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Service quality assessment of orange line metro train, Lahore, Pakistan

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Abstract. Service Quality increases the efficiency and effectiveness of a service leading to achieving the satisfaction of its users. A customer satisfaction score is considered one of the effective tools to achieve efficiency in any service. Service Quality and riders' satisfaction with public transport is important for social, political, environmental, and economic outcomes. The research aims to assess service quality from the perspective of users of the Orange Line Metro Train OLMT, Lahore. The study was based on two types of surveys one was the observatory and the other was a questionnaire-based survey. The observatory surveys at stations were carried out to note down the status of facilities available. A questionnaire-based survey was conducted from passengers at different OLMT stations. The average ridership of OLMT is approx. 65,000 per month till the first quarter of 2022. The research used random sampling techniques for the selection of users riding from different stations of OLMT. The study used eight service quality variables; i.e. accessibility, safety and security, comfort and cleanliness, customer care, infrastructure, amenities, and fare satisfaction; and environmental conditions. The study concluded that the customer satisfaction score for the OLMT service is 65%. The riders were moderately satisfied with service quality at stations of OLMT. The absence of the park-and-ride facility is one of the most critical and challenging things. The majority of riders highlighted that the behavior of the staff working at stations was not cooperative. Observatory surveys and riders' perceptions regarding various issues complement each other. The variables that need to be improved are particularly related to accessibility through the provision of park-and-ride facilities, comfort and convenience through the provision of additional facilities at the waiting area of stations. The findings of the study will help authorities and policymakers in improving factors that were identified during the surveys for the improvement of service quality.

1. Introduction

The public transportation system is an integral part of both urban and rural surroundings, its effectiveness, accessibility, and availability affect the majority of people either directly or indirectly [1]. Public Transport plays a significant role in the movement of people in an environment-friendly way and it is preferred by numerous developed countries such as Germany and Japan [2]. Unlike developed countries, there are few cities in developing countries such as Ahmedabad, Taipei, and Tangerang where

there is a decline in the utilization of public transport due to unsatisfactory service, and unnecessary delays [3]. In the parallel world, the share of private transportation has increased drastically, creating several problems such as congestion, pollution, accidents, etc. The provision of a decent public transportation system can mitigate all the adverse effects of private modes of transport issues effectively [4],[5]. The metro system is one of the most popular public transportation, growing worldwide and widely used in cities of developed countries as it works in a highly organized and efficient manner [6], [7]. One of the most crucial steps in ensuring the utilization of public transport is establishing strong mass transit networks that provide users with an excellent, affordable choice and decrease their use of private automobiles [1]. Thus, it is essential to improve the quality of services provided by mass transit systems to attract users and turn out to be as preferred mode of transport. Mass transit service providers must understand and identify the areas of improvement in the quality of services to attract users [8],[9].

There are two ways to assess the quality of service of mass transit. One is from the perspective of the service provider, i.e. effectiveness and efficiency of the service. The second one is from the perspective of its users i.e. the perception of its users and their satisfaction level. Therefore service quality can be understood as a measure that how well the service level meets the expectations of the customer regularly. It can also be defined as a metric that measures the delivery of services by an organization in comparison to its users' expectations. It is a valuable skill to measure and improve service quality to meet or exceed the expectations of users but perceptions regarding various features of a service are very different among users [10]. Several studies have examined the relationship of service quality with other factors. Numerous parameters are linked with the service quality such as efficiency, reliability, safety, comfort, and service personnel, adding to this, time of service is also crucial i.e. weekdays versus weekends and peak versus off-peak hours [11]. The requirement to evaluate the quality of service of transportation networks based on user perceptions has drawn more attention in recent years. It is a method of measuring the performance of transportation systems objectively in the context of service. Service Quality makes sure every passenger reaches their location on scheduled time, with the least amount of discomfort and annoyance [12]. Transit service providers are continuously striving hard to improve the quality of service through the experience of passengers' perception and satisfaction. Improving the perception and satisfaction of passengers towards the metro train is not only a way of retaining its existing users but also a way of attracting new passengers to the train [13]. The study of service quality of High-speed rail in Turkey examined and proved that there is a strong relationship between the quality of service and passenger loyalty, complaint, and satisfaction [14]. The research has also evaluated the gender disparity in the service quality of public transportation and findings reveal that the perception of passengers regarding the service quality varied differently across passenger's age and gender. Therefore gender-specific strategic measures are necessary to improve the quality of service [15],[16]. The study of the perception of users of public transport was conducted in the city of Porto. It revealed that most of the passengers use public transport due to its speed and comfort and the lack of other modes of transportation available for their routes [17]. An interesting study was conducted assessing the service quality and satisfaction of public transport from the perception of non-users of public transport. The study identified that comfort, punctuality, and frequency of service are equally important for private vehicle owners as well [18]. Another study was carried out regarding the perception of the passengers of Light rail transit in Addis Abbas. The analysis shows that the most important factor affecting the satisfaction of users is the safety, security, comfort, cleanliness, and frequency of service [17]. In the line with above research work, the theoretical framework in the current research adheres to the assumption that service quality can be assessed on the basis of the perceptions of the riders as well.

Pakistan is experiencing rapid urban growth and an increase in its population. Lahore is the country's second-largest city and the capital of its most populous province, Punjab. It is the second most populous city in Pakistan and is a hub of various educational institutions, and a diverse commercial center, with home to a diverse range of institutions, different housing developments, and industries on its outskirts. It is spread over an area of about 2,000 square kilometers with 10 million people [19]. Orange Line Metro Train (OLMT) was an effort to fulfill the transportation needs of the growing population and to control various traffic issues generated through the excessive use of private vehicles. It is the first metro

line in Pakistan initiated in 2020 (refer to figure 1). The line is served by 26 stations and is planned to tackle 250,000 passengers daily whereas the average daily passengers are approximately 65,000 [20].

In light of this situation, it is necessary to investigate the important element requiring investment to improve service quality from the perspective of users of the OLMT and to assess and recommend strategies to improve ridership up to the planned standard.

The first section presents a brief review of the literature and research problem. Section 2 elaborates on the research methodology adopted in this study. Section 3 discusses the results. Section 4 presents the conclusions of this research and suggestions for future research.

2. Method and Data Collection

2.1. Study Area

The OLMT connects major locations from north to south in the busiest city in 45 minutes. The OLMT runs at 80 kilometers per hour from Dera Gujran at the northern end of its route to Ali Town at the southern end in the city of Lahore, with 26 stations along the line. OLMT uses energy-saving fully automated electric trains, each of which has five 20-metre long bogies with 60 seats with a total track length of 27.12 kilometers. The operation time of the train is 5:30 to 23:30 (18 hours daily). There are 27 train sets each consisting of 5 cars are being acquired to meet the ridership demand. There are 26 stations along the line, including 24 elevated and 2 underground stations. The average distance between stations is 1.02 km, while the maximum is 1.54 km (from Sultanpura to Railway), and the minimum is 0.59 km (from Central to Anarkali). Rail lines are 9.7 meters below street level at Central Station and 8.7 meters below street level at Anarkali Station. Elevated stations are 22.5 meters wide, while Anarkali Station is 16 meters wide and Central Station is 49.5 meters wide. Although all elevated stations are 102 meters long, Anarkali and Central Stations are 121.5 and 161.6 meters long, respectively. For security purposes, emergency gates are provided on OLMT stations. Fire extinguishers are installed on stations and instructions to use them are mentioned clearly. Automated doors are located between platforms and trains in subway Stations. The public areas of the station are air-conditioned during the summer. Natural ventilation on the platforms and localized air conditioning in the ticket-hall level public rooms are provided by elevated stations [20],[21]. The stations are one of the main infrastructures in the metro system as they provide a place for various services such as purchasing tickets, boarding trains, waiting for points, etc. Maintaining and improving the services at the station in the metro system will ultimately improve the performance of the overall metro system [6],[7]. Thus, three OLMT stations were selected based on surrounding land uses and type of station i.e. Anarkali Station on Mall Road (Underground Station or mixed land use) in figure 2, UET Station on GT Road (Educational area) in figure 3, and Shah Noor station also known as Khatam-e-Nabuwat station on Multan Road (Commercial Hub) in figure 4. The research study considered riders' perceptions before and after on-board and off-board to the train regarding the overall service quality lightning of stations, waiting time, etc.

