TO UNDERSTAND THE QUALITY SERVICE RATINGS FOR URBAN BUS PERFORMANCE: WHAT IS QUALITY OF SERVICES IN BUS PERFORMANCE?

Shuhairy Norhisham[1],
[1]*Department of Civil Engineering, College of Engineering,*
Universiti Tenaga Nasional, Malaysia.
shuhairy@uniten.edu.my

Amiruddin Ismail[2] ,
[2]*Department of Civil and Structural Engineering,*
Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia, Malaysia

Muhamad Nazri Borhan[2],
[2]*Department of Civil and Structural Engineering,*
Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia, Malaysia

Herda Yati Katman[1] ,
[1]*Department of Civil Engineering, College of Engineering,*
Universiti Tenaga Nasional, Malaysia.

ABSTRACT

The overview of this paper is aimed at understanding the method of assessing bus performance in terms of quality of services. Numerous attributes have been ascribed to rate service quality. One such rating is related to the level of quality in service in its many dimensions. Therefore it was concluded that the factual dimensions of service quality are; tangibility, reliability, responsiveness, assurance and empathy; due to their highest ranking of measurement. These dimensions explored people's satisfaction and their determinants.

Introduction

The aim of this paper is to understand the philosophy behind identifying the quality of services used to assess bus performance. From previous research, it can be said that service reliability and frequency are the most important attributes to measure the quality of bus services. Shaaban & Khalil, (2013) mentioned that the attributes should also include accessibility, reliability and mobility provision which were rated by the target market as an important service attribute. Convenience according to Warman (2014) is defined as 'no effort in operating transport services that are purposed to install in the way they are operated'. Majumdar & Lentz (2011) were referring to the convenience attribute based on commuter preferences.

Test routes

As suggested by ISE & HINO (2010), the questionnaire used is divided into two separate surveys. The first questionnaire contains investigation of bus demands and problems, while the second measures the intention to use trial buses, public involved consciousness, recognition of the necessity of bus transportation services, and understanding of provided information. The second questionnaire is used as the main part to evaluate data. The following shows the different attributes divided into several parts:

- Individual attribute= address, sex, age, occupation
- Intention to use bus= need of bus use, destination, trip frequency, trip purpose
- Understanding of information= Recognition of the necessity of bus transportation services
- understanding of each information= recognition of the necessity of bus services and some reasons
- Public Involved consciousness= workable activities to contribute to sustain bus service

Significant Elements of Service Quality

The importance of Public Transport (PT) includes safety, accessibility, reliability, fares, communication, and trip experience. These services are held by private companies along with the government which have resulted in poor integration and coordination. (Kamaruddin, Osman, & Pei, 2012)

In terms of exogenous variables, (Ang, Mahat, & Ahmad, 2006) have distributed them into numerous classifications including quality of bus (tangibles), quality of driver (responsiveness, competence, credibility, courtesy, communication, understanding the customer), and quality of service (reliability, security, accessibility)

Haron, Noor, Sadullah, & Vien (2010) define service quality in terms of the load dimension item, which can be divided into a few types such as environment, economy, safety, and security, and accessibility.

In accordance with the study by Leong, Abidin, Bagheri, & Sadullah (2010) , the headway and segment time are the most important elements for transit line. This is because both attributes will possibly affect the passengers' decision to choose the best routes to reach their respective destinations. The five-valued parameters which passengers need to specify are: boarding time, wait-time factor, wait-time weight, boarding time weight, and auxiliary time weight which are the attributes that are applicable in the sensitivity analysis.

In terms of convenience, Warman (2014) believes that availability, information, time, customer care, comfort , security, and environment play an equally important role in ensuring the convenience of customers. Although availability is thought to be more important than journey time; both attributes, coupled with bus information are rated far more important than comfort and security to the customer. Majumdar & Lentz (2011) consider that the variables for convenience should include travel cost savings, frequency of service, time savings, and accessibility to jobs, together with the acceptance of a variety of payment options, and an opportunity to do other things while travelling.

Attributes/Categories used to measure Service Quality

Level of Service (LOS)

In terms of definition, level of service is a qualitative measurement that rates the level of traffic congestion. The selection of the most appropriate parameters for evaluating the level of service quality is a very important issue.

The demand for public transportation along with supplemental demand abundance correlated with the level of service on service routes which should be based on the population adjacent to the route. (Barnum, Tandon, & McNeil, 2008b)

Level of service is based on the users' perceptions. Perception includes imprecise terms and fuzzy sets that can be used to capture this imprecision. (C. Sheth, Triantis, & Teodorović, 2007) According to C. H. Sheth (2003) the level of service is as functional as time-based measurements which represent the full-range of passenger needs. Thus, the level of services should be carefully developed as they act as proxies of speed.

