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Identifying the Factors Affecting on Service Quality & Passenger Satisfaction in Commuter Train Services

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A B S T R A C T

This paper addresses identifying the factors affecting the service quality in commuter trains services and passenger satisfaction. To this end, the Service Quality Management Framework (SERVQUAL model) with five dimensions of service quality including reliability, assurance, tangibility, empathy, and responsiveness, have been used to assess the passengers' needs. In this study, the criteria of the model were chosen from the KANO Customer Satisfaction Model, and a combination of KANO and SERVQUAL models has been used for analyzing the data. Needs assessment of passengers in both stages of the survey was conducted through descriptive research and data were collected by the survey method. A survey is developed and is used to measure the required information and the SERVQUAL and KANO are used in the analysis. In this survey 200 commuter train passengers participated to complete the questionnaires. The results show in the Empathy dimension, using the travel pass for passengers is more important than the other factors; in the Tangibility dimension, the presence of modern equipment inside the train has the greatest impact on increasing the passengers' satisfaction. In the Assurance dimension, the staff's willingness to help passengers, especially passengers who are disabled or handicapped, as well as the employees' willingness to resolve the issues causing delay is also among the factors that enhance the passengers' satisfaction. On-time railway service is the most important factor in the Reliability dimension.

1. Introduction

The rapid growth of the service sector has led quality researchers to focus on the proper understanding of the quality of service. Providing high-level services is essential for companies that want to succeed in their area of activity [1, 2]. High service quality leads to customer loyalty [3], higher profitability [4] and lower costs. Information on product quality is not enough to address the quality of service [1], and finding the gap between improving domestic quality in a company and external criteria and customer requirements, and translating is a very important and complex process [5].

Quality of service is reviewed by a number of authors [8-6 ,3 ,1]. Parsuraman et al. have developed a tool called SERVQUAL to measure the service quality in organizations [1]. Railways, as one of the largest organizations providing passenger transportation services, should consider passengers requirements. Satisfaction with the service quality provided by passengers is very important in attracting people to the railway transportation and their loyalty.

According to the Tehran Transportation and Traffic Comprehensive Studies (TLGS) report, Tehran's (as the capital of Iran) population of 8.74 million people in 2014 reached 12.5 million in 2015, where 33.6% of whom are employed

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and 23.5% are studying. Due to numerous economic and social conditions, a large share of this population is made up of people living in Tehran, either working or studying in a commuter city of Tehran, or living in commuter cities. There are daily round trips to Tehran for work or study. In order to explore, identify and evaluate rail and road networks for connecting commuter trains, examine how commuter trains are designed for target cities, establish commuter base stations and implement appropriate strategies to accelerate physical progress, the projects of the operation of commuter trains were pursued by RAI more seriously.

Table 1 shows the synchronized estimation of a personal car on the entrance and exit axis of Tehran during the peak hours and the routes in which there is a commuter rail transport mode during similar hours.

As shown in Table 1, the total number of arrivals and departures at peak hours at the Tehran Gateway, according to statistics published in 2016 by the Tehran Transportation and Traffic Studies Company(TLGS), is 63,402 cars [9].

Despite the fact that in many commuter routes in Tehran, there is a commuter rail transport mode that can bring passengers to their destinations; in the first five months of 2016, only 12,383 passengers were driven by a commuter train on daily average that approximately 6,192 passengers were in the morning. Meanwhile, the number of passengers on the 5th Metro line at peak hours is 13,184. Comparison of these numbers suggests that the commuter trains have a small share of transport around the metropolis. Given that the first aspiration and perspective of railways in the passenger sector is the establishment of the most efficient commuter and commuter trains system in the country [10]. Providing better services for passengers causes increasing the number of passengers on the commuter trains, reducing private cars, reducing road traffic and fixing the proper position of the commuter trains in the lifestyle of people. Fortunately, statistics show that over the past three years, the number of commuter passenger travels has grown by 63% throughout the country [11]. However, it still has a small share in comparison with road transport and even metro. Therefore, considering the potential and demand available for transporting the metropolitan suburbs of Tehran, satisfaction of the people and improvement of the quality of commuter train services is one of the ways that can make railways take a larger share of the

Table 1. Entrance and exit axis of Tehran during the peak hours of the morning and commuter trains in 1395[9]

