

## Customer Satisfaction In Metro Rail - A Literature Review

Effulgence

Vol. 23, No. 1

January - June 2025

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### Abstract

Considerable research has been done on the topic of urban intra-city travel studying the customer satisfaction for the quality of services in the past. This research has been done with three major objectives: to study the research methodologies applied by the earlier researchers, to analyse the findings & conclusions of earlier research work so as to identify prime factors of the customer satisfaction for quality of services in urban intra-city travel modes, with emphasis given to metro rail travel in this research study. Harzing's Publish or Perish software was used to search keywords relevant to topic of research from the Google Scholar database. A screening process was manually conducted along with logical inclusion and exclusion criteria that reduced the search results from 999 to a final count of 21 research papers on which literature review was done and reported below. Quality of research papers selected was ensured in the manner that, research papers only published in the journals indexed in Scopus database were selected. Time, accessibility, safety, transfer environment, level of congestion, frequency, fare, ticket purchase facility, comfort, frequency were reported to be most significant factors of customer satisfaction in metro rail in the earlier research studies.

**Keywords:** Customer satisfaction, satisfaction, metro, rail, metro rail.

## INTRODUCTION

### History of Metro Rail Systems

London city in the southeast part of England in European continent holds the history of rapid transit in year 1863 ('History of Rapid Transit', 2023). It is

the place where first intra-city metro rail system was developed. In the month of May 1896 the famous metro rail in the Budapest city of Turkey become operational (World's Oldest Metro Systems - Railway Technology, n.d.). In the subsequent year of 1896 in the month of December the third oldest metro system of the world in the city of Glasgow in Scotland was opened (World's Oldest Metro Systems - Railway Technology, n.d.). In the subsequent years

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of 1897, 1900, 1901, 1902, 1904 and 1907 the metro rails in the cities of Chicago, Paris, Massachusetts, Berlin, Athens, New York, South-eastern Pennsylvania were opened respectively (World's Oldest Metro Systems - Railway Technology, n.d.). The most recent metro rail systems, in the world is Wenzhou Metro, Noida Metro and Jinan Metro opened in the month of January 2019 (The Newest Metro Systems in the World, 2019).

### **Important Factors of Customer Satisfaction in Public Transportation**

(Nurmahdi, 2019) stated in a research study that, the Customer Satisfaction Index (CSI) scored 75.05 on the 5 RATER elements of SERVQUAL Model, this score show that the customer is satisfied. In an urban city, customer satisfaction in transportation services plays an important role specifically the attributes considered to be very important are the on time performance, frequency of service and the travel speed (Mouwen, 2015). Organised survey of customer satisfaction have become an important device/ for the designers/planners of the public transportation (Guirao et al., 2016). Factors like security, punctuality, reliability, speed and comfort contribute to the dimensions of the greater importance in the felid of public transportation (Fonseca et al., 2010).

Among the six factors of dissatisfaction studied, the factor that led to most dissatisfaction in the customer using the serives of Docklands Light Railway in the city of London in UK, how the train company deal with the delays was reported to be, the factor that led to most dissatisfaction in customers. The said factor was reported by 50% of the respondents as the prime factor of dissatisfaction while other factors reported were punctuality/reliability (16%), journey length (7%), sufficient room for all to sit/stand (6%), ease of getting on/off (5%) and other factors contributed together for 15%. In the same study, factors that were cause of satisfaction were reported to be punctuality/reliability (38%), cleanliness inside train (18%), ease of getting on/off (7%), journey

length (7%), frequency of trains on route (6%) and other factors (23%) (Marinov et al., 2014).

Also in a study that assessed six distinct structures of varying levels of transferability in order to discover the best latent variable structure. The study identifies four latent variables to describe the service quality termed as 'Major Services' and 'Minor Services'. Major Serives includes attributes like service performance, trip comfort, safety while Minor Services includes staff performance (Soltanpour et al., 2020).