2.2. Survey Design

The survey was designed in two phases. The first one was an observatory survey conducted by the researchers to check on the ground reality of all facilities at stations. For this, a checklist was prepared to note whether the facilities are available at stations or not. In the second phase, passengers were involved through interviews via a designed questionnaire. The questionnaire was designed in three folds. First, the demographic information of the passenger was asked including age, education level, and ownership of a private vehicle. Secondly, the rider was asked about the usage of the metro train, and thirdly satisfaction level of various service quality dimensions was investigated. For this particular research, eight variables which are Accessibility, Safety and Security, Infrastructure, Customer Care (Staff), Comfort and cleanliness, Satisfy with Fare, Environmental Conditions and Amenities with 50 sub-indicators have been identified through the literature table 1.

Table 1. Service Quality Variable found in the literature.

Sr. No	Variables	Indicators	Reference
1	**Accessibility**	Escalators	[11],[17]
2		Staircase	
3		Lift for Disables	
4		Entry & Exit points	
5		Park & Ride Facility	
6	**Safety and Security**	Information /sign boards	[11],[17],[22]
7		Availability of Waiting Room	
8		Well Designed Lighting	
9		Fire Safety	
10		Protected Walkway	
11		Speed Limit Sign	
12		Warning Sign	
13		Weather Protection	
14		CCTV cameras at Stations	
15		Security Guards at Stations	
16		Safety at night	
17		Safety in Waiting Areas	
18	**Infrastructure**	Clear Signage, Arrows, and Barriers	[5],[17]
19		Recharge facility of Ticket	
20		Route Descriptions with a complete list of stops	
21		Cafeteria with proper Seating Arrangements	
22		Advertisement Boards	
23		Clock at Station	
24		Ticket and Enquiry Counters	
25	**Customer Care (Staff)**	Friendly, Courteous, Quick service staff	[11],[17],[22]
26		The behavior of managing staff at Stations	
27		Explanations and Announcement of Delays	
28	**Comfort & Cleanliness**	Cleanliness at Stations	[11] , [23], [24], [25]
29		The comfort of seats at Stations	
30		Over Crowdness while purchasing ticket	
31		Dustbins/trash cans at Station	
32		Sitting Benches at the Station	
33		Availability of Charging point	
34		ATMs Facility at Stations	
35		Wi-Fi and Mobile & Internet Signals at the station	
36		Sitting/Standing Capacity	
37		Comfort using Escalators	
38		Cleanliness in Train	
39	**Satisfy with Fare**	Satisfy with Fare	[15],[16], [22],[24]
40		Reasonable Ticket Price	
41		Estimated Fare Price	
42	**Environmental Conditions**	Landscaping at Station	[11],[17],[26]
43		Noise Level at Station	
44		Ventilation at Station	
45		Air Conditioning & Heating at Stations	
46		Cleanliness at stations	
47		Cleanliness at train	
48	**Amenities**	Availability of smart card facility	[15]
49		Availability of handrails	
50		Availability of grab handles	

The service quality variables were developed based on various sub-indicators taken from literature already published in the field of public transportation and the items from these studies were modified to suit the local context. These items were measured using a five-point Likert scale, from 1 = strongly dissatisfied to 5 = strongly satisfied. A higher score indicates a higher interest in a specific measure.

2.3. Sampling and Data Collection

For the observatory survey, the researchers visited all the stations of OLMT and noted down the list of facilities available. To select the passenger for the interview, Simple Random Sampling was used. In simple random sampling, the members of the sample are selected randomly and purely by chance. The quality of the sample is not affected as every member has an equal chance of being selected in the sample. This type of sampling is best for a highly homogenous population. Generally larger sample size gives more accuracy and precision but at the cost of time and finances. This research used average ridership per month from the year 2020 to 2022 as population and with a 95% confidence level, Yamane's formula yielded a sample size of 400. SPSS was used for data analysis. i.e. $n= N /1 + Ne^{2,}$ where, n = sample size, N: = size of the population, and E = error margin. A face-to-face interview was conducted at three stations in April 2022.