Highway Capacity Manual 2000 (HCM 2000) provides a Level of Service (LOS) with several modes which include auto, transit, bicycle and pedestrian modes. Transit LOS consists of service frequency, hour of services, passenger load, and service reliability. (Saberi, Ali Zockaie, Feng, & El-Geneidy, 2013)

The measurement for time spent waiting for a bus and boarding time for the whole journey helps to efficiently gauge the level of service, especially for the public bus system. This is in agreeance with the feedback given, indicating the inefficiency of the public bus system is almost always is associated with the wasting time factor. (Leong, Abidin, Bagheri, & Sadullah, 2010)

When referring to Eboli & Mazzulla (2012), performance standards must be established for each objective measured in order to evaluate and monitor service quality. Otherwise, it also can be expressed in a format of built-in interpretation. The format of LOS has been established by the Highway Capacity Manual for the evaluation of the road traffic flow quality levels.

Each objective was established prior to the measurement of the service quality. This was carried out so that the performance indicators could be expressed in a format that provides built-in interpretation. It is thought that appropriate measures make use of passengers that claim the level of service should be more oriented to the customers' needs and linked to their tastes (Eboli & Mazzulla, 2012)

Level of service (LOS) is divided into six ranges starting from A (highest quality) to F (lowest quality). The results will obtain the level of service since the results reflect the passengers' point of view and not the operators' point of view. (Yaakub & Napiah, 2011b)

Eboli & Mazzulla (2011) used nine level of service variables that contain walking distance to the bus stop, service frequency, service reliability, bus stop facilities, bus crowding, cleanliness, fare, availability of information at the bus stop, and personnel attitude. For the walking distance to the bus stop and ticket price, it is placed in a different category because it is considered a manipulated variable which is continuous and measured in time. Furthermore, Euro. C. Sheth et al. (2007) highlighted the issues revolving around the level of service to service coverage, frequency, duration, availability and quality of pedestrian routes to the transit stops, population, and job density. Transportation criteria include mobility, connectivity, accessibility, cost effectiveness, energy efficiency, air quality, impact of natural resources, noise, safety, neighbourhood impact, employment effects, and economic impact. Generally, the services for seat hours and seat miles would also be provided because the revenue or cost ratios are equal. Therefore, to determine the level of service, it is important to reflect on the environment too. (Barnum et al., 2008)
In addition, level of service is defined by C. Sheth et al. (2007) as pertaining to the specific operational, passenger and societal goals.

SERVQUAL

The most dominant instrument in measuring service quality is SERVQUAL proposed by Parasuman to measure the commuter's perception on service quality. Ilhaamie (2010) used the SERVQUAL scale to assess the level and significance of service quality

perception of commuters. Five important dimensions of SERQUAL are tangibility, reliability, responsiveness, assurance, and empathy. While, Mazzulla & Eboli (2006) developed SERVQUAL by marketing academics as a service quality evaluation method. Yang, Zhang, An, & Liu (2010) believe that there is a gap between service expectation and perception. They spilt the dimension into several parts which are described as follows:

- Service convenience= Information available, stations located properly, clear labels and signs, dynamic traveller information at stations, arrival information, convenient transfer
- Tangible facilities= Facilities in good condition, vehicles in good condition, clean carriage, accurate and in-time on-board information, inner – carriage facilities in good condition, enough seats or standing space
- Encounter with passengers= Rational price, considerate stuffs, polite stuffs, experienced drivers, no stops skipping, feedback and advice welcome
- Operation support = Short waiting time, timetable obeyed

Mode of Network

Currie (2005) divided trip attributes into transit mode neutral and transit mode. This is divided according to the satisfaction level of passengers that evaluate the attributes for alternative public transport modes differently. The trip attributes are made up of:

1) Transit Mode Neutral Trip Attributes

- Access walk: Walking distance from trip origin to transit stop/station
- Egress walk: Walking distance from alighting stop to trip destination
- Wait time: Time for arrival transit and time at transit
- Fare: Ticket price
- In-vehicle travel time: Time spent during traveling from boarding stop to alighting stop

2) Transit Mode Specific Trip Attributes

- Transfer penalty: Perceptual value of the need to transfer between one transit vehicle to another
- Mode-specific factors: Other factors perceived by passengers to vary with transit mode

According C. Sheth et al. (2007) five inputs are provided for mode of the network which are:

- Headway (min): the time difference between two consecutive service vehicles.
- Service duration (hours): summation of time for the whole day, which includes the overall service provided where the average value is taken.
- Costs (dollars): anything related to cost, which includes infrastructure, maintenance, operating costs, and other miscellaneous costs for all the service vehicles operating on that route.
- Number of intersections (number of intersections): the intersection of each route including signalized routes.
- Number of priority lanes (number of priority lanes): only bus accessible lanes on bus routes. The higher priority lanes for buses will increase the efficiency.