### **Objectives of the Study**

1. To study and report the methodologies applied in previous research studies on customer satisfaction in metro rail.
2. To analyse the results and findings of the earlier research studies on customer satisfaction in metro rail.
3. To detect and report the factors identified in the earlier research studies that lead to customer satisfaction for the quality of serives of metro rail.

### **Methodology**

#### **A. Search Strategy**

1. Databases Utilized - "Google Scholar"
2. Software tool used for keyword search - "Harzing's Publish or Perish".
3. Query run date - The query with the keywords mentioned in point number 4 below was run on 14-04-2024 at 11:14:41 AM.
4. Keywords, Bullions and Search Terms - "satisfaction" AND "metro rail"
5. Publication date range - Publication date range is from year 2013 to year 2023.
6. Click here to access the phase wise search report in excel format.

#### **B. Screening Process**

1. Manual screening of the title of research papers/articles/case studies was done

followed by the inclusion & the exclusion criteria(s) which is mentioned below in point number C (1), C (2) and D.

#### C. Inclusion Criteria & Exclusion Criteria

1. Relevance to the topic of study – Keywords specific and relevant/related to the topic of study were included in the Harzing's Publish or Perish software.
2. Nature of the article / papers included & Inclusion Criteria – Research articles, papers and case studies indexed in Google Scholar are included for this research study. While including the research articles, papers and case studies from Google Scholar it was made sure that only the articles/papers/case studies closely relevant to the topic of research are included while excluding other results published at Google Scholar. Articles/papers/case studies which had both the keywords in its title viz. "satisfaction" AND "metro rail" are included for this research study. Further, some search results with keywords in their title like "rail transit", "mass transit", "public transport", "metro stations", "metro services", "multimodal travel", "metro line", "multimodal transportation", "transit services", "electric train" etc. which are synonym or closely relates to the keyword "metro rail" (the searched keyword) were included as the part of analysis for this research study. This lead to an appropriate filtration and there were 49 research papers/articles/case studies included for further filtration, rejecting the 950 research papers/articles/case studies that didn't qualify the above mentioned criteria. Further, these 49 research papers/articles/case studies were examined and scanned for the quality of research sources / journals they were published in. Each publication source of the 49 research papers/articles/case studies were examined for the quality of the journals and it was

finally found that out of 49 research papers/articles/case studies, 19 papers/articles/case studies plus a research chapter from a book and a conference research paper were handpicked aggregating a total of 21, eliminating the remaining 28 papers/articles/case studies. Only the papers/articles/case studies that were published in the Scopus indexed journals were included for this study, hence ensuring the quality of the sources finalised for this study.

The above mentioned paragraph gives an idea on the nature of the research articles/papers/case studies considered and included for this literature review research study.

- D. Exclusion Criteria – The search operation executed in the "Harzing's Publish or Perish" software produced the results to its maximum capacity i.e. 999 results. Title that didn't contain the keywords mentioned in point number C (2) above were excluded for this literature review research study. Further the research articles/papers/case studies published in journals not indexed in Scopus are excluded from this study.

#### Customer Satisfaction in Metro Rail Systems

(De Oña & De Oña, 2015) reviewed and assessed the methodological approaches adopted to study quality of service(s) in the public transport modes based on the customer satisfaction in various public transports like airlines and airports, urban & metropolitan public transit/transport; & other medium of transport like dial-a-ride service, ferry passenger and paratransit. The summary presented in the research study reported use of Likert scale to collected data by survey method. Out of 80 research studies reported in the research paper, a 3-point Likert scale was reported to be made use in 3 research studies (3.75%), 4-point Likert scale was reported to be made

use in 1 research study (1.25%), 5-point Likert scale was reported to be made use in 38 research studies (47.5%), 7-point Likert scale was reported to be made use in 22 research studies (27.5%), 8-point Likert scale was reported to be made use in 1 research study (1.25%), 9-point Likert scale was reported to be made use in 4 research studies (5%), 10-point Likert scale was reported to be made use in 5 research studies (6.25%), 11-point Likert scale was reported to be made use in 6 research studies (7.50%). For the valid survey obtained in all the 80 research studies mean, median and mode were found to be 911.0568, 500 and 231 respectively.