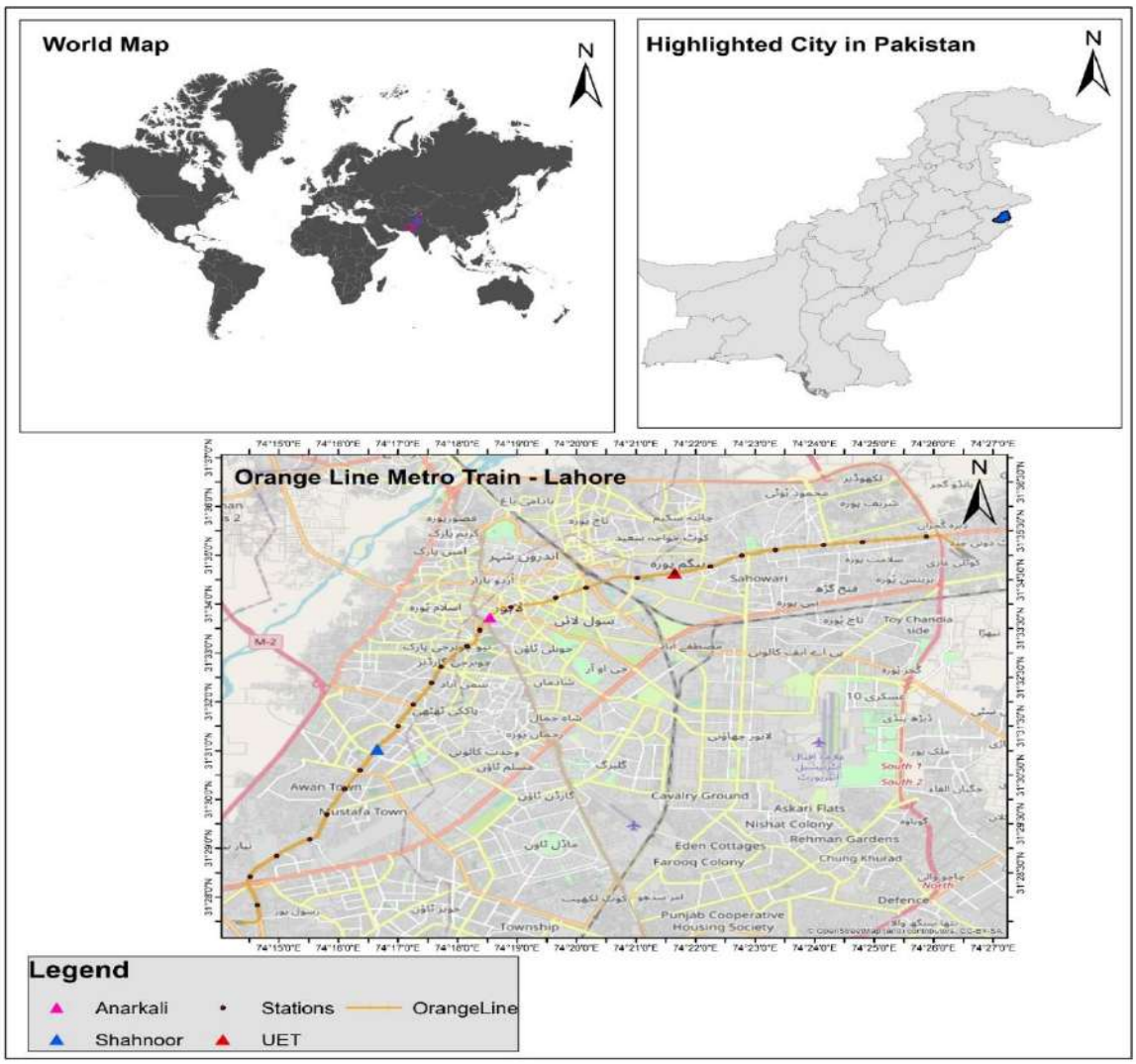

Figure 1. Stations of Orange Line Metro Train, Lahore, Pakistan

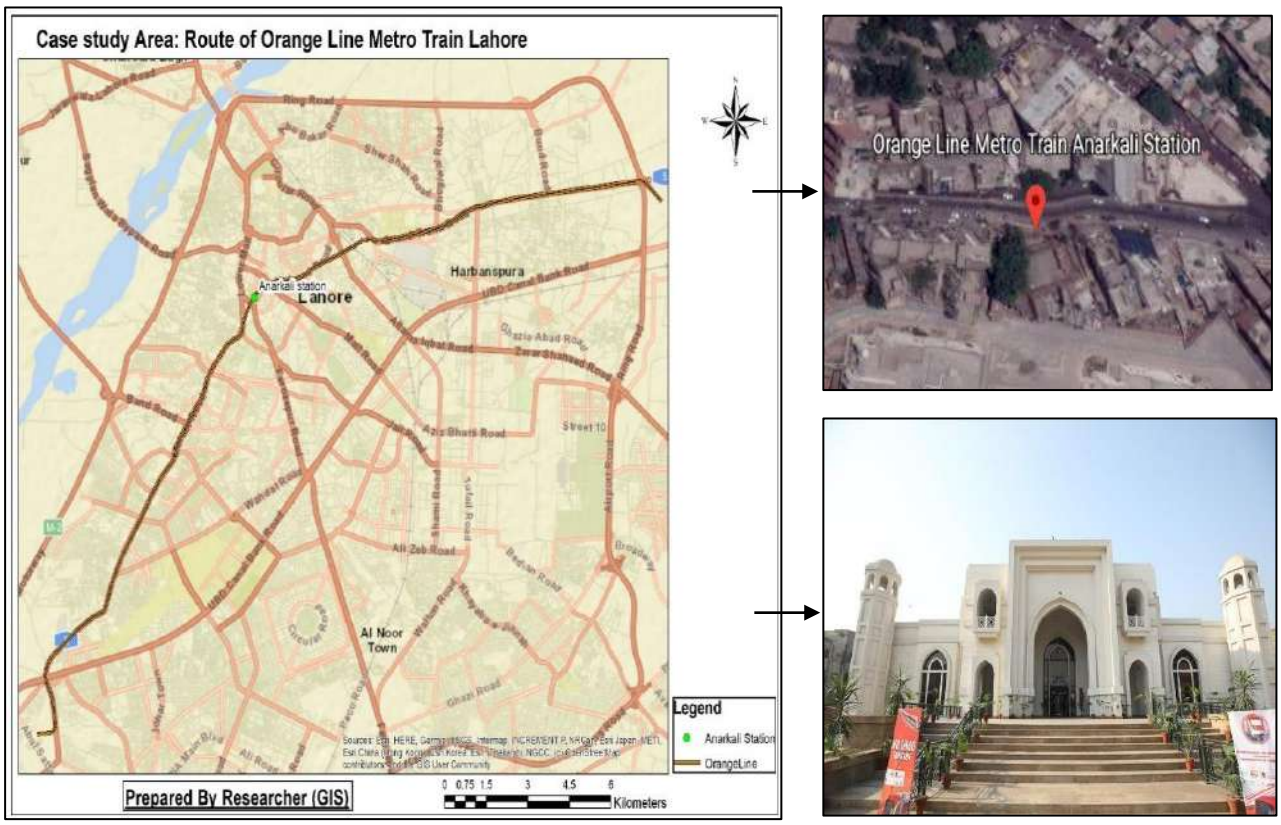

Figure 2. Location of Anarkali Station of Orange Line Metro Train, Lahore, Pakistan

