	Seat availability/over-crowding micro-bus	3.72	384.00	1.21	0.06
Pair 8	Speed of bus	3.26	384.00	1.03	0.05
	Speed micro-bus	3.17	384.00	1.23	0.06
Pair 9	Conductor behavior of bus	3.38	384.00	1.17	0.06
	Conductor behavior micro-bus	3.52	384.00	1.17	0.06
Pair 10	How easy to get on and off services of bus	3.39	384.00	1.20	0.06
	How easy to get on and off services micro-bus	3.70	384.00	1.18	0.06

The satisfaction level of bus and micro bus has been compared based on paired t test and the summary has been tabulated in the form of table. (Refer Table 7)

Table 7: Paired Samples Test

Criteria		Paired Differences					T	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
					Lower	Upper		
Pair 1	Comfort of bus - Comfort of micro-bus	-.32	1.30	.07	-.45	-.19	-.85	.00
Pair 2	Cleanness of the Service of bus - Cleanness of the Service micro-bus	.02	1.15	.06	-.09	.14	.40	.69
Pair 3	Frequency/reliability of services of bus - Frequency/reliability of services micro-bus	-.09	1.25	.06	-.22	.03	-1.42	.16
Pair 4	Access for various disable person of bus - Access for various disable person micro-bus	-.33	1.23	.06	-.45	-.21	-5.25	.00
Pair 5	Availability of timetable/route information of bus - Availability of timetable/route information micro-bus	-.10	1.20	.06	-.22	.02	-1.61	.11
Pair 6	Seating Arrangement/Space for standing of bus - Seating Arrangement/Space for standing micro-bus	-.35	1.45	.07	-.50	-.21	-4.74	.00
Pair 7	Seat availability/over-crowding of bus - Seat availability/over-crowding micro-bus	-.22	1.23	.06	-.34	-.09	-3.44	.00
Pair 8	Speed of bus - Speed micro-bus	.08	1.41	.07	-.06	.22	1.12	.26
Pair 9	Conductor behavior of bus - Conductor behavior micro-bus	-.14	1.09	.06	-.25	-.03	-2.52	.01
Pair 10	Easy get and off services of bus -Easy get and off micro-bus	-.31	1.21	.06	-.43	-.19	-4.97	.00

As per Table 7, with respect to criterion of cleanliness, frequency/ reliability, availability of time table/ route information and speed, there is no significance difference in these parameters of both bus and micro-bus in assessment of p-value. Remaining all six criteria of satisfaction shows there is significant difference between the service provided by micro-bus and bus. As the mean is negative, it shows that the service provided by bus is better than that of micro-bus. As the entire indicator has higher values for micro-bus, it can be said that user are little more satisfied by the service of bus.

Different perspective view given by the passenger toward the satisfaction criteria are as shown in pie diagram:

a) The perception of using on the factor contributing to discouragement from using the public transportation is summarized as Figure 6, which shows crowdedness and delay as the major factors.

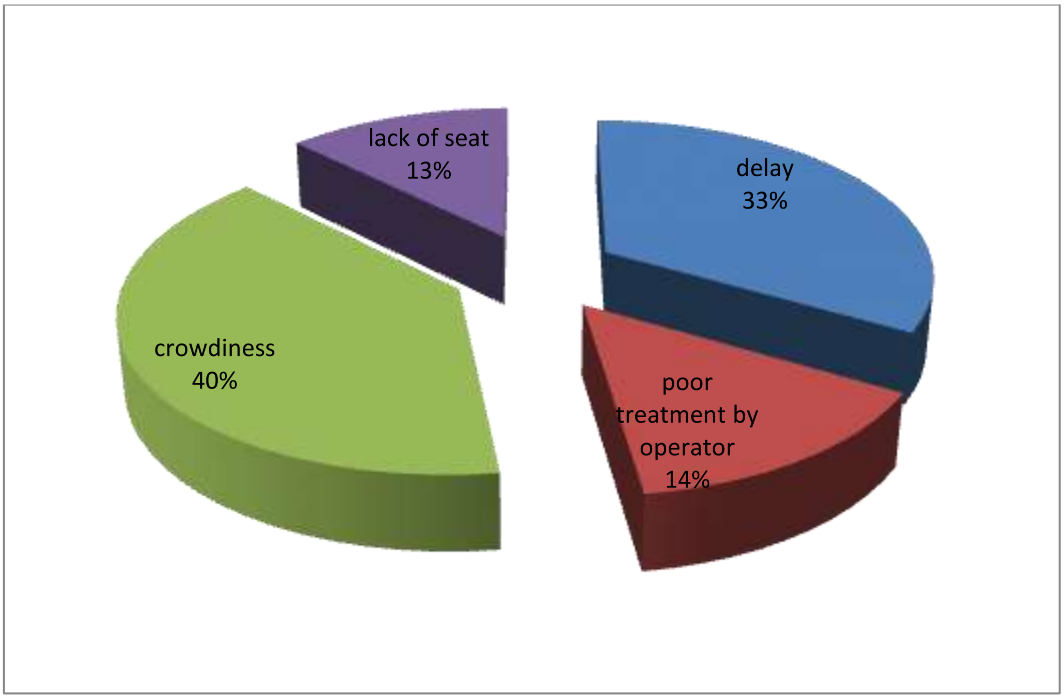

Figure 4 : Discouraging factor of using Public Transportation

b) The proportion of usage of bus and micro bus seems to be almost same as summarized in Figure 7.

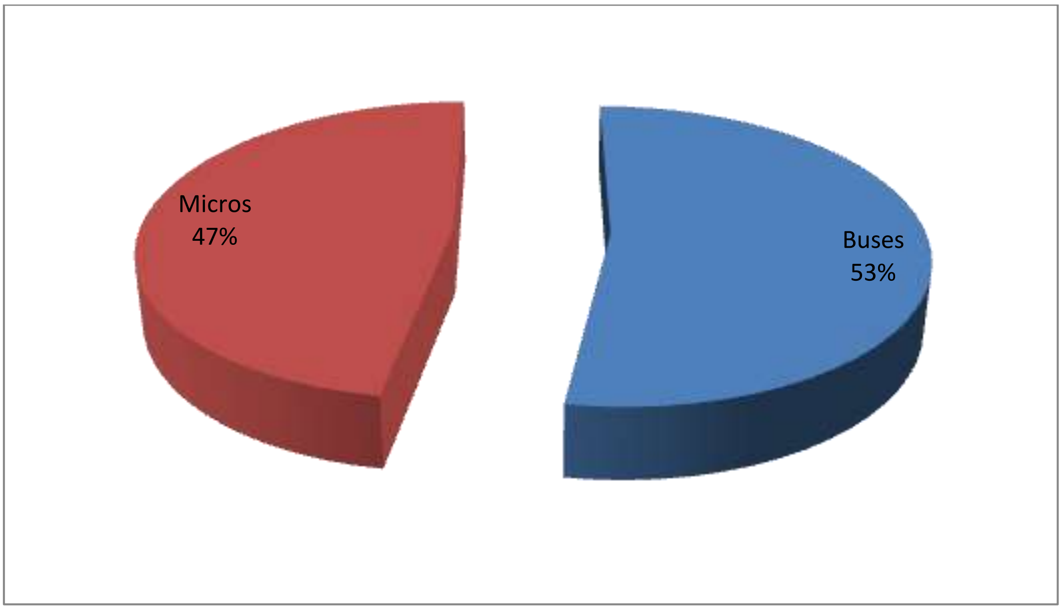

Figure 5: Mode of use public transportation

c) The waiting time for public transportation at the bus stop shows that people have to wait for about 15 minute in an average, which covers about 70% of total.

