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EVALUATING THE QUALITY OF SERVICE (QOS) OF URBAN BUS PERFORMANCE IN THE CAPITAL STATE OF PERAK, MALAYSIA

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Abstract

Global urbanisation results from demographic trends, such as population growth, migration from less urban to developed areas and international migration to developed countries. Rapid population growth has increased the number of vehicles. Moreover, ongoing infrastructure development has struggled to keep pace with the urban population growth. The objective of this study was to assess the quality of urban bus services in Perak, Malaysia. The data were collected from Terminal Bus Medan Kidd in Ipoh, Perak. To assess bus performance in this study, the transit capacity and quality of service manual (TCQSM, 2013) were selected as the main guidelines. Results showed that the average operational duration was 14 h and 4 min with daily rating of QOS C. The average service frequency recorded a headway of 76 min, a corresponding rating of QOS E. Punctuality assessment had an average on-time departure rate of 80.74%, a corresponding rating of QOS D. The overall QOS corresponded to an overall classification of QOS C (QOS score of 3.75). Bus services in Ipoh are operationally sufficient, but operational optimisation is required to achieve a more reliable and user-oriented bus service.

Keywords: sustainable public transportation, urban bus performance, quality of service (QOS), carbon footprint, green energy

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INTRODUCTION

Global urbanisation results from three main demographic trends: population growth, migration from rural to urban areas and international migration to developed countries (Rodrigue, 2024). According to United Nations publications, more than half of the world's population now lives in cities and this is expected to reach nearly 70% within the next 25 years (UNDESA, 2023; Chuhdary et al., 2025). Rapid urbanisation and development have increased the number of motorised vehicles and current urban infrastructure development has struggled to keep pace with the current population and development (Chow et al., 2019). High volume of vehicles and congestion caused major extensive interruption for road users (Shaji et al., 2023). Therefore, the public bus services should serve as the main mode of transport in the city area, linking suburban and residential areas with the urban centre (Ngadiman et al., 2020; Norhisham et al., 2021).

Recent literature addressed the urgency for operators to improve the daily services in certain locations to accommodate passenger demand and needs. Bus services have a major role and influence on human's daily movement patterns (Lachapelle & Boisjoly, 2023). Addressing issues raised by passengers and the physical condition of buses remains essential for bus operators (Rong et al., 2022). Consequently, there is a necessity to determine the present quality of bus performance in urban areas (Sugito et al., 2025). Evaluation of current bus performance includes monitoring the daily operational services as well as understanding passenger and people expectations and perceptions (Esmailpour et al., 2024; Nor & Miskam, 2020). As customers passengers have their expectations towards the bus service, which play a significant role in informing passengers on daily services (Kerber et al., 2021).

Previous literature had addressed a significant concern about the QOS of public bus services amongst scholars due to issues with passenger satisfaction and the number of daily ridership. QOS formally refers to the operational standard adopted by the public transport authority (Ubaidillah et al., 2022). There are several factors and challenges affecting the QOS assessment, such as punctuality, frequency and crowding (Liu et al., 2025). The Malaysian Government, through the Inland Public Transport Authority (APAD), is committed to improve the quality of public bus services despite the huge competition faced by local bus operators in Malaysia (Ministry of Transport Malaysia, 2019). In developing nations, bus services remain as one of the travel options within major cities in developing nations (Ramli et al., 2017).

Hamzah et al. (2023) highlighted dissatisfaction due to limited operating hours, especially in the evenings and during weekends, which limited bus usage despite the escalating need in city and suburban areas. Assessing bus performance should consider aspects such as reliability, quality, efficiency and effectiveness (Ponrahono et al., 2017). Authorities were strongly advised to

address the quality concerns raised by the local bus stakeholders (Pira et al., 2021). Various attributes affecting the quality, operational concerns raised by passengers to adapt their day-to-day movements effectively (Amir et al., 2025).

In literature concerns about the capability of bus drivers to follow the existing schedules were raised (Sogbe et al., 2025). Passenger and user trustworthiness towards the services was based on the on-time departure in the timetable (Bakar et al., 2022). Dependency and reliance towards bus services as the primary mode of connectivity declined due to lower service performance relative to other motorised modes (Shukri et al., 2020). In addition, recent challenges found an imbalance of demand and supply between bus services and passengers. Definitive solutions to improve urban public transportation were continuous planning and monitoring current services (Ponrahono et al., 2018). Bus authority and operators have addressed the preference and need for comfort, safety and cleanliness in the local bus station in Ipoh, Perak (Zulkiflee, 2020).