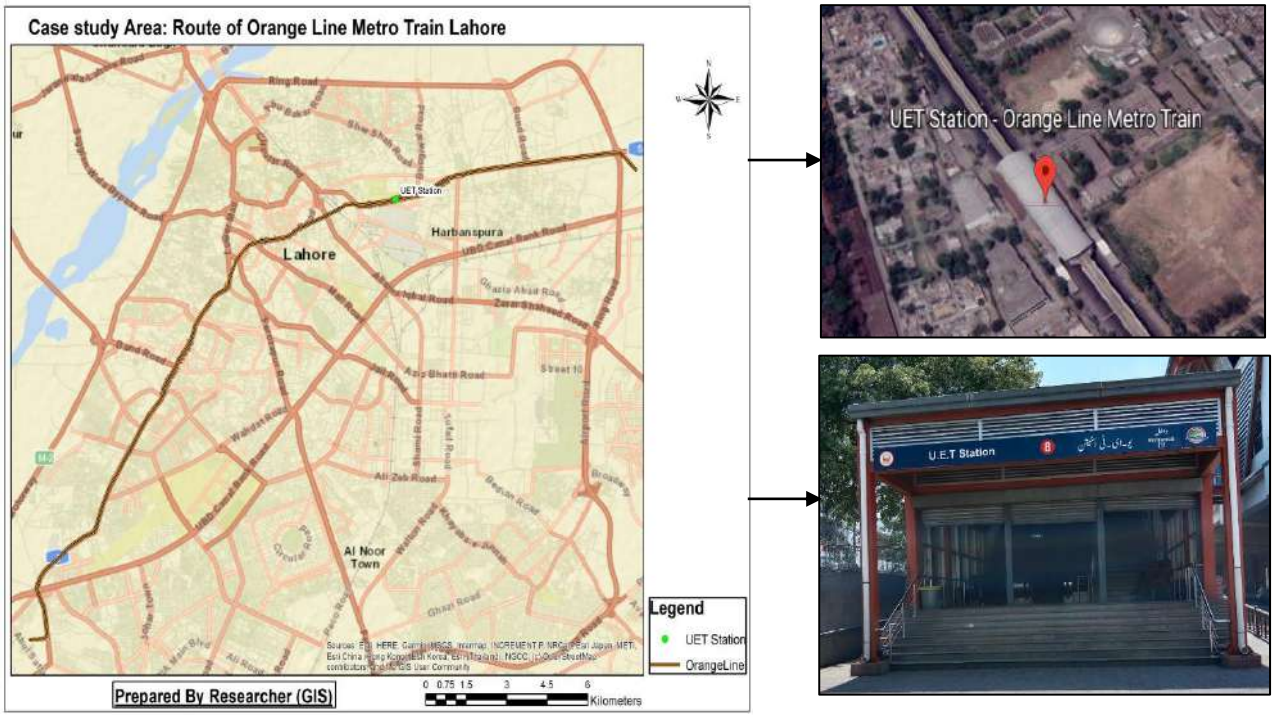

Figure 3. Location of UET Station of Orange Line Metro Train, Lahore, Pakistan

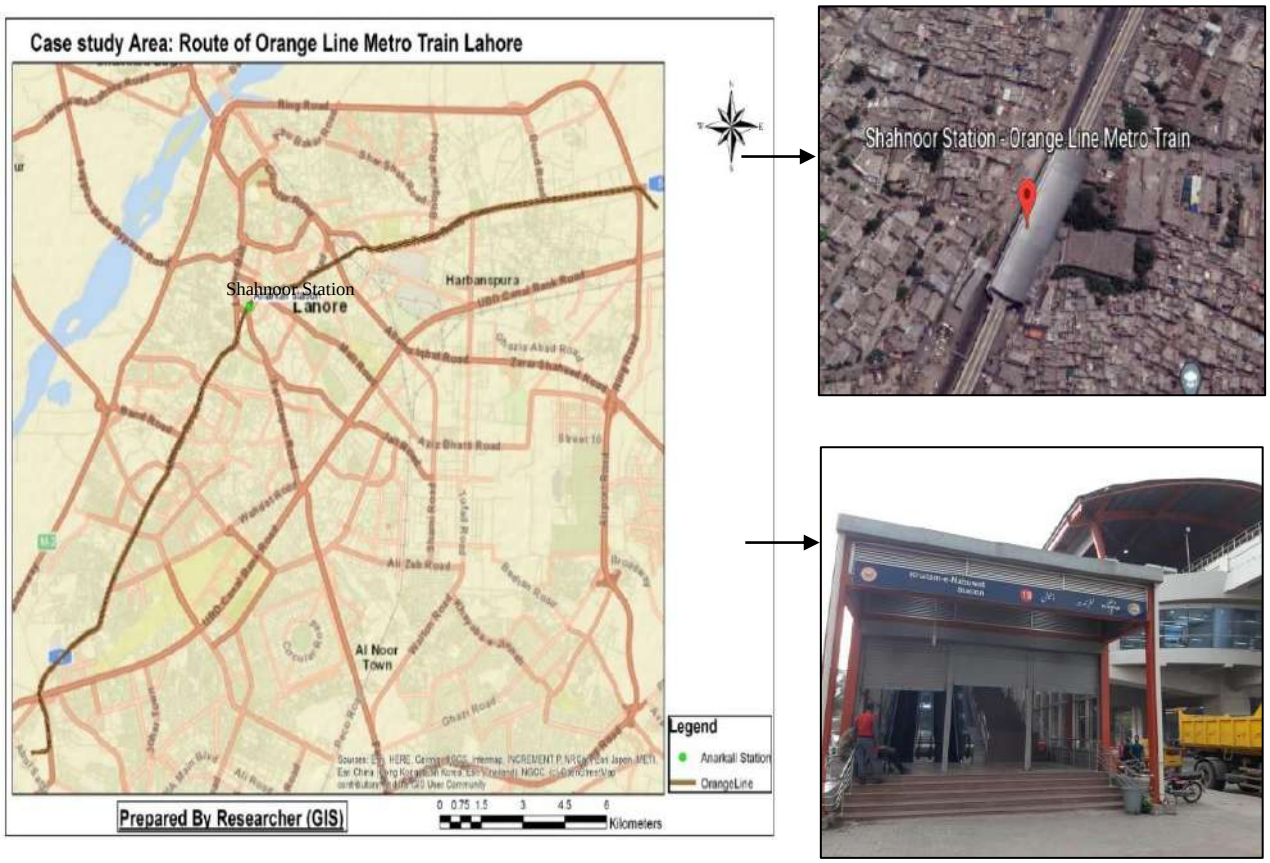

Figure 4. Location of Shahnoor Station of Orange Line Metro Train, Lahore, Pakistan

3. Results

3.1. Observatory Survey

The researcher visited all the stations and noted down all the facilities available at the stations. The complete survey is presented in table 2. During the observatory survey, it was revealed that stations are furnished with all the facilities for people of all ages. There are lifts, escalators, staircases, a proper ticketing facility, and appropriate signage to guide travelers. Stations are fully equipped to deal with emergencies. There is an appropriate lighting system at stations, firefighting arrangements, and emergency exit points. To ensure cleanliness at stations, there is a well-designed arrangement of the waste collection system, whereas the stations lack aesthetic beauty, with no artificial landscape at the stations. For the facilitation of passengers, the waiting area is there but unfortunately without proper seating arrangements. Stations lack one of the most important features, which is the park and ride facility. Not a single station has this facility. In a nutshell, UET station and Anarkali Stations comparatively have better services. The Anarkali station was observed as well-designed and spacious. The availability of various facilities among all the stations is more or less similar, however, the thing which differentiates from each other operation and maintenance of services.

Table 2. Check-list (Services Provided at Orange line Metro Train Stations)

Stations / Services	Advertising Board	Destination Indicators	Track	Subway/ Route Map	Sign Boards /Arrows	Proper Queue (Ticket Purchasing)	Dustbins	Sitting Benches	Ticketing Facility	Landscaping	Park & Ride Facility	Emergency Exit	Fire Arrangement	Waiting Area	Washroom (Male &	Stairs/Lift/ Escalator	Lighting	Clock	Pedestrian Bridge	Support Column
Ali Town	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Thokar Niaz Baig	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Canal View	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hanjarwal	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wahdat Road	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Awan Town	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sabzazar	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shahnoor	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Salahudin	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bund Road	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Samanabad	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gulshan-e-Ravi	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chaburji	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lake Road	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
GPO	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lakshmi	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Railway Station	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sultan Pura	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
UET	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baghbanpura	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shalimr Garden	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pakistan Mint	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mahmood Booti	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Islam Park	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Salamat Pura	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dera Gujran	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓

3.2. Analysis of User's Perception

3.2.1. Demographic Profile of Ride. Passenger demographic profile includes Gender, Age, Occupation, and Ownership of vehicle. A notable difference was observed in the users of the OLMT as presented in table 3. Female users were more as compared to male. 55% of the females were commuters and the remaining 45% were males. The users also vary in age as most of the females are using the OLMT service for educational and job purposes and range between 19 to 30 of age. As regard the ownership of private vehicle, 79% of users owned motorbike while 16 % of them owned a private car. The occupation of the passengers was also asked, 35% of the riders are full-time employed and use OLMT to reach their jobs. The trend of students using the OLMT was observed as well i.e. 25%.

Table 3. Demographic information of users of OLMT.

Category	**Percentage**			
Gender	Male	45%	Female	55%
Age	18 or below	25%	19 to 30	50%
	31 to 50	20%	51 to Above	5%
Ownership of vehicles	Car	16%	Bicycle	2%
	Motorbike	79%	Other	3%
Occupation	Student	25%	Employed Part Time	25%
	Employed Full Time	35%	Housewife	15%

3.2.2. Usage of Metro Train. The majority of the passengers use it metro train as it is safe and secure, comfortable, flexible time, and a good accessibility (refer to table 4). There is no Park and Ride facility available at stations, and 10% of the riders park their vehicle (bike) at their own risk. Most of the riders (55%) of OLMT used to come to the station on foot, and 25% were using a motorbike to reach the station. Most (75%) of the passengers reach their origin station in a time of 5 minutes or less and the maximum time to reach the ultimate destination is about 40 minutes.

Table 4. Reasons to Use OLMT.

Reasons for traveling	**Safe & secure**	**40%**	**Flexible trip**	**15%**
	Accessibility	20%	Comfort and cleanliness	25%
Park and ride facility	Yes	10%	No	90%
Mode of transport used for reaching the station	On foot	55%	On bike	25%
	Other modes	20%	Please Specify	Rickshaw
Time takes to reach the station origin	Within 2 min	20%	Within 3 min	15%
	Within 5 min	40%	Within 10 min	25%
Travel time to reach the destination	Less than 20 min	30%	20 to 30 min	20%
	30 to 40 min	25%	Above 40 min	25%

3.2.3. Service Quality. Service quality assessment of every variable along with its indicators was evaluated based on the rider's perception is presented in table 5 and explained under the sub-head.

