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# Passengers Satisfaction and Operational Performance Analysis of Public Transportation Service in Lamachour Chhorepatan Route of Pokhara

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**Abstract**
This study investigates the passengers' satisfaction and operational performance of the public transportation system in Lamachour Chhorepatan route in Pokhara. The Passengers' satisfaction is studied on the basis of questionnaire survey using 13 different sets of indicators. The results thus obtained from questionnaire survey was analyzed with the help of SPSS software.
Similarly, the operational performance is evaluated from a productive efficiency point of view. Effectiveness and Efficiency is measured using Data Envelopment Analysis (DEA) based on selected input (travel time, waiting time, running speed and number of stops and output (daily ridership and vehicle kilometer) variables.

**Keywords**
Public Transportation, Operational Performance, Passengers Satisfaction, DEA model, SPSS

## 1. Introduction

An efficient public transportation system is required for urban areas in developing countries like Nepal to reduce the problems of degrading environment, traffic congestion and poor level of service. Among the various modes of transportation, bus transit is the most sought after because of its door to door service, operational flexibility and cheap affordability.

Passenger satisfaction with public transport is defined as the degree to which an individual positively evaluates the overall quality of a public transport service.Passenger's perception towards public transportation must be assessed to evaluate the existing status. It also helps to recommend the improvement measures.The goal of public transport operators and authorities is to increase Passenger satisfaction and cost efficiency.Passenger satisfaction indicators that affect the reliability of the public transport system, travel time, speed, security, delays, travel expenses.[1] Research on passenger satisfaction of public transport has been carried out by a variety of indicators or variables. Indicator of travel time, frequency, and reliability of public transport fare, network coverage/distance to stop the vehicle[2], indicators of comfort and cleanliness of the vehicle[3] and safety indicators [4],[5]were used in various studies. Urban transport systems are faced with the challenge of improving the performance of public transport in line with expectations or interests of public transport passengers.

Similarly, performance of public buses at present scenario has to be evaluated. It is important to seek optimal solutions to operation parameters of public transits (such as frequencies, schedules) without jeopardizing the necessities of operation (meeting demands while achieving the highest level of consumer satisfaction). Balancing both sides of demand and supply issues is not an easy task and usually entails reduction of service quality to attain more reasonable level of expenditure.That is minimizing operation and maintenance cost (input) usually comes at the expenses of reduction in ridership. Also maximizing throughout (ridership) is usually associated with higher operational cost.Action has to be taken to introduce high efficiency public transportation mode that would better serve passenger while low efficiency mode of transport usage has to be discouraged with effective policy.

While evaluating the performance in the

transportation sector, it is worth noting that, unlike the production and consumption processes of the manufacturing sector, a transportation service cannot be stored, and therefore the output consumed, such as passenger-km, may vary considerably from the output produced, such as vehicle-km, in a transportation system. If the produced output is not consumed, it is lost (e.g., if a bus runs during the period at half capacity, the bus system cannot store the other half of its inventory)[6]. The consumed services occur concurrently with the produced services.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[7].A number of output variables such as vehicle kilometers, seating capacity, service hours, number of passengers, and average age of the fleets was used to evaluate bus service performance of Spanish transport systems.[8] Chu, Fielding and Lamar[9] developed a single index for measuring service efficiency as well as service satisfaction level of public transit agencies using DEA. Barnum et al. [10] evaluated the performances of 46 bus routes of U.S. transit systems using the DEA method.

## 2. Research Objective

The main objective of this study is to investigate the passenger satisfaction level and operational performance of public transportation in Lamachour Chhorepatan Route of Pokhara. The specific objectievs are:

- To find out the passenger satisfaction level towards public transportation in Lamachour Chhorepatan Route of Pokhara.
- To develop a model and measure the operational performance of public transit plying in this route.