Therefore, all public bus stakeholders should play their roles to facilitate better information on current bus performance between the government, bus operators and public (Saad, 2016). Punctuality influences passengers' decisions about the daily travel (Borhan et al., 2019). Previous studies indicated that service frequency built passengers' expectations and perceptions as users of services (Deb & Ahmed, 2018). Services that adhere accurately to timetables build greater trust (Norhisham et al., 2021). Consequently, evaluating urban bus services, particularly in terms of service quality, is essential. Therefore, the objective is to determine the quality of urban bus performance in Ipoh, Perak.

RESEARCH METHODOLOGY

Study Area

This section explains essential methods taken to determine the QOS of urban bus services in the capital state of Perak, Malaysia. Data from the Terminal Bus Medan Kidd in Ipoh, Perak were assessed, which serves as the main terminal for the local bus services hub in Central Perak. It covers several districts in Perak, such as Kinta, Central Perak, Kuala Kangsar, Kampar and Manjung. The data were collected between Jun and October in 2023. The Perak Transit was the only bus operator operating local bus services during data collection.

Table 1: Selected location in Ipoh, Perak

State Capitals	Selected Bus Terminal	Routes
Ipoh	Medan Kidd	T30A, T30B, T31A, T31B, T32, T33A, T33B, T34, T35, T36, T37, F100, F101A, F101B, F102, F103, 35, 37, 39, 46, 66

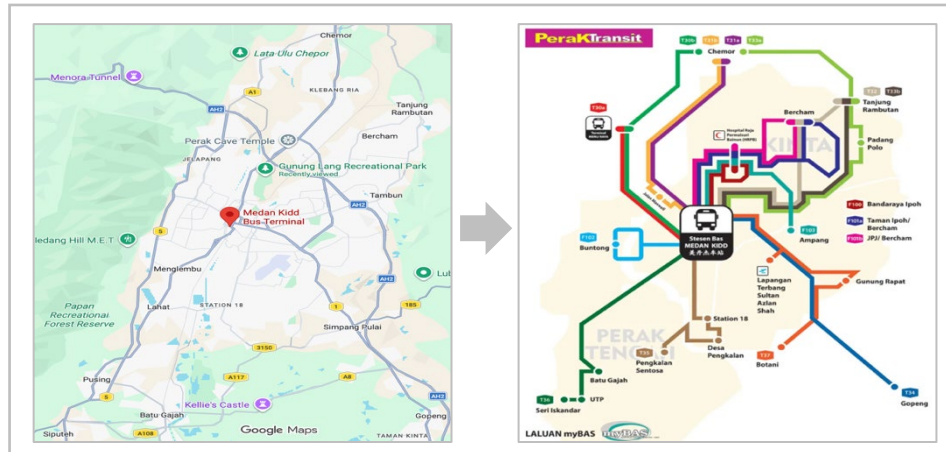


Figure 1: Map and bus route in Ipoh, Perak (Google Maps, 2025; Perak Transit, 2025)

Quality of services (QOS)

To measure the QOS of bus performance, the transit capacity and quality of service manual (TCQSM, 2013) (Transportation Research Board (TRB), 2013) were chosen as the main study guidelines. Therefore, this study presents the QOS of urban bus performance in Perak, Malaysia. At the end of this study, the QOS for each attributed were categorised based on grades stated in the guidelines and the overall QOS for bus performance in Ipoh was also identified.

Service hours

Service hours for bus services were determined by summing up the number of hours of bus operations, starting from the initial departure until the last departure across all routes in the selected location. The service hours for a specific route can be obtained from the service operator. Table 2 presents the QOS classification for service hours attributes according to TCQSM guidelines.

Table 2: Quality of services (QOS) for service hours (TRB, 2013)

Quality of Service (QOS)	A	B	C	D	E	F
Average Service Hours (Hours)	24 - 19	18 - 15	14 - 12	11 - 7	6 - 4	3 - 0

Service frequency

Service frequency of bus performance was assessed by calculating the average departure time for all routes in selected locations. Multiple headways were obtained for the entire day of bus services. Then, the average for each location was calculated. Frequency intervals were calculated by determining the different

time intervals between current scheduled departure time and previous consecutive scheduled departure for each route. Table 3 presents the QOS classification for service frequency attributes based on TCQSM guidelines.