	Entrance to Tehran	Exit from Tehran	Total entry and exit	percent	Commuter train route
Lavasanat	1,010	754	1,764	2.78	-
Roodehen	1,654	3,600	5,254	8.29	-
Khorasan	4,040	2,397	6,437	10.15	-
Vramin	3,228	1,668	4,896	7.72	Tehran-Pishva
Qom	114	1,410	1,524	2.40	Tehran-Qom
Qom highway	2,321	1,762	4,083	6.44	Tehran-Qom
Saveh	6,082	3,294	9,376	14.79	Tehran-Parand
aveh highway	2,705	1,254	3,959	6.24	Tehran- Parand
abad mostofi	370	249	619	0.98	Tehran-Parand
Shahriar	2,267	1,340	3,607	5.69	-
Andisheh	1,152	541	1,693	2.67	-
Shahr qods	1,537	644	2,181	3.44	Tehran-Karaj-Hahtgerd
Karaj	2,588	1,161	3,749	5.91	Tehran-Karaj-Hahtgerd
Karaj highway	8,081	6,179	14,260	22.49	Tehran-Karaj-Hahtgerd
Summation	37,149	26,253	63,402	100.00	12,383passenger

market. Due to very little research work in this area, consideration of designing a questionnaire for assessing passengers' satisfaction to improve the quality of service and satisfaction of passengers and providing a model for assessing the satisfaction of passengers in the commuter trains seems necessary. If the range of commuter trains as a passenger transportation service company is considered, the commuter train passenger is an organization that needs to try to obtain its satisfaction. In this paper, the concepts of the customer and different ways of measuring satisfaction will be examined to achieve a more precise definition of the problem. In the third section, using the SERVQUAL model and its integration with the KANO model and customer satisfaction analysis, and the quality of commuter trains is studied in the Tehran-Parand route from the passengers' viewpoint as a case study. The paper concludes with a discussion of the results and makes suggestions for future transportation studies and policy-relevant interventions

2. Literature Review

The term 'service quality' is used in evaluating customer satisfaction. Competitive advantages in providing superior service quality can increase the market share of a company. Considering the various definitions of the service quality, understanding the views and understanding of the customer is an important dimension [3]. Another definition of service quality is the level required to meet customer expectations [12]. In other words, improving the quality of service leads to new and frequent purchases of loyal customers and, as a result, increases profits and the number of customers[13]. Since service features cannot be pre-generated, they should always be beyond customer expectations and results. Customer satisfaction leads to loyalty that affects profit growth [14].

2.1. Service quality management of commuter train using SERVQUAL method

SERVQUAL uses a gap model theory to provide a framework for measuring the service quality that has five dimensions of service quality including: reliability, assurance, tangibility, empathy, and responsiveness. It then, defines 22 characteristics of service quality as the degree of difference between customer expectations and customer perception of the performance of their received services [7, 14, 17]. Previous commuter transport studies used the SERVQUAL method to assess the service quality [18]

2.2. KANO Quality theory and passenger satisfaction coefficient

In 1984, Dr. Noryaki KANO and his colleagues [19] presented a nonlinear relationship between service performance and passenger satisfaction; a model for identifying customer needs and potentials for product and service improvement [20]. Based on the modified Matzler and Heur Heuber model (1998), shown in Figure 1, KANO provides service quality in five categories including mandatory quality (M), one-dimensional quality (O), attractive quality (A), indifferent quality (I) and reverse quality (R). Customer Satisfaction Index (CS) measures value of the quality of passengers' satisfaction and dissatisfaction.

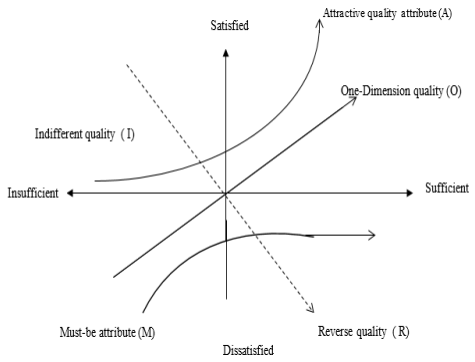

Figure 1. KANO's excitement and basic quality model adapted from Matzler and Hiterhuber (1998)[19]

The KANO model and the CS formula are used to show the qualitative value of the customer satisfaction index [20, 21] Figure 1.

