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Evaluation of urban public transportation routes in Bekasi district Indonesia

S Nuryati[1], A A Husaini[1], E Yulius[1], A S S Gunarti[1*], F Prihesnanto[1] and E Darma[1]

[1] Department of Civil Engineering, Universitas Islam 45, Bekasi, Indonesia
[*]Corresponding author email: anita_ft@unismabekasi.ac.id

Abstract

One of the factors to support and increase economic productivity in Bekasi district is transportation, so public transportation services are needed as the main support for community activities. The public transportation service in Bekasi district is urban transportation, which is less popular because people have switched to public transportation modes since the existence of ojol (online motorcycle taxis) which are more practical and flexible. Apart from that, in terms of urban transportation services in Bekasi district, it is still considered less satisfying for customers so there are few people interested. The aim of the research is to determine the performance, services, and maps of old and new city transport routes in Bekasi district on routes K33. The methods used in this research are the Slovin method for sampling respondents, a Likert scale to determine the score of question criteria, and the IPA method. to find out priorities for improving services in city transportation in Bekasi district. Assistance software used to analyze data using SPPS, Ms Excel, and route network maps using ArcGIS. The research results show that the smallest load factor performance value is 13%, headway is 112.42 minutes, frequency is 1 vehicle/hour, vehicle speed is 14.43 km/hour, longest travel time is 74 minutes, longest waiting time is 77.66 minutes, circulation time the longest was 163.05 minutes. City transportation services based on the results of the Cartesian diagram are a priority for increasing the waiting time criteria in transportation.

Keywords

Public transportation, Bekasi, route K33

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Introduction

One of the factors to support and increase economic productivity in Bekasi district is transportation, so public transport services are needed as the main support for community activities. Public transport services in Bekasi district are urban transport which is currently less attractive because people have switched modes of public transport since the existence of ojol (online motorcycle taxis) which are more practical and flexible, as well as private vehicles which are currently easy to own [1][2]. In addition, in terms of city transport services in Bekasi district, it is still somewhat

unsatisfactory to customers so that there are few enthusiasts. Several studies on the performance of city transport have been researched [3–6].

This study aims to determine the performance, service, and route mapping of city transport in Bekasi district on route K33. The benefits of this research are as a consideration for the local government of Bekasi Regency in monitoring performance and knowing shortcomings in the implementation of urban public transport operations.

This research focuses on urban transport in Bekasi district only on route K33, does not calculate operational scheduling plans, does not calculate public transport tariffs, analyses the level of service on urban transport route K33 using the Slovin method, importance performance analysis (IPA) method and Likert Scale, evaluates the performance of urban transport route K33.

Method

This research was conducted in Bekasi Regency, West Java and data collection was carried out on urban public transport in Bekasi Regency on route K33 (Figure 1). On route K33 the route travelled from Lemah Abang - Pasir Gombong - Lippo Mall which is 14.8 according to the Geo Tracker application. The time of implementation of dynamic transport surveys is carried out in 2 (two) sessions every day, namely in the morning at 06:00 - 08:00 WIB and in the afternoon at 16:00 - 18:00 WIB on weekdays and weekends while static surveys are carried out on weekdays and weekends from 06:00 - 18:00 WIB for route K33. The survey was conducted from 20 October 2033 - 29 October 2023. The stages of analysis carried out in this study include analysis of public transport operational performance, analysis of passenger satisfaction levels, validity and reliability test analysis, importance performance analysis (IPA), and mapping of public transport network routes.

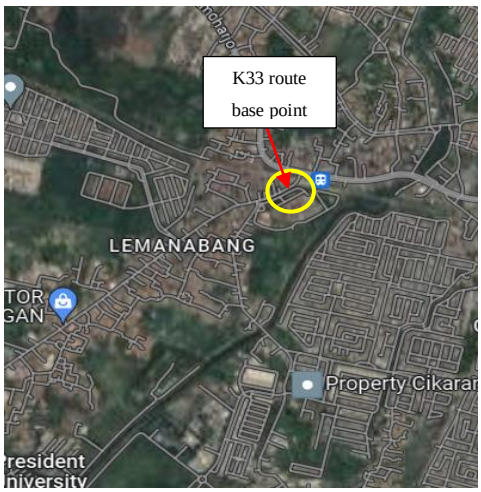

Figure 1. Research location

The data collected are primary data in the form of dynamic public transport data, static public transport data, passenger and driver interview data. Secondary data in the form of maps / routes, population data, public transport inventory data.

