

Estimation of transportation service quality for selected groups of users using customer satisfaction index

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ABSTRACT

The supply of effective and efficient public transportation services is important and essential for society and environment. This can encourage people to use public transit and reduce the usage of private cars which have roles in achieving sustainable goals that related to providing sustained modes of transportation. This, in turn, leads to avoid or reduce the effect of the most important global issues such as, traffic congestion, air pollution, fuel consumption, and other environmental consequences. Therefore, there is a need to identify the attributes that enhance the satisfaction and increase the usage of public transportation which are various across the different cultures, demographics, and purposes. In Iraq, there are a few studies that considered the demand for public buses as it is the main mode of public transportation. The aim of this paper is to measure to what extent the supplied public transportation service is satisfied through identifying the factors that enhance the choice of public transportation by road users and measure the quality service of public transportation. To achieve these objectives, a questionnaire method was used to collect the needed data for a specific group of people which are students and academic staff. The study areas, which were selected according to the purposes of trips which are education and work trips, are the area around Al-Essra University and Al-Mansour University in Al-Karadah sector in Baghdad City. The collected data was analyzed to describe the attributes that passengers based on in selecting the mode of transportation and to determine an aggregated index which can be used to quantify the quality of the public transportation service in the selected area. The results show that about 44% of people who prefer to use their private cars have decided this because of the long waiting time at bus stops and inside the buses. While about 42% of passengers who prefer to use public buses have decided their mode of transport based on the cost criteria. Regarding the transit service quality, it has been found that the safety indicator is the most important criterion that passengers based on in assessing the quality of service. This can be considered in further studies or transportation projects.

Keywords: Public transport, service quality, mode choice, educational trips, CSI

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1. Introduction

Public transportation is considered a way of sustainable transportation, with more 95% of roads are paved with flexible pavement [1-3]. It has different modes such as buses, trains, and underground railways [4]. The choice of transportation mode is affected by many factors, These factors can be classified into three groups, socio-economic characteristics, trip characteristics, and transportation system characteristics [5, 6].

The significant roles of the factors that are related to the socio-economic characteristics; such as age, gender, car-ownership, and income; in the choice of transportation modes have been demonstrated by many research and studies [7]. However, the degree of influence is different based on the difference in cultures and the general conditions of the area.

Trip characteristic is another factor affecting the mode choice process; depending upon the purpose of a trip such as work and shopping; travel time, trip beginning and destination, and distance [7-9].

Transportation system characteristics would influence individuals mode selection through certain factors such as usable routes, trip overall time, different types of charge of travel, and public transport system efficiency [6]. Other factors such as the value of time, safety, and comfort requirements also affect the choice of travelers. However, to what extent each of the above factors affects the mode choice process is different based on other control factors, such as the local conditions and various cultures. Therefore, there is a need to figure out the attributes and quantify their effect on the passenger selection of transportation mode, which in turn would be helpful to improve public transportation services and encourage individuals to use them in the local area.

The increase in using private cars in urban areas is considered one of the indicators of not achieving sustainable goals [1, 10]. As it leads to fluctuation in traffic speed, significant delay time, ineffective public transportation service, increase in the rate of road crashes, and environmental and economic negative consequences [1, 11-13]. Therefore, there is a need to improve the quality of the public transportation service and this requires identifying the service quality indicators.

2. Quality service of public transportation

Generally, service quality is defined as “the gap between consumer’s perceptions and expectations in terms of different dimensions of service quality which can affect their future use behavior [13-15]. In the other words, it can be defined as how the service meets the customers’ expectations [16]. It is used recently to evaluate the performance of the public transportation services from the customers’ point of view while it was assessed by the managers’ point of view in the past studies [11].