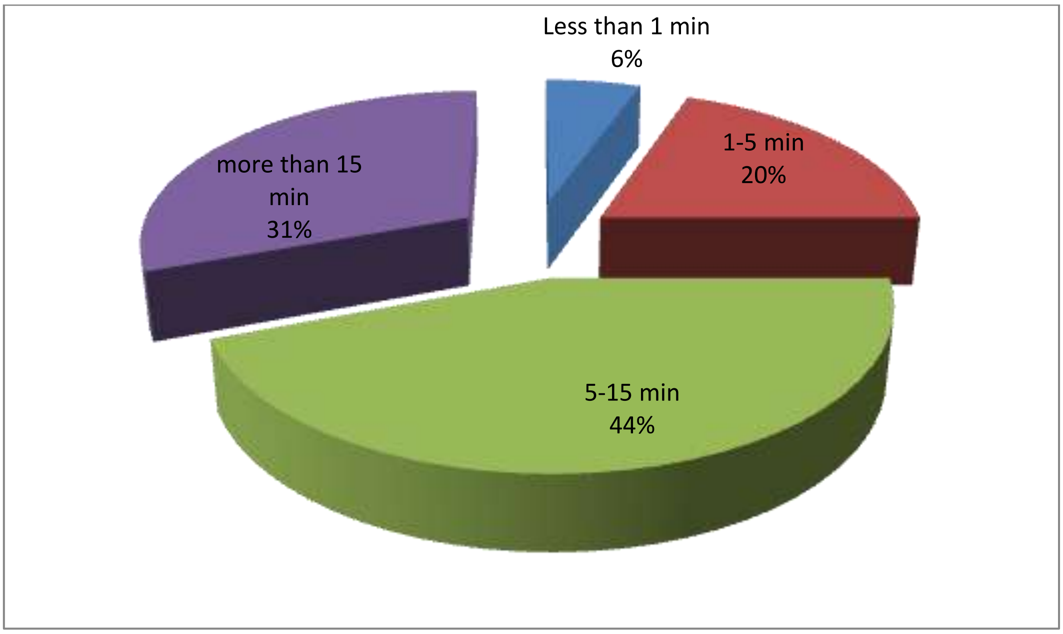

Figure 6: Waiting time for Public Transportation

d) Major people are not satisfied with the fare and collection technique as suggested in figure 9

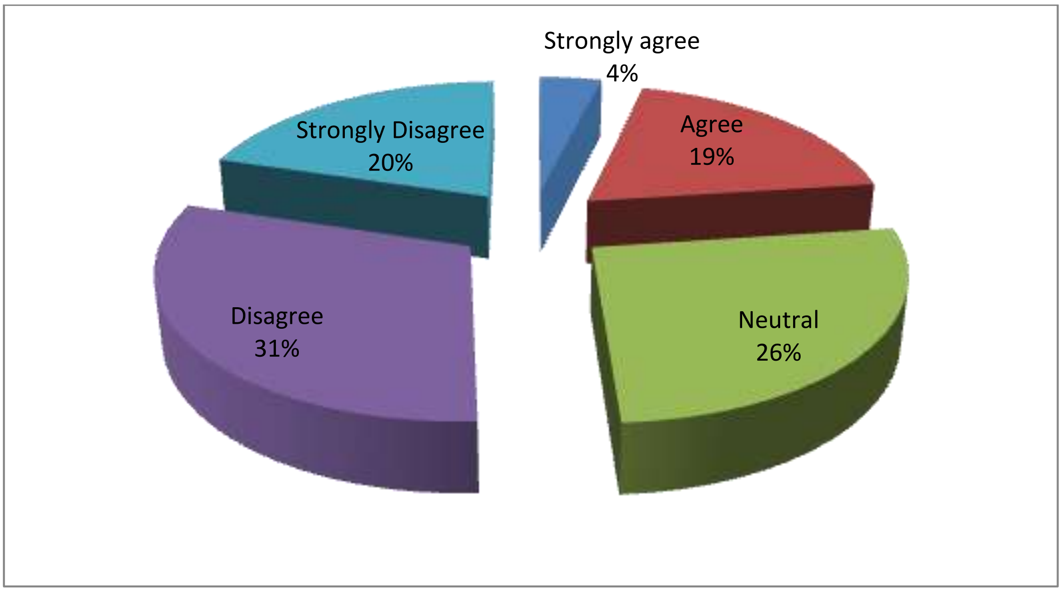

Figure 7: Satisfaction with fare

e) The perception of people towards the quality of the bus stops and shelters shows that majority of them are not satisfied with the current situation as shown in Figure 10 (1 for high satisfaction to 5 for the low satisfaction)

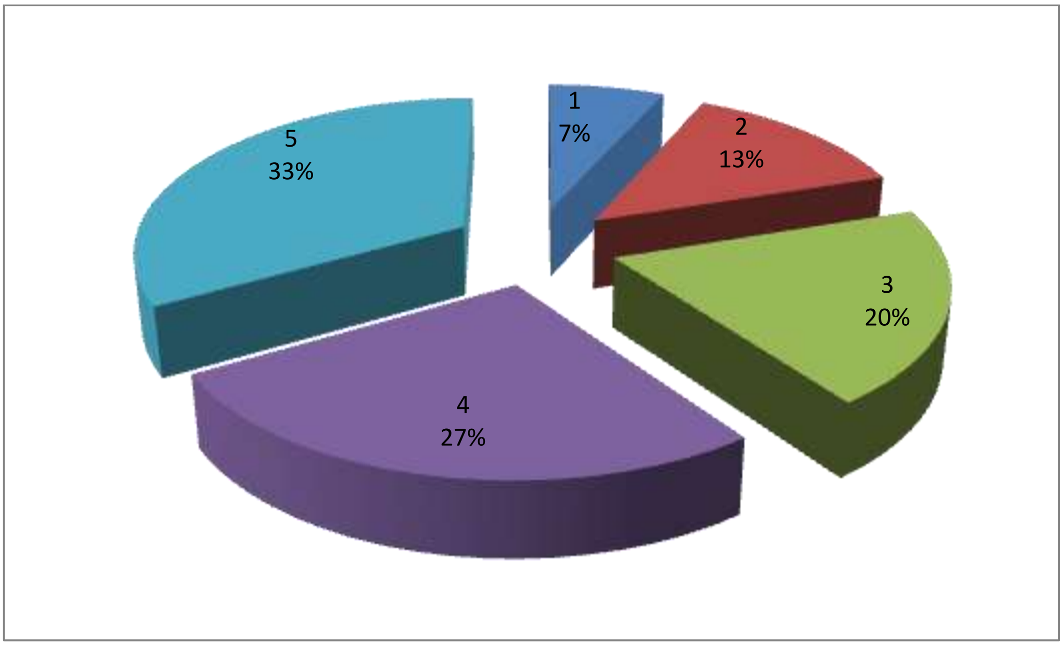

Figure 8: Satisfaction towards Bus Stops and Shelter

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Congestion is adding agony to the passengers. This research was focused on the study of ring road (27.3 km) stretch with moving observer method. The research covered five bus based and three micro-bus based transportations services. The directional flow data was collected at different time of the day. The journey speed of bus was found to be in a range of 8.03 kmph to 14.22kmph, whereas the running speed was in a range of 18.28 kmph to27.18 kmph respectively. Similarly, the journey speed of micro-bus was found to be in a range of 8.64 kmph to 9.58kmph, whereas the running speed was in a range of 15.08 kmph to16.45 kmph.

For the analysis of DEA model average number of passenger was taken as the output variable whereas the input variables were travel time, waiting time and the running speed. From the analysis of data using DEA model, it is found that the efficiency of the bus service was 24.5% more than that of the micro-bus service. When 100% efficiency was taken for Mahanagar Yatayat, 88.6% efficiency of bus and 56.5% efficiency of micro-bus were obtained by the DEA model analysis.

The obtained equations (shown below) suggested the decrease in efficiency with increasing travel time and running speed in contrast to increase in efficiency with increase in waiting time and average passengers in and out.

Y= 6.04 - 0.00105* Travel Time + 0.48 * Waiting Time - 0.323 * Running Speed + .56 * Average Passenger In/Out

For SPSS Model, ten indicators were taken for evaluation of services in which each respondent was asked to rate the services among numbers 1 to 5 where 1 represents (high satisfaction) and 5 represents (low satisfaction). Each indicator was then analyzed separately based on statistical tools.

As per pair sample statistics, none of the services provides satisfaction to the passenger. Whereas two tail pair t- test has been adopted to compare the service provided at 95% confidence interval and 5% error. Six indicators viz. comfort, access for disable person, seat arrangement and spaces for standing, seat available and overcrowd, conductor behavior and Easiness in alighting and boarding are statistically better in bus services compare to microbuses. But, there is not any difference in service provided by bus and microbuses in terms of other four categories. As none of the indicator has higher value, it can be said that user are satisfied by the services of bus compared to that of micro-bus.