3.2.3.1. Accessibility. It is the quality of being able to be reached or entered. It refers to a measure of the ease of reaching (and interacting with) destinations or activities distributed in space. A fundamental part of a person's mobility is their interaction with the mode of transport available and the environment. For the assessment of the Accessibility of OLMT, It has been classified under 6 sub-indicators. i.e. i) Escalators/Staircase ii) Lift for Disables iii) Entry & Exit points for arrival & departure passengers iv) Park & Ride Facility v) Information /sign boards. As per the analysis of the view of passengers at three stations of OLMT during peak hour regarding accessibility, 47% of riders of Anarkali and Shahnoor stations were dissatisfied with the escalator facility but at UET station 53% of riders were moderately satisfied. 41% of riders were not satisfied with the staircase at all three selected stations. 50% of the riders were moderately satisfied with the lift for the disabled. 47% of riders were not satisfied with the entry and exit points at all selected stations. Riders were equally 47% moderately satisfied at Anarkali, Shahnoor, and UET stations with park-and-ride facilities. 53% of riders were moderately satisfied with the information/sign board at Anarkali and UET stations and 50% at the Shahnoor station. Most of the passengers were moderately satisfied with the overall accessibility indicator at all selected stations during peak hours. The overall score of Accessibility is 3.2, 3.1, and 3.4 at Anarkali station, Shahnoor station, and UET stations respectively shown in figure 5. The score for all selected stations is above average which means that riders are moderately satisfied. However, the score for the sub-indicator varies in some cases. The lowest score for the sub-indicator facility of the staircase/escalator is 2.8 at Anarkali station, which stands for low satisfaction.

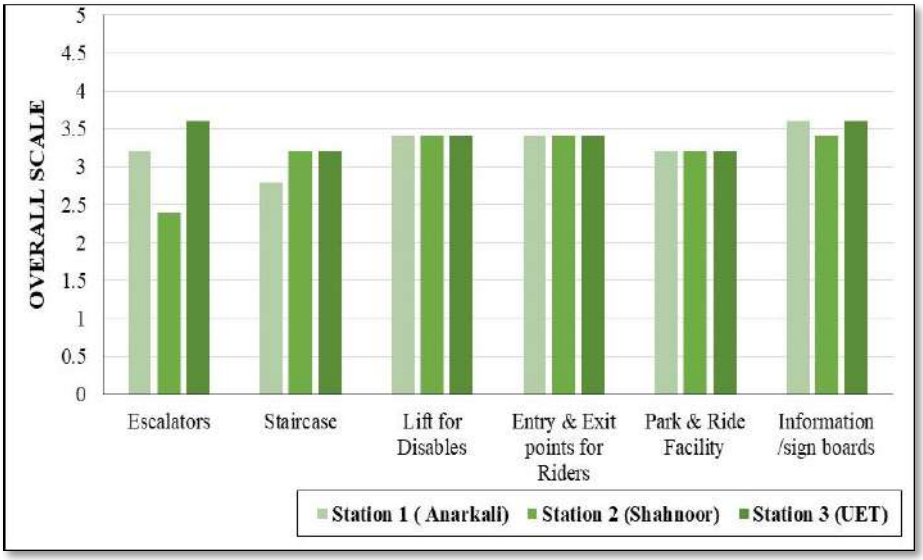

Figure 5. Perception of Riders Regarding Accessibility of Orange Line Metro Train.

3.2.3.2. Safety and Security. Safety is defined as the condition of being free from risk or danger. The transport system should be safe and secure for users, not just the simple incorporation of relevant design parameters but the security of users of the metro is also vital (personal security in confined spaces, crowds, etc.). Safety and security have been classified under 11 sub-indicators. i.e. i) Availability of Waiting Room ii) Well-Designed Lighting iii) Fire Safety iv) Protected Walkway v) Speed Limit warning Sign vi) Warning Sign vii) Weather Protection viii) CCTV Cameras at Stations ix) Security Guards at Stations x) Safety at night xi) Safety in Waiting Areas. 38% of passengers of Anarkali station and Shah Noor were moderately dissatisfied with the availability of waiting rooms and 47% of riders of station UET were neither satisfied nor dissatisfied with this variable. 65% of riders show satisfaction with well-designed lighting while at Anarkali and UET stations. 35% of riders were moderately dissatisfied with the lighting provided at stations. Fire safety is provided at OLMT stations so riders

showed equal satisfaction with this variable at three stations. With the speed limit sign provided at stations, OLMT riders were 47% satisfied, 23% were neither satisfied nor dissatisfied, 15% were moderately dissatisfied and the remaining 15% had indifferent views. Most of the riders were dissatisfied with CCTV cameras provided at stations, 44% were neither satisfied nor dissatisfied, 34% were moderately satisfied and the remaining 22% showed satisfaction with this variable. 34% of riders show satisfaction with security guards at stations and the remaining 66% show dissatisfaction with this variable. Safety at night is concerned the riders show dissatisfaction at the station with 65% at three stations 20% showing that they were satisfied and the remaining 15% had indifferent views. The score of the Safety and Security variable of Service Quality of OLMT of stations is above average figure 6, which shows a moderate satisfaction level. Whereas riders show concerns about the availability of waiting rooms and their safety issues.

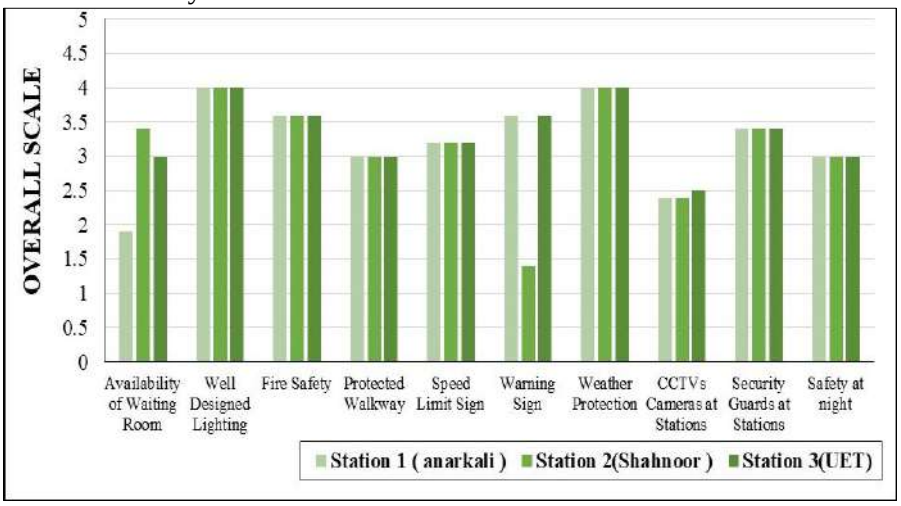

Figure 6. Perception of Riders about Safety and Security at Orange Line Metro Train.

3.2.3.3. Infrastructure. It is the set of fundamental facilities and systems that support the sustainable functionality of households and firms. Serving a country, city, or other area, including the services and facilities necessary for its economy to function. Infrastructure is the basic system that undergirds the structure of the economy. Examples of infrastructure include transportation facilities. Infrastructure has been classified under 7 sub-indicators. i.e. i) Clear Signage Arrows and Barriers ii) Recharge facility of Ticket iii) Route Descriptions with a complete list of stops iv) Cafeteria with proper Seating Arrangements v) Advertisement Boards vi) Clock at Station vii) Ticket and Enquiry Counters. The analysis shows that in the indicator of infrastructure highest number of riders were very satisfied with both variables clear signage, barriers, Arrows, and recharger facility of a ticket with 38% at all selected stations. 44% of rider was not satisfied with the route description with a complete route list of stops. The highest number of riders 47%. were not satisfied with the cafeteria facility at all selected stations. The advertisement facility was good because 67% of riders were moderately satisfied with this variable at Anarkali, Shahnoor, and UET. 35% of riders were neither satisfied nor dissatisfied with the clock at the station. 44% of the riders were moderately dissatisfied with the ticket and inquiry counter at Anarkali, Shahnoor, and UET. The analysis shows that riders had almost the same view about all the variables of indicator of infrastructure. Most of the riders were dissatisfied with the cafeteria facility and very satisfied with the recharge facility at selected stations. The score for SQ variable infrastructure was calculated as 2.8 for Anarkali Station and, Shahnoor Station which means the scoring is below average which shows riders are neither satisfied nor dissatisfied (refer figure 7). and 3.05 score was for the UET station meaning that riders are moderately satisfied. Riders were more concerned about the Cafeteria and proper Seating arrangements at the Anarkali and Shahnoor stations with a score of 2.