Table 3: Quality of services (QOS) for service frequency (TRB, 2013)

Quality of Service (QOS)	A	B	C	D	E	F
Service frequency (Minute)	< 10	10 - 14	15 - 20	21 - 30	31 – 60	> 60

Passenger load

Passenger load was determined based on the total number of passengers boarded and disembarked from the bus at every bus halt from the initial location to the destination. The total number of passengers was calculated for round-trip trips in each route. Data were collected during weekdays instead of weekends since the number of passengers on normal days was estimated to be greater than during weekends. Few routes were chosen in this analysis and passenger load was measured by dividing the overall number of passengers by the number of seats offered in each bus. Table 4 shows the QOS categorisation for passenger load attributes based on the TCQSM guidelines.

Table 4: Quality of services (QOS) for passenger load (TRB, 2013)

Quality of Service (QOS)	A	B	C	D	E	F
Passenger load (Passenger / Seat)	0.00 - 0.50	0.51 - 0.75	0.76 - 1.00	1.01 - 1.25	1.26 – 1.50	> 1.50

On-time performance

On-time performance refers to readiness of the bus to depart according to the timetables given by bus operators. It refers to the capability for buses depart and arrive at each bus stop based on the original timetable. The exact time of bus departure for the whole route was recorded and the exact time of bus departure was compared with the original schedule for all routes stipulated by the bus operators. On-time performance was categorised as the actual time departure between 1 min earlier and 5 min later than the timetable. To assess bus service quality, the percentage of on-time performance for overall routes was calculated accordingly. The percentage of on-time departures was stated after a comparison between the actual time of departure and scheduled departure. The QOS grade for each route was classified accordingly. Table 5 denotes the QOS grade for on-time performance service.

Table 5: Quality of services (QOS) for on-time performance (TRB, 2013)

Quality of Service (QOS)	A	B	C	D	E	F
On Time Performance (%)	100.0 - 95.0	94.9 - 90.0	89.9 - 85.0	84.9 - 80.0	79.9 - 75.0	< 75.0

RESULT AND DISCUSSION

Summary of Departure

This part describes the results of this study accordingly. The QOS results were gathered based on the procedure addressed in the Methodology part. Local bus services in Ipoh are operated by a single bus operator and the daily operation was controlled and monitored by the Transportation Ministry through Agensi Pengangkutan Awam Darat (APAD) under the Interim Stage Bus Support Fund (ISBSF) programme.

Service hours

Service hours are defined by the hours of bus services from the first departure until the last departure daily. Table 6 shows QOS for service hours attributes in this study. Analysis of the operating hours of bus operation in Ipoh indicated a moderate overall level of service availability, with an average operational duration of 14 h and 4 min daily, and thus corresponding to an overall QOS service hours rating of QOS C. Most route commenced operations between 5.40 AM and 7.10 AM and concluded between 7.00 PM and 9.55 PM, reflecting a general alignment with the typical daily travel demand, particularly for work and school related trips. Nevertheless, only a few of the routes, namely T30A, T30B, T32, T34 and T35, accomplished a rating of QOS B, which were mostly due to extensive service hours periods between 15 h and 16 h. These routes stipulated wider coverage hours of operation, which was very significant to cater to passenger demands in the early morning and late evening. On the other hand, most routes were graded as QOS C, with service hours stretching between 12 h and 14 h and 30 min, which showed the inadequate availability outside peak hours.

As a comparison based on an operational point of view, most routes graded as QOS C signified that public bus services in this study might have less demand after off-peak hours in the evening. Travel patterns were inconsistent, especially for students with extended schedules, shift workersector and unscheduled visitors. Routes such as 39 and 37, which operate for only 12 h daily, exhibited the shortest service hours period and may reduce the passenger expectation towards bus services and shift their travel option to the private mode. The current QOS study addressed that extended service hours improved the service reliability, user satisfaction and perceived accessibility, especially in

urban areas with diverse passenger movements. Therefore, the mid-range service hours were recommended for service extension, especially in early morning and late evening services in primary routes with higher passenger demand. Overall, the existing service hours were adequate for minimal daily movement and required a strategic improvement to improve the QOS from basic to better grade, increase public transport usage and develop urban accessibility in Ipoh, Perak.