Result and discussion

Performance analysis of city transport

The results of the operational analysis of urban transport include load factor, headway, frequency, speed, travel time, waiting time, circulation time in Bekasi district on both routes, namely:

1. Load factor

From the data obtained from the dynamic survey results, the number of passengers per segment on route K33 with a total of 4 segments is then calculated to obtain the load factor value. This value is the ratio between the number of passengers in the field and the capacity of urban transport. Figure 2 is the result of load factor calculation per survey session on both days.

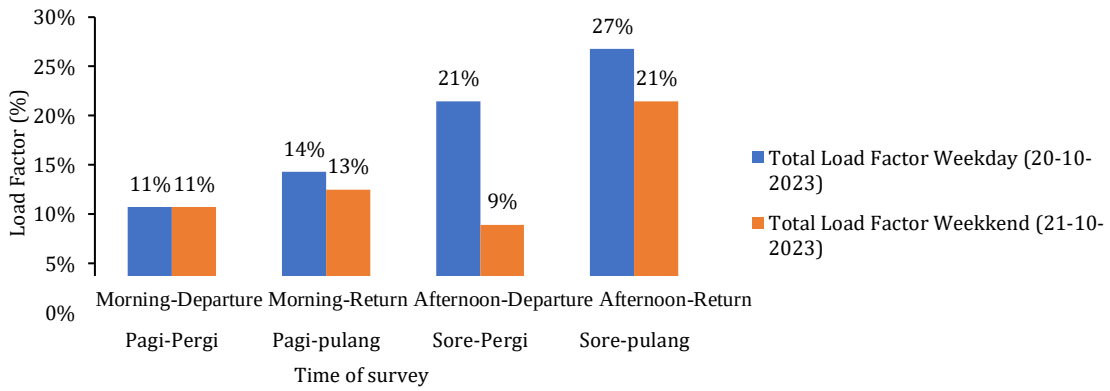

Figure 2. Load factor graph of route K33

Figure 2 shows that the largest load factor is in the afternoon-return survey session of 27% on 20 October 2023 (weekday), while the lowest load factor is in the morning-departure session of 11% on 20 October 2023 (weekday) and 21 October 2023 (weekend).

2. Headway

The dynamic survey results show the number of passengers per session, namely morning peak hour, off peak hour, and afternoon peak hour on route K33 and then calculated to get the headway value. This value is the time interval between one vehicle and another. Figure 3 is the result of the headway calculation per survey session on both days.

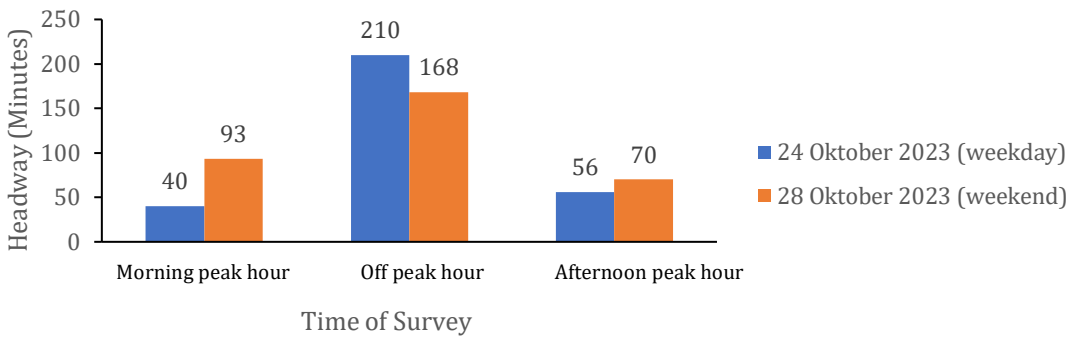

Figure 3. Headway graph of route K33

Figure 3 shows that the longest headway is in our off peak which is 210 minutes on 24 October 2023 (weekday), while the fastest headway is in our morning peak which is 40 minutes on 24 October 2023 (weekday).

