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Assessing Bus Performance Rating in Kajang, Selangor

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Abstract : The Transit Capacity and Quality of Service Manual (TCQSM) was chosen based on the review with four manuals and guidelines for the method will be applied. Six (6) attributes, namely Hours of Service, Passenger Load, Transit Auto Travel Time, Service Frequency, Punctuality Performance and Service Coverage were chosen for evaluation.[6][7][8]. A total of three (3) operators with seven (7) routes were identified in Kajang. Based on the final results, the Quality of Service (QOS) findings was rated as D , which was regarded as minimum or satisfactory. Most stakeholders' recommendations were: for the operators to provide information on bus scheduling and have accurate information for the passengers. It was suggested that in future this study can be extended to all routes and could be repeated after the opening of the Mass Rapid Transit (MRT) stations in Kajang, so as to provide a comparison and better evaluation of the public buses in Kajang.

1. Introduction

For the past 10 years, the increasing Malaysian population has caused a huge problem in major cities congestion. Improving the bus services is one of government's initiative for solution. Bus Network Revamp (BNR) in 2015 was implemented to reorganise the existing bus corridors into smaller corridors so as to improve the service efficiency. However, some setbacks and dissatisfaction were publicly voiced by passengers since the beginning of implementation. As Kajang falls within the BNR, and comprehensive studies were not previously conducted. There is a need for a detailed analysis on bus service performance rating status in Kajang.

This paper aims to assess bus service performance in Kajang through services quality performance rating. This paper aims to assess the quality of services for bus performance in Kajang, Malaysia. The scope of study for bus operations included headway analysis, bus scheduling, bus travel time prediction, fleet tracking system and ridership analysis [16], a literature research conducted by researchers from Universiti Tun Hussein Onn (UTHM), the bus service quality that was categorized by several attributes, such as service coverage, service frequency , service hour and service reliability [9].

In a study conducted on the Ipoh- Lumut corridor, and followed by the obtained results were referred to the Transit Capacity and Quality of Service Manual. This on-board survey was conducted to obtain data, such as frequency, headway and operating speed, which was used to obtain the punctuality index and expected waiting time [13][1].

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In China, service level determination by using simulation models was conducted in major cities [6]. The service level obtained depended on the ratio of the service coverage area and transit supportive areas. Findings from an Italian research showed that pedestrian crossing factor did not affect the service coverage area attribute [5][2].

There is a need for a performance assessment on quality of bus services in the Klang Valley [11]. The suitable attributes mentioned above been can determine the status in Malaysia. This paper is about a case study which aims to assess the performance or quality of service (QoS) of urban bus services in Kajang, Selangor.

2. Methodology

2.1 Service Hours

According to the *Transport Research board, Quality of Service Method of the Transit Capacity* and *Quality of Service Manual (3rd Edition*] [14], service hours is defined as the length of time in a day when a transit service is provided along a route. *)*[7][8 The current service hours are available from bus operators. To obtain the quality of service (QoS), a comparison of the number of operational hours per day was conducted and the obtained data can be compared with those given in Table 1.

Table 1 Service hour's vs quality of service

Quality of Service	A	B	C	D	E	F
Service (Hours)	>18	18-15	14-12	11-7	6-4	<4

2.2 Passenger Load

Based on *Transport Research Board, Quality of Service Method of the Transit Capacity* and *Quality of Service Manual (3rd Edition)* [14], passenger load is defined as load factor or passengers per seat. . In this thesis the required data were collected through an on-board observation. The number of passengers who a lightened and boarded a bus from the initial bus stop to next bus stop was recorded. [7][8] The passenger load was studied during peak hours of the day (AM Peak, Midday Peak and PM Peak). This was in accordance with the method used by the *Transit Capacity and Quality of Service Manual* and a research conducted by Leong, Wan Hashim and Ahmad Farhan, from Universiti Sains Malaysia (USM).[17]. The peak hours under study were as follows:

AM-Peak : 7.30am – 9.30am,
Midday-Peak : 12.00pm – 2.00pm
PM-Peak : 4.30pm – 6.30pm.

