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Determination of service quality attributes based on user perception for paratransit services in developing country like India

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Abstract

In case of developing countries like India, there is an urgent need to regulate the paratransit system because it faces various issues related to operation, service quality and enforcement. Regulation of these services requires delivery of services as per users' expectations. Thus, this research aims to identify the paratransit service quality parameters based on users' perception in Kolkata focusing on EM Bypass corridor (Ultadanga to Kamalgazi). This study focuses on auto-rickshaws, as the most popular mode amongst all types of paratransit modes in the city. 17 qualitative and quantitative paratransit service quality attributes were selected for the study area. Various surveys of were conducted in order to assess the user perception. This data has been then analyzed with the help of RIDIT technique to prioritize the selected attributes. Results indicate that customer service, safety and security, service hours, environmental sustainability and headway of service has been perceived as most important by the users. This is followed by the assessment of service delivery levels which is a function of users' expectation from the services. In this research, concept of Zone of Tolerance is utilized to assess service delivery levels which are bounded by the desired service level and minimum acceptable service level of paratransit service. The results demonstrated that the users' expectation varies significantly amongst user groups for certain service attributes such as auto stop proximity, delay in total journey time, etc. while the differences were minimal for other attributes such as service hours, crowding level inside the auto-rickshaw, etc.

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Keywords: Paratransit services; User perception, Service quality attributes, Prioritization, Zone of Tolerance

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1. Introduction

In case of developing countries, one of the reasons for poor service quality of paratransit modes is negligence towards the provision of services as per users' expectations. It is important to assess users' perception of service quality so that service delivery satisfying the maximum number of users on a consistent basis can be ensured (Das & Pandit, 2013). In order to form the basis of measurement of service quality, the paratransit system attributes which the users perceive as being important in the system performance should be considered. The performance of these attributes, if improved, increase the patronage of the existing paratransit system which faces several issues including reluctance of people using paratransit services because of poor service quality pertaining to some of the service quality parameters. Thus, there is a need to identify the relevant Quality of Service parameters for a given city. Based on the identified attributes, the service delivery levels of the paratransit system must be assessed from the users' point of view. Service delivery levels are a function of users' expectation from the services. Users' expectations are associated with Zone of Tolerance (ZOT) which is bounded by the desired service level and minimum acceptable service level of paratransit service. Since the expectations and needs vary between individuals of different socio-economic profile, it is important to analyze the service priorities of users from different groups.

This research, thus, aims to identify the paratransit service quality parameters for the specific case of Kolkata by reviewing the service attributes considered in previous researches for developing countries. These service attributes are then prioritized based on users' perceived level of importance. In addition, research also estimates service delivery levels (ZOT) for paratransit users based on the selected quantitative attributes.

This research is divided into various sections including research background, description about the selected study area, methodology of collection of the user perception data, research methodology, results and discussion. The paper finally ends with conclusion and recommendations.

Nomenclature

IPA	Importance-Performance Analysis
SEM	Structural Equation Modelling
TRB	Transportation Research Board
ZOT	Zone of Tolerance

2. Research background

2.1. Importance of user perception in assessment of paratransit service quality

The importance of user perception has been highlighted by various researchers as the primary determinant of service quality in order to identify the potential strengths and weaknesses of the services offered. As regular users suffer the consequences of poor transit service quality, their perception helps to improve the service quality. Exclusion of customers from improvement efforts can create difficulties (Das & Pandit, 2013). Notion of user satisfaction is to retain current users and attract potential ones. It is also found that improving market share and improving customer satisfaction individually results in higher profitability. It is important to assess users' perception of service quality so that service levels that will satisfy the maximum number of users on a consistent basis can be delivered (Das & Pandit, 2013). In order to form the basis of measurement of service quality, the paratransit system attributes which the users perceive as being important in the system should be considered. The improved performance of these attributes will increase the patronage of the existing paratransit system which faces several issues related to quality of service. In case of developing countries, importance of user perception for paratransit services has also been emphasized. Joewono & Kubota (2007a, 2007b) emphasized the need of evaluating user satisfaction to measure service quality for paratransit in Indonesia. The study establishes important attributes to explain user perception, methodology to measure service quality and management framework and strategies for future development. They reported the loyalty of paratransit users to various aspects of the modes despite of various dissatisfactions. They also conducted study to explore users' negative experiences and its relation with the users'

perception of overall satisfaction of paratransit services. The study also emphasizes differences in the perceived levels of importance of transit services between developed and developing countries. Woolf & Joubert (2013) emphasized the importance of people-centered view on paratransit services in South Africa in order to formalize the paratransit system. Similarly, other studies were also conducted in the context of developing countries where researcher attempts to investigate the potential of paratransit as feeder of mass transit system in developing countries based on commuters' satisfaction (Tanghphaisankun, Nakamura, & Okamura, 2009).

2.2. Tools and techniques for prioritization of service quality attributes

Various tools have been developed by researchers utilizing the user perception data such as Importance-Performance Analysis (IPA), Zone of Tolerance (ZOT), Structural Equation Modeling (SEM), Grey Relational Analysis (GRA), RIDIT etc. (Rashid & Pandit, 2017). Eboli & Mazzulla (2010) discussed the use of rating method and choice options to capture passengers' viewpoint on transit service quality. Lai and Chen (2011) applied Structural Equation Modelling technique to model relationship between users' behavioral intentions and various service quality attributes that affect them. Joewono and Kubota (2007) in one of their studies applied the path analysis tool to reveal the important determinants that influence overall satisfaction. They also applied Structural Equation Modeling (SEM) for assessment of relationship between users' negative experiences and overall satisfaction of paratransit services. Binomial regression analysis explores the characteristics of this loyal group of users. Pagano & McKnight (1983) analyzed the user perception data for dial-a-ride services which is based on Guilford's method. However, they could not validate their model. Pacquette, Cordeau, & Laporte, (2009) in their studies argued that ANOVA and Factorial analysis could have been better statistical tools to get more valid results. Recently, Neural Network approach and Fuzzy approach has been utilized for service quality prediction and user attribute ranking in case of Dhaka, Bangladesh (Islam, Hadiuazzaman, Banik, & Hasnat, 2016).