Efficiency and effectiveness have great importance as service quality measures of transport as they are easily defined and measured. The efficiency is characterized as produced service (expressed as vehicle kilometers), while the effectiveness is described as consumed service (passenger kilometers). However, there are other measures that would depend upon passengers’ preferences and demands which in turn affect the usage of public transport [16-18]. The criteria of public transportation service quality that affect the road users’ perception are considered in previous studies. The most important criteria are availability, accessibility, reliability, safety, speed, cost, and comfort [13]. The service quality from the riders’ point of view can be assessed using these criteria. The availability of the public transportation service can be measured in terms of the service frequency, space and seat availability, and time of service through optimizing timetables while accessibility can be reflected by the connection of public transit services with other transport services through optimum line routing and how closer the destination to the stops or terminals. Safety is considered to enhance the quality of service and it can be measured by the probabilities of traffic accidents resulted from public transportation. On the other hand, how the service is comfortable, clean, and pleasant to passengers has been also considered by some authors to describe the service quality and the passengers’ orientation. Regarding the speed of trips, passengers prefer faster trips with shorter travel time and fewer changes. Service cost can be measured by the fare amount and collection method [16, 19]. However, researchers approved that the demographic characteristics have a significant role in determining the satisfaction of the public transportation service. Furthermore, there is a significant difference regarding the attitudes of passengers’ behavior across different cultures [4]. Therefore, it is essential to identify the indicators that can be used in measuring the service quality of public transportation based on local conditions.

3. The aim of the research

The main aim of the research is identifying the main indicators that affect the mode choice and the main attributes that are used to quantify the public transit service in a selected study area in Baghdad City. It will focus on a specific trip purpose, educational trips, to a specific educational center in Baghdad City. To achieve the main aim, the following objectives are considered:

- a. Identifying the attributes of the public buses mode in the selected area that attract the users.
- b. Identifying the attributes of the private cars mode in the selected area that make users leave the use of public transportation.
- c. Identifying and quantifying the indicators of the public transportation service in the selected area.

4. The methodology of the research

To achieve the aim of the study, the following steps have been carried out:

- a. Selecting the study area

- b. Collecting the necessary data
- c. Analysing data to identify the main attributes that passengers based on in selecting the mode of transportation.
- d. Quantifying the service quality through identifying and quantifying the service quality indicators.

4.1. The study area

Selecting the study area depends on the purpose and the aim of the study. The area around two education centers which are Al-Essra University and Al-Mansour University is selected for this study. The main purpose of the trips to these centers is educational purpose. In addition, these two universities are private universities and this may affect the type of responses as most of the students belong to a high-income family class. Generally, the available modes of transport in Baghdad city at the time of the survey, and specifically in the study area, are cars, vanpooling, and Jitney which are minibuses having a capacity of 10 to 12 riders. There is no fixed timetable for public transportation trips. The routes of most of the public buses are fixed with changes in the conditions of high traffic congestion and other special conditions. Taxies are also a common mode of transportation in the study area.

4.2. Data collection

The needed data is identified based on the factors affecting the mode choice considered by previous studies. Questionnaire method is used in this study as it is the most suitable method to collect the needed data. The questionnaire list was divided into three sections;

- The first part was for private car mode users.
- The second part was for public transit users;
- The third part was for both of them to quantify the quality of public transportation service according to public opinion.

To determine the sample size, the number of students in both universities is considered the population size, about 15000. Then, the sample size with a confident level of 95% and marginal error of 5% was computed, it was about 375. Therefore, about 400 questionnaire forms were distributed, 290 of them females and 110 males.

4.3. Analyzing the collected data

The results of the study are presented here in three sub-sections according to the parts of the questionnaire.

4.3.1. The users of private cars

In this group of students, the main attributes that affect their choice according to the results of the data analysis are shown in Fig. 1. Most of the private car riders prefer this mode of transportation to avoid the too long waiting time at the buses' stops plus waiting time inside the bus until the vehicle is full. Around (42%) of the customers considered this factor is the main reason user their private cars. The second attribute, which was selected by about 22% of customers, is the speed of transportation mode, as buses are operated at a slower speed than private cars because of the frequent bus stops to load and unload passengers. The third attribute is the service frequency which was ticked by about (15%), and the better accessibility destinations which were ticked by (13%). The remaining customers have used the private car to avoid the multiple vehicle riders to reach their destination. These attributes can reflect the negative factors of using public buses that should be considered by the operators to improve the operational performance of the public buses.

4.3.2. The users of public buses

The results of the second group of customers who prefer to use public transportation are analyzed using the same method. The factors motivating the use of public transport are shown in Fig. 2.

The low price service was the main reason for about 55% of passengers to use public buses while about 23% of customers use public buses because they do not own cars. About 15% of passengers show that the public buses service is available and they considered this as a factor of choosing public bus service. The remaining passengers considered the safety factor is attributed to select the buses service.