Previous research studies (out of 54 studies) on analysing service quality by (classified on) model type reported were: disaggregated models on performance perception(s) & expectation(s) with no importance were 3 (5.55%), disaggregated models on performance perception(s) & expectation(s) with importance were 4 (7.40%), disaggregated models on only performance perception(s) with importance were 8 (14.81%), aggregated models on performance perception(s) and expectation(s) were 16 (29.62%), aggregated models on only performance perception(s) were 7 (12.96%) (De Oña & De Oña, 2015).

An overview of earlier studies on public transport classified based on the approach taken to specify weight of the attribute(s) used in service quality analysis by the technique of obtaining primary data through the customer satisfaction surveys, by asking for importance directly, such studies were found to be 40. Whereas earlier studies carried using a model derived from customer satisfaction surveys: by method of 'Bivariate Pearson Correlations (BPC)' were found to be 2, by the statistical method of 'Regression Analysis' were found to be 8, by the method of Structural Equation Model (SEM) were found to be 22, by the method of Path Analysis it was calculated to be 6 (De Oña & De Oña, 2015).

(Aydin et al., 2015) studied the customer satisfaction for the rail transits system of Istanbul by

implementing the MCMD (Multi Criteria Decision Making) framework that works in three steps: first step includes determining criteria of customer satisfaction, calculating sample size ( $n = 6150$ ), conducting surveys (across 6 transit lines), making data analysis in SPSS and presentation of the report. The second step involved calculation of the weight of the main criteria (of customer satisfaction) by using Fuzzy Analytical Hierarchical Process (FAHP), in which weights are calculated by for the sub-criteria by the trapezoidal fuzzy numbers based on customer responses. Third step is performed on the basis of step 2 where an evaluation of results sought from the step 2 is made for each rail transit line by fuzzy-Choquet integral, followed by sensitivity analysis and interpretation of the results. These results make it clear that there was a significant difference between the levels of the customer satisfaction for all the 6 transit lines surveyed and; time, accessibility and safety were mentioned to be the 'most important' criteria for customer satisfaction.

In a study on topic of service quality of MMHT (Multimodal Transportation Hub) in Anand Vihar, Delhi (Chauhan et al., 2021) measured the user satisfaction of public transport by collecting data from 515 samples (simple random sampling method) using the survey method on a 5-point Likert scale of satisfaction. Transfer environment and important facilities (transfer distance, parking, escalators, walkways, lifts, encroachments, obstructions) were discovered to be most influencing factors followed by safety and security (in waiting areas, in transfer areas, CCTV, adequate lighting), while accessibility and signposting (pick up and drop, separate exit and entry points, information signages, markings and crossings), comfort and convenience (variety of shops, restaurants, ATMs, waiting areas, seating availability, Wi-Fi, mobile and internet signals, charging pints, noise, air quality and cleanliness) and transport modes and travel information (accuracy and reliability of travel information, frequency, travel information boards/screens, time table) has moderate influence; staff management and ticketing

(ticket and enquiry counters, behaviour and staff assistance, time in queuing, security checks and busing tickets) had least influence on the service quality.

(Mokhtarian & Pendyala, 2018) analysed data drawn from American Time Use Survey 2013 from its wellbeing module to study: the feelings/emotions that people (i.e. travellers) have for their travel episodes, the differences based on various socio-economic groups for travel related emotions, the way travel is compared with other activities in terms of stimulating well-beings feelings; to conclude that, there are many (numerous) factors that can be associated with variations in travel satisfaction. Most of the people (i.e. travellers) were relatively satisfied with the travel that they undergo. Emotional feelings and moods are not necessarily caused by the travel episodes.