The limitations of the methods discussed above require a large amount of data following a specific distribution pattern as well as data on perceived satisfaction and importance levels for overall service quality and service quality of individual attributes for recognizing appropriate service quality attributes. However, RIDIT analysis does not require a large amount of data with a specific distribution pattern. These techniques can establish the importance of service quality attributes with the help of only importance or satisfaction data which is extremely relevant because satisfaction data are not always available since the population under study may not have experienced the entire service or certain parts/attributes of the service. RIDIT analysis is a simple and easy tool to procure results from ordinal data. It is closely related to distribution free statistical methods. This method assigns a continuous quantitative value (between 0 and 1) to different categories of ordinal scale and to the attributes rated on the scale through empirical cumulative probability transformation of scale. The calculated RIDIT values can be used for prioritization of the attributes in a multi-attribute analysis (Rashid & Pandit, 2017).

2.3. Selection of Quality of Service attributes for paratransit services

Quality of paratransit service attributes includes all qualitative and quantitative service attributes that affect users' perception of service quality. These attributes further facilitate the assessment of level of service based on user perception. Users, in addition to make their judgment of the overall service quality, also make their judgment on individual service quality attributes. These individual attributes may vary for different persons depending on their past experiences and expectations with services (Das & Pandit, 2013). These attributes form the basis of estimation of service delivery levels as per their expectations. The performance of these attributes, if improved, increase the patronage of the existing paratransit system which faces several issues related to quality of service. Thus, the relevant quality of paratransit service attributes for a given city should be identified using proper methodology. Existing literature provides large number of paratransit service quality attributes (quantitative and qualitative) in the context of developing countries. It is not practical to analyze the user satisfaction considering all possible attributes as some of the attributes may not be relevant for a given city or region. Therefore, set of relevant attributes should be finalized which is appropriate for the context of the study area chosen as the relevant attributes may vary between different geographic or economic regions The local service delivery environment in a given city or region influences the passengers' service quality expectations and travel needs. In this direction, Joewono & Kubota (2007b)

underline the difference in service quality attributes between developing and developed countries. The study also states that, for developing countries, prioritization of service quality improvement should start at the core of service considering the requirement of regular users, followed by increasing the market by providing more information, with the final improvement being the improvement of supporting infrastructure and environmental impacts. This final group of aspects involves supporting factors which widen access to potential users.

This section presents a chronological review of existing literature to facilitate identification of paratransit service quality attributes. Various literatures classified the service quality attributes into various classes such as the model proposed by Philip & Hazlett (1997) is based on three classes of attributes: pivotal (greatest influence on the satisfaction levels), core and peripheral attributes (lowest influence on the satisfaction levels). The UNE-EN 13186 standard (2003) classifies the service's characteristics into basic, proportional and attractive, depending on how compliance and non-compliance affects customer satisfaction. The TCQSM (TRB, 2004) classified attributes into availability factors (more important), and comfort and convenience factors (less important). Eboli & Mazzulla (2007) classified the attributes into basic and non-basic attributes according to their impact on the overall service quality based on the preferences showed by the users.

Different methodologies have been adopted by various researchers for the identification of final transit service quality attributes for a particular study area. Robson (2009) has carried out extensive literature review followed by revalidating them by consulting various stakeholders including local authorities. dell'Olio, Ibeas, & Cecin (2010) conducted a series of focus group discussions amongst users of public transportation to identify the key transit service quality indicators.

Extensive research based on rigorous literature review has been done by Joewono & Kubota (2007b) in Indonesia who selected 54 service quality attributes categorized into nine factors for exploring users' perception, with each factor having multiple attributes ranging from three to nine. In case of India, (Basu, Varghese, & Jana (2017) critically examines the paratransit sector of Kolkata and Mumbai and focus on assessment of service quality by selecting specific attributes followed by analysis using Structural Equation Modelling. In addition, several service quality attributes were also identified for dial-a-ride services in developed countries. Table 1 shows various paratransit service quality attributes identified literature review. Table 2 underlines the comparison of those attributes identified by various researchers. One of the earliest works was conducted by Falcocchio (1979). He indirectly mentioned three attributes (convenience, comfort and safety with 11 sub-attributes) that could define service quality in dial-a-ride services. In the same direction, Pagano & McKnight (1983) selected a list of attributes to develop a service quality index for dial-a-ride services. The list, after experts' opinion, was composed by eight attributes with 41 sub-attributes i.e., reliability, comfort, convenience of making reservations, extent of service, vehicle access, safety, driver characteristics and responsiveness. He underlines that the most important attributes are different for two different socio-economic groups. Reliability is the most important attribute for the users under age 65, while safety is most important for those over 65. Denson (2000) also uses some of the attributes listed by Pagano and McKnight (1983) to evaluate service quality of Delaware dial-a-ride services. Knutsson (1999) conducted the study to estimate the demand for public dial-a-ride services in Sweden. He identified five service quality attributes (i.e., information, dignity, comfort, trip time and price) with 40 sub-attributes. As our study is based on stage carriage paratransit system which is variation of public transit system, therefore, in addition to paratransit service attributes, public transit attributes were also studied (Das & Pandit, 2013, 2014, 2016; Rashid & Pandit, 2017, 2018).

Table 1: Paratransit service quality attributes and sub-attributes identified by literature review

Paratransit service attributes	**Sub-attributes**
Availability (Av)	Width of coverage area (Av1)
	Proximity/Walking distance to stop (Av2)
	Suitability of linkage among route destination (Av3)
	Service hours/Length of operation time in one day (Av4)
	Flexibility in availability of mode such as during night/weekends (Av5)
	Frequency/Headway (Av6)