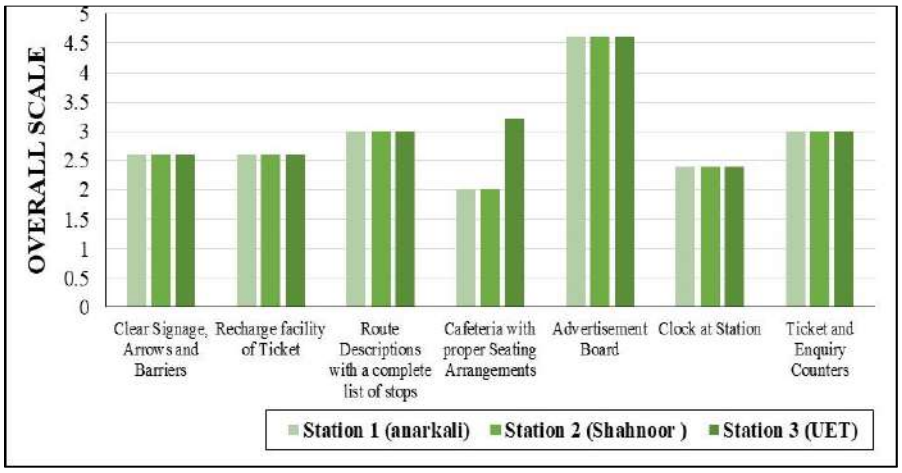

Figure 7. Perception of Riders about Infrastructure of Orange Line Metro Train.

3.2.3.4. Customer Care (Staff). Customer care is the act of assisting customers with public transport. Their roles include providing services and product information and resolving any issues about the services offered by the organization. Customer care services are also a great way to attract new customers by delivering valuable information to the users and introducing them to new services. Customer care service representatives help customers with complaints and questions and give customers information about services. For this particular research regarding the service quality of OLMT, Customer Care (Staff) has been classified under 3 sub-indicators. i.e. i) Friendly, Courteous, Quick service from staff ii) Behavior of managing staff at Stations iii) Explanations and Announcement of Delays. During peak hours as per the analysis of Anarkali, Shahnoor, and UET stations, 23% of riders were moderately dissatisfied with the behavior of managing staff, 38% were neither satisfied nor dissatisfied and the remaining 39% had indifferent views. Most riders show satisfaction with the explanation and announcement of delays as 79% of riders were satisfied, 15% were dissatisfied and the remaining 6% had indifferent views. Figure 8 shows the overall score of customer care is 2.2, 2.8, and 2.8 at Anarkali Station, Shahnoor Station, and UET respectively. The score of Anarkali station is moderately dissatisfied. The score of Shahnoor station and UET station is below average which means that riders are neither satisfied nor dissatisfied.

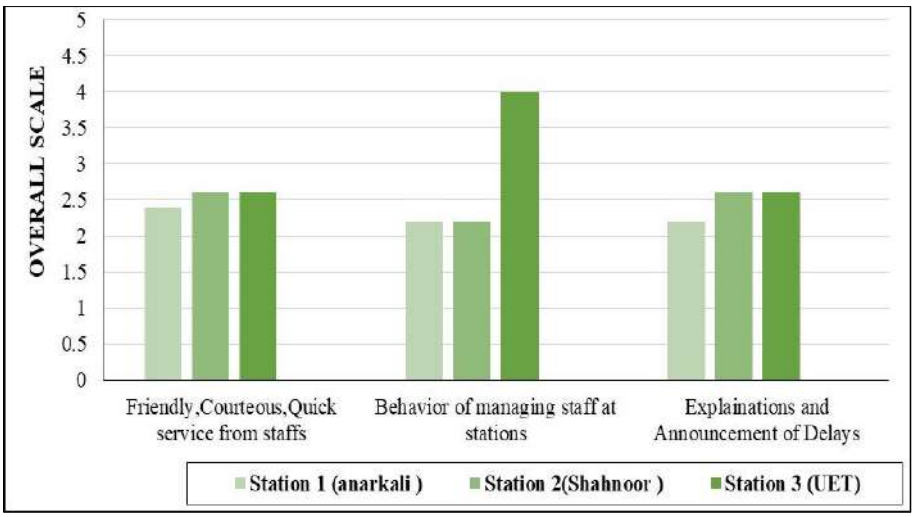

Figure 8. Perception of Riders about the Customer Care of Orange Line Metro Train.

3.2.3.5. Comfort & Cleanliness. Comfort is a state of physical ease and freedom from pain or constraint. Cleanliness is both the abstract state of being clean and free from germs, dirt, trash, or waste and the habit of achieving and maintaining that state. For this particular research regarding the service quality of OLMT, comfort and cleanliness have been classified under 11 sub-indicators. i.e. i) Cleanliness at Stations ii) Comfort of seats at Stations iii) Crowdness while purchasing ticket iv) Dustbins/trash-cans at Station v) Sitting Benches at Station vi) Availability of Charging point vii) ATM Facility at Stations viii) Wi-Fi and Mobile & Internet Signals at station ix) Sitting/Standing Capacity x) Comfort using Escalators xi) Cleanliness in Train. According to a review of the comfort and cleanliness of the service from three OLMT stations. At all of the chosen stations, 80% of passengers were satisfied with the cleanliness, while 20% were not. Sixty percent of train passengers were happy with the comfort level of train seats, compared to 38% who were not, and 2% who were neutral. When buying a ticket, 67 % of passengers expressed discontent with the overcrowding, 26 % expressed satisfaction, and the remaining 7 % had neutral opinions. Passengers were not supplied with sitting benches, which resulted in a 70 % dissatisfaction rate, a 15% satisfaction rate, and the remaining 15 % having ambivalent opinions. Rider dissatisfaction with the facilities was at 87% due to the lack of Wi-Fi, with the remaining 13% having neutral opinions 49 % of passengers were not satisfied with the sitting-standing capacity, 35 percent were, and 16 % had no opinion. Anarkali, Shahanoor, and UET stations received a score of 3.0, 2.7, and 2.9 respectively for the variable Comfort & Cleanliness which was below average at Shahnoor and UET stations, indicating that riders were only somewhat dissatisfied and above average at Anarkali station with moderate satisfaction (figure 9). Crowdness while purchasing ticket sub-variable is below average. This demonstrates the riders' unhappiness.

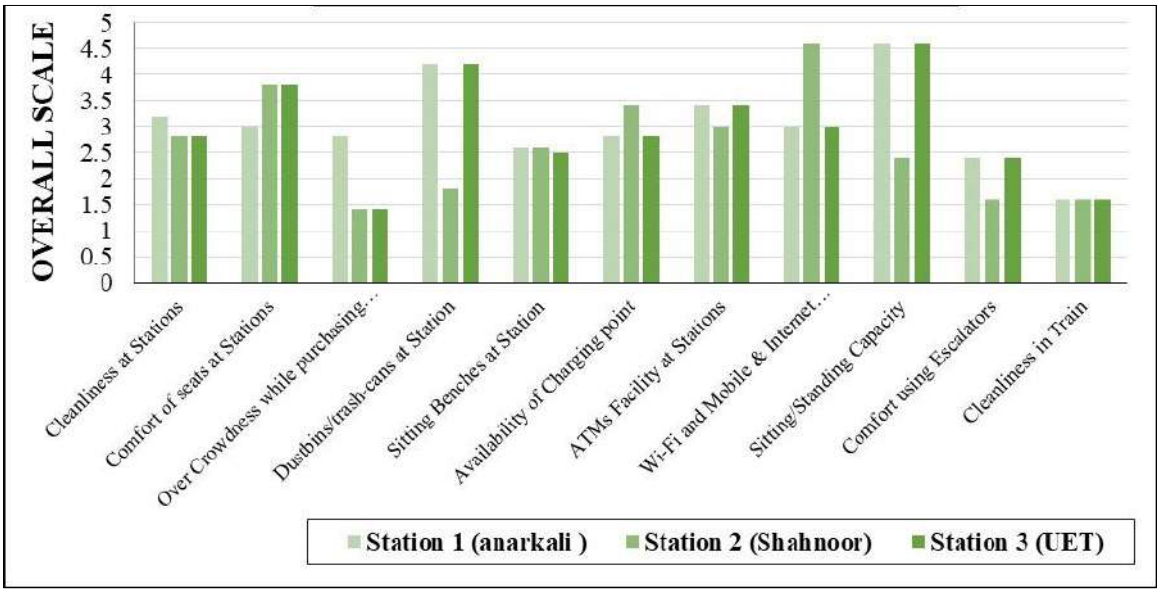

Figure 9. Perception of Riders Regarding Comfort and Cleanliness at Orange Line Metro Train.