(Majumdar et al., 2021) researched to determine key determinants of travel satisfaction in New Delhi by the method of questionnaire administered on 898 respondents. Data was majorly collected on a 5-point Likert scale. The study concluded that demographic factors like age and gender, and also accessibility and built environmental factors like safety and security, condition and availability of walkways, level of congestion were the factor determinants of travel satisfaction.

(Majumdar et al., 2020) conducted a study to explore and prioritise key characteristics, for Hyderabad Metro Rail, influencing the overall metro service quality by administrating a 5-point Likert scale questionnaire, subsequently performing TOPSIS and Importance Performance Analysis on the collected data. The study concluded that factors such as connection to metro, frequency of metro and metro fare are the most important factors of satisfaction but the performance of above said factors were unsatisfactory. The study recommended to pay more emphasis on these factors to achieve and overall improvement in the quality of metro travel service.

(Saw et al., 2020) investigated the passenger satisfaction for Tyne and Wear Metro services by collecting the required data from questionnaire on 200 sample size based on 15 different attributes. Principal Component Analysis (PCA) and Cross Tabulation Analysis (CTA) was made use of, to analyse data on passenger satisfaction. Ticket purchase facility, quality of the infrastructure, security, comfort and safety were found and reported to be the significant factor(s) of passenger satisfaction, derived by performing PCA. While the CTA predicted that there lies a significant difference the demographic profiles (specifically gender, age, employment and the frequency of the use of metro) and the satisfaction scores.

(Ismael & Duleba, 2021) studied relationship i.e. association between 'satisfaction and perceived public transport service quality' of the private vehicle-users (due to Covid - 19 pandemic), by the way of PLM-SEM (Partial Least Square - Structural Equation Modelling) technique, in city of Budapest, Hungary by collecting data through questionnaire for 100 sample size. The study revealed that safety and security were not found to be significantly associated with satisfaction whereas accessibility and perceived service quality were found to be significantly associated with satisfaction.

(Wang & Gao, 2022) studied two factors, i.e. travel choice and the travel well-being, to determine that, out of both the factors which was more related to the travel choice behaviour in the post Covid - 19 pandemic era, in the city of Xi'an, China. The study was done by administering questionnaire on 604 respondents. One of the major conclusions of the study (Wang & Gao, 2022) is that there exist a positive (+ve) correlation between travel mood and travel satisfaction. Travel satisfaction is not directly responsible to affect the behaviour of the travellers that can/may lead to switch to other modes of transportation.

(Kar et al., 2022) measure the heterogeneity in the perceived satisfaction for the users of private cars

and motorised two wheelers for 17 selected attributes based on the gender and age group for metro satiations in Delhi, India. Responses were measured on a 6-point Likert scale via a tablet based survey instrument for collection of the satisfaction based responses. The study (Kar et al., 2022) concluded that the age group and gender significantly influences the perceived satisfaction of the users. The users of the service were reported to be highly satisfied with Egress time while dissatisfied with presence of VMS (variable message size).

(Srivastava & Dash, 2019) recognised the factor(s) that have a major impact on satisfaction of the commuters of Delhi Metro Rail. The data was collected from 1015 samples from all the 160 metro stations by the survey method to apply inferential analysis to analyse the data. The factor that has a direct influence on the satisfaction of the commuter were those having a direct influence on the senses of the commuters. While delay, jerking and crowding in train were the factors of high dissatisfaction.

(Luo et al., 2023) studied the factors that are influential in the customer satisfaction of transit service. The study examined the data from the social media from Sian Weibo, data was collected from 1,77,807 microblogs, in order to understand customer satisfaction. The technique of sentiment analysis was used to estimate the customer satisfaction. Further the authors used beta regression model to identify main influential factors of satisfaction. The results of this study specifies that time, travel mode, space, age and gender contribute to be influential factors of customer satisfaction in transit service.