3. Frequency

The results of the headway calculation are used to calculate the frequency of urban transport. Frequency is the number of vehicles operating at any one time. Table 1 is the result of frequency calculation per survey session on both days. Table 1 shows the highest average frequency on 24 October 2023 (weekday) was 2 vehicles/hour, while the lowest average frequency was 1 vehicle/hour on 28 October 2023 (weekday).

Table 1. Recapitulation of K33 route frequency

Survey Time Session	24 October 2023 weekday (Vehicles/hour)	28 October 2023 weekend (Vehicles/hour)
Morning Peak hour	2	1
Off peak hour	1	1
Afternoon Peak hour	1	1
Average	2	1

4. Vehicle speed

From the dynamic survey data, the travel time from the initial departure to the final destination is obtained and the distance travelled from the starting point to the destination is obtained. From these two data can be calculated the speed of city transport route K33. Figure 4 is the result of the calculation of the speed of city transport route K33.

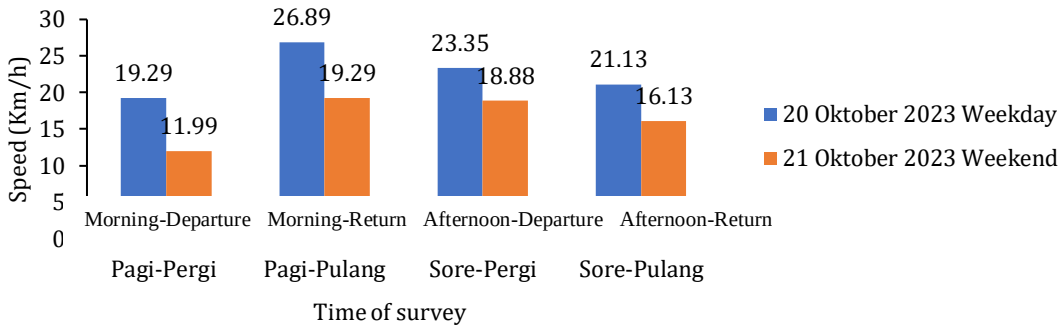

Figure 4. Speed graph of route K33

Figure 4 shows that the highest speed occurred in the morning-return session at 26.89 km/h on 23 October 2023 (weekday), while the lowest speed was in the morning-departure session at 11.99 km/h on 22 October 2023 (weekend).

5. Vehicle travel time

Vehicle travel time is defined as the ratio between the distance travelled by a vehicle from origin to destination and the speed at which the vehicle operates. Vehicle travel time is calculated using the time transport departs from origin to destination. From the dynamic survey data, the travel time of urban transport route K33 is obtained. Figure 5 is the result of the calculation of travel time for urban transport route K33.

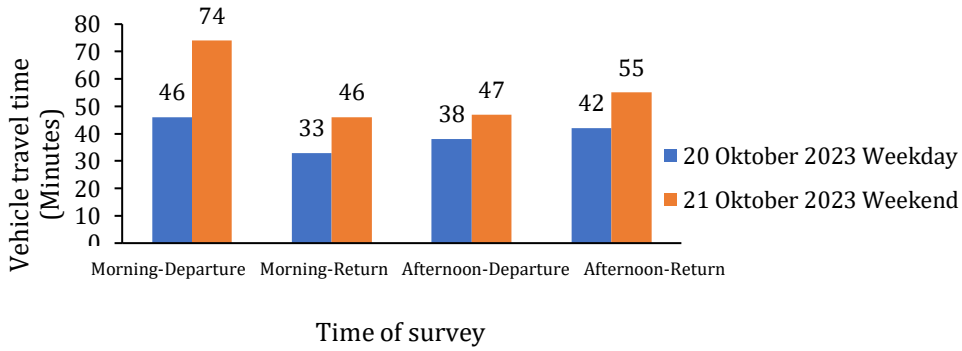

Figure 5. Travel time graph of route K33

Figure 5 shows that the longest travel time occurs in the morning-departure session, which is 74 minutes on 21 October 2023 (weekend), while the fastest travel time is in the morning-return session, which is 33 minutes on 20 October 2023 (weekday).

6. Transport waiting time

Waiting time for transport is influenced by the frequency of transport. The more frequency of transport, the faster the waiting time required for passengers to board the transport. Table 2 is the result of the calculation of waiting time for route K33.