Table 6: Quality of services (QOS) for service hours attributes

Route	First trip	Last trip	Hours of services	QOS
T30A	6.00 AM	9.00 PM	15.00	B
T30B	6.30 AM	9.30 PM	15.30	B
T31A	6.10 AM	8.10 PM	14.00	C
T31B	7.10 AM	9.10 PM	14.00	C
T32	6.05 AM	9.05 PM	15.00	B
T33A	5.40 AM	7.40 PM	14.00	C
T33B	7.00 AM	9.00 PM	14.00	C
T34	6.15 AM	9.15 PM	15.00	B
T35	5.55 AM	9.55 PM	16.00	B
T36	6.00 AM	7.30 PM	13.30	C
T37	5.40 AM	7.00 PM	13.20	C
F100	6.30 AM	8.10 PM	13.40	C
F101A	6.00 AM	8.00 PM	14.00	C
F101B	7.00 AM	9.00 PM	14.00	C
F102	6.05 AM	8.05 PM	14.00	C
F103	5.55 AM	7.55 PM	14.00	C
35	6.00 AM	8.30 PM	14.30	C
37	7.00 AM	7.00 PM	12.00	C
39	6.30 AM	6.30 PM	12.00	C
46	6.00 AM	7.30 PM	13.30	C
66	6.00 AM	8.30 PM	14.30	C
Average			14.04	C

*Score range: A = 6, B = 5, C = 4, D = 3, E = 2, F = 1

Service frequency

The results of service frequency in this study showed that all routes had a long gap of operational frequency, with 76 min of total average headway, resulting in an overall QOS grade of QOS E. Table 7 indicates the overall results for service frequency attributes in this study. Most routes operated with extensive and inconsistent gaps between each departure, with intervals between 60 min and 120 min, signifying irregular service delivery through the bus network. There were several routes operating at approximately 60 min intervals, namely T30A, T30B, T32, F102 and F103, which were graded in QOS E. It showed the inadequate service attractiveness for time-sensitive travel trips. In addition, several routes involving T31A, T33A, T33B, F101A, F101B, and 39, revealed tremendously long headways surpassing 120 min between each trip, were classified as grade

QOS F. These outcomes recommended that service frequency still reflect a main limitation in the bus services, especially when linked to normal established urban public bus services targeted that aimed customer friendly services with more frequent and less waiting time.

Table 7: Quality of services (QOS) for the service frequency attribute

Route	Minute										Average interval	QOS
	210	150	120	90	80	60	45	40	30	20		
T30A						15					60	E
T30B						15					60	E
T31A			7								120	F
T31B			7								120	E
T32						15					60	E
T33A			7								120	F
T33B			7								120	F
T34						9			12		43	E
T35						10			12		44	E
T36							18				45	E
T37					1	12					62	F
F100										41	20	C
F101A			7								120	F
F101B			7								120	F
F102						14					60	E
F103						14					60	E
35						1	1	19			41	E
37						12					60	E
39	1	1	3								144	F
46				5		6					74	F
66						8			13		41	E
										Average	76	E

*Score range: A = 6, B = 5, C = 4, D = 3, E = 2, F = 1

From an analysis perspective, only one route (F100) was classified as QOS C, with an average gap of nearly 20 min, showing a comparatively reliable and frequent service. This difference addressed a significant inconsistency in bus service delivery within routes in the same location. The present public transport study consistently highlighted that higher service frequency increased convenience for passengers, reduced waiting time and enhanced the overall service effectiveness against private vehicles. With regard to Ipoh, most routes were the QOS E and QOS F, which recommended that the existing service frequency may discourage consistent ridership, specifically for passengers, students and transit-based users. The result signified that while limited high-frequency service exists the bus network was unable to offer comprehensible and extensive frequency daily.

Passenger load

The assessment of passenger load attributed for several bus routes in Ipoh, , suggesting a very significant level of service, with all measured routes accomplishing QOS of QOS A. Passenger load results within the assessed route were constantly low, going between 0.08 and 0.22, even with disparities in the total number of passengers boarding. For example, Route T30B and T100 recorded comparatively higher boarding counts, yet continued with low load factors, suggesting adequate bus capacity to accommodate the demand accordingly. Likewise, routes T34 and T37, which recorded lower passenger boardings and exhibited lower occupancy levels. The total average passenger load showed that bus services were managing under capacity, demonstrating slight crowding conditions and a high level of passenger comfort through the data collection period.