## 3. Methodology

### 3.1 Study Area

Pokhara Metropolitan city is the largest metropolitan city of the country with an area of 464.34 sq. km. According to CBS 2011, the population of Pokhara city is 414,141 and this population is supposed to increase in a drastic manner. Pokhara has annual population growth rate of 5.6 percent. At present, 45 percent population of Pokhara use private vehicle. The study route consists of Lamachour- Chhorepatan (one of the longest route covering major city centers from North to South). The total length of this route is 11.5 Km and covers almost all the major city centers where there is maximum passengers flow and is one of the busiest route.Two private companies are operating the public transportation in this route viz. Pokhara Bus Bewasai Samiti (PBBS) and Bindhyabasini Bus Bewasai Samiti (BBBS). So, this study is focused in studying the Passengers' satisfaction as well as the performance analysis of these bus operators in this route.

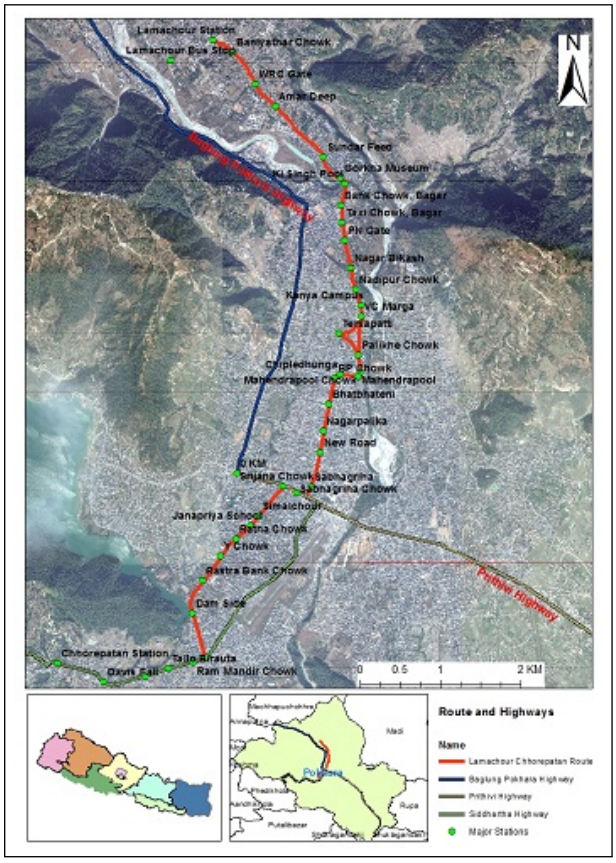


**Figure 1:** Study Area: Lamachour Chhorepatan Route

### 3.2 Data Collection

Primary and secondary data have been collected for the study.

#### 3.2.1 Primary Data Collection

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 are:

- Satisfaction Survey (Questionnaire Survey)
- On Board Survey

In order to visualize the people perception towards public transportation, 384 data were collected for the satisfaction level assessment between two bus service providers. Structured questionnaire survey has been carried out to the public transportation Passenger within the Lamachour Chhorepatan Route. The questionnaire survey has been collected from the passenger using the public transportation services within this route, either by collecting at station or during the trip.

For On Board Survey, 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 route is noted down.The trips were made at different course of time in each direction. Thirty six sets of data from two bus service providers, covering morning peak (9 AM – 11AM), evening peak (4 PM-6 PM) and off peak (1:30 PM- 3:30 PM) was collected during the study.

#### 3.2.2 Secondary Data Collection

Secondary data like number of vehicles operated by the operators in this route, their time tables, vehicular composition, public vehicle route and their frequency, passenger travel trip demand, was collected from these bus operators plying on this route.

## 4. Data Analysis

The obtained data have been processed for two major objectives: satisfaction level assessment and Performance assessment. Questionnaire survey is used for satisfaction level assessment, whereas on board survey along with major primary data has been assessed for efficiency assessment. SPSS model has been used to materialize the people perception level towards public transportation and DEA model is used for assessment of performance.

### 4.1 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 (H0): There is not any difference between the satisfaction levels of both the company buses for specified service/performance indicator.

Alternative Hypothesis (Ha): There is any difference between the satisfaction levels of both the company buses for specified service/performance indicator.

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

### 4.2 DEA based Performance Analysis

DEA model is used to find out the performance of public transportation and for this purpose four input variables and two output variables as summarized in Table 1. Based on the types of input and output variables, two approaches were identified in the literature to use DEA to measure the performance of a transit system viz. efficiency and effectiveness.