	Availability of alternative mode (Av7)
Accessibility (Ac)	Barrier or disruption to use paratransit from pedestrian, street vendor, etc. (Ac1)
	Availability, completeness, and quality of stop (Ac2)
	Ease to enter and exit the car (e.g., the ease to open the car door, height of step) (Ac3)
Reliability (Re)	Waiting time for pick-up at home (Re1)
	Waiting time for pick-up away from home (Re2)
	On-time performance/Punctuality related with departure (Re3)
	On-time performance/Punctuality related with arrival (Re4)
	On-board travel time (Re5)
	Number of transfers (Re6)
	Transfer time (Re7)
	Delay because of car breakdown or other emergency case (Re8)
	Speed of the vehicle (Re9)
	Trip denials (Re10)
	Missed trips (Re11)
Information (Inf)	Easy acquisition, availability, amount, and media of information regarding the service (Inf1)
	Quality of information regarding the service, e.g., completeness, clarity, etc. (Inf2)
	Availability of information regarding route direction, e.g., map, route, etc. (Inf3)
	Availability of information regarding the service, e.g., fare, etc. (Inf4)
	Availability of information in case of emergency/ delay/cancellation of service (Inf5)
Customer service (Cus)	The ease to submit complaints, requests, opinions, etc. on normal days or holidays (Cus1)
	Follow-up and coordination regarding complaints, requests, etc. (Cus2)
	Crew's skill and ability including knowledge, coordination, and motivation (Cus3)
	Crew's skill and ability to handle medical emergency (Cus4)
	Crew's attitude to serving the customer, including politeness, honesty, etc. (Cus5)
	Crew's help provided to the passenger, e.g., to move the luggage, etc. (Cus6)
	Crew's help provided to special passengers, e.g., elderly, pregnant women, etc. (Cus7)
	Professionalism (Cus8)
Comfort (Comf)	Air quality and temperature inside the car, including car noise (Comf1)
	Cleanliness inside the car from dust, garbage, or graffiti (Comf2)
	Quality and condition of material inside the car, e.g., seat, lamps, etc. (Comf3)
	Availability of supporting equipment, e.g. communication, entertainment, AC. etc. (Comf4)
	Design and arrangement of stop, the ease to move, and length of queue (Comf5)
	Design and arrangements inside the car, the ease to move, and sitting position (Comf6)
	Number of seats, which influence crowdedness (Comf7)
	Comfort during trip from start until stop (Comf8)
	Smoothness of the ride (Comf9)
	Guaranteed seat or location for wheelchair (Comf10)
	Seats at waiting areas for pickups away from home (Comf11)
	Shade at waiting areas for pickups away from home (Comf12)
Safety and security (Saf)	Security from criminal incident in daytime/night at auto atop/inside the vehicle (Saf1)
	Availability and the ease to be observed by officers, e.g., police (Saf2)
	Availability and ease to use emergency equipment, e.g., first aid, phone, etc. (Saf3)
	Safety from theft/robbery/pickpocketing at auto atop/inside the vehicle (Saf4)
	Safety from road accidents (Saf5)
	Safety from falling (Saf6)
	Availability of security staff (Saf7)
	The ease to observe risky action of the driver, e.g., speeding (Saf8)
Fare (Fare)	Suitability of fare structure for the mode used (Fare1)
	Total of expenses paid to use the service (Fare2)
	Ease of payment (Fare3)

	Advantage in using the mode compared to the expenses (Fare4)
	Saving because of using this mode compared to other modes such as public transport (Fare5)
	Comparison of fare with one's ability to pay (Affordability) (Fare6)
Negative Externalities (Ext)	Level of emission, noise pollution, and sight pollution (Ext1)
	Level of resources consumption to operate the mode, e.g., fuel (Ext2)
	Level of space consumption in this city for the operation of this mode (Ext3)
	Level of congestion impact or disruption caused by this mode (Ext4)
	Level of road deterioration caused by this mode (Ext5)
	Effect of this mode operation on the economic life of this city (Ext6)
	Effect of this mode operation on the social, cultural, political life in this city (Ext7)

Table 2: Comparison of paratransit service attributes identified by various researchers

Attribute	Falcocchio (1979)	Pagano & McKnight (1983)	Knutsson (1999)	Denson (2000)	Joewono & Kubota (2007b)
Av1					√
Av2	√	√	√		√
Av3			√		√
Av4		√			√
Av5		√	√		
Av6					√
Av7					√
Ac1					√
Ac2					√
Ac3	√		√		√
Re1		√			
Re2	√	√	√	√	√
Re3	√	√	√		√
Re4			√	√	√
Re5	√		√		√
Re6	√		√		
Re7	√	√	√		√
Re8			√		√
Re9		√	√	√	
Re10			√	√	
Re11					
Inf1			√		√
Inf2		√			√
Inf3					√
Inf4					√
Inf5		√			√
Cus1		√	√		√
Cus2		√	√		√
Cus3		√	√		√
Cus4		√	√		√

Cus5		√	√	√
Cus6			√	√
Cus7				√
Cus8		√	√	
Comf1	√	√		√
Comf2		√		√
Comf3				√
Comf4				√
Comf5		√		√
Comf6		√	√	√
Comf7	√		√	√
Comf8				√
Comf9	√	√	√	
Comf10	√	√		
Comf11				
Comf12				
Saf1		√	√	√
Saf2				√
Saf3				√
Saf4	√	√		√
Saf5	√	√		√
Saf6				√
Saf7				
Saf8				√
Fare1			√	√
Fare2				√
Fare3		√		√
Fare4				√
Fare5			√	√
Fare6				√
Ext1				√
Ext2				√
Ext3				√
Ext4				√
Ext5				√
Ext6				√
Ext7				√

Research conducted in the context of developing countries highlights the importance of quantitative attributes of paratransit services such as frequency/headway, proximity/walking distance, speed of the vehicle, waiting time at the stop, on-board travel time, transfer time and on-time performance. In addition, some of the qualitative attributes were also found as important determinant of service quality such as availability of information, punctuality of drivers, availability of information, comfort, safety and security, customer service, reliability, notification of delay, flexibility in service timings, availability of information, ease of getting reservation, degree of crowding and

cleanliness (Joewono & Kubota, 2007b; Pagano & McKnight, 1983; Sumaedi et al, 2012). Recent literatures underline number of additional attributes such as environmental concerns (Joewono & Kubota, 2007b) which were not relevant for earlier times but important in today's scenario.