2.3. SERVQUAL and KANO models used to measure commuter train services

According to the authors', only two studies have already been conducted on the quality of service and passenger satisfaction from the commuter trains. In the first paper by Lai and Wu (2011) in the Taiwan Railways, using the KANO

model and the ANOVA analysis, the needs of passengers were identified and the quality of Taiwan's high-speed transportation system was improved. In the aforementioned study, the passengers were classified based on demographic characteristics and personal information. Their purpose in this study was to find the factors influencing the return of passengers and reuse after experiencing the journey with this. In this paper, the MAX (A, O, M) method was used [15] .Also, in the second article by Mokonyama in South Africa, with the combination of the KANO and SERVQUAL article, he found effective factors on the satisfaction and needs of the passengers. In order to attract and favors passengers to this transport system, a questionnaire was distributed among the two groups of commuter passengers who have a personal car that some of them used to travel by train and some of them used to travel with private cars. In his results, the satisfaction of passengers in public transport is a dynamic phenomenon and states that for both groups in this study the respect and politeness of the staff, the level of security and reliability of the system has been classified as the main issues of According to the studies, surveying the level of satisfaction of commuter trains has not been done using quality models. The purpose of the present article is to use the combination of SERVQUAL and KANO model to find the satisfaction level of commuter train passengers in Tehran and then analyze more accurately the effective measures using other methods of KANO questionnaire. The process for this study is shown in Figure 2.

In Table 2, the requirements of the KANO model and the definitions of each of these requirements for assessing commuter train quality are briefly summarized [18 ,17]. In Table 3, commuter services metrics were evaluated by SERVQUAL and KANO to identify satisfaction indices and also, the satisfaction and dissatisfaction indicators were listed in Table 2.

3. Method

In this paper, a questionnaire based on the five dimensions of SERVQUAL and KANO model is developed which includes attractive qualitative, one-dimensional, mandatory and an indifferent attribute group. Focal groups and personal interviews, as well as participatory

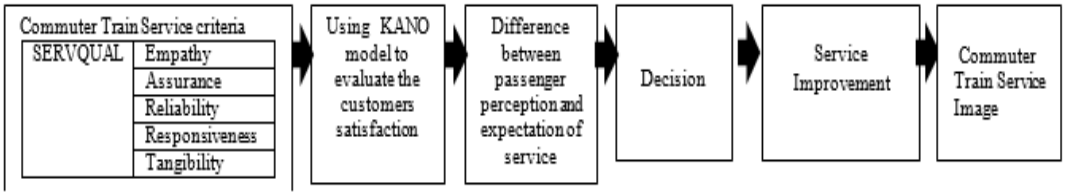

Figure 2: Proposed integrated model of service quality and safety to improve Commuter Train Service images

Table 2. KANO's model and the Customer Satisfaction Coefficient (CSC) formula

Requirements	Meet product or service requirement	Customer satisfaction coefficients
Must-be quality (M)	The customer becomes very dissatisfied if this requirement is not met, but if sufficient it will not result in more Satisfaction.	Formula: Satisfaction index $(\boldsymbol{SI}) = \frac{(\boldsymbol{A}+\boldsymbol{O})}{(\boldsymbol{A}+\boldsymbol{O}+\boldsymbol{M}+\boldsymbol{I})}$ Formula: Dissatisfaction index $(\boldsymbol{DI}) = \frac{(\boldsymbol{M}+\boldsymbol{O})}{(\boldsymbol{A}+\boldsymbol{O}+\boldsymbol{M}+\boldsymbol{I})\times(-\mathbf{1})}$
One-dimension quality(O)	The higher performance, the more improvement in customer satisfaction	
Attractive quality (A)	Absence does not cause dissatisfaction but will fulfil the customer requirement and lead to more customer Satisfaction.	
Indifferent quality (I)	The customer is not very interested, whether it is present or not.	
Reverse quality (R)	The customer has no desires and expects the reverse.	

Table 3. Commuter Train Service quality measurement based on SERVQUAL and KANO's Model