Table 2. Recapitulation of waiting time for route K33

Survey Time Session	24 October 2023 Weekday (minute)	28 October 2023 Weekend (minute)	Standard 5-20 (minute)	Description
Morning peak hour	20	47	5-20	Not fulfil
Off peak hour	105	84	5-20	Not fulfil
Afternoon Peak hour	28	35	5-20	Not fulfil

Average	51	55	5-20	Not fulfil

Table 2 shows the longest average travel time on 28 October 2023 (weekend) is 55 minutes, while the fastest average travel time on 24 October 2023 (weekday) is 51 minutes.

7. Circulation time

Circulation time is obtained by calculating the time required by city transport in 1 turnaround from point A to point B. Data obtained from dynamic surveys include time from point A to B, delay time, and stop time. Table 3 is the result of the calculation of the circulation time of route K33. TAB is the average travel time from A to B, TBA is the average travel time from B to A, TTA is the vehicle stop time at A, TTB is the vehicle stop time at B, CT ABA is the circulation time from A to B back to A, sAB is the deviation of travel time from A to B, sBA is the deviation of travel time from B to A.

Table 3. Recapitulation of circulation time of route K33

Route K33	TAB 1	TBA 2	sAB 5%x 3	sBA 5%x 4	TTA 10%x 5	TTB 10%x 6	CT ABA 8
20-10-2023 (Weekday)							
Morning session	46	33	2.3	1.7	4.6	3.3	91
Afternoon session	38	42	1.9	2.1	3.8	4.2	92
Average							91
21-10-2023 (Weekend)							
Morning session	74	46	3.7	2.3	7.4	4.6	138
Afternoon session	47	55	2.35	2.8	4.7	5.5	117
Average							128

Table 3 shows the longest average circulation time on 21 October 2023 (weekend) is 128 minutes, while the fastest average travel time on 20 October 2023 (weekday) is 91 minutes.

Cartesian diagram analysis of city transport service levels

The results of the Cartesian diagram analysis of urban transport are used to determine the level of urban transport service in Bekasi district on the two routes, whether it is in accordance with customer perceptions or not.

Coordinate values are obtained from questionnaire scores. The X coordinate is represented by the average score per performance criteria while the Y coordinate is represented by the average score per expectation criteria. Table 4 is a recapitulation of the average value of the performance level and expectation level.

Table 4. Average value of performance and expectations of route K33

Question items	Performance (X)	Expectations (Y)
P1	3,55	4,44
P2	3,74	4,39
P3	3,12	4,27
P4	3,95	4,24
P5	2,54	4,44
P6	4,07	4,32
P7	4,02	4,19

Question items	Performance (X)	Expectations (Y)
P8	3,27	4,07
P9	3,97	4,11
P10	3,11	3,76

The values in Table 4 are inputted into the SPSS application to be processed into a Cartesian diagram which produces 10 criteria for each dimension into four quadrants, namely quadrant I, quadrant II, quadrant III, quadrant IV. FIGURE 6 is the result of the cartesian diagram analysis using the SPSS application.

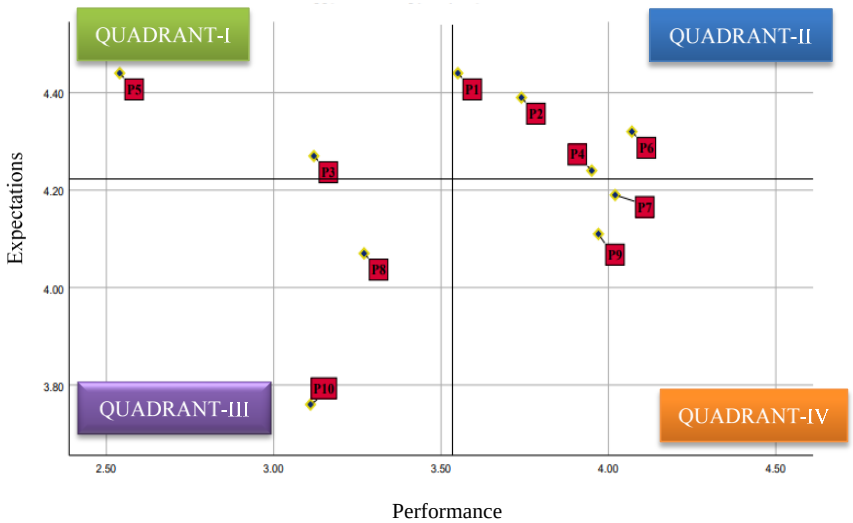

Figure 6. Cartesian diagram of route K33

Based on the results of the Cartesian diagram analysis (Figure 6), it is obtained that the level of improvement and priority improvement in quadrant I is on the service criteria for waiting time in route transportation and comfort in transportation. This is in accordance with research [7]. The level of satisfaction is still low so it is the top priority for improvement. The implementation of public transport improvement strategies can increase the number of LRT users in Indonesia [8] which is a strategy to reduce the use of private vehicles.