2.4. Zone of tolerance for paratransit service quality attributes

As far as knowledge of author is concerned, concept of Zone of Tolerance has not been applied for paratransit services so far. It has been applied extensively for service quality assessment of public transit services (Das and Pandit, 2013, 2014, 2016; Rashid and Pandit, 2017, 2018). As explained earlier, users' expectations are associated with Zone of Tolerance (ZOT) which represents the range of service performance a customer would consider satisfactory and is bounded by the desired service level (S_{des}) and minimum acceptable service level (S_{acc}) of paratransit service which is used to determine Overall Zone of Tolerance (Das & Pandit, 2016). Users' perception and expectations for different service quality attributes varies between individuals based on gender, age, income, travel needs, personal needs and their past experience from services (Das & Pandit, 2016).

3. Study area

The present study has been carried out in the city of Kolkata (West Bengal). It is one of the largest metropolitan cities in India, with a population of 4.49 million (Census 2011). Paratransit modes in Kolkata include auto-rickshaws, mini buses, e-rickshaws and pedal-powered non-motorized cycle rickshaws. This study focuses on auto-rickshaws, as it constitutes the most popular mode amongst all types of paratransit modes operating in the city. Auto-rickshaws in Kolkata act a stage carrier operating either along fixed feeder routes or along public transit corridor. Travel demand in the city is served through 125 auto-rickshaw routes operated by private operators (Notification No. 1276-WT/4M-23/95, dated 31.3.2017, Beltala RTO). These routes are subjected to the operation of around 11,315 registered auto-rickshaws with fixed number of auto-rickshaws per route. These services are managed by various formal and informal stakeholders including government authorities, enforcement wing of the government authorities, operators, unions, starters, informal agents and judiciary system.

The study is focused on 20 km stretch on the Eastern Metropolitan Bypass corridor from Ultadanga to Kamalgazi as shown in Figure 1. 24 auto-rickshaw routes were identified to serve the travel demand, majority of which act as a feeder to the identified stretch of public transit corridor. These routes have various intermediate and terminal stops. Major terminal stops include Ruby General Hospital, Gariahat, Ballygunje, Peerless hospital, Jadavpur 8B bus stop, Garia, Phoolbagan More, Sealdah Court Complex, Karunamoyee and Ultadanga. Intermediate stops include Tagore Park, VIP Bazaar, Panchanangram, Bengal Chemical, Salt Lake gate, Mukundpur, Rajpur, Sonarpur, Patuli, Golpark, etc. Despite the integral nature of auto-rickshaws to the transit system, it is often plagued with regulatory issues as these services are usually provided with private operators which do not comply with regulations. It results in operational inefficiency, poor service quality and enforcement issues. High demand, coupled with inadequate rule enforcement and the profit-making motives of operators, make overloading a common practice in auto-rickshaws in the city. Due to the absence of adequate rule enforcement, the operators of informal transport modes often retrofit their vehicles to carry more passengers than the manufacturers originally intended the vehicles to hold. The system also faces various issues in auto-rickshaw stops such as availability of information on routes and stops locations, schedules of other integrated transit modes (bus), time and fare information, information regarding frequency of auto-rickshaws, availability of shade from sun and rain, CCTV surveillance, drop-off bays, seating infrastructure, adequate lighting, dust bins, signage and fire extinguishers. However, some of the issues may be because of misperceptions which have created a negative perception about paratransit services.

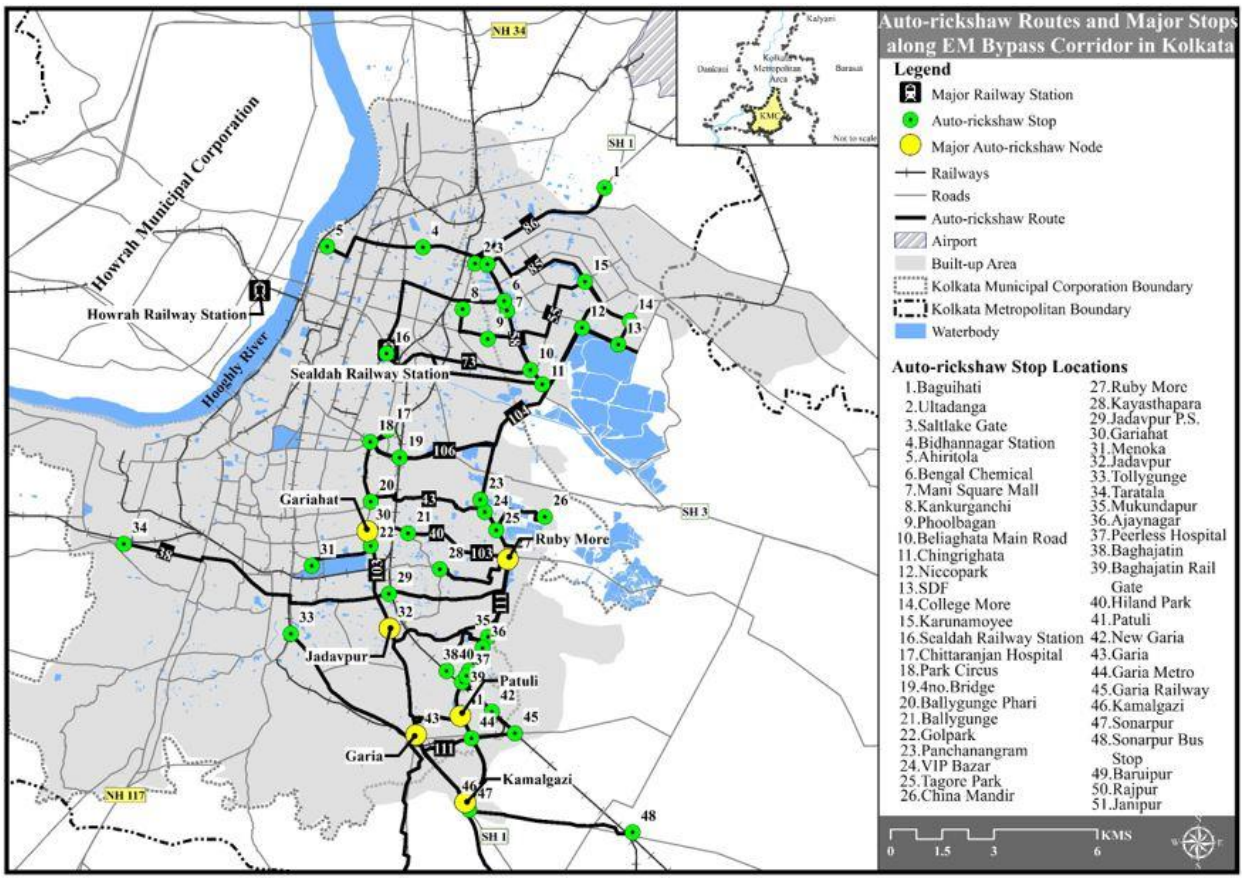

Figure 1: Paratransit routes and major stops along the Eastern Metropolitan Bypass corridor, Kolkata