Service quality measurement and Dimensions of SERVQUAL	Criteria	Measurement formulae based on KANO's Model
Empathy	1 Employees provide individual attention to the passenger 2 Alternative train schedules are available 3 Commuter Train Service schedules are convenience 4 Commuter Train Service handling includes modern equipment and facilities 5 Employees understand the passenger's specific needs 6 Employees provide speed handling	Satisfaction index$(\boldsymbol{SI}) = \frac{(\boldsymbol{A}+\boldsymbol{O})}{(\boldsymbol{A}+\boldsymbol{O}+\boldsymbol{M}+\boldsymbol{I})}$ Dissatisfaction index$(\boldsymbol{DI}) = \frac{(\boldsymbol{A}+\boldsymbol{O})}{(\boldsymbol{A}+\boldsymbol{O}+\boldsymbol{M}+\boldsymbol{I})}$ M = Must-be quality O =One-dimension quality A = Attractive quality I = Indifferent quality
Assurance	7 Commuter Train Service safety operations 8 Commuter Train Service performed confident actions with passenger tangibles 9 Provide necessary information 10 Commuter Train Service staff have the knowledge to answer questions 11 Employees willingness to help 12 Employees promptly handle of train delays	
Reliability	13 Train are On-time 14 Commuter Train staff performed accurate service during the case 15 Insistence on travel service	
Responsiveness	16 Interest in solving train delay problems 17 Employees are willing to help in unexpected situations 18 Courtesy of crew	
Tangibility	19 Modernized trains and seat comfort 20 In-train entertainment facility 21 Appearance of employees 22 Cleanness	

observations of 200 passengers from the Tehran Parand commuter train, were conducted for a week in the second half of December 2015. Reviewing the KANO model is important by formulating coupled service questions to get the most accurate feedback from train passengers. This questionnaire was created by the pair of questions asked by passengers. As a result, each question has two parts as shown in Table 6 [18, 19].

The following observations were categorized according to the observations based on efficient quality traits and inefficient methods. Examples of the three potential needs of passengers in the KANO questionnaire are shown in Table 4. Questions A1, A2, A3 capture the audience's emotions when a commuter train has a specific feature, while Questions B1, B2, B3 cover the audience's emotions when the commuter train does not offer that feature. For each question, the passenger selects one of five alternative responses as described below: 1 = I like this feature very much, 2 = I like this feature, 3 = I am indifferent to this feature 4 = I can get along with this feature and 5 = I do not like this feature.

3.1. Data

Due to the fact that the average number of commuter passenger traffic on the Parand route in the first eight months of 2015 includes 37318 people in Iran, using stratified random sampling, with a percentage error below 1% proportional to the volume of 217 people were selected as a

Table 4. Examples of potential customer requirements based on a Kano questionnaire measuring satisfaction index (SI) and dissatisfaction index (DI).

Potential customer requirements		1	2	3	4	5
A_1	How would you feel if the Commuter Train Employees provide individual attention to the passenger?					
B_1	How would you feel if the Commuter Train Employees don't provide individual attention to the passenger?					
A_2	How would you feel if the Commuter Train is safe to operate according to schedule?					
B_2	How would you feel if the Commuter Train is not safe to operate according to schedule?					
A_3	How would you feel if the Commuter Trains are On-time?					
B_3	How would you feel if the Commuter Trains aren't On-time?					

Table 5. Socio-demographic characteristic of respondents

Row	Age	Number	Education	Number	Frequency of usage (per week)	Number
1	Under 20	17	Under Graduate	32	1-2	33
2	21-31	87	Graduate	101	3-4	52
3	31-40	93	Bachelor	83	5-6	65

sample, and finally 200 completed questionnaires were obtained. The Cochran formula is used to determine the sample size according to the size of the population [26].

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N}\left(\frac{z^2 pq}{d^2} - 1\right)} \cong 200 \qquad (1)$$

The descriptive data of the distribution of respondents based on demographic characteristics show that respondents can be divided into five age groups namely under the age 20, 21-30, 31-40, and up to 40 years old. As indicated in Table (5), the highest percentage of respondents is between the ages of 31 and 40, and the lowest percentage is for respondents with less than twenty years. In terms of gender, 82.5% of the respondents are men and 17.5% are women, and the highest percentage of use of the train is the group that employs more than six times the train. Also, in terms of education, people with the high school diploma and bachelor's degree have the highest and the people with a master's degree and above have the lowest frequency. This suggests that in order to improve the satisfaction of the passengers, it is important to consider the characteristics that are most important for the groups that have the most frequency of using commuter trains.

3.2. SERVQUAL and KANO models used to measure commuter train services

To compare the advantages of service quality in different situations and improve the range of commuter trains, a case study was carried out using the SERVQUAL and KANO model. As shown in Table 4, the combination of the KANO and SERVQUAL models are used to measure passengers' satisfaction and improve the quality of the services of the commuter trains. The five criteria examined were the SERVQUAL model and the SI and DI calculations based on the KANO formula [21, 25]. An SI value near 1 shows higher satisfaction and also shows the highest level of dissatisfaction for DIs near 1. [27, 28].