Table 8: Quality of services (QOS) for passenger load attribute

Routes	Number of passenger boarding	Passenger load	QOS
T30B	28	0.22	A
T34	5	0.08	A
T37	17	0.09	A
T100	15	0.22	A
F103	8	0.14	A
Average		0.75	A

*Score range: A = 6, B = 5, C = 4, D = 3, E = 2, F = 1

Based on the outcomes, it showed that low passenger load results were mostly linked with enhanced journey comfort, decreasing the standing situations and improving passenger satisfaction level, as underlined in current service quality of public transportation studies. In the circumstance of Ipoh, the consistently higher QOS evaluation designated that the current capacity provided was more than enough for existing demand and needs levels. While these conditions were a very positive point of passenger and user views, they showed an underutilisation of bus services, especially when the passenger load attributed findings were also considered with other service quality attributes. Literature outcomes recommend that low passenger loads reveal disparities between service supply and demand by users, possibly occurring from irregular services, low ridership levels or short operating hours. Generally, the passenger load outcomes not only exhibit a significant performance in terms of crowd and comfort, but also underline the importance of a combined assessment of service quality attributes to ensure that high QOS in passenger load contributes a significant service efficiency and continues to maintain a sustainable public transport in Ipoh.

On-time performance

Lastly, the on-time performance assessment for bus services in Ipoh exhibited a sufficient level of overall timetable compliance with an average on-time departure level of 80.74%, resultant to an overall QOS grade of QOS D. Considered disparities in timetable compliance were seen within routes in this study. Certain routes, such as T32, F102 and F103 attained a 100% of on-time performance according to the timetable, demonstrating highly reliable operations and classified as QOS A. Other routes, including T30B, T34 and 35, were also achieved, with an on-time percentage surpassing of 90%, reflecting higher timetable compliance. On the other hand, a few routes, namely T31A, F100 and 37, 39 and 66, indicated on-time performance lower than 70%, classifying QOS rating of QOS F. These difference highlighted irregularities in operational consistency within the bus services in this study.

Table 9: Quality of services (QOS) for on-time performance

Route	Total departure	Number of on time departure	On time percentage (%)	QOS
T30A	16	13	81.25	D
T30B	16	15	93.75	B
T31A	8	3	37.50	F
T31B	4	3	75.00	E
T32	16	16	100.00	A
T33A	8	7	87.50	C
T33B	8	7	87.50	C
T34	22	20	90.91	B
T35	23	20	86.96	C
T36	19	16	84.21	D
T37	14	11	78.57	E
F100	42	30	71.43	F
F101A	8	7	87.50	C
F101B	8	6	75.00	E
F102	15	15	100.00	A
F103	15	15	100.00	A
35	22	20	90.91	B
37	13	7	53.85	F
39	6	4	66.67	F
46	12	10	83.33	D
66	22	14	63.64	F
Average			80.74	D

*Score range: A = 6, B = 5, C = 4, D = 3, E = 2, F = 1

Based on the previous study, on-time performance attributes are extensively known as a critical element of passenger expectation and trustworthiness towards the reliability of public transportation. Certain routes with high schedule compliance provided a high expectation, thereby reducing perceived waiting times and improving passenger trustworthiness. Contrariwise, routes with poor schedule compliance may cause substantial inconvenience to passengers, especially when merged with extensive service headways, as service interruptions can intensify uncertainty and lower the feasibility of travel time according to the permitted schedule by the public transportation authority. Current transport findings constantly address that unreliable service can deter existing users and play a part in total dependency towards private vehicles. In this study, most routes were classified as QOS D, QOS E, and QOS F, showing that several routes exhibited strong reliability and the overall bus service performance remained imbalanced. Improving schedule compliance, specifically on low-performing routes by managing punctuality, operational monitoring, and traffic management, would be important to improve the overall QOS and reinforce the function of bus services as a main transport mode in urban mobility.