**Table 1:** Inputs and Outputs used for DEA model

| SN | Input Variables | Output Variables |
|---|---|---|
| 1 | Total travel time of vehicle in one round (minute) | Total no. of passengers per trip (Effectiveness) |
| 2 | Running Speed (m/s) | Vehicle KM (Efficiency) |
| 3 | Waiting time at station (minute) | |
| 4 | Number of Stations | |

The basic methodology adopted during the study is the setup of various input and output variables. Waiting time, running speed, travel time per trip and

number of stops were selected as the input variables based on literature and the research objective; whereas the average passenger in and out per trip and vehicle km has been selected as output variables. The waiting time at station has a positive impact on the passenger boarding and aligtning; as higher waiting time may leads to high passenger. Similarly, higher running speed leads to less number of average passenger patronage per trip. Higher travel time leads to less satisfaction towards that mode and hence results in less efficiency. Also number of stations in the route too affect the passengers patronage.There is an 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.

## 5. Results and Discussion

### 5.1 Passengers Satisfaction Assessment

Data obtained were checked for the statistical significance with 95 percent level of confidence. SPSS model was used to analyze the satisfaction level based on the data collected. For higher satisfaction level, a value of 5 was given whereas for low satisfaction a value of 1 was given.A value of 2.5 is taken as the average. When the value obtained for the particular types of service is less than 2.5, the service provided is said to be unsatisfactory whereas if the mean is greater than 2.5, the service provided is said to be satisfactory. Thirteen different parameters were chosen as shown in Figure 2 for the satisfaction study of the two public company buses operating in Pokhara. Here, it can be observed that for PBBS it is found that passengers are satisfied with indicators like, availability, frequency, timetable, network, seat comfort, journey time and safety. But for BBBS, passengers are satisfied with cleanliness, seat availability, seat comfort, standing space, behavior of operators, journey time and safety. For both the operators it is found that passengers are unsatisfied with ease of entering and existing and waiting time.

Similarly, different perspective view given by the passenger toward the satisfaction criteria was also analysed. About 59 percent of the Passengers chose Pokhara Nagar Bus as their preference while remaining chose Bindhyabasini Bus as their preference, as shown in Figure 3. Similarly, Figure 4, shows the obstructing factors that reduces the reliability of Public Transportation. According to the Passengers, Delay and crowdedness accounts for about 29 and 27 percent each and Long waiting also accounts for 17 percent and similarly other factors like Lack of seat, No door to door service and poor treatment by the operators accounts for 5,5 and 3 percent each. Similarly, Figure 5 shows the satisfaction level of passengers with the fare. 35 percent of Passengers agree with this current fare while 31 percent disagree with it and 30 percent remains neutral and 4 percent disagree with this current fare. Figure, 6 shows that about 52 percent of the Passengers are willing to pay 5 percent more while 29 percent are willing to pay 5-10 percent more in their current fare if better facilities are provided. Also 14 percent passengers are willing to pay 10-15 percent extra while only 5 percent are willing to pay more than 15 percent extra fare if better facilities are provided.