Data were taken according to the above timings, where a one-day data were collected on a weekday and a weekend. The passenger load, or load factor of the bus after each stop, was calculated by using the equation 1. Then the load factor was compared with Table 2 to obtain the quality of service for passenger load.

$$\text{Passenger Load} = \text{Load Factor} = \text{No of Passengers} / \text{No of Seats} \times 100\% \quad (1)$$

Table 2 Passenger load quality of service

Quality of service	A	B	C	D	E	F
Service level	Up to 50% seated load	Up to 50% seated load	Up to 50% seated load	Up to 50% seated load	Up to 50% seated load	Up to 50% seated load

2.3 Transit Auto Travel Time

Based on the *Transport Research Board Quality of Service Method of the Transit Capacity* and *Quality of Service Manual (3rd Edition)* [14], transit auto travel time is the ratio between transit time and auto vehicle time. The time taken by a bus to travel from the initial point to the end point is termed as the transit time, while auto vehicle time refers to the time a car takes to travel on the same path as the bus. The transit auto travel time was also conducted according to the previously identified peak hours (AM Peak, Midday Peak and PM Peak). This observation was in accordance with the method used in the *Transport Research Board - Transit Capacity and Quality of Service Manual* [14] together with the research done by Leong et al. [17] from USM. The daily peak hour timing were:-

AM Peak	:	(7.30am – 9.30am)
Midday Peak	:	(12.00pm – 2.00pm) and
PM Peak	:	(4.30pm – 6.30pm)

The time taken for a bus and a car to travel from the initial point to end point on the same route was recorded. Ratio between transit time and auto vehicle time was calculated and compared with Table 3 as to determine the quality of service.

Table 3 Transit Auto Travel Time vs. Quality of Service

Quality of Service	A	B	C	D	E	F
Transit Auto Travel Time Ratio	1	>1-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0	>2.0

2.4 Service Frequency

The service frequency for both routes were obtained from their respective operators. RapidKL T450's service frequency was obtained from the customer information service via the social media, while that of SMART Selangor was enquired from Majlis Perbandaran Kajang. Quality of service was obtained by comparing the results with data in Table 4.

Table 4 Services Frequency

Quality Of Service	A	B	C	D	E	F
Average headway (min)	<=5	>5-10	11-15	16-30	31-59	>60

2.5 Punctuality Performance

In this study a bus stop for each route was selected for observation. These bus stops were ideal to choose because they were both located in Kajang town. As for RapidKL T450, the Metro Point Complex bus stop was chosen for study, and where the bus stop is located within the Kajang High School, Kajang market, Kajang Hospital neighborhood and of walking distance to Kajang town centre. On the other hand, the Kajang Hospital bus stop was chosen for SMART Selangor. This bus stop is within the vicinity of Kajang High School, Metro Point Complex and is also of walking distance to the main Kajang town centre. The recorded arrival time for these buses were compared with the arrival schedule timing.

'Punctuality ' is defined as the arrival of 1 minute early to 5 minutes late. Hence, the actual arrival time at a particular bus stop was compared to the scheduled arrival time [15][14]. However, since the public were not provided with the scheduled timetable from both service providers and information about the timetable was not available , the scheduled timetable for both routes were manually tabulated according to the service frequency given by the operators[12]. Therefore, to resolve the quality of service, the total punctual arrivals was divided by the total actual arrivals to obtain the punctuality performance percentage. The quality of service was determine by comparing the percentage value with those in Table 5.

Table 5 Punctuality performance of quality of service

Quality of Service	A	B	C	D	E
Punctuality performance	95%-100%	90%-94%	80%-89%	70%-79%	<70%

2.6 Services Coverage

Service coverage for all seven (7) routes were marked on a map. The route for each operator was marked with a different color. A buffer of radius 400mfrom the center line of the road was highlighted with yellow, which indicated the boundary for a particular service route coverage .The area was then divided into grid boxes whereby the percentage of the area that lied within each box was estimated. The total coverage area was later and compared with Table 6 below:

Table 6 Service coverage quality of service

Quality of Service	**Service Coverage Area Percentage (**%)	**Comment**
A	90.00- 100.00	Virtually major origins and destination served
B	80.00 - 89.90	Most major origins and destinations served
C	70.00 - 79.90	About ¾ of higher density areas served
D	60.00 - 69.90	About two-thirds of higher density areas served
E	50.00 - 59.90	At least ½ of the higher density areas served
F	<50.00	Less than ½ of higher density areas served

3. Results

3.1 Service Hour

Three (3) bus operators which have their operational routes mainly within Kajang area were identified. RapidKL operates on four (4) routes, LNH Bas Mini operates on two (2) routes, while SMART Selangor operates on only one (1) route. The service hours for RapidKL were officially obtained. Majlis Perbandaran Kajang provided the service hours for SMART Selangor, while that of LNH Bas Mini was obtained via their customer hotline. Table 7, shows the operating hours for all routes, the quality of service obtained and bus performance for services hour in Kajang.