Given the values obtained from these two formulas, it can be seen that the desired attribute will affect the increase or decrease in customer satisfaction. This kind of analysis is important because it can be used to identify the characteristics that cause a significant increase or decrease in passenger satisfaction and reduce the number of dissatisfaction. For example, in the results of the questionnaire, help provided by the internal staff of the stations causes 65% increase customer satisfaction, while the lack of attention

Table 6. Customer requirement survey after severe weather conditions using SERVQUAL and the KANO model.

Customer requirements	A	M	O	I	SI	DI	Customer requirements	A	M	O	I	SI	DI
Empathy							Reliability						
Employees provide individual attention to the passenger	41	59	103	23	0.64	-0.72	13 Train are On-time	27	43	116	36	0.64	-0.72
Alternative train schedules are available	27	35	101	22	0.69	-0.74	14 Commuter Train staff performed accurate service during the case	22	53	76	73	0.44	-0.58
Use integrated card with other modes	38	30	127	22	0.76	-0.72	15 Insistence on travel service	23	44	100	54	0.56	-0.65
Commuter Train Service schedules are convenience	21	28	81	86	0.47	-0.5	Good access to station	18	57	111	34	0.59	-0.76
Commuter Train Service handling includes modern equipment and facilities	47	35	97	31	0.69	-0.63	**Responsiveness**						
Employees understand the passenger's specific needs	31	33	78	51	0.56	-057	16 Interest in solving train delay problems	31	48	104	40	0.61	-0.68
Employees provide speed handling	61	39	81	59	0.59	-0.5	17 Employees are willing to help in unexpected situations	42	40	73	72	0.51	-0.5
Assurance							18 Courtesy of crew	35	43	98	55	0.57	-0.61
7 Commuter Train Service safety operations	21	62	113	32	0.59	-0.77	**Tangibility**						
8 Commuter Train Service performed confident actions with passenger tangibles	28	78	112	11	0.61	-0.83	19 Modernized trains and seat comfort	68	17	96	50	0.71	-0.49
9 Provide necessary information	26	79	101	19	0.56	-0.8	20 In-train entertainment facility	24	57	122	23	0.64	-0.79
10 Commuter Train Service staff have the knowledge to answer questions	34	53	109	33	0.62	-0.70	21 Appearance of employees	42	35	82	63	0.56	-0.52
11 Employees willingness to help	20	68	127	11	0.65	-0.86	22 Cleanness	14	59	137	19	0.66	-0.86
12 Employees promptly handle of train delays	44	30	91	61	0.60	-0.53							

and assistance to disabled and veterans by officers and train staff will have 86% negative effect of commuter passengers. Bus network uniform cards are items that greatly increase customer satisfaction by 76%. Lack of these cards causes 70% of dissatisfaction. By aligning tickets, passenger satisfaction from commuter train services can be increased significantly. Another example of the results shows that the presence of more help desks at the station will increase the satisfaction of passengers by 56%, and if there is no sufficient guide in the station, customer satisfaction reduces by 80 percent. The lack of guides in commuter train stations is one of the problems for passengers. As the results show, the lack of help desks reduces the satisfaction of the passengers, greatly. The presence of a toilet in the train will result in 65% of the passengers' satisfaction and will decrease passengers' dissatisfaction by 85%. Metro and bus access from the train station will increase the passenger's satisfaction by 58%, while the lack of access will cause 76% of dissatisfaction. The comfort of the train seats increases the satisfaction by 64 percent and inadequacy of seats causes 79 percent of dissatisfaction. Information to other features is shown in Table 5.

According to the results of satisfaction index and dissatisfaction index, charts of distribution of features were drawn in each of the dimensions of quality. Figure 3 shows that recreational facilities within the train are attractive to passengers, and the railways can absorb more passengers to the system by increasing these facilities. Among the recreational facilities on the commuter trains, Wi-Fi, TV, newspapers, and magazines can be mentioned. Another significant point in the results from the satisfaction indicators shown in Figure 3 is the concept related to staff in the issue of handling problems in the train and the staff politeness, from the perspective of the passengers as a mandatory quality, and failure to comply will result in customer loss. The comfort of the train seats is one of the other things deemed mandatory quality by the passengers. Other questioned items from passengers' point of view are in the category of one-dimensional quality, which can increase the satisfaction of passengers by increasing its quality. Another interesting