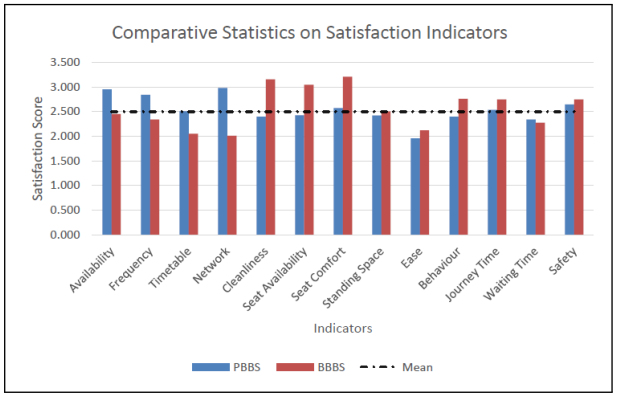


**Figure 2:** Comparative Statistics on Satisfaction Indicators

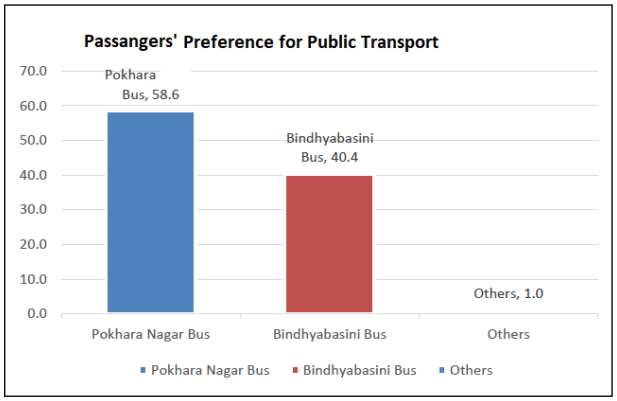


**Figure 3:** Passengers' Preference for Public transportation

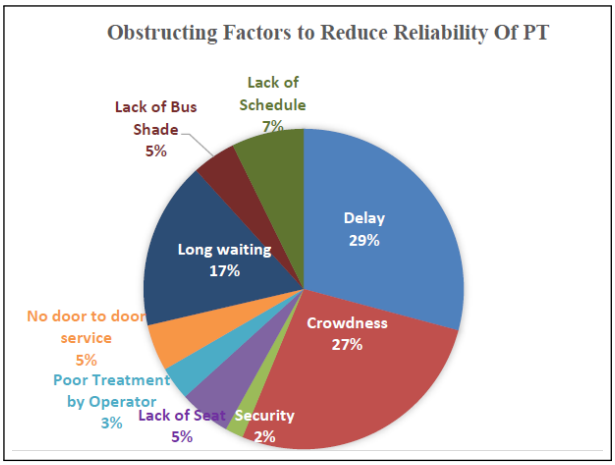


**Figure 4:** Obstructing Factors to reduce Reliability on Public transportation

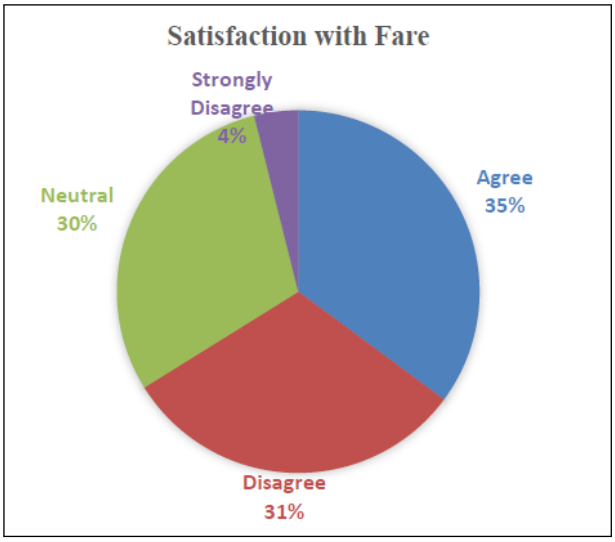


**Figure 5:** Satisfaction with Current Fare

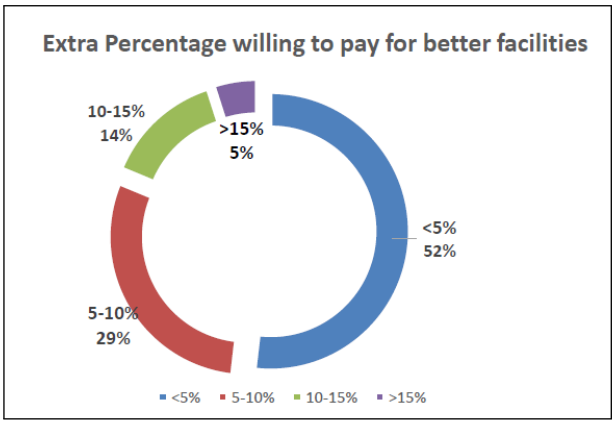


**Figure 6:** Extra percentage of fare willing to pay for better facilities

## 5.2 On Board Survey Analysis

For this study, based on the total length of this route, total travel time and delay, average journey speed and running speed has been calculated. Similarly, based on the on board survey all the input parameter have been averaged to come with the summarization of all the input variables and have been tabulated.