4. Collection of user perception data

In order to assess user perception of service quality, survey questionnaire were prepared based on identified attributes (refer to Table IV and Table V). Random sampling of the users has been performed in order to include users from different socio-economic categories as paratransit services in the city are availed by all user groups. Therefore, in this research, equal weight was given to all the user groups as it is important to consider expectations of all user groups of different socio-economic profile and travel needs. User groups include regular and non-regular users, users with and without private vehicles, male and female users, peak and off-peak users. There were five income groups: the Economically Poor or EWS (with income <Rs 6,000/month), the Lower Income Group or LIG (with income between Rs 6,000-10,000/month), the Lower Middle Income Group or LMIG (with income between Rs 10,000-20,000/month), the Higher Middle Income Group or HMIG (with income between Rs 20,000-50,000/ month) and the High Income Group or HIG (with income >Rs 50,000/month). There were also four age groups (<30 years, 31-45 years, 46-60 years and >55 years) and groups as per trip purpose. The percentage share of these user groups in the total sample of auto-rickshaw users surveyed in Kolkata is presented in Table 3.

Table 3: Percentage share of different socio-economic groups in total sample of auto-rickshaw users in Kolkata

Socio-economic groups	Percentage of respondents
Age	
<30 years	37.4%

31-45 years	41.0%
46-60 years	18.6%
>61 years	3.0%
Gender	
Male	67.3%
Female	32.7%
Monthly income	
EWS (<6,000)	17.9%
LIG (6,000-10,000)	18.3%
LMIG (10,000-20,000)	29.6%
HMIG (20,000-50,000)	28.0%
HIG(>50,000)	6.2%
Availability of private vehicle	
Users with private vehicle	32.7%
Respondents without private vehicle	67.3%
Regularity of usage	
Regular users	81.7%
Non-regular users	18.3%
Trip purpose	
Compulsory trips (work, education, health, home)	93.6%
Non-compulsory trip (leisure, shopping)	6.4%
Time of the day	
Morning peak hour	12.0%
Evening peak hour	11.7%
Non-peak hour	76.3%

A total of 500 samples for were determined in which 100 samples were collected on-board bus surveys along the transit corridor, equally distributed among the bus routes. Bus users were surveyed to ensure the collection of data regarding integration of public and paratransit services. 300 samples were collected on-board auto-rickshaw, equally distributed among selected 24 feeder auto-rickshaw routes along EM bypass. As, it is not feasible to complete the entire questionnaire within the short time duration of auto-rickshaws trips, separate questionnaires were prepared for quantitative and qualitative attributes. 200 samples for quantitative attributes and 100 samples for qualitative attributes were collected. 100 samples of user perception survey for potential auto-rickshaw users at household level are also collected. Thus, the total of 400 samples was collected for quantitative attributes for analysis of ZOT. The survey was conducted on all working days covering morning peak hours (8:00 AM – 11:00 AM), evening peak hours (5:00 PM – 8:00 PM) and non-peak hours (11:00 AM – 5:00 PM and 8:00 PM – 8:00 AM). Majority of survey started from the terminal auto-rickshaw stops of a given auto-rickshaw route and passengers were surveyed en-route till the vehicle the next terminal stop of the route for both onward and return journeys. In this way, passengers boarding from intermediate stops have also been surveyed. In the quantitative attribute survey, user perception data was collected on four data points, i.e., level of importance for each attribute on a 5-point Likert scale (Not Important-1/ Slightly important-2/ Important-3/ Very important-4/ Critical-5), level of satisfaction on a 5-point Likert scale (Very poor-1/ Poor-2/ Average-3/ Good-4/ Very good- 5), minimum acceptable level of service and desired level of service for each attribute.

It has been observed that major share of the people sampled were male (refer to Table III). Maximum share of respondents were 31-45 years old, and only 3% were older than 61 years. Most (67.3 %) of the people sampled do not own a private vehicle. Majority (93.6 %) of people make compulsory trips. The rest of the respondents traveled

for other reasons, such as shopping and leisure purpose. Most of the respondents are regular users of auto-rickshaw services. LMIG represents the maximum share of respondents.

The collected data is refined and incomplete responses are eliminated from the data. After data cleaning, 257 responses in Kolkata have been obtained. Resulted data has been analyzed with the help of RIDIT technique for prioritization of the selected attributes. This is followed by the estimation of service delivery levels.

5. Research methodology

This section presents a list of identified para-transit service quality attributes that have been used to assess the level of service based on user perception. Initially, nine broad para-transit service quality attributes with 67 sub-attributes were identified from literature review (refer to Table 1). These were further refined considering the fixed-route characteristics of para-transit services of the region. The two criteria adopted for the final selection of indicators are as follows:

- Attributes that were specified by majority of researchers
- Attributes that best described paratransit service quality in the context of India according to the expert opinion and researcher's own judgment

Using the criteria discussed above, 17 paratransit service quality attributes are finalized which are discussed in Section 6.1.

In the next stage of this research, selected service quality attributes are prioritized using RIDIT Analysis technique.

Based on the identified quantitative service attributes, ZOT for different user groups are calculated. As explained in Section 2.3, difference in users' perception and expectation must be taken into consideration. Therefore, Mean Zone of Tolerance has been estimated separately for different user groups for each service attribute

Finally, the Overall Zone of Tolerance was determined considering all user groups (refer to Table 7) for each attribute.

The overall zone ensures the expectations of all user groups without any undue bias toward any particular user group having a skewed ZOT (Das & Pandit, 2013).