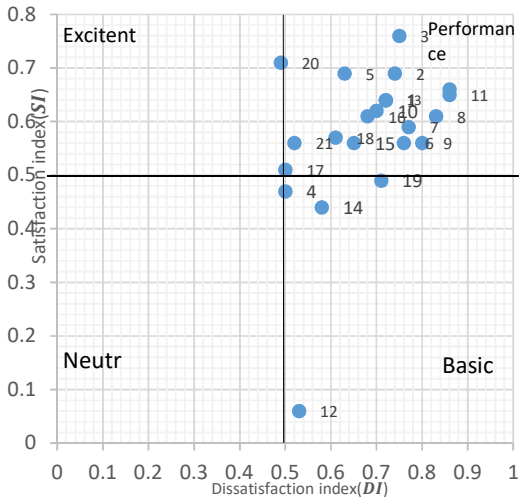

Figure 3. Kano model classification

point is that according to the comments of the respondents, none of the characteristics questioned are classified in the indifferent quality group.

In order to answer the question of how important each dimension of services is from the point of view of the commuter train passengers when assessing their quality of service, after collecting the questionnaires, the average expectations, perceptions and importance of each aspect of the quality of service are calculated from the customers' point of view. Comparing the perceptions and expectations of commuter train passengers, there is a significant difference in all five dimensions of quality ($P<0.05$). This means that at 95% confidence level, passengers have received a service that is different from their expectations. As shown in Table 7, the average gap between perceptions and expectations is 1.972, which indicates a gap in the quality of service received by passengers. The highest reliability gap is 2.28, which is significant due to the assumptions of the T-test. Also, the lowest gap in responsiveness dimensions is -1.7. This is while people have the highest expectations of commuter train services in terms of responsiveness factors and it can be concluded that considering the calculation of the lowest gap in this section, railways have been able to better serve the satisfaction of people than other dimensions of quality. The average scores given by people in all aspects of quality to their perceptions of commuter trains are 3.81. The average score in the expectations of service delivery is 5.782. This reflects the high

expectations of the people from the commuter train, which suggests that there is a good public view of the service, and if what they receive is closer to their expectations, more satisfaction and more loyalty to the commuter train will be achieved.

4. Conclusions

According to the SERVQUAL method, among the five components of service quality, reliability has the greatest gap between expectation and perception. Trip and Ria (2002) used a questionnaire to assess the passengers' satisfaction of USA Amtrak railroad. The results of the study show that the main experience of onboard passengers shows the satisfaction of the passengers from the train and causes them to once again use the train. Significantly, the similarity of the results of the study by Trip and Ria (2002 with the results obtained in this research is about the importance of seat comfort, staffing, and passenger feedback [20]. In the study implemented in South Africa, they found that the respect and politeness of the staff was one of the main issues of satisfaction.

With this in mind, in order to reduce this gap and improve commuter train services and increase passenger satisfaction, it is suggested that commuter train services deliver their services without delay to passengers within the specified hours, and try to provide low delay services as the preference of its activities. On the other hand, another factor after the reliability of the gap between passengers' expectations and perceptions is empathy. The commuter train complex should provide more effective travel and service delivery and meet the needs of the passengers at the right time. Also, after combining two methods of analysing and calculating indices, it was concluded that, in a common way, the uniformity of the commuter train ticket with BTRs and buses and facilitating access from commuter train stations to terminals public transport as well as the attention of train and stations staff to help passengers or disabled passengers will make passengers more comfortable, as well as more loyal to commuter trains. For future studies, it is suggested to use non-deterministic analysis techniques such as fuzzy analysis and also use of questionnaires that measure other aspects of quality in an organization such as KANO. Also, in order to implement the results obtained in the rail transport industry, according to information derived from Table 8, in order to prioritize implementation of proposed solutions based on each analysis methodology to improve the service of the commuter railways of the Islamic Republic of Iran is proposed. According to train its personnel in case of assisting passengers and considering their requirements, especially disabled passengers.

Table 6. Existing gap values between expectations and perceptions

Service quality measurement and dimensions	expectations	perceptions	Gap	t-statistic
Empathy	5.69	3.5	-2.189	18.03
Assurance	5.96	4.19	-1.76	13.65
Reliability	5.27	2.98	-2.28	16.53
Responsiven	6.29	4.58	-1.7	11.76
Tangibility	5.7	3.8	-1.9	15.16
Average	5.782	3.81	1.972	

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