**Table 2:** Summary of On Board Survey Data for Lamachour Chhorepatan Route

| Route Length = 11.5 Km | | | |
|---|---|---|---|
| Number of Stops = 35 | | | |
| S. N | Parameters | Pokhara Bus | Bindhyabasini Bus |
| 1 | Travel Time (min) | 65.07 | 66.27 |
| 2 | Waiting Time (min) | 19.37 | 19.88 |
| 3 | PABT (min) | 4.52 | 5.46 |
| 4 | Number of Passengers | 53.33 | 52.67 |
| 5 | Journey Speed (kmph) | 10.62 | 10.42 |
| 6 | Running Speed (kmph) | 16.84 | 14.9 |

PABT = Passanger Alighting and Boarding Time

**Table 3:** Summary of On Board Survey Data for Chhorepatan Lamachour Route

| Route Length = 12.15 Km | | | |
|---|---|---|---|
| Number of Stops = 35 | | | |
| S. N | Parameters | Pokhara Bus | Bindhyabasini Bus |
| 1 | Travel Time (min) | 74.5 | 71.7 |
| 2 | Waiting Time (min) | 30.34 | 20.78 |
| 3 | PABT (min) | 6.73 | 6.22 |
| 4 | Number of Passengers | 69.67 | 62.67 |
| 5 | Journey Speed (kmph) | 9.79 | 10.18 |
| 6 | Running Speed (kmph) | 16.8 | 14.34 |

## 5.3 Performance Analysis

DEA-Solver-Learning Version (V8) is used in order to compute the efficiency and effectiveness of the two

bus operators from the obtained inputs and outputs. The Excel based DEA Solver was run for four different cases: two for Lamachour Chhorepatan route to compute the efficiency and effectiveness each and two for Chhorepatan Lamachour route. If the output variable reflects the efficiency measure (vehicle-kilometers), then the DEA is actually evaluating the "efficiency" of the system. If the output reflects the effectiveness measure (total number of passengers per day), then the DEA is actually evaluating the "effectiveness" of a system.

#### 5.3.1 Effectiveness Analysis

Effectiveness examines the relationship between produced outputs and consumed service or how well a service offered by operators is consumed by a community. This means that not all of the service offered (measured by vehicle-km, no. of passengers) would be used by a community. If the public transit attracts more passengers without increasing service, or reduces service but still serves a similar number of passengers, effectiveness will be more.[11]

**Table 4:** Results of Effectiveness Analysis on Lamachour Chhorepatan Route

| | Travel Time | Waiting Time | Running Speed | Stops | Passangers |
|---|---|---|---|---|---|
| Max | 66.27 | 19.87 | 16.84 | 35 | 53.33 |
| Min | 65.07 | 19.36 | 14.89 | 35 | 52.67 |
| Average | 65.67 | 19.615 | 15.865 | 35 | 53 |
| SD | 0.6 | 0.255 | 0.975 | 0 | 0.33 |
| Correlation | | | | | |
| | Travel Time | Waiting Time | Running Speed | Stops | Passangers |
| Travel Time | 1 | 1 | -1 | 0 | -1 |
| Waiting Time | 1 | 1 | -1 | 0 | -1 |
| Running Speed | -1 | -1 | 1 | 0 | 1 |
| Stops | 0 | 0 | 0 | 1 | 0 |
| Passangers | -1 | -1 | 1 | 0 | 1 |

No. of Efficient DMUs = 2
No. of Inefficient DMUs = 0

#### 5.3.2 Efficiency Analysis

Efficiency represents the process through which service inputs are transformed into outputs. This means that a transit agency invests capital in vehicles, fuels, information system, maintenance and other operational inputs. This investment produces a certain service for a community such as vehicle-km, seat-km, and seat-hours (outputs). An agency is considered efficient if it can reduce inputs to produce a fixed amount of outputs, or increase outputs while using similar or fewer inputs[11]. Similarly, the term efficiency refers to the comparison between the real or observed values of output(s) and input(s) with the optimal values of input(s) and output(s) used in a production process. Efficiency captures the degree to which, bus operators for example attain maximum output (vehicle-miles or passenger boarding) with given inputs (labor, fuel, capital), or the minimum level of input that can be used to produce a given level of output.[6]