5.2 Recommendation

When compared with respect to efficiency and satisfaction level, bus services are found more effective and reliable than micro-bus services in inner ring road of Kathmandu valley. So, buses are recommended for effective and efficient public transportation in the Kathmandu Inner Ring Road (H016) compared to micro bus service. Mahanagar Yatayat is a new approach of public transportation dedicated to serve ring-road passengers. Based on the study due to high efficiency value based on DEA model, its shows that the service provided by Mahanagar Yatayat is more efficient compared to other bus services. We can foresee different advantages of its implementation in the public transportation sector. The specific recommendations are summed up as:

a) DEA Model Analysis:

- Bus service is 24.5% more efficient than micro-bus service which suggests the need of replacement of micro buses by proper bus services. Even the larges buses (Mahanagar Yatayat) have 11.4% greater efficiency than other smaller buses and hence smaller buses need to be replaced by large buses like Mahanagar Yatayat for increasing the overall efficiency of public transportation system.

b) SPSS Model Analysis:

- There seem to be arrangement of comfort during travelling in public transportation.
- There is a need for better and clean public transportation.
- Need to improve frequency and reliability of services for the passengers.
- The schedule of public transportation should be regularity and there should provide the route information in each intersection.
- Seating arrangement and space for standing is not sufficient.
- There are no facilities for the disable person during riding and take off, thus there should be easy access for them.

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"Public Transportation Status in Ring Road (A case study of Mahanagar Yatayat) NCE"

APPENDIX

APPENDIX-A.

Sample of data is as follows:

a) Bus Travelling data of Inner Ring Road on clockwise direction

City Transport service

Clockwise Direction

Bus No. Ba 1 Kha 2165 **Initial Passenger on bus = 6**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	9	4.30	42.00	14.00		Chabahil	1.00
2	9.08	0.65	21.00	5.00	2.00	Gausala	
3	9.11		15.00	4.00	1.00	Tilganga	
4	9.13		15.00	2.00	3.00	Airport	
5	9.14		15.00	3.00	2.00	Sinamangal	
6	9.3	2.45	33.00	3.00	8.00	Koteshwor	5.00
7	9.34		12.00	4.00		Balkumari	
8	9.36		18.00	4.00	2.00	Kharibot	
9	9.41		21.00	4.00	3.00	Gwarko	3.00
10	9.46	0.55	27.00	3.00	6.00	Satdobato	1.00
11	9.5		9.00		3.00	MahaluxmiChowk	
12	9.53		21.00	1.00	6.00	Yatayat	
13	9.55		9.00		3.00	Akantakuna	1.00
14	9.57		3.00		1.00	Nakkhu	1.00
15	10.06	2.35	39.00	5.00	8.00	Balkhu	6.00
16	10.13		3.00		1.00	Khasibaza	
17	10.15	4.50	30.00	4.00	6.00	Kalanki	
18	10.23		6.00	1.00	1.00	Sitapaila	
19	10.25	1.95	3.00	1.00		Swayambhu	
20	10.25		6.00		2.00	Sano Varang	
21	10.31	0.85	9.00	3.00		Vanasthali	
22	10.33	0.75	15.00	5.00		Balaju	
23	10.37	0.90	6.00	1.00	1.00	MachhaPokhari	
24	10.42		3.00		1.00	Gangabu	
25	10.44	0.85	9.00	3.00		Shamakhushi	
26	10.47		45.00	3.00	12.00	Narayan GopalChowk	1.00
27	11		15.00		5.00	Chabahil	
	2 hour	16.50	7.50	73.00	77.00		19.00

City Transport service

Clockwise Direction

Bus No. Ba 2 Kha 3747 **Initial Passenger on bus 9**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	11	4.10	54.00	18.00		Chabahil	
2	11.06		3.00	1.00		Mitra Park	2.00
3	11.09		3.00		1.00	Jay Bageshwori	
4	11.1	0.70	18.00	3.00	3.00	Gausala	
5	11.13		6.00	1.00	1.00	Tilganga	
6	11.14	0.65	21.00		7.00	Airport	2.00
7	11.18	1.75	15.00	1.00	4.00	Sinamangal	
8	11.21	0.50	30.00	3.00	7.00	Tinkune	
9	11.24	4.45	33.00	6.00	5.00	Koteshwor	3.00
10	11.45	1.65	21.00	4.00	3.00	Gwarko	11.00
11	11.56	0.70	18.00		6.00	Satdobato	7.00
12	12	0.55	27.00	3.00	6.00	MahaluxmiChowk	
13	12.03		21.00	4.00	3.00	Yatayat	
14	12.1		15.00	3.00	2.00	Akantakuna	6.00
15	12.13	0.75	15.00	2.00	3.00	Dhobighat	
16	12.18	2.55	27.00	4.00	5.00	Balkhu	2.00
17	12.24	0.65	21.00	5.00	2.00	Sitapetrol Pump	
18	12.27	4.05	57.00	13.00	6.00	Kalanki	
19	12.37		27.00	2.00	7.00	Bafal	
20	12.39		9.00	1.00	2.00	Sitapaila	
21	12.41	2.50	30.00	4.00	6.00	Swayambhu	
22	12.46		6.00		2.00	Sano Varang	
23	12.48		6.00		2.00	DhungeDhara	
24	12.5	0.90	6.00	2.00		Vanasthali	
25	12.54	3.40	36.00	5.00	7.00	MachhaPokhari	
26	1	2.55	27.00	9.00		Naya Bus Park	2.00
27	1.02	0.45	33.00		11.00	Shamakhushi	
28	1.14		3.00	1.00		Basundhara	1.00
29	1.16	4.55	27.00	6.00	3.00	Narayan GopalChowk	4.00
30	1.24		6.00		2.00	Dhumbarahi	
31	1.25		9.00	2.00	1.00	SukeDhara	
32	1.29		9.00		3.00	Gopi Krishna Fall	
33	1.31		3.00		1.00	Chabahil	
	2n hour 31 min	35.30	10.70	103.00	111.00		40.00

City Transport service

Clockwise Direction

Bus No. Ba 2 Kha 468 **Initial Passenger on bus 12**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	3.3	4.40	36.00	12.00		Chabahil	
2	3.4		6.00	2.00		Mitra Park	3.00
3	3.44		24.00	5.00	3.00	Gausala	1.00
4	3.46	1.85	9.00	2.00	1.00	Tilganga	
5	3.49	1.70	18.00	1.00	5.00	Airport	
6	3.55	2.65	21.00	3.00	4.00	Sinamangal	
7	3.58		3.00		1.00	Tinkune	
8	4.08	2.50	30.00	7.00	3.00	Koteshwor	5.00
9	4.14		6.00		2.00	Balkumari	3.00
10	4.29	1.55	27.00	6.00	3.00	Gwarko	1.00
11	4.41	0.75	15.00	2.00	3.00	Satdobato	9.00
12	4.42		39.00	3.00	10.00	Thamshikhel	
13	4.44		21.00	2.00	5.00	MahaluxmiChowk	
14	4.46		42.00	4.00	10.00	Yatayat	
15	4.55	1.75	15.00	2.00	3.00	Akantakuna	5.00
16	4.56		12.00	2.00	2.00	Nakkhu	
17	4.59		6.00	1.00	1.00	Dhobighat	
18	5.01		3.00		1.00	Sanapa	
19	5.1	6.10	54.00	8.00	10.00	Balkhu	
20	5.14		12.00		4.00	Sitapetrol Pump	
21	5.25	4.65	21.00	5.00	2.00	Kalanki	3.00
22	5.29	1.80	12.00		4.00	Sitapaila	
23	5.32	0.60	24.00	6.00	2.00	Swayambhu	
24	5.34		9.00		3.00	ThuloVarang	
25	5.4	3.80	12.00	3.00	1.00	Vanasthali	
26	5.52	5.65	21.00	4.00	3.00	Balaju	3.00
27	5.55	1.85	9.00		3.00	MachhaPokhari	
28	5.59	0.35	39.00	6.00	7.00	Naya Bus Park	2.00
29	6.03		21.00	4.00	3.00	Gangabu	
30	6.08	2.80	12.00	3.00	1.00	Shamakhushi	
31	6.11		42.00	7.00	7.00	Basundhara	
32	6.21	1.95	3.00	1.00		Narayan GopalChowk	6.00
33	6.24		3.00	1.00		ChappalFactori	
34	6.27		6.00	1.00	1.00	SukeDhara	
35	6.33		18.00		6.00	Chabahil	4.00
	3 hour 3 min	42.15	10.85	103.00	114.00		45.00

