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A comprehensive study of Delhi metro: Identification and analysis of the major factors affecting the service quality of the Delhi metro

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Abstract
In recent years, organizations have increasingly considered service quality and its various dimensions. This concept has made a significant contribution to the growth of corporations and the provision of better service to customers. Improved services are now available for transportation agencies and commuters. Persuading more commuters to opt for public transportation would mitigate everyday problems such as road traffic congestion, traffic accidents, late-night travel and pollution. This study identifies and analyses the major factor of service quality of Delhi metro commuters. This study surveyed 600 commuters' perceptions to explore with the help of exploratory factor analysis and identify seven factors of service quality regarding Delhi metro services. Information factor in this study is the most important factor of the study and connectivity is the least important factor of the study.

Keywords: Delhi metro, service quality, customers' satisfaction and public transportation

Introduction
A well-organized transportation system is essential for a country's economic development and helps in promoting national and global integration. An adequate transportation system also benefits the nation's economic efficiency and competitiveness. In the present scenario, several modes of transportation are available, but there were not many options to travel in previous times. There was a time when people used to travel by walking or used horse-driven carnages and bullock – carts as transport. Therefore, people had to take several halts while travelling for long distances and had to spend money on making travel arrangements. But nowadays, these modes of transportation are rarely used due to technologies and development. Millions of people travel from one place to another for different purposes such as tours, business, study, meetings friends and relatives etc. All the places like Metro stations and railway stations, airports, and bus stops are always overcrowded with people.

Metro Railway in India
In the Indian context, the metro railway is fair of recent origin. Firstly, metro services in the country were functionally directed under the Indian railway. But Indian railway does not have sufficient funds for metro services development, So the Kolkata metro railway foundation was laid down in 1972 and construction work started in December 1973-1974. Kolkata Metro was the first metro railway in India. Irregular supply of raw materials leads to the commencement of service and opening of commercial services in 1984. Thus, the underground routes were started with the first rapid transit line which covered 97.5km. The second and third phases were opened in 2009 and 2010 respectively.

Delhi Metro Rail Corporation
The Delhi Metro Rail Corporation, a well-known mode of public transportation, has helped to alleviate the situation. The Delhi Metro Rail Corporation Ltd. is a state-owned company which was registered on 03-05-1995 under the Company Act 1956. Delhi Metro Rail Corporation was established with the equal participation of the government of India and the government of the national central territory of Delhi. The Delhi Metro is a metro system serving Delhi and the National Capital Region, including Faridabad, Gurugram, Bahadurgarh, Noida and Ghaziabad, India. It is the second oldest metro in India after the Kolkata metro. As of August 2018, the Delhi Metro is the busiest and largest metro in India. Delhi Metro Rail Corporation is the 9th longest metro system and the 16th largest in ridership in the world. The Delhi Metro's largest system in India consists of nine coded regular lines.

Literature Review
Shankar Kumar. S and Dr B. Jeyaprabha (2018) exhibited an Empirical Study on Commuters' Satisfaction with Chennai Metro Rail Limited In this study, primary and secondary data were used. The study concluded that more than 50% of commuters were satisfied with Chennai Metro's services. The goal of this study was to provide low-

cost services to commuters. Commuters were pleased with the service and offered suggestions to improve the quality of the Chennai metro rail system.

M. Devi Prasad and B. Raja Shekhar (2010) [2] examined a study under the title "A Service Quality Scale for Measuring Indian Railway Passenger Services". This study used the RAILQUAL model which included three new service quality factors in the SERVQUAL model. For analysis, data were collected from 140 respondents but only 112 respondents' responses were used to analyse and determine the difference between the respondents' expectations and perceptions. In this study, the researcher examined the average gap score of perceived and expected service quality, i.e., -1.73, which defined that the perceived quality did not meet expectations and passengers were not satisfied. So, this model helps pinpoint the area of managerial action and attention as well as helps improve service quality and reduce the gap.

Anjali Sharma and Dr. A.K Mishra (2013) studied titled "Measuring Commuters' Perception of Service Quality Using SERVQUAL in Delhi Metro". For this study, 1200 respondents were selected and in this study security was a very important factor included in the SERVUAL model. Security was an important factor that included separate compartments for women in the metro and the metro platform. So based on these conclusions Delhi Metro concentrates on its security and delivers satisfaction to the Metro commuters.