3.2.3.6. Satisfy with Fare. Something satisfactory is acceptable to good enough to fulfill a need, wish, or requirement of fare. For this particular research regarding the service quality of OLMT, comfort and cleanliness have been classified under 3 sub-indicators. i.e. i) Satisfy with Fare ii) Reasonable Ticket Price iii) Estimated Fare. The study about fare satisfaction included data from these Anarkali, Shah Noor, and UET stations during peak hours. The fare received positive feedback from 60% of passengers, negative feedback from 30%, and neutral feedback from 10% of passengers. A reasonable ticket price resulted in 76% of attendees being pleased, 14% being dissatisfied, and 10% not having an opinion. Figure 10 shows the majority of passengers say they are happy with the anticipated fare at the Anarkali, Shah Noor, and UET stations. The score of Satisfy with Fare is 3.2 at Anarkali station, at Shahnoor

station, and at UET station the score is 3 which shows riders are neither satisfied nor dissatisfied with the service quality.

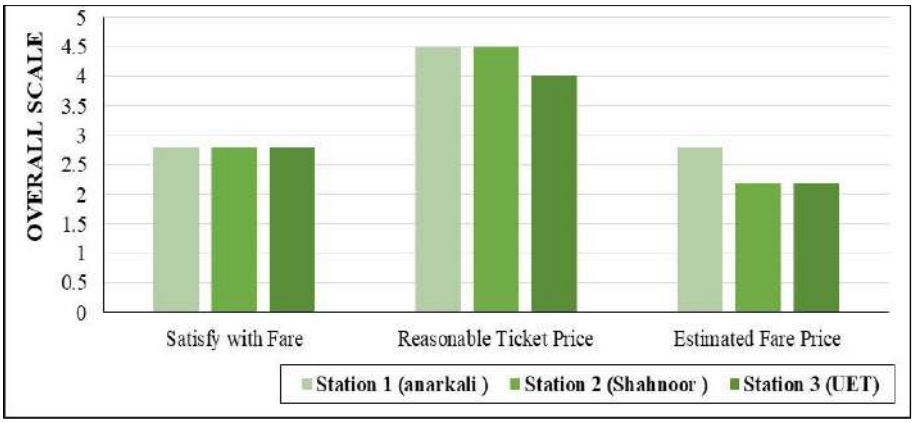

Figure 10. Perception of Riders Regarding Satisfaction regarding the Fare of Orange Line Metro Train.

3.2.3.7. Environmental Conditions. The presence in the environment, including the soil, groundwater, surface water, or ambient air, of any Hazardous Material at a level that exceeds any applicable standard or threshold under any Environmental Law or otherwise requires investigation or remediation including, without limitation, investigation, study, health or risk assessment, monitoring, removal, treatment or transport under any applicable Environmental Laws. For this particular research regarding the service quality of OLMT, comfort and cleanliness have been classified under 6 sub-indicators. i.e. i) Landscaping at Station ii) Noise Level at Station iii) Ventilation at Station iv) Air Conditioning & Heating at Stations v) Cleanliness at stations vi) Cleanliness at the train. Riders complained about the landscaping at the stop. 76% of passengers indicated discontent, 23% expressed happiness, and 4% stated neutral views. Only 20% of respondents were comfortable with the noise level at stations, which left 80% of people dissatisfied with this feature. The percentage of passengers who gave the ventilation and air conditioning system a somewhat satisfied rating was the same across all stations. Only 16% of passengers were dissatisfied with the standard of cleanliness provided at stations or trains, making up 84% of the total. The environmental conditions at Anarkali Station, Shahnoor Station, and UET stations attained a score of 3.4, suggesting that customers were moderately satisfied with the station's environment. Figure 10 shows that scoring for the ventilation and cleaning sub-indicator is below average which shows the dissatisfaction of riders

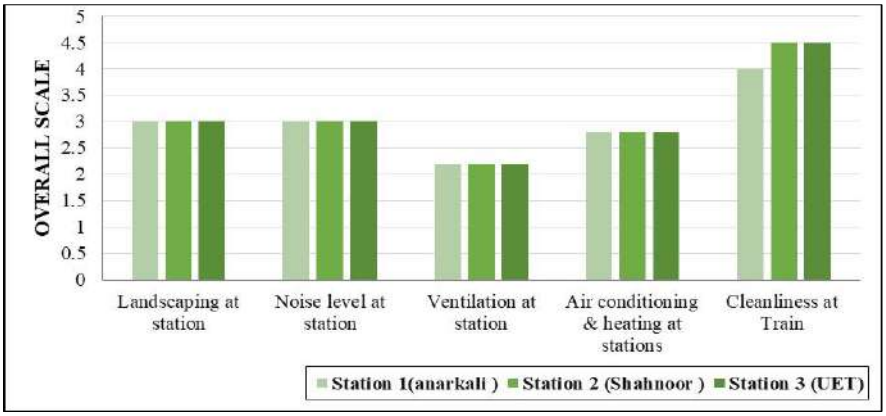

Figure 11. Perception of Riders Regarding Environmental Conditions of Orange Line Metro Train.

3.2.3.8. Amenities. A desirable or useful feature or facility of a building or place. For this particular

research regarding the service quality of OLMT, comfort and cleanliness have been classified under 3 sub-indicators. i.e. i) Availability of smart card facility ii) Availability of handrails iii) Availability of grab handles. An assessment of amenities during peak hours found that passengers value the availability of card readers, handrails, and grab handles. The remaining 67 percent of passengers expressed moderate pleasure, while 13% indicated neither happiness nor dissatisfaction and 20% expressed neutral sentiments. Amenities, a variable, describe how the overall variable and its sub-indicators are scored. Figure 12 shows that passengers were very satisfied with the amenities at these stations, as seen by the station scores of 4.5 at Anarkali, 4.5 at Shahanoor, and 4.5 at UET.

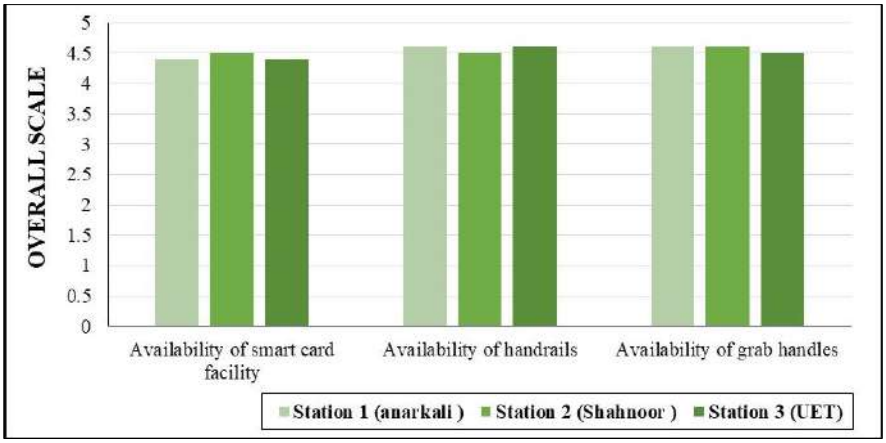

Figure 12. Perception of Riders Regarding Amenities of Orange Line Metro Train.