b) **Bus Travelling data of Inner Ring Road on Anticlockwise direction**

KareBinayak Mount Everest Transport service							
Anti-clockwise Direction							
Bus No. Ba 2 Kha		**9439**				**Initial Passenger on bus**	**3**
SN	**Travel Time**	**Waiting Time**	**PABT(sec)**	**In**	**Out**	**Destination**	**Jam**
1	9.15	8.60	24.00	8.00		Kalanki	
2	9.34	0.65	21.00	3.00	4.00	Balkhu	8.00
3	9.36	2.30	42.00	8.00	6.00	Akantakuna	
4	9.47	0.60	24.00	5.00	3.00	Satdobato	5.00
5	9.49	1.80	12.00	1.00	3.00	BNB Hospital	
6	10.06	0.75	15.00	4.00	1.00	Gwarko	12.00
7	10.11		18.00		6.00	Kharibot	2.00
8	10.15	0.85	9.00	2.00	1.00	Balkumari	1.00
9	10.19	1.40	36.00	7.00	5.00	Koteshwor	1.00
10	10.23		6.00	1.00	1.00	Tinkune	
11	10.25	1.65	21.00	5.00	2.00	Sinamangal	
12	10.29	1.60	24.00	6.00	2.00	Airport	1.00
13	10.36	1.35	39.00	7.00	6.00	Gausala	3.00
14	10.40	0.60	24.00	3.00	5.00	Mitra Park	1.00
15	10.49	1.55	27.00		9.00	Chabahil	5.00
16	10.53	0.80	12.00	3.00	1.00	SukeDhara	
17	10.55		12.00		4.00	Dhumbarahi	
18	11.02	2.85	9.00		3.00	Narayan GopalChowk	5.00
19	11.07	3.15	51.00	15.00	2.00	Basundhara	
20	11.13	1.75	15.00	2.00	3.00	Shamakhushi	
21	11.18		3.00		1.00	Gangabu	
22	11.20	0.55	27.00	6.00	3.00	Naya Bus Park	
23	11.23	4.55	27.00	3.00	6.00	MachhaPokhari	
24	11.36	0.65	21.00	2.00	5.00	Balaju	6.00
25	11.40		42.00	5.00	9.00	Vanasthali	
26	11.41	1.85	9.00	2.00	1.00	Sano Varang	
27	11.45	0.65	21.00	1.00	6.00	Swayambhu	
28	11.48	0.90	6.00		2.00	Bafal	
29	11.55		18.00	6.00		Kalanki	4.00
	2 hour 40 min	37.75	12.25	105.00	100.00		54.00

KareBinayak Mount Everest Transport service							
Anti-clockwise Direction							
Bus No. Ba 2 Kha		**5919**				**Initial Passenger on bus**	**8**
SN	**Travel Time**	**Waiting Time**	**PABT(sec)**	**In**	**Out**	**Destination**	**Jam**
1	12	6.50	30.00	10.00		Kalanki	
2	12.08		27.00	7.00	2.00	Rubiline	
3	12.25	5.80	12.00	2.00	2.00	Balkhu	15.00
4	12.33		6.00		2.00	Dhobighat	
5	12.38	0.90	6.00		2.00	Nakkhu	3.00
6	12.49	1.00	0.00			Akantakuna	8.00
7	12.53		15.00	2.00	3.00	Yatayat	1.00
8	12.55	2.80	12.00	1.00	3.00	MahaluxmiChowk	
9	1.03	3.85	9.00	2.00	1.00	Satdobato	2.00
10	1.13		12.00		4.00	BNB Hospital	3.00
11	1.2	2.35	39.00	6.00	7.00	Gwarko	5.00
12	1.27	0.90	6.00	2.00		Kharibot	2.00
13	1.3		12.00	1.00	3.00	Balkumari	
14	1.34		21.00	2.00	5.00	Bhatbhateni	2.00
15	1.41	1.40	36.00	7.00	5.00	Koteshwor	5.00
16	1.45	5.60	24.00	3.00	5.00	Gaurigau	
17	1.53	1.55	27.00	6.00	3.00	Sinamangal	
18	1.57	5.75	15.00	4.00	1.00	Airport	
19	2.08	4.50	30.00	7.00	3.00	Gausala	3.00
20	2.17		18.00	3.00	3.00	Mitra Park	2.00
21	2.21	3.45	33.00	5.00	6.00	Chabahil	2.00
22	2.29	0.60	24.00		8.00	Dhumbarahi	2.00
23	2.37	6.60	24.00	4.00	4.00	Narayan GopalChowk	5.00
24	2.46		9.00	2.00	1.00	Basundhara	
25	2.49	1.40	36.00	5.00	7.00	Shamakhushi	
26	2.58	1.80	12.00	2.00	2.00	Naya Bus Park	5.00
27	3.02		15.00	1.00	4.00	MachhaPokhari	
28	3.1	2.85	9.00	1.00	2.00	Balaju	6.00
29	3.15	3.75	15.00	3.00	2.00	Vanasthali	
30	3.21		15.00	1.00	4.00	Sano Varang	
31	3.24	5.75	15.00	5.00		Swayambhu	
32	3.32	0.50	30.00	5.00	5.00	Sitapaila	
33	3.4		36.00	6.00	6.00	Kalanki	3.00
	3 hour 40 min	66.50	10.50	105.00	105.00		74.00

KareBinayak Mount Everest Transport service							
Anti-clockwise Direction							
Bus No. Ba 2 Kha		**9440**				**Initial Passenger on bus**	**15**
SN	**Travel Time**	**Waiting Time**	**PABT(sec)**	**In**	**Out**	**Destination**	**Jam**
1	4	9.50	30.00	10.00		Kalanki	
2	4.12		9.00		3.00	Khasibaza	
3	4.13	0.85	9.00	1.00	2.00	Sitapetrol Pump	
4	4.23	2.35	39.00	5.00	8.00	Balkhu	6.00
5	4.33	1.70	18.00	3.00	3.00	Akantakuna	4.00
6	4.36		15.00		5.00	Yatayat	
7	4.43	1.35	39.00	5.00	8.00	Satdobato	5.00
8	4.47	0.80	12.00		4.00	BNB Hospital	
9	4.56	3.65	21.00	1.00	6.00	Gwarko	6.00
10	5.02		21.00	2.00	5.00	Kharibot	
11	5.08	0.85	9.00		3.00	Balkumari	4.00
12	5.13	1.60	24.00	8.00		Koteshwor	2.00
13	5.2		9.00		3.00	Tinkune	2.00
14	5.24	7.50	30.00	3.00	7.00	Gaurigau	
15	5.34	0.80	12.00	2.00	2.00	Sinamangal	
16	5.37		0.00			Airport	
17	5.39		21.00	6.00	1.00	Tilganga	
18	5.4	2.45	33.00	1.00	10.00	Gausala	3.00
19	5.48		3.00		1.00	Mitra Park	4.00
20	5.54	4.45	33.00	8.00	3.00	Chabahil	4.00
21	6.02		15.00	5.00		SukeDhara	
22	6.04		15.00	5.00		Dhumbarahi	
23	6.06		12.00		4.00	ChappalFactori	
24	6.15	1.70	18.00	4.00	2.00	Narayan GopalChowk	7.00
25	6.18	2.70	18.00		6.00	Basundhara	
26	6.23	0.95	3.00		1.00	Shamakhushi	
27	6.25	2.30	42.00	9.00	5.00	Gangabu	
28	6.33		9.00	3.00		Naya Bus Park	3.00
29	6.35	2.95	3.00		1.00	MachhaPokhari	
30	6.45	4.65	21.00	5.00	2.00	Balaju	4.00
31	6.52		3.00		1.00	Vanasthali	
32	6.55		9.00	2.00	1.00	Sano Varang	
33	6.57	0.05	57.00	8.00	11.00	Swayambhu	
34	7	1.90	6.00		2.00	Sitapaila	
35	7.07		36.00	7.00	5.00	Kalanki	3.00
	3 hour 7min	52.10	10.90	103.00	115.00		57.00