Table 7 Hours of service vs quality of service for all routes

Day	**Time**	**Direction**	**Passenger Load Factor**
Weekday	AM Peak	Billion to Pekan Kajang	0.59
		Pekan Kajang to Billion	0.53
	Midday Peak	Billion to Pekan Kajang	0.92
		Pekan Kajang to Billion	0.36
	PM Peak	Billion to Pekan Kajang	0.44
		Pekan Kajang to Billion	0.99
Weekend	AM Peak	Billion to Pekan Kajang	0.55
		Pekan Kajang to Billion	0.16
	Midday Peak	Billion to Pekan Kajang	0.28
		Pekan Kajang to Billion	1.20
	PM Peak	Billion to Pekan Kajang	0.42
		Pekan Kajang to Billion	1.13
		Average (Weekday)	0.64 (64%) - B
		Average (Weekend)	0.62 (62%) - B
		Average (All)	0.63 (63%) - B
		Overall Quality of Service (QOS)	B

3.2 Passenger Load

Passenger load factor was obtained by dividing the number of passengers with the number of seats. The factor was obtained at each bus stop by identifying the number of passengers that remained after each stop. Data of both routes were obtained from a one-day observation on a weekday and a weekend at peak hours (AM Peak, Midday Peak and PM Peak). Table 3.2 shows the passenger load summary for RapidKL T450 route.

The initial stop for RapidKL T450 was at Billion Bandar Teknologi, in Kajang and the end stop was at Kajang town. Then the return route data was taken. The initial stop for SMART Selangor was at Surau Al- Islah and end stop was at Kajang town. The return route data was also taken. Then the average of all passenger load factors was converted to percentage to obtain the quality of service. The passenger load data are tabulated in Table 8.

Table 8 Passenger load factor summary for RapidKL T450

Day	**Time**	**Direction**	**Passenger Load Factor**
Weekday	AM Peak	Billion to Pekan Kajang	0.59
		Pekan Kajang to Billion	0.53
	Midday Peak	Billion to Pekan Kajang	0.92
		Pekan Kajang to Billion	0.36
	PM Peak	Billion to Pekan Kajang	0.44
		Pekan Kajang to Billion	0.99
Weekend	AM Peak	Billion to Pekan Kajang	0.55
		Pekan Kajang to Billion	0.16
	Midday Peak	Billion to Pekan Kajang	0.28
		Pekan Kajang to Billion	1.20
	PM Peak	Billion to Pekan Kajang	0.42
		Pekan Kajang to Billion	1.13
		Average (Weekday)	0.64 (64%) - B
		Average (Weekend)	0.62 (62%) - B
		Average (All)	0.63 (63%) - B
		Overall Quality of Service (QOS)	B

3.3 Transit Auto Travel Time

The travel time for both routes were recorded. The return journey for each route, was also recorded. For example, the recording of journey data for RapidKL T450, which was from Billion Bandar Teknologi in Kajang to Kajang town, was repeated for the return journey. The time for a bus and car was recorded for each stop then the ratio of both was calculated. The results obtained are tabulated as follows:

Table 9 Summary for RapidKL T450 and SMART Selangor

Operator	**Weekday Average Ratio & QOS**	**Weekend Average Ratio & QOS**	**Average Ratio & QOS**	**Overall QOS**
RapidKL T450	1.31 (C)	1.37 (C)	1.34 (C)	1.21 (B)
SMART Selangor	1.09 (B)	1.07 (B)	1.08 (B)	

3.4 Punctuality Performance

The punctuality performance for both RapidKL T450 and SMART Selangor was recorded and tabulated. The service frequency was used as a guide to evaluate the punctuality performance of the buses since the scheduled arrival timetables were not available. The summary of the results are shown in Table 10.

Table 10 Punctuality Performance for both routes

Route	**Day**	**Total Actual Arrivals**	**No of punctual Arrivals**	**Punctuality Percentage**	**Average Punctuality Percentage**	**Quality of Service**
RapidKL T450	Weekday	18	11	61.11%	50.00%	E
	Weekend	18	7	38.89%		
SMART Selangor	Weekday	34	30	73.53%	77.31 %	D
	Weekend	37	E	81.08%		
					Average	E

3.5 Service Frequency

Based on the obtained service frequency from respective bus operators it was found that the service frequencies were not fixed on a timing schedule. Instead the service frequencies were on a time range. Hence, the average of time range will be used to determine the quality of service for the buses. The information was summarized in Table 11.