Quality of Services (QOS)

The overall QOS assessment for bus services in Ipoh showed a sufficient level of service performance, with a mean QOS score of 3.75, resulting in an overall grade of QOS C, as shown in Table 10. The study result revealed a varied result within the assessed service quality attributes. Service hours, classified as QOS C (score = 4), indicated that operating hours were generally adequate for daily travel necessities but still limited in early-morning and late evening hours. In contrast, service frequency emerged as the lowest attribute, obtaining QOS E (score = 2), showing prolonged headways and infrequent services that lower convenience and accessibility. Conversely, passenger load is classified as QOS A (score = 6), indicating a low occupancy level and high passenger load within all routes. On-time performance, graded as QOS D (score = 3), revealed moderate timetable adherence for all routes. Collectively, these outcomes showed that a disparity in QOS attributes existed, whereby certain attributes had good reliability and limited availability.

Table 10: The overall quality of services (QOS) in Ipoh

Attributes	QOS	QOS Score	Mean QOS	Overall QOS
Service hours	C	4	3.75	C
Service frequency	E	2		
Passenger load	A	6		
On-time performance	D	3		

*Score range: A = 6, B = 5, C = 4, D = 3, E = 2, F = 1

Current literature on public bus services highlights that overall service quality effectiveness is limited by its weakest service quality attributes, especially those related to availability and reliability. In the case of Ipoh, the strong performance showed by the passenger load attribute did not fully balance by deficiencies in service frequency and on-time performance, as infrequent and unreliable services can considerably diminish perceived service quality regardless of the comfort situation. The overall classification in this study was QOS C, which showed that the bus services offered a fundamental and functional bus service, but lack consistency and availability and are essential to remain competitive as compared to private transport and e-hailing modes. To improve service quality, room for improvement in service frequency and on-time performance are essential, together with enhancements to longer service hours. In summary, the integrated QOS outcomes proposed that while bus services in Ipoh are operationally adequate, strategic service planning and operational optimisation are essential to accomplish a more reliable, balanced, user-friendly services. The results show that bus services are aligned with the implementation of transit-oriented development (TOD) policy in Ipoh, Perak, where most of the urban areas are covered by stable and continuous public bus services. Bus operators and state authorities should monitor current bus services compared with the main principles of transit-oriented development (TOD), which are the transit system, density, and potential of land development, and economic development.

In addition, passengers and users also conveyed substantial concerns in certain areas, such as requiring real-time information on bus services along the whole route to promote usage of bus services as a preferred transportation mode. This study was conducted after the post-COVID-19 pandemic. The core limitation of this study was focus solely on a quantitative engineering approach to QOS attributes. Therefore, the recent study should act as a fundamental understanding of urban bus service quality in this country, and it is strongly suggested to combine both quantitative and qualitative methods, as well as the adaptation of the Internet of Things (IoT), in future studies in this area. Moreover, the public transport authority, states local council and bus operators should work closely together to improve bus services and urban public transportation for the benefits of passengers and users in Ipoh.

CONCLUSION AND RECOMMENDATION

The motivation of this study is to assess the QOS of urban bus performance in Ipoh, Perak. This study primarily evaluated bus services in Ipoh by assessing its QOS using the transportation engineering guidelines, Transit Capacity and Quality of Service of Manual (TCPRM, 2013). Four attributes were assessed in this study, which covered service hours, service frequency, passenger load and on-time performance. A total of 21 bus routes in Ipoh were assessed. The results

demonstrated that the average operating hours were 14 h and 4 min daily, resultant to an overall QOS service hours rating of QOS C. The average service frequency recorded a headway of 76 min, reflecting an overall QOS rating of QOS E. Passenger load results across the route were consistently low, between 0.08 and 0.22, despite variations in the number of passengers boarding, corresponding to an overall QOS rating of QOS A.

On the other hand, the assessment of on-time performance for bus services in Ipoh demonstrated a moderate overall level of schedule adherence, with an average on-time departure rate of 80.74%, corresponding to an overall QOS rating of QOS D. The overall QOS assessment for bus services in Ipoh indicated a moderate level of system performance, with a mean QOS score of 3.75, corresponding to an overall classification of QOS C. The integrated QOS results suggested that while bus services in Ipoh are operationally sufficient, strategic service planning and operational optimisation are required to achieve a more balanced, reliable and user-oriented public bus service. The outcomes of this study can be a reference for the authority and bus operators to upgrade the QOS of urban bus services. Further study on this topic by other researchers is highly recommended.

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DISCLOSURE STATEMENT

The author declares that there is no conflict of interest in this research.

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