6. Results and Findings

6.1. Quality of Service attributes for paratransit services for Kolkata

Using the methodology described in Section 5, Table 4 describes 17 paratransit service quality attributes (9 quantitative attributes and 8 qualitative attributes) which were considered relevant for the study area. Among all attributes, the qualitative attributes were further divided into a number of sub-attributes. Some service attributes like 'headway of service', 'waiting time', and 'auto-rickshaw stop design' have been further categorized on the basis of terminal and intermediate auto-rickshaw stops because of difference in expectation of services in terminal and intermediate stops. Other than the attributes identified in majority of researches, cleanliness and maintenance frequency of auto-rickshaw stops, parking bays, controlled entry and exit for facilitating channelized movement for accessing auto-rickshaw, drop off bays or adequate space to allow other vehicles to pass, availability of shade from rain and sun, availability of seating infrastructure, availability of adequate lighting, availability of dust bins, Availability of signages (directional, regulatory and prohibitory), availability of fire extinguishers, provision of CCTV surveillance, availability of side rails for protection, availability of first aid kit, provision of GPS inside the vehicle, use of music system inside the vehicle, integration of paratransit and public transit fare structure, availability of pink auto service were added in the list identified by literature review after expert opinion survey.

Table 4: Description of quantitative and qualitative service quality attributes that are considered relevant for study area

Paratransit service quality attributes	**Description**
Auto-rickshaw stop proximity	Perceived distance from the home, workplace, etc. to auto-rickshaw stop (meters) Alternately, it can also be expressed as time taken to access the nearest auto-rickshaw stop (minutes)
Headway of service	Perceived time difference between any two successive auto-rickshaws when they cross a designated point (minutes) Users' perceive a difference in headway of service at terminal and intermediate stops
Waiting time at the stop	Perceived time spent by user at the auto-rickshaw stop for next arriving vehicle (minutes)
Service hours	Perceived time duration of auto-rickshaw service operation on an average working day(hours)
Delay in total journey time	Perception of difference between expected travel time and actual travel time (minutes)
Crowding level inside the auto-rickshaw	Perceived average occupancy inside the vehicle (pax)
Cleanliness and maintenance frequency at auto-rickshaw stop	Perceived upkeep of auto-rickshaw stop amenities (days)
Auto-rickshaw stop design (terminal and intermediate stops)	Facilities available within an auto-rickshaw stop and its surrounding environment. The sub-attributes of this attribute are as follows: • Parking bays* • Controlled entry and exit for facilitating channelized movement for accessing auto-rickshaw* • Quality pedestrian infrastructure to access the stops (accessibility)* • Route and stop location availability at stop and other media • Availability of schedule of other integrated transit modes (bus) at stop and other media • Availability of time and fare information for various routes at stop and other media • Availability of information regarding frequency of auto-rickshaws at various routes at stop and other media • Drop off bays or adequate space to allow other vehicles to pass • Availability of shade from rain and sun • Availability of seating infrastructure • Availability of adequate lighting • Availability of dust bins • Availability of signages (directional, regulatory and prohibitory) • Availability of fire extinguishers* • Provision of CCTV surveillance* *sub-attributes which are not considered for intermediate auto-rickshaw design
Auto-rickshaw design	Exterior and interior design features of the auto-rickshaw. The sub-attributes of this attributes are as follows: • Appropriate seating arrangement and leg space (ease to move and sit) • Availability of luggage space • Adequate lighting inside the vehicle • Availability of side rails for protection
Amenities within auto-rickshaw	Amenities present within the vehicle. The sub-attributes of this attributes are as follows: • Use of music system inside the vehicle • Availability of first aid kit • Provision of GPS
Customer service	Assistance provided by the operators or administrative units. The sub-attributes of this attributes are as follows: • Ease to submit complaints/opinions/requests • Follow up and coordination regarding complaints/requests • Professionalism (driver's coordination and behaviour, adherence to traffic rules, etc)

	• Driver's training to control driving style • Help provided by drivers (including elderly/handicapped) in case of medical emergency and to move the luggage, if required • Trip refusal
Auto fare	The system to determine amount to be paid by transit passengers for a given trip. The sub-attributes of this attributes are as follows: • Integration of paratransit and public transit fare structure • Ease of payment (cash transaction or on-board ticketing by driver/electronic payment system) • Suitability of fare structure (flat fare/distance based fare)
Safety and security	Perception of safety and security while using the service. The sub-attributes of this attributes are as follows: • Safety from road accidents while travelling in an auto rickshaw • Safety from theft/robbery at the stop/inside the vehicle • Safety from assault/harassment at the stop/inside the vehicle • Availability of pink auto service • Availability of driver's complete information (contact number, address, license information) • Display of women and child helpline numbers/emergency numbers at auto stop and within auto-rickshaw
Environmental sustainability	Factors contributing to the quality of the environment. The sub-attributes of this attributes are as follows: • Suffocation/health hazards/annoyance (inconvenience) caused while travelling in an auto-rickshaw • Intrusion or obstruction caused by parked auto-rickshaws in the middle and along the side of the road

6.2. Prioritization of paratransit service quality attributes

User perception data has been analyzed with the help of RIDIT technique as shown in Table 5 and Table 6 (Rashid & Pandit, 2017). In this case, five-point scale has been converted into three-point scale (very poor = 1 + poor = 2 = 1 and very good = 5 + good = 4 = 3) as the frequency of responses in higher (very good) and lower (very poor) order of scale for most of the attributes are very few or missing. RIDIT analysis assumes that the intervals of an underlying continuous distribution are represented by discrete categories. The mean RIDIT for that group can be computed for the distribution of groups over the same categories. In summary, RIDIT analysis provides an alternative to rank order statistical analysis (Bikash, Pravat, & Sreekumar, 2010). It assigns a continuous quantitative value (varies between 0 and 1) through empirical cumulative probability transformation of scale. Higher RIDIT value means higher importance of attribute and vice versa. 0.5 represents mean RIDIT value. However, it does not mean that the attributes with RIDIT lower than 0.5 are not important. These attributes are also important, but less important than the attributes with RIDIT value greater than 0.5 (Rashid & Pandit, 2017).