Leong et al. (2010) state that boarding time can be applied in node/specific value. The time required for each boarding shows the penalty added to the trip impedance. Another parameter that is suitable are wait-time factor, wait time weight, boarding time weight, and auxiliary time weight.

Bus Information System (BIS)

The lack of information will make the movement of bus routes slower. The problem with bus crew scheduling is that it tends to create lots of work which include vehicle scheduling, crew scheduling, and crew rostering information, stored in a database and recorded as historical cases. (Liu, Ma, Guan, Song, & Fu, 2012).

Bus Information System (BIS) is classified into two forms which are bus location and expected arrival times. The factors that affect the optimal expected arrival times are punctuality of bus operation or operating time distribution, accuracy of predicting bus arrival time, attitude of users waiting at the stop, and bus operation strategies when a gap between the real and scheduled time occurs. However, generating bus arrival information errors is prevented when processing and stipulating it as a system error. Consequently, the system can be reorganized and detected to calculate the statistical average when they create a method to correct bus arrival information. (SHIN, KANG, & KOOK, n.d.)

Service Quality Index (SQI)

Service Quality Index provides an operationally appealing measure of current or potential service effectiveness. Hence, it is important to identify the service quality that attributes on global customer satisfaction. (Mazzulla & Eboli, 2006)

Mazzulla & Eboli (2006) defined product services as the measurement of cost efficiency which is measured in vehicle kilometres; meanwhile the consumed service is known as a measurement of service effectiveness.

In the research carried out by Eboli & Mazzulla (2008), Service Quality Index was used as their attribute in order to determine the level of service quality, which shows that they calculated SQI by using estimated coefficient. This index is calculated like a linear combination of attributes, which is weighted against its importance. For example, 13 service quality attributes of bus industries were selected where each of them on three levels produced different alternatives.

Similarly, Govender (2014) also used Service Quality Index in a questionnaire survey. The questionnaires were divided into five (5) categories and then combined into a cumulative index which was termed the perception of service quality index (PSQ). The

attributes and dimensions for service quality were divided into two groups which are RECSA Service Quality Dimensions and RATER Service quality Dimensions. The description of services attributes are as follows (Source. Adapted from McKnight et al. (1986); Parasuraman et al. (1988)):

1) RECSA Service Quality Dimensions

- Reliability= Arriving on time, notification of delays, waiting away from home delays en-route
- Extent of service= Total hours of service, Service on weekends, Service on public holidays, Service on weekdays, Service in the evening
- Comfort= Guaranteed smooth seat ride, Sheltered waiting areas, air conditioning
- Safety= Low probability of accidents, Low probability of falling, Low probability of assault
- Affordability= Alternatives –season tickets, Cheap fares, Value for money

2) RATER Service quality Dimensions

- Reliability= The ability to perform the promised service in a dependable and accurate manner
- Assurance= Knowledge and courtesy of employees and their ability to convey trust and confidence
- Tangibility= the physical evidence of the service, eg. the appearance of the personnel and physical facilities, and equipment used to provide the service
- Empathy= Caring, individualized attention provided to customers
- Responsiveness= The readiness and willingness to help customers in providing prompt timely services

Other attributes that can be measured are fares, travel time, waiting time during peak and non-peak hours, safety, and reliability of the new system, reduction of externalities: fuel consumption for vehicles used along the corridor, demonstrating the undeniable advantage of formal public transport.

Customer Satisfaction Index (CSI)

Customer Satisfaction Index is calculated based on the average of one and by using weighting system based on importance. Rate of importance and satisfaction were assigned to the customers for each service attribute. The average of the weighting was then divided. By this way, the average weighting can be obtained. Then the summary of CSI were obtained based on the sum of all weighted scores. (Mazzulla & Eboli, 2006)

Punctuality Index

Napiah & Yaakub (2010) used the Punctuality Index (PI) that is helpful in indicating the time gap between scheduled and actual arrival with the departure time for a bus, or also called the headway adherence. Based on the Yaakub & Napiah (2011a) research, they divided punctuality index into several parts which are:

- Punctuality index P1 as an index indicating the magnitude of a time gap between actual arrival time and scheduled arrival time.
- Punctuality index P2 as magnitude of a time gap between actual headway and scheduled headway.
- Punctuality index P3 is an index indicating the magnitude of a time gap between average headway of a day and each headway of successive buses.