Table 11 Service frequencies for Route RapidKL T450 and SMART Selangor

Route	**Service Frequency Time Range**	**Average Service Frequency**	**Quality of Service**
RapidKL T450	30 – 45 mins	37.5 mins	E
SMART Selangor	15 – 20 mins	17.5 mins	D
Average			D

3.6 Service Coverage

Service coverage method was applied to identify the coverage area percentage of bus service. A service coverage area radius of 400m from the road was plotted on the map and equally divided boxes were drawn on it to determine the coverage area percentage within each box. The bus service route is drawn in Figure 1 while the 400m radius coverage is highlighted in yellow with a black border. The service coverage percentage was estimated from each box and then the percentage summation was calculated. This service coverage percentage only considered the residential areas. The operating bus service coverage in Kajang was determined and summarized in the Table 12 below.

Table 12 Service coverage area percentage for Kajang buses

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Nos.	30	3	3	2	2	2	4	7	4	7	3

Service Coverage Area = [(0% x 30) + (10% x 3) + (20% x 3) + (30% x 2) +
(40% x 2) + (50% x 2) + (60% x 4) + (70% x 7) +
(80% x 4) + (90% x 7) + (100% x 3)] / 65
= 35.5% (QOS F)

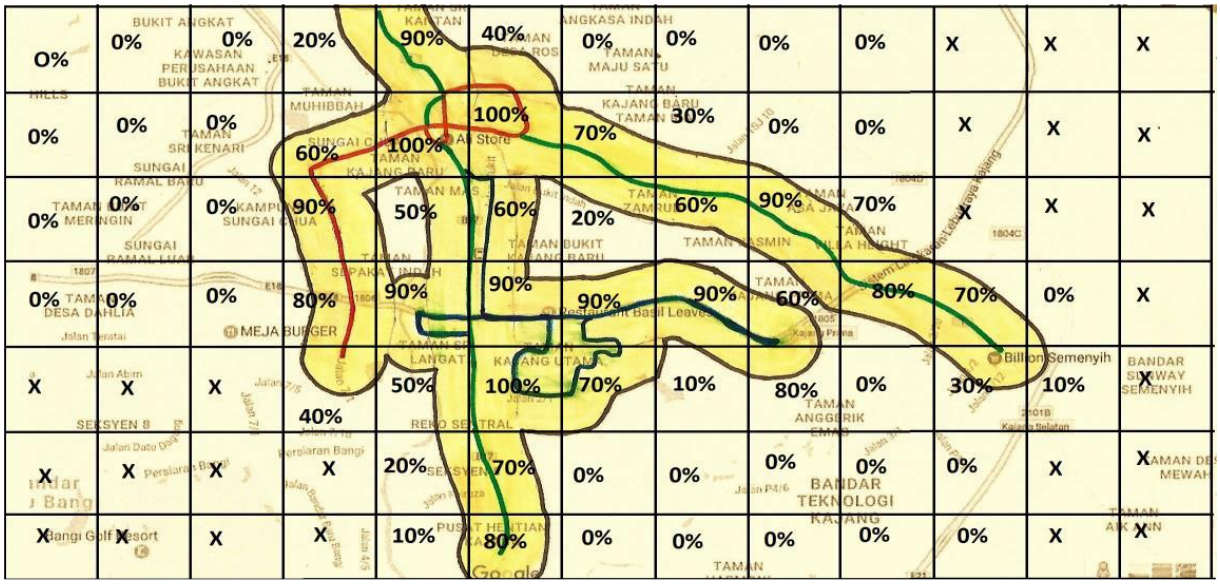

Figure 1 Service coverage for buses operating within Kajang

3.7 Average quality of service summary for bus performance in Kajang
The overall results were calculated according to the method applied by Ponrahono, Bachok, Osman, Ibrahim, Abdullah and Abdullah [18] in their study entitled Assessing the Urban and Rural Stage Bus Services Disparities in Peninsular Malaysia:

Table 13 Final average score and quality of service (QOS) categorization

Attributes	QOS	QOS Score	Mean QOS	Final Overall QOS
Hours of Service	B	5	3.5	D
Passenger Load	B	5		
Service Frequency	D	3		
Transit Auto Travel Time	B	5		
Service Coverage	F	1		
On Time Performance	E	2		
Total Score		21		

4. Conclusion

This paper was prepared to assess the bus performance in Kajang, Selangor by using the quality of service rating. It is recommended that major route of Jalan Reko, where RapidKL and LNH Bas Mini plies, be reviewed for future studies since it is also the major route that connects to Kajang town. On the other hand, as the Klang Valley Mass Rapid Transit's Sg Buloh – Kajang line is due to operationalise in July, 2017, the public transportation system landscape in Kajang will be changed. Hence, this study could be repeated with a more comprehensive scope and coverage to obtain better understanding and knowledge of the public bus service performance rating in Kajang. As an outcome of this case study, service frequency, service coverage area and most importantly the punctuality performance should be improved. As for attributes, service hours, passenger load and auto travel time are good and should be maintained. In conclusion, the overall bus performance for Kajang is D , which require improvement.