c) MicrosTravelling data of Inner Ring Road on Anticlockwise direction

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja **Initial Passenger on bus 1**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	9	5.65	21.00	7.00		Kalanki	
2	9.08		6.00		2.00	Bhatbhateni	
3	9.12	0.85	9.00	1.00	2.00	Khasibaza	3.00
4	9.14	1.70	18.00	4.00	2.00	Sitapetrol Pump	
5	9.25	1.85	9.00		3.00	Balkhu	6.00
6	9.34		27.00	2.00	7.00	Nakkhu	5.00
7	9.4	1.85	9.00	3.00		Akantakuna	4.00
8	9.43		6.00	1.00	1.00	Yatayat	
9	9.45	4.80	12.00	2.00	2.00	MahaluxmiChowk	
10	9.56	1.95	3.00		1.00	Satdobato	4.00
11	10.02		6.00		2.00	BNB Hospital	2.00
12	10.1	2.90	6.00	2.00		Gwarko	6.00
13	10.16	0.70	18.00	4.00	2.00	Balkumari	1.00
14	10.19		18.00		6.00	Bhatbhateni	
15	10.26	2.75	15.00	2.00	3.00	Koteshwor	5.00
16	10.32		12.00		4.00	Tinkune	1.00
17	10.35	3.85	9.00	3.00		Sinamangal	
18	10.41	1.85	9.00		3.00	Airport	
19	10.44		15.00	4.00	1.00	Tilganga	
20	10.5	2.90	6.00	2.00		Gausala	4.00
21	10.52		9.00	1.00	2.00	Mitra Park	2.00
22	11.01	3.75	15.00		5.00	Chabahil	7.00
23	11.07	0.75	15.00	5.00		SukeDhara	
24	11.13	2.90	6.00		2.00	Shamakhushi	2.00
25	11.19	0.85	9.00	2.00	1.00	Gangabu	1.00
26	11.26	2.95	3.00		1.00	Naya Bus Park	4.00
27	11.31	1.80	12.00	2.00	2.00	MachhaPokhari	1.00
28	11.41	0.70	18.00	3.00	3.00	Balaju	5.00
29	11.44		6.00	1.00	1.00	Vanasthali	
30	11.47	2.95	3.00		1.00	Swayambhu	
31	11.51	0.65	21.00	6.00	1.00	Sitapaila	
32	11.59		33.00	8.00	3.00	Kalanki	5.00
	2 hour 59 min	48.60	6.40	65.00	63.00		68.00

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja | **Initial Passenger on bus** **2**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	12.30	5.80	12.00	4.00		Kalanki	
2	12.45	0.65	21.00	3.00	4.00	Balkhu	5.00
3	12.48		9.00		3.00	Akantakuna	
4	12.53	2.80	12.00	3.00	1.00	Satdobato	1.00
5	12.58	1.85	9.00	1.00	2.00	BNB Hospital	
6	1.10	1.80	12.00	3.00	1.00	Gwarko	8.00
7	1.16		9.00		3.00	Kharibot	2.00
8	1.18	1.85	9.00	2.00	1.00	Balkumari	1.00
9	1.24	0.80	12.00	3.00	1.00	Koteshwor	2.00
10	1.26		3.00	1.00		Tinkune	
11	1.30	1.90	6.00	1.00	1.00	Sinamangal	1.00
12	1.33		6.00		2.00	Airport	
13	1.40	1.65	21.00	5.00	2.00	Gausala	5.00
14	1.45		6.00	2.00		Mitra Park	1.00
15	1.50	1.90	6.00		2.00	Chabahil	3.00
16	1.54	1.95	3.00		1.00	SukeDhara	
17	1.58		24.00	5.00	3.00	Dhumbarahi	
18	2.05		9.00	1.00	2.00	Narayan GopalChowk	5.00
19	2.07	4.75	15.00	3.00	2.00	Basundhara	
20	2.15	2.75	15.00	2.00	3.00	Shamakhushi	1.00
21	2.19		3.00		1.00	Gangabu	
22	2.22	4.95	3.00	1.00		Naya Bus Park	2.00
23	2.28	0.75	15.00	3.00	2.00	MachhaPokhari	
24	2.36	1.75	15.00	2.00	3.00	Balaju	5.00
25	2.40	0.95	3.00	1.00		Vanasthali	
26	2.43		6.00	1.00	1.00	Sano Varang	
27	2.45		15.00		5.00	Swayambhu	
28	2.47	1.00	0.00			Bafal	
29	2.50	2.85	9.00	3.00		Kalanki	1.00
Total=	**2 hour 20 min**	**41.20**	**4.80**	**50.00**	**46.00**		**43.00**

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja **Initial Passenger on bus** **6**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	3.3	6.85	9.00	3.00		Kalanki	
2	3.39		15.00		5.00	Khasibaza	
3	3.41	0.95	3.00	1.00		Sitapetrol Pump	1.00
4	3.5	3.55	27.00	5.00	4.00	Balkhu	5.00
5	3.55		6.00	1.00	1.00	Sanapa	
6	4.03	2.65	21.00	3.00	4.00	Akantakuna	5.00
7	4.08		6.00	2.00		Yatayat	1.00
8	4.15	4.70	18.00	1.00	5.00	MahaluxmiChowk	5.00
9	4.27	2.75	15.00	4.00	1.00	Satdobato	5.00
10	4.32		12.00		4.00	BNB Hospital	
11	4.43	3.85	9.00	2.00	1.00	Gwarko	9.00
12	4.49	1.70	18.00	1.00	5.00	Kharibot	
13	4.55		21.00	5.00	2.00	Balkumari	3.00
14	4.57	1.00	0.00			Bhatbhateni	
15	5.03	2.75	15.00	2.00	3.00	Koteshwor	3.00
16	5.1		6.00	2.00		Tinkune	2.00
17	5.12	5.90	6.00		2.00	Gaurigau	
18	5.21	0.90	6.00	1.00	1.00	Sinamangal	1.00
19	5.24		12.00	3.00	1.00	Airport	1.00
20	5.26	1.75	15.00	2.00	3.00	Tilganga	
21	5.32	2.95	3.00	1.00		Gausala	2.00
22	5.39	0.90	6.00		2.00	Jay Bageshwori	2.00
23	5.44	0.75	15.00		5.00	Mitra Park	3.00
24	5.52	2.90	6.00	2.00		Chabahil	5.00
25	5.57		6.00	1.00	1.00	SukeDhara	
26	6.05		15.00	4.00	1.00	Narayan GopalChowk	6.00
27	6.08	1.75	15.00		5.00	Shamakhushi	1.00
28	6.14	1.90	6.00	2.00		Gangabu	2.00
29	6.17		24.00	5.00	3.00	Naya Bus Park	
30	6.2	4.95	3.00	1.00		MachhaPokhari	
31	6.32	0.95	3.00		1.00	Balaju	5.00
32	6.35		6.00	1.00	1.00	Vanasthali	
33	6.37	1.85	9.00		3.00	DhungeDhara	
34	6.41	1.90	6.00	2.00		Sano Varang	
35	6.45	0.85	9.00	1.00	2.00	Swayambhu	
36	6.5	0.75	15.00	5.00		Sitapaila	2.00
37	7.01		9.00	2.00	1.00	Kalanki	3.00
	3 hour 31 min	59.40	6.60	65.00	67.00		72.00

d) Micros travelling data of Inner Ring Road on Clockwise direction

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja | **Initial Passenger on bus 4**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	9	4.85	9.00	3.00		Chabahil	
2	9.08		0.00			Mitra Park	4.00
3	9.1		6.00		2.00	Jay Bageshwori	
4	9.14	0.80	12.00	4.00		Gausala	1.00
5	9.16		18.00	3.00	3.00	Tilganga	
6	9.19	1.00	0.00			Airport	
7	9.23	0.60	24.00	2.00	6.00	Sinamangal	
8	9.25		9.00		3.00	Tinkune	
9	9.33	3.85	9.00	3.00		Koteshwor	3.00
10	9.42	0.75	15.00	3.00	2.00	Gwarko	3.00
11	9.44		9.00		3.00	BNB Hospital	1.00
12	9.51	1.90	6.00	2.00		Satdobato	2.00
13	9.53		9.00		3.00	MahaluxmiChowk	
14	9.55		12.00	1.00	3.00	Yatayat	
15	10	0.75	15.00	3.00	2.00	Akantakuna	2.00
16	10.03		6.00	1.00	1.00	Dhobighat	
17	10.07		6.00	2.00		Sanapa	
18	10.17	3.75	15.00	4.00	1.00	Balkhu	3.00
19	10.2		6.00		2.00	Sitapetrol Pump	
20	10.25	2.55	27.00	4.00	5.00	Kalanki	1.00
21	10.27		3.00	1.00		Bafal	
22	10.28		3.00		1.00	Sitapaila	
23	10.32	1.75	15.00	3.00	2.00	Swayambhu	
24	10.33		21.00	2.00	5.00	Sano Varang	
25	10.34		3.00		1.00	DhungeDhara	
26	10.37		9.00	3.00		Vanasthali	
27	10.4		3.00		1.00	MachhaPokhari	
28	10.47	1.75	15.00	3.00	2.00	Naya Bus Park	2.00
29	10.49		6.00	2.00		Shamakhushi	
30	10.51		9.00		3.00	Basundhara	
31	10.56	0.95	3.00		1.00	Narayan GopalChowk	2.00
32	10.57		18.00	5.00	1.00	Dhumbarahi	
33	11.01		6.00		2.00	SukeDhara	
34	11.03		30.00	7.00	3.00	Chabahil	
	2 hour 3 min	22.05	5.95	61.00	58.00		24.00