3.2.4. Customer Satisfaction Score

Table 5 shows the scoring of each service quality variable according to the opinion of passengers of OLMT. This table is drawn after analysis of all the data gathered through the questionnaire. Scoring is done for each variable and then description about the variable is described clearly according to the score each variable falls at. The scoring formula used to calculate the score of each variable is:

$$\text{Scoring} = \frac{\text{Highest Score} - \text{Lowest Score}}{\text{Number of Classes}}$$

Customer satisfaction score (CSAT) is a metric that reflects the overall customer satisfaction with a service in terms of quality. Customer Satisfaction score (CSAT) helps authorities to determine the reasons for consumers' satisfaction and dissatisfaction. The following formula is used to calculate customer satisfaction with the service:

$$\text{CSAT} = \frac{\text{Total number of Satisfied Customers} \times 100}{\text{Total Number of Responses}}$$

$$= \frac{260 \times 100}{400}$$

CSAT = 65% Approximate 65% of passengers are satisfied with the Service

Table 5. Satisfaction score of Service Quality Variable of OLMT

Variable	Indicator	Station 1 (Anarkali)		Station 2 (Shahnoor)		Station 3 (UET)	
		Indicator Score	Variable Score	Indicator Score	Variable Score	Indicator Score	Variable Score
Accessibility	Escalators/	3.2	3.2	2.4	3.1	3.6	3.4
	Staircase	2.8		3.2		3.2	
	Lift for Disables	3.4		3.4		3.4	

Variable	Indicator	Station 1 (Anarkali)		Station 2 (Shahnoor)		Station 3 (UET)	
		Indicator Score	Variable Score	Indicator Score	Variable Score	Indicator Score	Variable Score
	Entry & Exit points for arrival & departure passengers	3.4		3.4		3.4	
	Park & Ride Facility	3.2		3.2		3.2	
	Information /sign boards	3.6		3.4		3.6	
Safety and Security	Availability of Waiting Room	1.9	3.1	3.4	3.0	3	3.24
	Well Designed Lighting	4.0		4		4	
	Fire Safety	3.6		3.6		3.6	
	Protected Walkway	3.0		3		3	
	Speed Limit Sign	3.2		3.2		3.2	
	Warning Sign	3.6		1.4		3.6	
	Weather Protection	4.0		4		4	
	CCTV cameras at Stations	2.4		2.4		2.5	
	Security Guards at Stations	3.4		3.4		3.4	
	Safety at night	3.0		3		3	
	Safety in Waiting Areas	2.4		2.4		2.4	
Infrastructure	Clear Signage, Arrows and Barriers	2.6	2.8	2.6	2.8	2.6	3.05
	Recharge facility of Ticket	2.6		2.6		2.6	
	Route Descriptions with a complete list of stops	3.0		3		3	
	Cafeteria with proper Seating Arrangements	2.0		2		3.2	
	Advertisement Boards	4.6		4.6		4.6	
	Clock at Station	2.4		2.4		2.4	

Variable	Indicator	Station 1 (Anarkali)		Station 2 (Shahnoor)		Station 3 (UET)	
		Indicator Score	Variable Score	Indicator Score	Variable Score	Indicator Score	Variable Score
	Ticket and Enquiry Counters	3.0		3		3	
Customer Care (Staff)	Friendly, Courteous, Quick service staff	2.4	2.2	2.6	2.8	2.6	2.8
	Behavior of managing staff at Stations	2.2		3.2		3.2	
	Explanations and Announcement of Delays	2.2		2.6		2.6	
Comfort & Cleanliness	Cleanliness at Stations	3.2	3.0	2.8	2.7	2.8	2.9
	Comfort of seats at Stations	3.0		3.8		3.8	
	Over Crowdness while purchasing ticket	2.8		1.4		1.4	
	Dustbins/trash cans at Station	4.2		1.8		4.2	
	Sitting Benches at Station	2.6		2.6		2.5	
	Availability of Charging point	2.8		2.8		2.8	
	ATMs Facility at Stations	3.4		3.4		3.4	
	Wi-Fi and Mobile & Internet Signals at station	3.0		3		3	
	Sitting/Standing Capacity	4.6		4.6		4.6	
	Comfort using Escalators	2.4		2.4		2.4	
	Cleanliness in Train	1.6		1.6		1.6	
Satisfy with Fare	Satisfy with Fare	2.8	3.2	2.8	3.0	2.8	3
	Reasonable Ticket Price	4.0		4		4	

Variable	Indicator	Station 1 (Anarkali)		Station 2 (Shahnoor)		Station 3 (UET)	
		Indicator Score	Variable Score	Indicator Score	Variable Score	Indicator Score	Variable Score
	Estimated Fare	2.8		2.2		2.2	
Environmental Conditions	Landscaping at Station	3.0	3.4	3	3.4	3	3.4
	Noise Level at Station	3.0		3		3	
	Ventilation at Station	2.2		2.2		2.2	
	Air Conditioning & Heating at Stations	2.8		2.8		2.8	
	Cleanliness at stations	4.8		4.8		4.8	
	Cleanliness at train	4.6		4.6		4.6	
Amenities	Availability of smart card facility	4.4	4.5	4.5	4.5	4.4	4.5
	Availability of handrails	4.6		4.6		4.6	
	Availability of grab handles	4.6		4.6		4.6	

4. Conclusion and Recommendation

This study identified the service quality factors which are critical for determining the satisfaction of the passengers. This study sought to assess the service quality of OLMT based on eight factors; Accessibility, Safety and Security, Infrastructure, Customer Care (Staff), Comfort and cleanliness, Satisfy with Fare, Environmental Conditions, and Amenities. This study devised further indicators of each variable for in-depth analysis to obtain comprehensive information on passenger satisfaction. A face-to-face survey of 400 passengers was conducted and their satisfaction levels with various variables and indicators were collected. Based on the results of the observatory survey and interview following are the concluding results.

Firstly, customer care and park-and-ride facility are the most important service quality variable, which is observed as dissatisfactory. The behavior of customer care staff is below average. Dissatisfaction levels among riders were observed regarding the park-and-ride facility due to the non-availability of park-and-ride facilities at many stations. The authority should make necessary arrangements for the provision of park-and-ride facilities for the passengers and ensure the training of staff to behave properly.

Secondly, the fare is one of the critical contributors to the service quality of the metro train, as it is the same for traveling between any two stations. The authority should devise a rational fare policy and it should be based on the distance rather than the same for all. Later on at the end of 2022, the authority changed the fixed fares policy to a distance-based fare policy. Thirdly, passengers are satisfied with the safety provisions and this was also observed during the survey. The Punjab Mass Transit Authority has managed a proper lighting system, security, and closed circuit televisions (CCTV). Fourthly, socio and demographic characteristics do not have any major inference on the service quality variable. Since

different age group passenger travel for various purposes and seems satisfied with the overall service quality.

Finally, it is important to mention that the satisfaction level associated with various variables of service quality has been assessed for users of the Orange Line Metro train. Since it is the first-ever automated metro train service in Pakistan, therefore, the result can neither be compared with other cities of Pakistan nor can not be generalized for all other cities across the world.

The study provides important insights into the factors influencing passenger satisfaction with OLMT. In summary, this study will help service providers, policymakers, and researchers to identify effective and specific measures that could improve the quality of service of the metro train by enhancing passenger satisfaction and increasing its ridership. It also helps the service providers to maximize their profits and could effectively and effectively execute its metro train extensión plan successfully. To achieve the main aim of transit providers, future research is required to explore the perceptions of riders of different socio-economic groups and also towards the users of informal public transport to attract them to use metro service.

5. Limitation of Research

Since the research is based on the perception of users, which is affected by demographic and socio-cultural values. It is also pertinent to mention that the service of the train may be different at peak and off-peak times. The survey was conducted during the peak hours and the perception of users may vary during the off-peak hours. During the research, it is felt that the service quality may also be assessed from the perspective of female users.

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