Map of previous and current routes of the city transport system

The results of observations and surveys in the field show that there are differences in the K33 route based on the 2007 Decree of the Transportation Agency with the K33 route based on the results of field surveys. Route mapping is made using the ArcGIS application. Figure 7 shows that the initial route of route K33 includes Cikarang Terminal - Lemahabang - Pasir Gombong - Mall Lippo - Serang, but after observations and field surveys there was a change in route to Lemah Abang - Mall Lippo. This change occurred due to the revitalisation carried out at the Cikarang terminal (starting point). On that route there is another route, namely K35, while on the Serang route (end point) there is another route, namely K17 so that the K33 route is trimmed to Lemahabang - Mall Lippo.

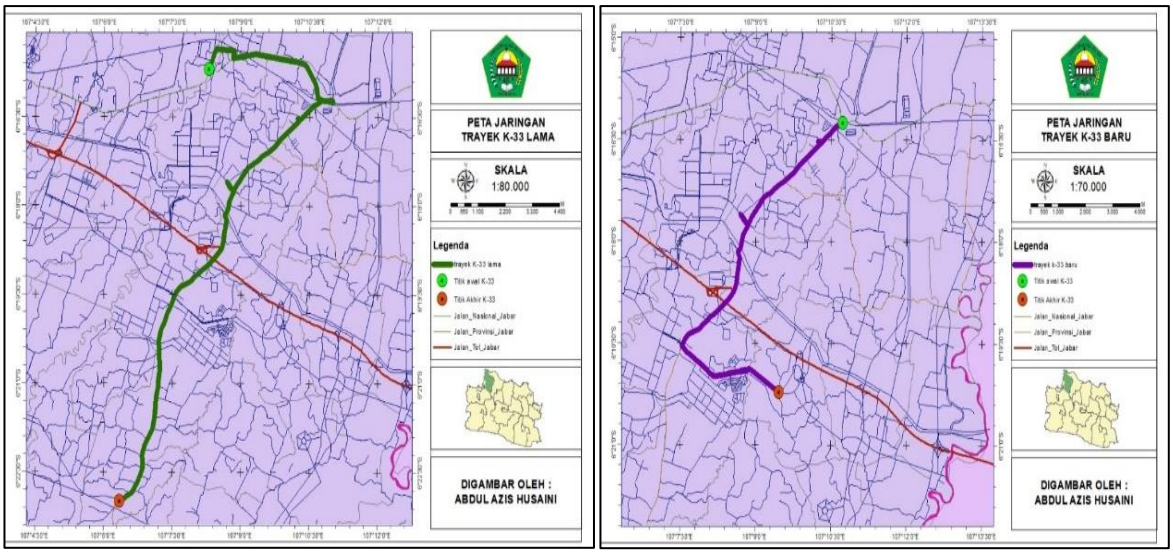

Figure 7. The oldest and newest K33 route

Conclusion

The performance of route K33 shows the results of the smallest average load factor of 13%, the longest average headway of 110 minutes, a frequency of 1 vehicle/hour average late speed of 16.57 km/hour, the longest waiting time of 55 minutes. Of the five performance results, only the longest average travel time (56 minutes) and the longest circulation time (128 minutes) meet the performance requirements of public transport.

The level of service of route K33 based on the results of the Cartesian diagram can be prioritised to improve and increase service waiting time in transport and comfort in transport. On route K33 there is a route change, which starts from the Cikarang terminal and ends in Serang, to start at Lemahabang and end at Lippo Cikarang Mall. The route change occurred because there was already a K17 route in the direction to Serang so that based on the manager's agreement, the K33 route only reached the Lippo Cikarang Mall.

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