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6. References

[1] Chang, S.K.J. and Hsu, C.L., Modeling Passenger Waiting Time for Intermodal Transit Stations, Journal of Transportation Research Board No. 1753, pp.69-75, 2001.

[2] Amiril, A., Nawawi, A. H., Takim, R., & Latif, S. N. F. A. (2014). Transportation Infrastructure Project Sustainability Factors and Performance. *Procedia - Social and Behavioral Sciences*, *153*, 90–98. http://doi.org/10.1016/j.sbspro.2014.10.044

[3] Bachok, S., Osman, M. M., & Ponrahono, Z. (2014). Passenger's Aspiration Towards Sustainable Public Transportation System: Kerian District, Perak, Malaysia. *Procedia - Social and Behavioral Sciences*, *153*, 553–565. http://doi.org/10.1016/j.sbspro.2014.10.088

[4] Department of Statistics, M. (2011). Population and Housing Census of Malaysia 2010. *Department of Statistics, Malaysia*, 77. http://doi.org/10.1007/s13398-014-0173-7.2

[5] Eboli, L., Forciniti, C., & Mazzulla, G. (2014). Service Coverage Factors Affecting Bus Transit System Availability. *Procedia - Social and Behavioral Sciences*, *111*, 984–993. http://doi.org/10.1016/j.sbspro.2014.01.133

[6] Lee, D. A., Watson, C. H. L. S., Central, L., Regional, F., Authority, T., Hair, V. I. C. E. C., … Wilson, F. (2007). *COOPERATIVE*. Washington DC, USA.

[7] Piriyawat, C., Candidate, D., & Author, P. (n.d.). Alternative Methods for Investigating Bus Service Quality and User Dissatisfaction in Bangkok and Its Vicinity Alternative Methods for Investigating Bus Service Quality and User Dissatisfaction in Bangkok and Its Vicinity.

[8] Redman, L., Friman, M., Gärling, T., & Hartig, T. (2013). Quality attributes of public transport that attract car users: A research review. *Transport Policy*, *25*, 119–127. http://doi.org/10.1016/j.tranpol.2012.11.005

[9] Rohani, M. M., Wijeyesekera, D. C., & Karim, A. T. A. (2013). Bus operation, quality service and the role of bus provider and driver. *Procedia Engineering*, *53*, 167–178

[10] Sabra, W. and A. (2003). A Comparison between Highway Capacity Manual and Critical Lane Volume Analysis Methodologies for Traffic Impact Study Applications, 1–7.

[11] Shariff, N. M. (2012). Private Vehicle Ownership and Transportation Planning in Malaysia. In *International Conference On Traffic And Transportation Engineering* (Vol. 26, pp. 64–68).

[12] Suwardo, Napiah, M. B., & Ibrahim B. Kamaruddin. (2009). On-Time Performance and Service Regularity of Stage Buses in Mixed Traffic. *World Academy Of Science, Engineering And Technology*, *3*(7), 1137–1144.

[13] Suwardo, W., Napiah, M., & Kamaruddin, I. (2008). Punctuality And Expected Waiting Time Of Stage Buses In Mixed Traffic. *Jurnal Transportasi*, *8*(3), 213–226. Retrieved from htt

[14] Transportation Research Board (TRB) (1999). A Handbook for Measuring Customer Satisfaction and Service Quality. *TCRP 3rd Edition Report 47*

[15] Yaakub, N., & Napiah, M. (2011). Public Transport: Punctuality Index for Bus Operation, World Academy of Science. *Engineering and Technology*, *60*(12), 12–23.

[16] Hazril, M. I., Sabri, S. M. I. & Tajedi, N. A. A. (2013). A study on previous and ongoing research

regarding public transportation in Malaysia. Proc. Malaysian Technical Universities Conference on Engineering & Technology (MUCET), Kuantan, Pahang, Malaysia, 3-4 December.

[17] Leong, L. V., Ibrahim, W. H. W & Sadullah, A. F. M. (2006). Passenger car equivalents and saturation flow rates for through vehicles at signalized intersections in Malaysia. *ARRB Conference – Research into Practice 2006*, Canberra, Australia.

[18] Ponrahono, Z., Bachok, S., Osman, M. M., Ibrahim, M., Abdullah, M. F & Abdullah, A. (2015). Assessing the urban and rural stage bus services disparities in Peninsula Malaysia. Journal of the Malaysian Institute of Planners 13(2015): 65-84.