Sheeba. A. A and Dr. K. Kumuthadevi (2015) [4] explored a study under the title "Service Quality of Southern Railways – Satisfaction on Facilities: Kerala Passengers Perspective". This study was done in Southern Railway Kerala and data were collected from 220 commuters. This study analysed the facility factors containing Amenities provided and their variables to determine the travellers' satisfaction. It's revealed that the passengers are not satisfied with the services and facilities provided to Kerala's Commuters'. This study will be helpful to retain the passengers and enjoy its services in the future.

Sanjay Singh (2016) makes an attempt for "Assessment of Passenger Satisfaction with Public Bus Transport Services: "A Case Study of Lucknow City (India)". And it is found that comfort and safety have an important effect on commuters' satisfaction and the elegant design of buses, the adequate capacity of the buses and accessibility have no impact on passengers' satisfaction. This study revealed that most of the commuters were dissatisfied with Lucknow Bus Transport's services. This study suggested improving the service quality of bus services and improving the level of customer satisfaction.

B. Manikandan and Dr T. Vanniarajan (2016) [5] examined "Service Quality In Bus Services: An Empirical Study In Tamil Nadu" In this research, data were collected from 980 passengers of Madhuri district, but only 624 respondents gave a proper response. This study evaluated the passenger perception of bus service quality and the passengers' satisfaction. SEM identified service quality factors to improve bus service quality and increase passenger satisfaction. It was suggested that the operators improve their behaviour with passengers. All aspects of service quality have a significant positive influence on passenger satisfaction.

Objectives of the Study

To identify and analyse major factors affecting the service quality of the Delhi Metro.

Research Methodology

The primary data was used to collect information from commuters of the Delhi metro. A well-structured questionnaire is used to collect data for the study. The data was also used to collect the information from, published articles, metro websites and various reports. In this study, a non-probability sampling technique has been used. In the category of non-random sampling type, the purposive method is used to select the sample and 600 questionnaires were distributed to the respondents. The analysis is performed with the help of Exploratory Factor Analysis.

Analysis and Interpretations

Factor Analysis

Table 1

Statement/Variable	Factor Loadings	Factor order	Labelling of the factors	Total Variance Explained	Reliability (Cronbach's Alpha)
Announcement frequency and accuracy is high	.788	Factor	Information	12.465	.926
Announcement clarity is effective	.785				
Information regarding arrival and departure is up-to-date	.779				
Information access is easy inside the metro and on the metro map	.774				
The mobile application service provided by metro is useful	.737				
The user-friendly website for metro	.723				
The information inside the metro is	.711				

sufficient					
Proper lighting facility on the platform and in metro	.776	Factor	Platform Service	11.689	.914
Toilet facility is available on the platform	.758				
The number of exit and entry gates is sufficient on the platform	.731				
Adequate number of token counters on a platform and easy-to-buy token	.728				
Proper cleanliness on the platform	.713				
Proper Medical facility on the platform	.691				
Drinking facility and Availability of Catering services on the platform	.678				
The metro has to add more new coaches	.765	Factor	Tangibility	10.134	.904
Automatic fare collection gates are working properly	.762				
Air conditioning in the metro is satisfactory	.758				
Proper and comfortable Seating space is provided in metro	.696				
Seats reserved for old- age and physically disabled people	.694				
Lift and escalator work properly	.672				
Staff understand passengers' specific needs	.880	Factor	Responsive-ness	8.845	.891
The staff is knowledgeable and always willing to help customers	.816				
Polite and well-mannered staff	.795				
Staff provides the solution to passenger complaints	.794				
Availability of staff on token counter and handling your requests	.782				
Frequency of train that meets your needs	.775	Factor	Reliability	8.375	.871
Environmentally safe operation	.769				
24 hours services should be available	.775				
Travelling by metro is economical	.695				
The metro has a convenient travelling schedule	.681				
Security of women in the metro is high	.836	Factor	Security	8.331	.869
Safety on the platform is adequate	.787				
The number of CCTV cameras on metro and platforms is adequate	.785				
Pickpocketing events do not increase	.784				
The metal detector used by security forces is effective	.761				
Provide feeder bus services for last-mile connectivity which is useful	.776	Factor	Connectivity	8.103	.860
Connectivity of platform with t road is satisfactory	.727				
There is reasonable and adequate access for disabled people	.714				
Easy access to your home station and workplace place	.692				
Parking charges are reasonable and you find your vehicle safe	.615				
Overall reliability					.879

(Source: Researcher's Calculation through SPSS)

"Extraction Method: Principal Component Analysis."
Rotation Method: "Varimax with Kaiser Normalization."
Rotation converged in 5 iterations.