Table 5: Prioritization of service quality attributes of paratransit system of Kolkata

Paratransit service attribute	**RIDIT score**	**Rank**
Customer service	0.595	1
Safety and security	0.593	2
Service hours	0.561	3
Environmental sustainability	0.521	4
Headway of service at terminal stops	0.521	5
Auto-rickshaw stop proximity	0.514	6
Waiting time at terminal stops	0.508	7
Auto-rickshaw design	0.497	8
Auto fare	0.494	9

Crowding level inside the auto-rickshaw	0.479	10
Terminal auto-rickshaw stop design	0.468	11
Waiting time at intermediate stops	0.466	12
Cleanliness and maintenance frequency at auto-rickshaw stop	0.463	13
Amenities within auto-rickshaw	0.460	14
Intermediate auto-rickshaw stop design	0.457	15
Headway of service at intermediate stops	0.456	16
Delay in total journey time	0.448	17

The findings highlight that users give more importance to qualitative attributes such as customer service, safety and security and environmental sustainability. Among quantitative attributes service hours, headway and waiting time for terminal stops and auto-rickshaw stop proximity have been given priority by users. In addition, sub-attributes of qualitative attributes are also prioritized based on same methodology. Table 6 represents the prioritization of sub-attributes of selected qualitative attributes. The results of the study would also help the policy makers to prioritize attributes and sub-attributes for effective policies and management framework from the users' perspective.

Table 6: Prioritization of sub-attributes of terminal auto-stop design of Kolkata

Sub-attributes	**RIDIT Score**	**Rank**
Terminal auto-stop design		
Availability of adequate lighting	0.583	1
Availability of dust bins	0.551	2
Availability of seating infrastructure	0.545	3
Drop-off bays or adequate space to allow other vehicles to pass	0.543	4
Availability of fire extinguishers	0.539	5
Availability of signage	0.538	6
Availability of shade from sun and rain	0.526	7
Availability of information regarding frequency of auto-rickshaws at various routes and through other media	0.515	8
Provision of CCTV surveillance	0.503	9
Availability of time and fare information for various routes at stops and through other media	0.483	10
Availability of schedules of other integrated transit modes (bus) at stops and through other media	0.473	11
Quality pedestrian infrastructure to access the stops	0.459	12
Availability of information on routes and stops locations at auto-rickshaw stops and through other media	0.459	13
Controlled entry and exit for channelized movement	0.423	14
Parking bays	0.360	15
Intermediate auto-stop design		
Availability of information on routes and stops locations at auto-rickshaw stops and through other media	0.628	1
Drop-off bays or adequate space to allow other vehicles to pass	0.604	2
Availability of information regarding frequency of auto-rickshaws at various routes and through other media	0.600	3
Availability of time and fare information for various routes at stops and through other media	0.541	4
Availability of adequate lighting	0.541	5
Availability of schedules of other integrated transit modes (bus) at stops and through other media	0.483	6
Availability of signage	0.427	7
Availability of seating infrastructure	0.404	8

Availability of shade from sun and rain	0.398	9
Availability of dust bins	0.374	10
Auto-rickshaw design		
Availability of side rails for protection	0.533	1
Adequate lighting inside the vehicle	0.499	2
Availability of luggage space	0.491	3
Appropriate seating arrangement and leg space	0.477	4
Amenities within auto-rickshaw		
Availability of first aid kit	0.600	1
Provision of GPS	0.560	2
Music system inside vehicle	0.340	3
Customer service		
Professionalism	0.542	1
Follow-up and coordination regarding complaints/requests	0.524	2
Driver's training	0.516	3
Ease to submit complaints/opinions/requests	0.482	4
Help provided by drivers in case of emergency and to move luggage, if required	0.478	5
Trip refusal	0.457	6
Auto fare		
Suitability of fare structure	0.528	1
Ease of payment	0.519	2
Integration of para-transit and public transit	0.453	3
Safety and security		
Display of women and child helpline/ emergency contact numbers at auto stops/ inside vehicles	0.582	1
Availability of complete information about the auto-rickshaw driver	0.555	2
Availability of Pink auto-rickshaw service	0.555	3
Safety from assault/ harassment at the stop/ inside the vehicle	0.479	4
Safety from theft/ robbery at the stop/ inside the vehicle	0.429	5
Safety from road accidents while travelling in an auto-rickshaw	0.401	6
Environmental sustainability		
Suffocation/ health hazards/ annoyance (inconvenience) caused while travelling in an auto-rickshaw	0.512	1
Intrusion or obstruction caused by haphazard parking of auto-rickshaws in the middle and along the side of the roads	0.488	2

6.3. Zone of Tolerance for paratransit users based on quantitative paratransit service quality attributes in Kolkata

The results of the mean zones of tolerance for different socio-economic user groups and the overall zone of tolerance for different paratransit service are summarized in Table 7. Results indicate the difference in level of importance for different service quality attributes for different user groups. The results demonstrated that the paratransit users' expectation varies significantly amongst user groups for certain service attributes such as auto stop proximity, delay in total journey time, cleanliness and maintenance frequency at auto stop and headway of service at terminal stops while the differences were minimal for certain other attributes such as service hours, crowding level inside the auto-rickshaw, headway of service at intermediate stop and waiting time at terminal and intermediate stops.

It has been observed that users of age group less than 30 years have lower ZOT for delay in total journey time because this group mainly consists of people making school trips. Users have lower tolerance for headway of service at terminal stops than intermediate stops which means users expect frequent services at terminal stops. Users in age group greater than 61 years have higher ZOT than other groups.

These findings may be used by policy makers in a given city to provide services for specific user groups as per expectations. Such services can always be provided when there are no financial constraints for the policy makers or when there is enough demand for these services. However, under the given socioeconomic condition in Kolkata, it is not possible to provide specialized services for particular user groups such as higher frequency of services at terminal stops for people having age group greater than 61 years, male riders, during off-peak hours (because of lesser frequency of bus services). Thus, it is important to give equal weightage to the expectations of all user groups while providing the services.