These factors reflect the strengths of the public buses service and could be considered in enhancing the attitude of road users to use public buses.

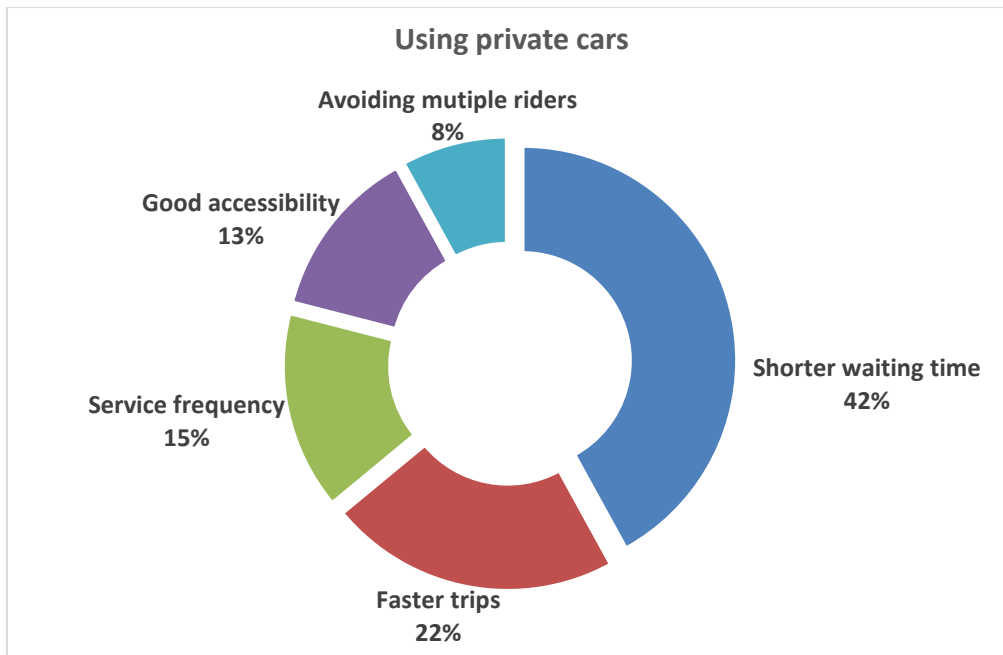


Figure 1. Results of private cars users

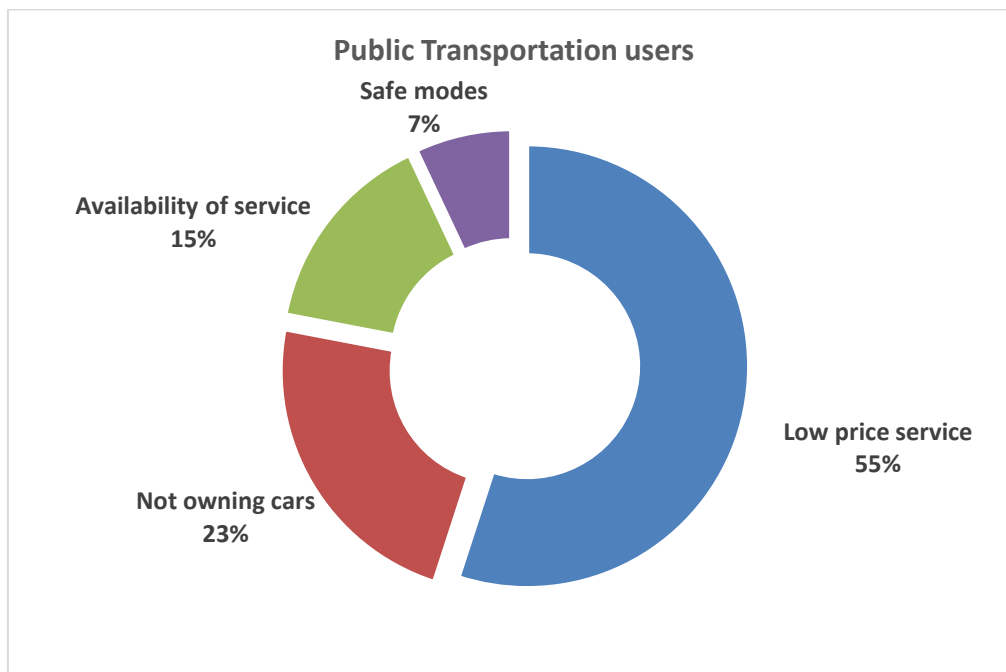


Figure 2. Results for public buses users

4.3.3. Results for service quality attributes

Regarding the measurement of the service quality, the most govern attribute for the chosen group in this study were:

- Comfortable service, about 36% of respondents had chosen this attribute as the main indicator of the service quality of the public buses,
- The number and location of bus stops. About 27% of respondents considered that more frequent stops along the busy route can improve the quality of the transit service.

- The driver behaviour includes the driving style, as 19% of respondents have been measuring the service quality through the behavior of the buses' drivers.
- Frequency of service. Only 15% considered this attribute as an important factor.
- The cost of service is chosen by only 3% of respondents.

Fig. 3, shows the results for service quality attributes.

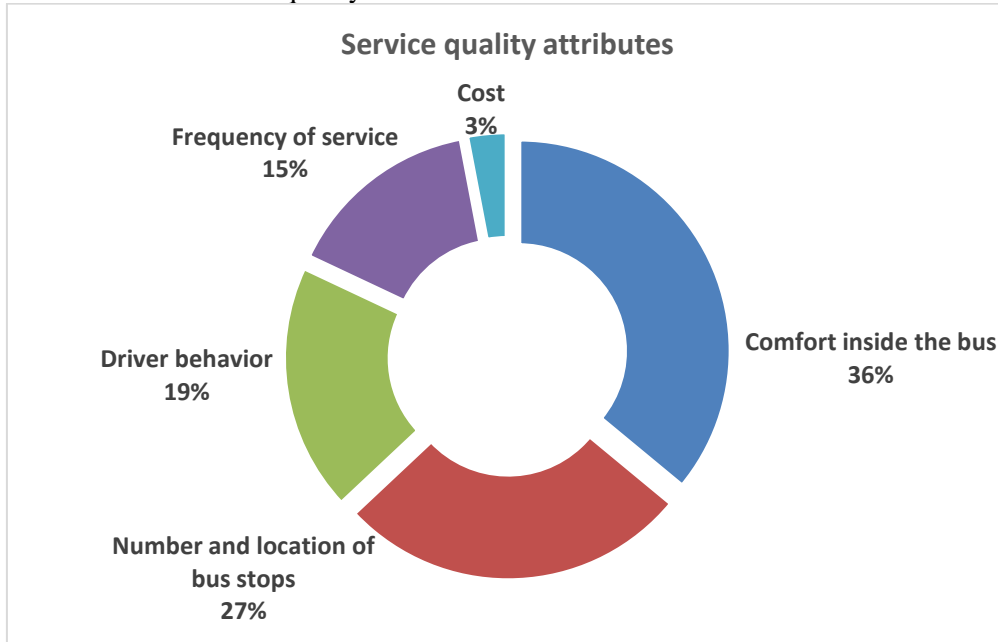


Figure 3. Results for service quality attributes

4.3.4. Service quality index SQI

Service Quality index SQI is used to quantify the quality of the supplied public transportation service. It is used to indicate the overall satisfaction of various customers' attitudes [17]. To construct the index, the procedure of JRC-EC (2008) [18] has been followed:

The indicators of the service quality based on the users' demands were identified firstly based on the review of previous studies. The selected indicators are grouped into four groups, access to destinations, bus routes, comfort, and safety. The sub-indicators included in each group are shown in Table (1) [19,20].

The weighting of indicators. To measure the selected indicators, the public opinion method was used. Questionnaire forms were used in which customers were asked to rate the importance of the selected sub-indicators using 1-10 scale. These rates are used to weight the indicators and the results of weighting are shown in Table (1).

Finding the individual score. The score of each sub-indicator is determined individually based on the customers' opinion through the questionnaire form. This can quantify the perception of the customers. The customers were asked to assess the public transit quality by giving points in scale 1 to 10 representing the level of service according to every sub-indicator individually.