Therefore, it is shown that the punctuality is a quantitative measure of reliability. The term punctuality is a comparison between actual arrival time and scheduled arrival time at a station. On the other hand, the departure time is a more preferable measurement than arrival time for passengers since heavy ridership can cause lengthy dwell times. (Yaakub & Napiah, 2011b)

Earliness Index (EI)

Saberi et al. (2013) defined Earliness Index (EI) as the percentile rank of delay/headway deviation of zero. It is percentage of delay/headway deviations in its frequency distribution that are lower or equal to it.

Width Index

Frequency services are to capture the width of the distribution of headway deviations. The Width Index (WI) is defined as the 95th percentile of headway deviations minus the 5th percentile of headway deviations divided by the average scheduled headway (Saberi et al., 2013)

Sensitivity analysis

Vien, Bagheri, & Sadullah (2010) described sensitivity analysis as an instrument for the input parameters of an assessment, with respect to its impact on model output. It is useful to apply model development and model validation to reduce the levels of uncertainty. Five parameters that are measured are boarding time, wait time factor, wait time weight, auxiliary time weight, and boarding time weight. Martínez & Viegas (2011) viewed a sensitivity analysis in terms of parameters of the system that help to understand the parameters which could significantly reduce system costs.

Mohammed, Alelweet, Karim, & Shams (2012) use sensitivity analysis as an attribute to measure service quality. The two groups recognised were travel time and travel cost reduction. Travel time reduction is tested by taking the public transport services from the sensitivity analysis of modelling. Meanwhile, travel cost reduction is the reduction of the fare to encourage people to start using the minibus. Whilst Leong et al. (2010) said the attribute for sensitivity analysis applicable are boarding time, wait-time factor, wait-time weight, boarding time weight, and auxiliary time weight.

Conclusion

Overall, numerous attributes can be used for service quality rating. One related to the level of service quality in its main dimensions. Therefore it could be concluded that the factual dimensions of service quality are tangibility, reliability, responsiveness, assurance, and empathy due to the highest ranking of measurement. The dimensions were investigated to further explore people's satisfaction of urban bus performances and their determinants.

Qualitative systems can be summarized as service reliability and frequency that are important attributes which are most effective in attracting car users that are linked to individual perceptions, motivations and contexts.(Shaaban & Khalil, 2013)

REFERENCE

ANG, C.-L., MAHAT, N. I., & Ahmad, Y. H. J. (2006). SERVICE QUALITY SATISFACTION OF PUBLIC BUS SERVICE : A STRUCTURAL EQUATION MODELING APPROACH. *International Journal of Management Studies (IJMS)*, *13*, 49–63.

Barnum, D. T., Tandon, S., & McNeil, S. (2008a). Comparing the Performance of Bus Routes after Adjusting for the Environment, Using Data Envelopment Analysis. *Journal of Transportation Engineering*, *3073*(Mc 243), 1–26.

Barnum, D. T., Tandon, S., & McNeil, S. (2008b). Comparing the Performance of Urban Transit Bus Routes after Adjusting for the Environment , Using Data Envelopment Analysis. *UIC Great Cities Institute*.

Currie, G. (2005). The Demand Performance of Bus Rapid Transit. *Journal of Public Transportation*, *8*, 41–55.

Eboli, L., & Mazzulla, G. (2008). A Stated Preference Experiment for Measuring Service Quality in Public Transport. *Transportation Planning and Technology*, (October 2012), 37–41.

Eboli, L., & Mazzulla, G. (2011). DISCRETE CHOICE MODELS AS A TOOL FOR TRANSIT SERVICE QUALITY EVALUATION. *Electronic Journal of Applied Statistical Analysis: Decision Support Systems and Services Evaluation*, *2*(1), 65–73. doi:10.1285/i2037-3627v2n1p65

Eboli, L., & Mazzulla, G. (2012). Performance indicators for an objective measure of public transport service quality. *European Transport*, (51), 1–21.

Govender, K. K. (2014). Public transport service quality in South Africa: A case study of bus and mini bus services in Johannesburg. *African Journal of Business Management*, *8*(10).

Haron, S., Noor, S. M., Sadullah, A. F. M., & Vien, L. L. (2010). THE HEADWAY PATTERNS AND POTENTIAL PARAMETERS OF BUS TRANSPORTATION IN PENANG. *Proceeding of Malaysian Universities Transportation Research Forum and Conferences*, *2010*(December), 279–290.