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja **Initial Passenger on bus 2**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	11.15	4.50	30.00	10.00		Chabahil	
2	11.26		3.00		1.00	Mitra Park	4.00
3	11.29		18.00	3.00	3.00	Jay Bageshwori	2.00
4	11.32	2.90	6.00	2.00		Gausala	1.00
5	11.37	2.75	15.00	1.00	4.00	Tilganga	
6	11.43	0.45	33.00	3.00	8.00	Airport	1.00
7	11.5	4.70	18.00	4.00	2.00	Sinamangal	
8	11.58		3.00		1.00	Tinkune	
9	12.07	4.75	15.00	2.00	3.00	Koteshwor	7.00
10	12.18		12.00	2.00	2.00	Balkumari	3.00
11	12.21	1.75	15.00	3.00	2.00	BNB Hospital	1.00
12	12.35	2.95	3.00		1.00	Satdobato	10.00
13	12.4	0.85	9.00	2.00	1.00	MahaluxmiChowk	
14	12.42		6.00		2.00	Yatayat	
15	12.48	2.85	9.00	2.00	1.00	Akantakuna	5.00
16	12.53		9.00	1.00	2.00	Dhobitghat	
17	1.03	9.85	9.00	1.00	2.00	Balkhu	7.00
18	1.16		9.00		3.00	Sitapetrol Pump	
19	1.23	2.85	9.00	2.00	1.00	Kalanki	5.00
20	1.28		6.00	1.00	1.00	Bafal	
21	1.29	4.90	6.00	1.00	1.00	Sitapaila	
22	1.35	1.70	18.00	4.00	2.00	Swayambhu	
23	1.39		3.00		1.00	Sano Varang	
24	1.41	1.65	21.00	5.00	2.00	DhungeDhara	
25	1.45	2.85	9.00	1.00	2.00	Vanasthali	
26	1.55		0.00			Balaju	5.00
26	1.57	0.75	15.00	3.00	2.00	MachhaPokhari	1.00
27	2.02	1.90	6.00	2.00		Naya Bus Park	2.00
28	2.06	0.75	15.00	3.00	2.00	Gangabu	
29	2.09		15.00	3.00	2.00	Shamakhushi	1.00
30	2.11	1.80	12.00	1.00	3.00	Basundhara	
31	2.25	1.95	3.00		1.00	Narayan GopalChowk	10.00
32	2.28	0.95	3.00	1.00		Dhumbarahi	
33	2.32		3.00		1.00	SukeDhara	
34	2.33		21.00	5.00	2.00	Gopi Krishna Fall	
35	2.4		12.00		4.00	Chabahil	4.00
	3 hour 25 min	85.35	6.65	68.00	65.00		69.00

Koteshwor Micro Transportation service

Clockwise Direction

Micro No. Ba 1 ja **Initial Passenger on bus 3**

SN	Travel Time	Waiting Time	PABT(sec)	In	Out	Destination	Jam
1	3	7.45	33.00	11.00		Chabahil	
2	3.14		3.00		1.00	Mitra Park	5.00
3	3.16	1.70	18.00	1.00	5.00	Gausala	
4	3.2	0.60	24.00	2.00	6.00	Tilganga	
5	3.26	0.85	9.00	1.00	2.00	Airport	2.00
6	3.28	2.70	18.00	5.00	1.00	Sinamangal	
7	3.34		6.00		2.00	Tinkune	
8	3.43	5.85	9.00	2.00	1.00	Koteshwor	7.00
9	3.57	1.90	6.00	2.00		Balkumari	5.00
10	4.03		6.00		2.00	Kharibot	3.00
11	4.1	2.75	15.00	5.00		Gwarko	5.00
12	4.21	1.75	15.00	3.00	2.00	Satdobato	5.00
13	4.25		9.00		3.00	MahaluxmiChowk	
14	4.32		15.00	4.00	1.00	Yatayat	5.00
15	4.43	0.90	6.00		2.00	Akantakuna	9.00
16	4.45	1.75	15.00	3.00	2.00	Nakkhu	
17	4.49		3.00	1.00		Sanapa	
18	5.03	5.85	9.00	2.00	1.00	Balkhu	12.00
19	5.12		6.00	1.00	1.00	Sitapetrol Pump	
20	5.15	0.95	3.00		1.00	Khasibaza	1.00
21	5.23	4.75	15.00	3.00	2.00	Kalanki	5.00
22	5.31		3.00	1.00		Sitapaila	
23	5.35	1.75	15.00	3.00	2.00	Swayambhu	2.00
24	5.39	0.95	3.00		1.00	Sano Varang	
25	5.47	2.80	12.00	1.00	3.00	DhungeDhara	5.00
26	5.52		6.00		2.00	Vanasthali	
27	5.59	2.95	3.00	1.00		Balaju	5.00
28	6.05	0.65	21.00	2.00	5.00	MachhaPokhari	1.00
29	6.07	1.90	6.00		2.00	Gangabu	
30	6.11		6.00		2.00	Shamakhushi	
31	6.13	2.85	9.00	2.00	1.00	Basundhara	
32	6.27	2.75	15.00	3.00	2.00	Narayan GopalChowk	9.00
33	6.32	0.95	3.00	1.00		SukeDhara	
34	6.35	1.75	15.00	2.00	3.00	Gopi Krishna Fall	
35	6.4		6.00		2.00	Chabahil	2.00
	3 hours 40 min	57.90	6.10	62.00	60.00		88.00

APPENDIX-B.

a) Comparison of Bus and Micro

Here analysis result of DEA model is as follows:

Results from DEAP Version 2.1

Instruction file = eg1-ins.txt

Data file = eg1-dta.txt

Output orientated DEA

Scale assumption: VRS

Slacks calculated using multi-stage method

EFFICIENCY SUMMARY:

Firm crstevrste scale

1 1.000 1.000 1.000 -

2 0.755 1.000 0.755 irs

mean 0.877 1.000 0.877

Note: crste = technical efficiency from CRS DEA

vrste = technical efficiency from VRS DEA

scale = scale efficiency = crste/vrste

Note also that all subsequent tables refer to VRS results

SUMMARY OF OUTPUT SLACKS:

Firm output: 1

1 0.000

2 0.000

Mean 0.000

SUMMARY OF INPUT SLACKS:

firm input:	1	2	3
1	0.000	0.000	0.000
2	0.000	0.000	0.000
Mean	0.000	0.000	0.000

SUMMARY OF PEERS:

firm peers:

1 1

2 2

SUMMARY OF PEER WEIGHTS:

(in same order as above)

firm peer weights:

1 1.000

2 1.000

PEER COUNT SUMMARY:

(i.e., no. times each firm is a peer for another)

firm peer count:

1 0

2 0

SUMMARY OF OUTPUT TARGETS:

firm output: 1

1 113.580

2 59.890

SUMMARY OF INPUT TARGETS:

firm input:	1	2	3
1	173.960	45.690	6.340
2	181.330	53.070	4.430

FIRM BY FIRM RESULTS:
Results for firm: 1
Technical efficiency = 1.000
Scale efficiency = 1.000 (crs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 113.580 0.000 0.000 113.580
input 1 173.960 0.000 0.000 173.960
input 2 45.690 0.000 0.000 45.690
input 3 6.340 0.000 0.000 6.340
LISTING OF PEERS:
peer lambda weight
1 1.000
Results for firm: 2
Technical efficiency = 1.000
Scale efficiency = 0.755 (irs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 59.890 0.000 0.000 59.890
input 1 181.330 0.000 0.000 181.330
input 2 53.070 0.000 0.000 53.070
input 3 4.430 0.000 0.000 4.430
LISTING OF PEERS:
peer lambda weight
2 1.000
3

b) Comparison of buses of transportation agencies

Here analysis result of DEA model is as follows:

Regression Statistics	
Multiple R	0.807980364
R Square	0.652832268
Adjusted R Square	0.566040335
Standard Error	0.046153849
Observations	6

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.016023	0.016022789	7.521808	0.051767
Residual	4	0.008521	0.002130178		
Total	5	0.024544			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	
Intercept	0.368118008	0.195392	1.88400072	0.132667	-0.17438	0.910612	-0.17	
X	0.004696298	0.001712	2.742591501	0.051767	-5.8E-05	0.009451	-5.8E	

PROBABILITY OUTPUT

Percentile	y
8.333333	0.832
25	0.832
41.66667	0.874
58.33333	0.903
75	0.968
91.66667	1

SUMMARY OUTPUT

From DEAP Version 2.1
Instruction file = eg1-ins.txt
Data file = eg1-dta.txt
Output orientated DEA
Scale assumption: VRS
Slacks calculated using multi-stage method
EFFICIENCY SUMMARY:

firm	crstevrste		scale
1	0.710	0.787	0.903 drs
2	0.874	1.000	0.874 irs
3	0.635	0.763	0.832 drs
4	0.673	0.809	0.832 drs
5	0.812	0.839	0.968 drs
6	1.000	1.000	1.000 -
mean	0.784	0.866	0.901

Note: crste = technical efficiency from CRS DEA
vrste = technical efficiency from VRS DEA
scale = scale efficiency = crste/vrste
Note also that all subsequent tables refer to VRS results
SUMMARY OF OUTPUT SLACKS:

firm output:	1
1	0.000
2	0.000
3	0.000
4	0.000
5	0.000
6	0.000
Mean	0.000

SUMMARY OF INPUT SLACKS:

firm input:	1	2	3
1	44.170	4.050	1.820
2	0.000	0.000	0.000
3	63.000	9.210	1.160
4	72.830	11.690	1.160
5	85.330	21.500	0.190
6	0.000	0.000	0.000
mean	44.222	7.742	0.722

SUMMARY OF PEERS:

firm	peers:
1	6
2	2
3	6
4	6
5	6
6	6

SUMMARY OF PEER WEIGHTS:
(in same order as above)

firm	peer weights:
1	1.000
2	1.000
3	1.000
4	1.000
5	1.000
6	1.000

PEER COUNT SUMMARY:
(i.e., no. times each firm is a peer for another)

firm	peer count:
1	0
2	0
3	0
4	0
5	0
6	4

SUMMARY OF OUTPUT TARGETS

firm	output: 1
1	137.000
2	106.200
3	137.000
4	137.000
5	137.000
6	137.000

SUMMARY OF INPUT TARGETS:

firm	input: 1	2	3
1	121.000	37.500	5.730
2	173.400	40.180	5.080
3	121.000	37.500	5.730
4	121.000	37.500	5.730
5	121.000	37.500	5.730
6	121.000	37.500	5.730

FIRM BY FIRM RESULTS:
Results for firm: 1
Technical efficiency = 0.787
Scale efficiency = 0.903 (drs)
PROJECTION SUMMARY:

variable original radial slack projected
value movement movement value
output 1 107.830 29.170 0.000 137.000
input 1 165.170 0.000 -44.170 121.000
input 2 41.550 0.000 -4.050 37.500
input 3 7.550 0.000 -1.820 5.730
LISTING OF PEERS:
peer lambda weight
6 1.000
Results for firm: 2
Technical efficiency = 1.000
Scale efficiency = 0.874 (irs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 106.200 0.000 0.000 106.200
input 1 173.400 0.000 0.000 173.400
input 2 40.180 0.000 0.000 40.180
input 3 5.080 0.000 0.000 5.080
LISTING OF PEERS:
peer lambda weight
2 1.000
Results for firm: 3
Technical efficiency = 0.763
Scale efficiency = 0.832 (drs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 104.580 32.420 0.000 137.000
input 1 184.000 0.000 -63.000 121.000
input 2 46.710 0.000 -9.210 37.500
input 3 6.890 0.000 -1.160 5.730
LISTING OF PEERS:
peer lambda weight
6 1.000
Results for firm: 4
Technical efficiency = 0.809
Scale efficiency = 0.832 (drs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 110.830 26.170 0.000 137.000
input 1 193.830 0.000 -72.830 121.000
input 2 49.190 0.000 -11.690 37.500
input 3 6.890 0.000 -1.160 5.730
LISTING OF PEERS:
peer lambda weight
6 1.000
Results for firm: 5
Technical efficiency = 0.839

Scale efficiency = 0.968 (drs)
PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	115.000	22.000	0.000	137.000
input	1	206.330	0.000	-85.330	121.000
input	2	59.000	0.000	-21.500	37.500
input	3	5.920	0.000	-0.190	5.730

LISTING OF PEERS:
peer lambda weight
6 1.000

Results for firm: 6
Technical efficiency = 1.000
Scale efficiency = 1.000 (crs)
PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	137.000	0.000	0.000	137.000
input	1	121.000	0.000	0.000	121.000
input	2	37.500	0.000	0.000	37.500
input	3	5.730	0.000	0.000	5.730

LISTING OF PEERS:
peer lambda weight
6 1.000

c) Comparison of MahanagarYatayat, Buses and Micros

Thus the result obtains from the DEA model which shows that Mahan agar is more efficient than other bus and micro transportation service.

SUMMARYOUTPUT

Regression Statistics	
Multiple R	0.993626364
R Square	0.98729335
Adjusted R Square	0.974586701
Standard Error	0.035957648
Observations	3

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.100461	0.100461	77.69895116	0.071915
Residual	1	0.001293	0.001293		
Total	2	0.101754			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.231624829	0.069578	3.328983	0.185776132	-0.65245	1.1157
X	0.005743122	0.000652	8.814701	0.071915036	-0.00254	0.0140

Results from DEAP Version 2.1
Instruction file = eg1-ins.txt
Data file = eg1-dta.txt
Output orientated DEA
Scale assumption: VRS
Slacks calculated using multi-stage method
EFFICIENCY SUMMARY:

firm	crstevrste		scale	
1	0.565	1.000	0.565	irs
2	0.704	0.795	0.886	drs
3	1.000	1.000	1.000	-
mean	0.756	0.932	0.81	

Note: crste = technical efficiency from CRS DEA
vrste = technical efficiency from VRS DEA
scale = scale efficiency = crste/vrste
Note also that all subsequent tables refer to VRS results
SUMMARY OF OUTPUT SLACKS:

firm	output: 1
1	0.000
2	0.000
3	0.00
mean	0.000

SUMMARY OF INPUT SLACKS:

firm	input: 1	2	3
1	0.000	0.000	0.000
2	63.550	9.830	0.740
3	0.000	0.000	0.000
mean	21.183	3.277	0.247

SUMMARY OF PEERS:

firm	peers:
1	1
2	3
3	3

SUMMARY OF PEER WEIGHTS:
(in same order as above

firm	peer weights:
1	1.000
2	1.000
3	1.000

PEER COUNT SUMMARY:
(i.e., no. times each firm is a peer for another)

firm	peer count:
1	0
2	0
3	1

SUMMARY OF OUTPUT TARGETS:

firm	output: 1
1	59.889
2	137.000

3 137.000

SUMMARY OF INPUT TARGETS:

firm input: 1 2 3

1 181.330 53.070 4.430

2 121.000 37.500 5.730

3 121.000 37.500 5.730

FIRM BY FIRM RESULTS:

Results for firm: 1

Technical efficiency = 1.000

Scale efficiency = 0.565 (irs)

PROJECTION SUMMARY:

variable original radial slack projected

value movement movement value

output 1 59.889 0.000 0.000 59.889

input 1 181.330 0.000 0.000 181.330

input 2 53.070 0.000 0.000 53.070

input 3 4.430 0.000 0.000 4.430

LISTING OF PEERS:

peer lambda weight

1 1.000

Results for firm: 2

Technical efficiency = 0.795

Scale efficiency = 0.886 (drs)

PROJECTION SUMMARY:

variable original radial slack projected

value movement movement value

output 1 108.890 28.110 0.000 137.000

input 1 184.550 0.000 -63.550 121.000

input 2 47.330 0.000 -9.830 37.500

input 3 6.470 0.000 -0.740 5.730

LISTING OF PEERS:

peer lambda weight

3 1.000

Results for firm: 3

Technical efficiency = 1.000

Scale efficiency = 1.000 (crs)