(Chauhan et al., 2022) evaluated service quality of MMTH (Multimodal Transportation Hub) in Delhi, India. The research paper was aimed at evaluating role of gender heterogeneity to examine service quality of MMTH through technique of satisfaction survey of 515 respondents. This study (Chauhan et al., 2022) concluded that transfer environment and

facilities, security & safety to be most influential factors for the males and females.

(Xue & Chen, n.d.) studied the influence/effect of passenger loyalty and satisfaction on the service quality of Fuzhou Metro (line 1). SERVPREF scale was used to measure the 'service quality', 'satisfaction' and 'loyalty' on a 5-point Likert scale from 523 respondents. The study reported that 'A --- > Assurance' has the greatest impact on satisfaction of the customer followed by 'T --- > Tangibility', 'R -- - > Reliability', 'E --- > Empathy', and 'R --- > Responsiveness' being the least impactful.

(Zacharias & Liu, 2022) studied role of the access environment for the travel satisfaction in Metro commute. Access by the means of bicycle, foot and bus were measured on a 5-point satisfaction scale. Dummy variable regression method and three factor theory were employed to identify factor structure of the attribute(s) of the environment under different access means. Results of the (Zacharias & Liu, 2022) study show that egress and access satisfaction were reported to be more important than satisfaction of the metro trip for overall trip satisfaction for cycling and walking modes. Access distance was found to be negative, but marginally for satisfaction related to cycling and not so significant for walking. Pathway, crossing safety, street connectivity, greenery, shade were reported to be significant for pedestrians accounting for the variance of 51%. Parking facility, directness, service and distance were concluded to be significant for bicyclist for satisfaction, accounting for the variance of 62%. Stop location of the bus was reported to be very important and the passengers were concerned regarding the experience of the walk to the bus stop. For the travel by public transport, egress and access environment is reported to be important for overall satisfaction.

(Pani et al., 2023) studied the disparities in gender for the attitudes, satisfaction and behaviour in multimodal travel by collecting 897 responses in Delhi, India. The study quantified the links between behaviour and attitudes in the different segments of

the multimodal travel for dissonance (i.e. passengers traveling in a mode that is non-preferred) and consonance (i.e. passengers traveling in a mode that is preferred). Using the gap hypothesis tests, gender disparities were assessed in travel satisfaction. This study (Pani et al., 2023) revealed that, the choices of the multimodal are largely linked to the attitudes specific to the modes. It also revealed that most of consonance passengers (i.e. passengers traveling in a mode that is preferred) come under the car users while most of dissonance passengers (i.e. passengers traveling in a mode that is non-preferred) fall under public transport.

(Das, 2021) presented case study of Mumbai city on understanding satisfaction of the users' towards quality of the public transit. The authors citing the limitation of the data collection through the technique of survey advocated use of Twitter Data (i.e. Tweets) to understand service quality of public quality systems in Greater Mumbai, India. The authors stated that, the nature of the tweets (positive or negative remarks / expressions conveyed in the tweets by the users) can/may be used make a judgement of the satisfaction or the dissatisfaction of the users for service quality of public transit systems. The study identified delay and cleanliness as the factors responsible for the users' dissatisfaction. Further, the users usually make tweets conveying their dissatisfaction in the peak and rush hours. In the said study it was found the people were keen on expressing their negative comments rather than positive comments on Tweeter for quality of services.

(Sukwadi et al., 2022) aimed to formulate a satisfaction model that would quantify effects/impact of service quality as well as also quantify the perceived accessibility as a mediating variable on passengers overall/total satisfaction for Mass Rapid Transit (MTR) in Jakarta. The study also aimed at exploring the important factors for measuring quality of service of MTR in Jakarta. Using the SEM method in R studio, 24 variables were tested for the study. Thematic analysis was

used to evaluate qualitative data. The study concluded that with an increase in the perceived accessibility by service quality the travel satisfaction would also increase. Travel satisfaction & perceived accessibility are affected by service quality.