Standardizing the results. The individual scores have been standardized to assure consistency and regularity of the results with the determined weights of the sub-indicators according to average values. For example, the standardized weighted score of the accessibility sub-indicator equals to $(9/8.5)*(7) = 7.412$.

Aggregating the standardized weighted score for the sub-indicators of each group, then for all groups to find the overall aggregated SQI using Equation 1.

$$SQI = \sum_{i=1}^n SQI_i * w_i \quad (1)$$

Where:

SQI = Overall Quality Service Index,

$$SQI_i = \text{Individual service quality index of indicator group } i = \sum_{si=1}^m SQI_{si} * w_{si} \quad (2)$$

SQI_{si} = Individual service quality index of sub-indicator s_i

i = indicator number, si = sub-indicator number

n = number of indicators' groups, m = number of sub-indicators per each group

w_i - the weight of indicator i , w_{si} =weight of sub-indicator si .

The results of the above steps are shown in Table (1).

According to the results shown in Table 1, it can be noticed that safety criteria can be considered the most influential on the quality of the public transportation service. The driver behavior and the availability of safety facilities such as seat belt are the other indicators have also significant effect such as access to the destination, comfort, and bus routing. The driver behavior and the availability of safety equipment inside buses have been rated as the most important sub-indicators. However, the importance rate of the other sub-indicators is significant as well. These results are not surprising as these indicators have been highly considered by users of public transportation in other cities and countries. The interesting point is that the cost of the trip has been selected by a few number of customers. This may interpret that cost criteria is less important for users than the selected indicators and the users may pay more for highly quality service. However, the low cost is considered by a high percentage of public transportation service. This means that the determination of the fare of public buses should consider the low and medium-income people.

Regarding the quality of the existing service, the overall score indicated a moderate level as the overall score equals 6.77. This means that the customers perception to the public transit service is not high and the service needs improvement. The users of public transportation indicate that the existing service can be rated as safe as its safety score is 7.8 out of 10. However, according to the global criteria, the transport mode could be considered safe when it achieves 100% of the safety criteria. Therefore, more attention could be paid to the safety requirements of public buses. The indicators related to the comfort and bus route have less scores and this means that these indicators should be considered in the improvement of the public transportation service.

Table 1. Results of SQI

Indicator groups	Sub Criteria	Weights of indicators	Perception score	Standardized weights	Weighted-standardized scores
Access to destinations	Accessibility	9	7	1.059	7.412
	Frequency of services	8	6.5	0.941	6.118
	Average	8.5	6.75		6.8
Bus route	Frequency of buses departures (departures/ route)	8	6	0.941	5.647
	Travel time (min)	9	6.5	1.059	6.882
	Average	8.5	6.25		6.27
Comfort	Inside bus service, cleanliness and accessibility to seats	8	6.5	1	6.5
	Braking behavior	8	6	1	6
	Average	8	6.25		6.25
Safety	Driver behavior while driving including speeding	10	8.5	1.081	9.189
	Street furniture including lighting	9	7.5	0.973	7.297
	Availability of safety requirements such as seat-belt	10	8	1.081	8.649
	Enforcement	8	7	0.865	6.054
	Average	9.25	7.75		7.80
SQI					6.77

5. Conclusions and recommendations

The following points have been concluded from the results of this study:

1. The waiting time inside buses is the criteria that about half of the respondents based on in selecting the private mode of transport. Therefore, it is recommended to consider these factors in further studies and find the solution to reduce them.
2. The low buses' fare is the factor that more than half of the respondents consider as the positive point of using the public buses in the selected study area. However, the cost criterion has not been selected by the majority of the respondents to quantify and evaluate the current service quality. This means that the other criteria are more important than the cost for the riders. Therefore, the other characteristics of the public buses need to consider in future plans of public transportation improvements.
3. The comfort indicator in terms of service inside buses, cleanliness, accessing to seats, and the driving behavior are considered by about third of the users as an important indicator of public transit service quality. This is followed by the number and location of bus stops.
4. The indicators of service quality that have been rated as the most important are those categorized within safety, access, bus route, and comfort groups of indicators.
5. Safety factors have gained the highest perception scores while the others have slightly less scores. However, the overall score reflects the moderate service quality level which means bus service needs improvements to consider all the factors that customers identify and reach their expectations.

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