**Table 5:** Results of Efficiency Analysis on Lamachour Chhorepatan Route

| | Travel Time | Waiting Time | Running Speed | Stops | Veh.Km |
|---|---|---|---|---|---|
| Max | 66.27 | 19.87 | 16.84 | 35 | 11.5 |
| Min | 65.07 | 19.36 | 14.89 | 35 | 11.5 |
| Average | 65.67 | 19.615 | 15.865 | 35 | 11.5 |
| SD | 0.6 | 0.255 | 0.975 | 0 | 0 |
| Correlation | | | | | |
| | Travel Time | Waiting Time | Running Speed | Stops | Veh.Km |
| Travel Time | 1 | 1 | -1 | 0 | 1 |
| Waiting Time | 1 | 1 | -1 | 0 | -1 |
| Running Speed | -1 | -1 | 1 | 0 | 1 |
| Stops | 0 | 0 | 0 | 1 | 0 |
| Veh.Km | 1 | -1 | 1 | 0 | 1 |

No. of Efficient DMUs = 2
No. of Inefficient DMUs = 0

#### 5.3.3 Discussion on Performance (Effectiveness and Efficiency)

Output based BCC-O model was run in DEA-Solver LV 8.0 with two DMUs as PBBS and BBBS and the results is as shown in Table 4. It is obtained that the output (i.e Number of Passengers) has perfect negative correlation with inputs: Travel time and Waiting time whereas Running Speed is perfectly positive correlated while number of Stops has no correlation with the output. Also from Table 5 it is obtained that the output (i.e Vehicle Km) has perfect positive correlation with inputs: Travel time and

Running Spped whereas Waiting Time is perfectly negative correlated while number of Stops has no correlation with the output.

Thus, it can be observed that on comparing 2 DMUs (Decision Making Units), i.e. Pokhara Bus Bewasai Samiti and Bindhyabasini Bus Bewasai Samiti, the efficiency and effectiveness value is obtained to be 1. Since, there is no any benchmark available to take as a reference, so both the DMUs are effective as well as efficient.

## 6. Conclusion

From Passenger Satisfaction Assessment it is obtained that in reference to availability of service, frequency of service, time table/ route information and Network coverage, it is statistically better in Pokhara Nagar Bus services compare to Bindhyabasini Bus. Similarly, in reference to seat availability/ crowding, seat comfort and staff behavior Passengers are relatively more satisfied with Bindhyabasini Bus. But, there is not any difference in service provided by both the bus in terms of other six categories. This type of study should be carried out time and often because satisfaction is qualitative and depend upon one's perception.

From the on board survey method, the operational characteristics of both the service provider was collected. The average travel time, waiting time and running speed by Pokhara bus is obtained to be 65.07 minutes, 19.37 minutes and 16.84 kmph and that of Bindhyabasini Bus was obtained to be 66.26 minutes, 19.87 minutes and 14.89 kmph for Lamachour Chhorepatan Route. Also for Chhorepatan Lamachour Route, it was 74.5 minutes, 30.34 minutes and 16.80 kmph for Pokhara Bus and 71.7 minutes, 20.78 minutes and 14.34 kmph for Bindhyabasini Bus. Better performing service obviously will have better satisfaction level, so it's absolutely necessary to maintain or even increase the present performance level.

Similarly, DEA based operational performance analysis shows that both the service providers (PBBS and BBBS) seems effective and efficient, as the effectiveness and efficiency value is obtained to be 1. This could be because there is lack of benchmark to compare with and hence on comparing the DMUs on themselves results to become efficient as well as effective. As it is known fact that satisfied passengers are loyal passengers, so in order to retain their services and prevent them from choosing private vehicles, the public transportation service providers should focus on increasing their services' performance.

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