(Bharadwaj, 2023) investigated the prime determinants of service quality & its effect on satisfaction of the commuters for Delhi Metro Rail Corporation. The authors used purposive sampling to select sample size and collected data on a 5-point Likert scale by the technique of the structured questionnaire from 850 commuters. The authors made use to the SEM (structural equation model) to confirm importance of research model. The study revealed that security and assurance and empathy are the significant determinants of satisfaction of the commuters. The study (Bharadwaj, 2023) further explained that commuters' friendliness for each other and quality of services offered by metro are inversely related. This study concluded that, more and more people will be prompted to use the metro if higher reliability of the metro is achieved.

(Kar et al., 2023) identified the priority attributes that influence the accessibility to the station based on riders' choice perception. The riders for this research study were the private vehicle users (who chose the metro ride). With an objective of studying the satisfaction for selected attributes for the influencing accessibility a 6-point Likert ordinal rating scale was designed to collect data from 1050 respondents from the parking lots of different metro stations in Delhi. Priority rankings for the attributes were derived by employing the well-established models viz. "TOPSIS (Technique for the Order Preference by Similarity to Ideal Solution), MADM (Multi Attribute Decision Making), RIDIT (Relative Identified Distribution Integral Transformation) and GRA (Grey Relational Analysis)". The verdict of this study mainly indicated that users have higher satisfaction with 'In Vehicle Travel Time' and 'Egress Time'. The Spearman's rank order correlation analysis was performed on the attribute rankings derived by the above mentioned methods. At 99% confidence level

the correlation analysis showed a +ve (positive) relationship among the methods of ranking.

(Ismael & Duleba, 2023) measure the perception and satisfaction for the quality of service of the habitual private transports users and the occasional private users in the city of Budapest, Hungary. Data from 364 occasional user and 136 habitual users was collected by a paper based and online satisfaction survey. Convenience sampling method was used to select the sample. After conducting the descriptive analysis, Students T-tests (two independent sample) was administered to find the overall satisfaction and varying perceptions. Also an OPM (Order Probit Model) and IPA (Importance Performance Analysis) was carried out on the data. Findings/conclusions of the study show that habitual users of the public transportation were satisfied more than the occasional users. The IPA show that, the 'information provided' attribute was found to be 'an attribute of high priority improvement' for habitual users. For both the users, cost was found to be most significant for all the models that contributed to the overall satisfaction.

## CONCLUSION

Overall customer satisfaction is the significant measure of service quality for metro rail or public transit systems across globe. Researchers by the way of using primary data collection technique, online / paper based questionnaire as a tool, measured predominately on a '5 Point Likert Scale' have tried to identified the critical factors/attributes that lead to overall satisfaction of the customers in metro rail travel in different cities of the world. Time, accessibility, safety, transfer environment, level of congestion, frequency, fare, ticket purchase facility, comfort, frequency were reported to be the most significant factors of customer satisfaction in public transit facilities, specifically metro rail.

The prominent models, methods and techniques that were found to be used to analyse data to identify the prime factors for customer satisfaction in public

transit systems in earlier studies are MCMD (Multi Criteria Decision Making) framework (Aydin et al., 2015), Fuzzy Analytical Hierarchical Process (FAHP) (Aydin et al., 2015), Importance Performance Analysis (Majumdar et al., 2020), Principal Component Analysis (PCA) and Cross Tabulation Analysis (CTA) (Saw et al., 2020), PLM-SEM (Partial Least Square - Structural Equation Modelling) technique (Ismael & Duleba, 2021), technique of sentiment analysis (Luo et al., 2023), beta regression model (Luo et al., 2023), dummy variable regression method and three factor theory (Zacharias & Liu, 2022), gap hypothesis tests (Pani et al., 2023), gender disparities (Pani et al., 2023), TOPSIS (Technique for the Order Preference by Similarity to Ideal Solution), MADM (Multi Attribute Decision Making), RIDIT (Relative Identified Distribution Integral Transformation) and GRA (Grey Relational Analysis) (Kar et al., 2023) and OPM (Order Probit Model) (Ismael & Duleba, 2023).

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