Table 7: Mean Zone of Tolerance (M_{ZOT}) and Overall Zone of Tolerance (O_{ZOT}) for auto-rickshaw users for paratransit service attributes (Auto stop proximity, service hours, delay in total journey time, crowding level inside the auto-rickshaw) in Kolkata

User groups	**Auto stop proximity (metres)**		**Service hours (hours)**		**Delay in total journey time (minutes)**		**Crowding level inside the auto-rickshaw (pax.)**	
	S_{acc}	S_{des}	S_{acc}	S_{des}	S_{acc}	S_{des}	S_{acc}	S_{des}
<30 years	722.50	360.00	15.17	16.63	8.40	3.42	4.23	3.86
31-45 years	636.19	332.95	14.57	15.89	9.10	4.00	4.19	3.83
46-60 years	688.33	316.67	15.24	16.58	9.00	4.17	4.33	3.81
>61 years	800.00	320.00	16.25	16.63	11.38	4.13	4.25	4.00
Male	753.33	335.24	15.40	17.06	9.15	4.08	4.37	3.86
Female	649.25	341.73	14.76	15.96	8.76	3.69	4.17	3.84
EWS (<6,000)	697.39	300.87	16.05	17.48	7.63	3.72	4.24	3.76
LIG (6,000-10,000)	675.74	272.34	15.11	16.49	9.47	3.70	4.40	3.85
LMIG (10,000-20,000)	708.42	357.89	14.61	15.82	8.82	3.70	4.26	3.87
HMIG (20,000-50,000)	661.11	365.56	14.61	16.07	9.19	3.94	4.13	3.88
HIG(>50,000)	655.21	346.84	15.05	16.34	9.63	4.05	4.24	3.83
Users with private vehicle	680.95	360.95	14.80	16.01	9.14	4.10	4.12	3.83
Users without private vehicle	684.39	329.25	15.05	16.47	8.77	3.68	4.29	3.85
Regular users	789.79	394.89	15.49	16.87	11.38	4.74	4.11	3.83
Non-regular users	659.43	327.24	14.85	16.19	8.33	3.61	4.26	3.85
Compulsory trips (work, education, health, home)	688.99	362.45	15.00	16.39	8.56	3.78	4.30	3.86
Non-compulsory trip (leisure, shopping)	708.57	381.59	15.47	15.83	10.45	4.59	4.20	3.91
Morning peak hour	1002.67	525.33	15.53	16.87	12.07	6.43	4.00	3.77
Evening peak hour	523.87	268.39	14.77	16.55	6.90	3.55	4.19	3.81
Non-peak hour	659.59	322.45	14.92	16.20	8.72	3.46	4.28	3.86
O_{ZOT}	704.03	368.91	15.01	16.21	9.25	4.07	4.22	3.86

*continued in next page

User groups	Cleanliness and maintenance frequency at auto-rickshaw stop (minutes)		Headway of service at terminal stops (minutes)		Headway of service at intermediate stops (minutes)		Waiting time at terminal stops (minutes)		Waiting time at intermediate stops (minutes)	
	S_{acc}	S_{des}	S_{acc}	S_{des}	S_{acc}	S_{des}	S_{acc}	S_{des}	S_{acc}	S_{des}
<30 years	3.05	0.94	5.95	2.81	7.67	3.41	8.35	4.65	7.93	3.98
31-45 years	2.70	0.87	7.14	3.59	8.29	4.36	8.26	4.30	8.64	4.24
46-60 years	3.80	1.21	5.92	2.90	6.77	3.65	9.02	5.35	8.10	4.15
>61 years	3.25	0.97	7.00	2.63	7.38	3.88	10.75	4.00	9.25	4.00
Male	3.71	0.96	5.86	2.58	7.10	3.18	8.86	4.61	8.00	3.68
Female	2.74	0.96	6.76	3.41	8.06	4.18	8.35	4.62	8.43	4.33
EWS (<6,000)	2.90	0.86	5.15	2.17	7.11	3.74	8.43	4.67	7.93	3.76
LIG (6,000-10,000)	4.56	1.30	6.40	2.36	6.94	2.83	9.43	4.28	8.17	3.36
LMIG (10,000-20,000)	2.47	0.84	6.68	3.34	8.05	3.78	8.53	4.86	8.43	4.29
HMIG (20,000-50,000)	2.47	0.94	6.76	3.89	8.26	4.72	8.04	4.53	8.28	4.42
HIG(>50,000)	3.67	1.13	7.30	3.18	7.63	3.35	8.81	4.54	8.52	4.21
Users with private vehicle	2.40	0.86	6.99	3.19	7.54	3.94	7.98	4.45	7.76	4.15
Users without private vehicle	3.37	1.01	6.21	3.12	7.84	3.82	8.77	4.70	8.55	4.10
Regular users	3.95	1.08	7.45	3.45	7.87	3.79	9.47	5.06	8.13	3.89
Non-regular users	2.85	0.94	6.24	3.07	7.71	3.87	8.30	4.52	8.33	4.17
Compulsory trips (work, education, health, home)	2.17	0.76	6.53	3.32	7.51	3.71	8.55	4.68	7.82	3.85
Non-compulsory trip (leisure, shopping)	3.55	1.29	5.77	3.39	8.02	3.36	8.75	5.14	9.59	4.13
Morning peak hour	5.58	1.04	8.73	4.63	7.53	3.87	10.90	5.03	8.23	3.83
Evening peak hour	2.29	0.99	6.77	4.00	9.35	5.10	6.52	3.68	9.23	4.68
Non-peak hour	2.79	0.95	6.07	2.78	7.52	3.66	8.46	4.70	8.15	4.07
$\mathbf{O_{ZOT}}$	4.14	0.97	6.52	3.20	7.62	3.69	8.61	4.63	8.52	4.19

7. Conclusion

The present study focuses on importance of user perception in determination of service quality attributes. The attributes were prioritized by RIDIT technique. The findings highlight that users give more importance to qualitative attributes than quantitative attributes in case of large Indian cities like Kolkata. This study provides the basis of selection of paratransit service quality attributes in case of developing countries for future researches. This method can be utilized by the policy makers to prioritize the paratransit services. However, the prioritization of attributes from the perspective of people from the different socio-economic group is needed. The findings of this study will help policy makers to design services from the users' perspective.

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