PROJECTION SUMMARY:

variable original radial slack projected

value movement movement value

output 1 137.000 0.000 0.000 137.000

input 1 121.000 0.000 0.000 121.000

input 2 37.500 0.000 0.000 37.500

input 3 5.730 0.000 0.000 5.730

LISTING OF PEERS:

peer lambda weight

2 1.000

d) Result obtain comparison of Micros of transportation agencies

Results from DEAP Version 2.1

Instruction file = eg1-ins.txt

Data file = eg1-dta.txt

Output orientated DEA

EFFICIENCY SUMMARY:

firm	crstevrste		scale	
1	1.000	1.000	1.000	-
2	1.000	1.000	1.000	-
3	0.996	1.000	0.996	drs
mean	0.999	1.000	0.999	

Note: crste = technical efficiency from CRS DEA
vrste = technical efficiency from VRS DEA
scale = scale efficiency = crste/vrste
Note also that all subsequent tables refer to VRS results

SUMMARY OF OUTPUT SLACKS:

firm output:	1
1	0.000
2	0.000
3	0.000
mean	0.000

SUMMARY OF INPUT SLACKS:

firm input:	1	2	3	4	5	6
1	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000
3	7.000	0.000	500.000	1000.000	200.000	100.000
mean	2.333	0.000	166.667	333.333	66.667	33.333

SUMMARY OF PEERS:

firm	peers:	
1	1	
2	2	
3	2	1

SUMMARY OF PEER WEIGHTS:
(in same order as above)

firm	peer weights:	
1	1.000	
2	1.000	
3	0.800	0.200

PEER COUNT SUMMARY:
i.e., no. times each firm is a peer for another)

firm	peer count:
1	1
2	1
3	0

SUMMARY OF OUTPUT TARGETS:

firm output:	1
1	135000.000
2	146250.000
3	144000.000

SUMMARY OF INPUT TARGETS:

firm input:	1	2	3	4	5	6
1	70.000	21500.000	4500.000	45000.000	4000.000	3500.000
2	30.000	24000.000	4500.000	45000.000	5000.000	4000.000
3	38.000	23500.000	4500.000	45000.000	4800.000	3900.000

FIRM BY FIRM RESULTS:
Results for firm: 1
Technical efficiency = 1.000
Scale efficiency = 1.000 (crs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 135000.000 0.000 0.000 135000.000
input 1 70.000 0.000 0.000 70.000
input 2 21500.000 0.000 0.000 21500.000
input 3 4500.000 0.000 0.000 4500.000
input 4 45000.000 0.000 0.000 45000.000
input 5 4000.000 0.000 0.000 4000.000
input 6 3500.000 0.000 0.000 3500.000
LISTING OF PEERS:
peer lambda weight
1 1.000
Results for firm: 2
Technical efficiency = 1.000
Scale efficiency = 1.000 (crs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
outpu1 146250.000 0.000 0.000 146250.000
input 1 30.000 0.000 0.000 30.000
input 2 24000.000 0.000 0.000 24000.000
input 3 4500.000 0.000 0.000 4500.000
input 4 45000.000 0.000 0.000 45000.000
input 5 5000.000 0.000 0.000 5000.000
input 6 4000.000 0.000 0.000 4000.000
LISTING OF PEERS:
peer lambda weight
2 1.000
Results for firm: 3
Technical efficiency = 1.000
Scale efficiency = 0.996 (drs)
PROJECTION SUMMARY:
variable original radial slack projected
value movement movement value
output 1 144000.000 0.000 0.000 144000.000
input 1 45.000 0.000 -7.000 38.000
2 23500.000 0.000 0.000 23500.000
input 3 5000.000 0.000 -500.000 4500.000
input 4 46000.000 0.000 -1000.000 45000.000
5 5000.000 0.000 -200.000 4800.000
input 6 4000.000 0.000 -100.000 3900.000
LISTING OF PEERS:
peer lambda weight
2 0.800
1 0.200

APPENDIX C

Hi, I am a student of Tribhuvan University and I am conducting this survey to analysis of the variability of user's behavior and their level of satisfaction from the use of transit systems. This survey is conduct for to find out the satisfaction level of the Inner Ring Road. I kindly request you to fill the questionnaire and provide necessary information.

Customer Survey Questionnaire

1. What age group are you in?
   15- 29 ☐ 30- 45 ☐ 45 – 60 ☐ ☐ >60

2. What is the main purpose of your journey today? *Please tick one box*
   Business ☐ Job ☐ elaxation ☐
   Education ☐ Shopping ☐ Other ☐

3. What is the most important reason you ride public transportation?
   a) Cheaper than driving car ☐ d) Saves wear and tear on car ☐
   b) No car available/do not drive ☐ e) Good for environment ☐
   c) Avoid traffic rules & regulation ☐ f) Avoid parking ☐

4. Which problems discourage you from using the Public Transportation?
   Delay ☐ Crowdedness ☐ Lack of seat ☐
   Poor treatment by operator ☐

5. What factors that will decrease your comfort outside the public transportation?
   Long waiting ☐ Security ☐ other ☐
   Lack of bus shade ☐ Lack of schedule ☐

6. Which mode often you used?
   Micro ☐ Bus ☐

7. What is the reason behind choosing the most often used public transport mode
   (a) Speed ☐
   (b) Comfort ☐
   (c) Journey Time ☐
   (d) Reliability ☐
   (e) Other ☐

8. How long do you wait for the public transport mode at the bus stop?
   Less than 1min ☐ 5-15 min ☐ more than 15 min ☐
   1-5 min ☐

9. Are you satisfied with the service provided at the fare?

Strongly agree ☐ Agree ☐ Disagree ☐
Neutral ☐ Strongly disagree ☐

10. How is the quality of the bus stops and shelters provided? 1 (high satisfaction) to 5 (low satisfaction)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

11. What percentage willing you pay for the better improvement in public transportation?

☐ < 5% ☐ 5-10 % ☐ 10-15 % ☐ >15 %

12. Have you travel in Mahnagar Yatayat?

If yes

- After Introduction of MahanagarYatayat, has the bus service reliability increased?

YES ☐ NO ☐

- Do you think that the waiting time and travel time at bus stops is decreased after transit service improvements?

YES ☐ NO ☐

13. How satisfied are you with this service provided by bus?

Please rate each one from 1 (high satisfaction) to 5 (low satisfaction)

a) Comfort	1☐ 2 ☐3 ☐4 ☐ 5☐
b) Cleanliness of the services	1☐ 2 ☐3 ☐4 ☐ 5☐
c) Frequency/reliability of services	1☐ 2 ☐3 ☐4 ☐ 5☐
d) Access for various disable person	1☐ 2 ☐3 ☐4 ☐ 5☐
e)Availability of timetable/route information	1☐ 2 ☐3 ☐4 ☐ 5☐
f) Seating Arrangement/Space for standing	1☐ 2 ☐3 ☐4 ☐ 5☐
g) Seat availability/over-crowding	1☐ 2 ☐3 ☐4 ☐ 5☐
h) Speed	1☐ 2 ☐3 ☐4 ☐ 5☐
i) Conductor behavior	1☐ 2 ☐3 ☐4 ☐ 5☐
j) How easy to get on and off services	1☐ 2 ☐3 ☐4 ☐ 5☐

14. How satisfied are you with this service provided by micro?

Please rate each one from 1 (high satisfaction) to 5 (low satisfaction)

a) Comfort	1☐ 2 ☐3 ☐4 ☐ 5☐
b) Cleanliness of the services	1☐ 2 ☐3 ☐4 ☐ 5☐
c) Frequency/reliability of services	1☐ 2 ☐3 ☐4 ☐ 5☐
d) Access for various disable person	1☐ 2 ☐3 ☐4 ☐ 5☐
e)Availability of timetable/route information	1☐ 2 ☐3 ☐4 ☐ 5☐
f) Seating Arrangement/Space for standing	1☐ 2 ☐3 ☐4 ☐ 5☐
g) Seat availability/over-crowding	1☐ 2 ☐3 ☐4 ☐ 5☐
h) Speed	1☐ 2 ☐3 ☐4 ☐ 5☐
i) Conductor behavior	1☐ 2 ☐3 ☐4 ☐ 5☐
j) How easy to get on and off services	1☐ 2 ☐3 ☐4 ☐ 5☐