Name of Factors

Information

This factor consists of seven variables: "Announcement frequency and accuracy are high", "Announcement clarity is effective," "Information regarding arrival and departure is adequate", "Information access is easy inside the metro and about the metro map," "User-friendly web site of the metro", "Mobile application service provided by metro is useful" and "Information inside the metro is sufficient". Factor loading of each variable/statement of information dimension is more than 0.5. It is the main factor or dimension because it explains the maximum percentage of the variance of 12.465 of the total variances explained and it has an 'Eigenvalue' of 13.277. Cronbach's alpha value for this factor is 0.926, which defines the internal consistency and reliability of data.

Platform Service

This factor consists of seven variables: "Proper lighting facility on the platform and in the metro", "Toilet facility is available on platform", "Number of exit and entry gates are adequate on the platform", and "An adequate number of token counters on the platform and easy to buy token s", "Proper cleanliness on the platform", "Proper Medical facility on the platform" and "Drinking facility and Availability of Catering services on the platform". Factor loading of each variable/statement of information dimension is more than 0.5. It is the second main factor/dimension because it explains the variance percentage of 11.689 and it has an 'Eigenvalue' of 4.266. Cronbach's alpha value for this factor is 0.914, which defines the internal consistency and reliability of data.

Tangibility

This factor consists of six variables: "The metro has to add more new coaches", "Automatic fare collection gates work properly", "Air conditioning in the metro is satisfactory", and "Proper and comfortable Seating space is provided in the metro", "Seat reservation for old age people and physically disabled people", and "Lift and escalator work properly". Factor loading of each variable/statement of information dimension is more than 0.5. It is the third main factor/dimension because it explains the percentage of variance which is 10.134 and it has an 'Eigenvalue' of 2.322. Cronbach's alpha value for this factor is 0.904, which defines the internal consistency and reliability of data.

Responsiveness

This factor consists of five variables: "Staff is knowledgeable and always willing to help customers", "Polite and well-mannered staff", "Staff provides the solution to passengers complaints", "Availability of staff on the token counter and handling your requests" and "Frequency of train that meets your needs". Factor loading of each variable/statement of information dimension is more than 0.5. It is the fourth main factor/dimension because it explains the percentage of the variance of 8.845, and it has an 'Eigenvalue' of 2.143. Cronbach's alpha value for this factor is 0.891, which defines the internal consistency and reliability of data.

Reliability

This factor consists of five variables: "Frequency of train that meets your needs", "Environmentally safe operations", "24 hours services should be available", "Travelling by metro is economical", and "The metro has a convenient travelling schedule." Factor loading of each variable/statement of information dimension is more than 0.5. It is the fifth main factor/dimension because it explains the percentage of variance, which is 8.375, and it has an 'Eigenvalue' of 1.912. Cronbach's alpha value for this factor is 0.871, which defines the internal consistency and reliability of data.

Security

This factor consists of five variables: "Security of women in a metro is high", "Safety on the platform is adequate", "Number of CCTV cameras in metro and platforms are adequate", "Pickpocketing events do not increase", and "Metal detector used by security forces is effective". Factor loading of each variable/statement of information dimension is more than 0.5. It is the sixth main factor/dimension because it explains the variance percentage of 8.331, and it has an 'Eigenvalue' of 1.725. Cronbach's alpha value for this factor is 0.869, which defines the data's internal consistency and reliability.

Connectivity

This factor consists of five variables: "Providing feeder bus services for last-mile connectivity which is useful", "Connectivity of platform with the road is satisfactory", "There is reasonable and adequate access for disabled persons", "Easy access to your home station and working place", and "Parking charges are reasonable, and you find your vehicle safely". Factor loading of each variable/statement of information dimension is more than 0.5. It is the seventh main factor/dimension because it explains the percentage of the variance of 8.103 and has an 'Eigenvalue' of 1.533. Cronbach's alpha value for this factor is 0.860, which defines the internal consistency and reliability of data.

Conclusion

The Delhi Metro Rail Corporation, a well-known mode of public transportation, has helped to alleviate the situation. While the metro system has left a lasting impression on commuters and spared the passengers from the inconvenience of travelling on the capital's congested roads; thus, the purpose of this study is to investigate the service quality of the Delhi Metro Rapid Transit System using the modified SERVQUAL service quality model**.** Based on the findings researcher identify and analyse the seven factors of service quality; information is the main factor or dimension because it explains the maximum percentage of the variance of 12.465 of the total variance explained and it has an 'Eigenvalue' of 13.277 and connectivity is the seventh main factor/dimension because it explains the percentage of variance 8.103 and it has an 'Eigenvalue' of 1.533

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