Ilhaamie, A. G. A. (2010). Service Quality in Malaysian Public Service : Some Findings. *International Journal of Trade, Economics and Finance*, *1*, 40–45. doi:10.7763/IJTEF.2010.V1.8

ISE, N., & HINO, Y. (2010). Effects of Information Provision to Encourage Public Involved Consciousness Toward Sustainable Bus Service. *Research Associate, Urban Research Plaza*, (November 2009), 11–18.

Kamaruddin, R., Osman, I., & Pei, C. A. C. (2012). Customer Expectations and its Relationship Towards Public Transport in Klang Valley. *JOURNAL OF ASIAN BEHAVIOURAL STUDIES*, *2*.

Leong, L. V., ABIDIN, N. I. Z., BAGHERI, Y., & SADULLAH, A. F. M. (2010). Sensitivity Analysis of Passenger Volume for Public Bus Services : Case Study of Penang Island , Malaysia. *Journal of the Eastern Asia Society for Transportation Studies*, *8*.

Liu, T., Ma, J., Guan, W., Song, Y., & Fu, P. (2012). Design and Implementation of Bus Crew Scheduling System Using Integrated Case-based and Rule-based Reasoning. In *2012 Fifth International Joint Conference on Computational Sciences and Optimization* (pp. 475–479). Ieee. doi:10.1109/CSO.2012.110

Majumdar, S. R., & Lentz, C. (2011). Individuals' Attitudes Toward Public Transit in a Rural Transit District. *Public Works Management & Policy*, *17*(1), 83–102. doi:10.1177/1087724X11421953

Martínez, L. M., & Viegas, J. M. (2011). Design and Deployment of an Innovative School Bus Service in Lisbon. *Procedia - Social and Behavioral Sciences*, *20*, 120–130. doi:10.1016/j.sbspro.2011.08.017

Mazzulla, G., & Eboli, L. (2006). A Service Quality experimental measure for public transport. *European Transport*, *34*, 42–53.

Mohammed, A. A., Alelweet, O. A., Karim, M. R., & Shams, O. A. (2012). An optimization solution by service science management and engineering (SSME) for using minibuses service as an alternative for private cars around Hentian Kajang in Malaysia. *Journal of Civil Engineering and Construction Technology*, *3*(1), 25–41. doi:10.5897/JCECT11.028

Napiah, M., & Yaakub, N. (2010). PRELIMINARY ASSESSMENT ON RELIABILITY OF PUBLIC BUS SERVICE IN KOTA BHARU. *Proceeding of Malaysian Universities Transportation Research Forum and Conferences 2010*, (December), 49–58.

Saberi, M., Ali Zockaie, K., Feng, W., & El-Geneidy, A. (2013). Definition and Properties of Alternative Bus Service Reliability Measures at the Stop Level. *Journal of Public Transportation*, *16*, 97–122.

Shaaban, K., & Khalil, R. F. (2013). Investigating the Customer Satisfaction of the Bus Service in Qatar. *Procedia - Social and Behavioral Sciences*, *104*(1), 865–874. doi:10.1016/j.sbspro.2013.11.181

Sheth, C. H. (2003). *The Measurement and Evaluation of Performance of Urban Transit Systems : The Case of Bus Routes*.

Sheth, C., Triantis, K., & Teodorović, D. (2007). Performance evaluation of bus routes: A provider and passenger perspective. *Transportation Research Part E: Logistics and Transportation Review*, *43*(4), 453–478. doi:10.1016/j.tre.2005.09.010

SHIN, D., KANG, K., & KOOK, W. (n.d.). A Study of Evaluation Index and Level for Real-Time Bus Arrival Information Reliability.

Vien, L. L., Bagheri, Y., & Sadullah, A. F. B. M. (2010). Analysis of Headways on Passenger Loads for Public Bus Services : Case Study of Penang Island , Malaysia. *European Journal of Scientific Research*, *45*(3), 476–483.

Warman, M. (2014). Valuing Convenience in Public Transport.

Yaakub, N., & Napiah, M. (2011a). Public Transport : Punctuality Index for Bus Operation. *World Academy of Science, Engineering and Technology*.

Yaakub, N., & Napiah, M. (2011b). Quality of Service and Passenger's Perception – A Review on Bus Service in Kota Bharu. *International Journal of Civil & Environmental Engineering IJCEE-IJENS*, *11*(October).

Yang, X., Zhang, D., An, J., & Liu, H. (2010). Passengers' perception based public transportation service quality evaluating methodology. *The Sixth Advanced Forum on Transportation of China Service*, 155–160. doi:10.1049/cp.2010.1121