Confirmatory Factor Analysis to Test Validity of Passenger Satisfaction Questionnaire

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ABSTRACT

A well organized and proficient transport system is must for persistent economic growth of the nation. Public transportation is very significant tool in promoting the development of backward regions. The intensification of an efficient transport system has transformed the whole world into one interrelated unit. To examine the service quality perceived by the passengers availing the Chandigarh Transport undertaking (CTU) bus service, a well-structured questionnaire was designed. For the purpose, six constructs were included in the questionnaire. Out of these, five constructs were based on the SERVQUAL model. These were tangibility, reliability, responsiveness, assurance and empathy. Apart from these, one additional important construct safety was also included. The statements in the questionnaire were examined thoroughly to ascertain that the statements were related to the purpose of the study. Confirmatory Factor Analysis (CFA) was conducted using Smart PLS to test the reliability and validity of the data. Through CFA, the results were set up as legitimate. The study found that passenger perception towards the quality of public bus service is a multi-dimensional phenomena comprising six factors. It was also discerned that the conventional model of service quality is a five dimensional model. However theoretically, in this study, six constructs have been taken which were found to be valid and highly reliable.

Keywords: *SERVQUAL, Factor Loading, Construct Reliability, Convergent Validity, Discriminant Validity.*

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INTRODUCTION

In today's business philosophy, customer (passenger) satisfaction has become increasingly important in measuring organizational performance. In every concern, customers serve as leading indicators since the dissatisfaction of customers can eventually make them shift to other suppliers. If proper focus is not maintained on the customers, it may become the cause of the future decline of an organization. Satisfied customers are often loyal and considered as an asset to the business. They serve as an important element and add a benchmark to the company's performance. Every content customer can fetch dozens of more new customers. A word of the mouth advertising campaign is the most convincing unpaid form of publicity triggered by the experience of customers.

It is relevant to understand the customers which further helps to make them happy. It is widely said that the customer is the king of the market. Customer satisfaction, customer retention and their opinion about the service of the organization are very important to ascertain that the concern is fulfilling customer expectations and adding value to the customers. Satisfaction of customers acts as a mirror to the future. How the customer is treated today is directly linked with the amount of money a concern will fetch in the future. To obtain an excellent performance from the customers, significant internal factors should be focused. These internal factors serve as a base to satisfy the needs of the customers.

OBJECTIVE OF THE STUDY

The present study attempts to test the reliability and validity of passenger satisfaction questionnaire availing CTU bus service.

REVIEW OF LITERATURE

Parasuraman et al., (1985) explored that service quality mainly refers how well the quality of service delivered conforms to the expectations of the consumers. Consumers use similar criteria for evaluating service quality. These criteria fall into ten categories and are termed as "Service quality determinants". These criteria are reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding and tangibility.

Parasuraman et al., (1988) analyzed that while measuring service quality, five distinct dimensions are taken. Termed as SERVQUAL dimensions, these five dimensions capture the items of the original 10 dimensions. The five dimensions are tangibility, reliability,

responsiveness, assurance and empathy. The study tested for internal consistency and factor loading. High reliability is an essential condition for scale construct reliability.

Shyu et al., (2011) demonstrated the Restaurant Over-service Measure through confirmatory factor analysis. It was explored in the study that in order to examine the over-service for customer service, restaurants may implement this measure. It was further indicated whether or not all the constructs agreed to its scale and reliability.

Hamid et al., (2017) attempted that the consideration of discriminant validity is of extreme importance which involves latent variables and indicator items that represent the construct. So, discriminant validity should be constructed beforehand. This ensures that the latent constructs are actually different from each other.

Li & Xin Cao, (2018) explored the various factors of passenger satisfaction by administering Hohhot's urban public transportation system. Exploratory factor analysis and confirmatory factor analysis was used for empirical research. It was found that layout, design, security, comfort, reliability and convenience are vital factors for bus service satisfaction. The study also focused on various measures to improve passenger satisfaction.

Sokchan & Hengsadeekul, (2018) observed that for the success of an organization engaged in providing services, the service quality is an important determinant. By meeting the customer's requirements, delivery of service could be great. The cutthroat competition in Cambodia's bus transport industry had required the operators to provide high-quality passenger bus service. For that purpose, before implementing any strategy, the operators have to focus on the needs of the passengers.

Bose & Pandit, (2019) used confirmatory factor analysis to observe that whether there are any differences in perception among various user groups relating to bus service attributes. The user groups were categorized on the basis of socio-economic characteristics and travel habit of users. Confirmatory factor analysis was used on the entire data as well as user satisfaction data to authenticate the results.

RESEARCH METHODOLOGY

Research methodology is a detailed plan used for collecting and analyzing data to get the required information and to address the research problem. It is a framework that holds together all parameters of the research project.

Data Collection

The primary data for the present study was gathered from 300 passengers at sector 17 and sector 43 bus-terminuses through a well designed structured questionnaire. The passengers included in the research study travelled to local areas, sub-urban and inter-state areas availing Chandigarh Transport Undertaking (CTU) bus service.

Sample Size

As the population was infinite Bill Godden formula was used to calculate the sample size.

Sample size (n) = $Z^2 * (p) * (1-p) / (M.E)^2$

Where; p = probability of being part of the sample. (0.50)

Z = 1.96

M.E = Margin of error (0.05)

Computed sample size=384

In total, 450 questionnaires were distributed. Some questionnaires were not returned, some were incomplete, while there were a few were with unengaged responses. Therefore, after removing such questionnaires, 300 completely filled questionnaires were retained.

Sampling Technique

Purposive sampling was used in the study. Purposive sampling is a non-probability sampling in which the researcher uses convenience and judgment to select the right respondent from the population to be included in the study.

Measurement Scale

The responses of the respondents were examined based on five alternative answers through a " 5- point Likert scale", value of which range from 1 to 5 indicating (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agreed, (5) Strongly Agree.

QUESTIONNAIRE DESIGN

To measure the satisfaction of passengers concerning services provided by CTU, a well-structured questionnaire was designed. To develop the questionnaire, existing literature

on the SERVQUAL model (comprising five constructs namely tangibility, reliability, responsiveness, assurance and empathy) was reviewed. Extensive deliberations were held with non-academicians (CTU Administrative Staff) and two senior experts in the related field. After the discussions, it was decided that safety is one of the most important criteria to determine the service quality of a transport business. If the passengers feel safe and secure, only then they will avail public transportation. Therefore, safety was included as a separate dimension of service quality.

CONTENT VALIDITY OF THE QUESTIONNAIRE

The content validity is used to test whether the items in the scale are meant to measure the domain under study. Every statement of the questionnaire relating to the passengers was thoroughly examined by the researcher and found that the contents of each item in the questionnaire were related to the objectives of the study. To analyze whether the content of the questionnaire was relevant to the topic, the questionnaire was comprehensively reviewed and approved by the two senior experts in the related field, Dr. Amanpreet Singh (School of Management Studies, Punjabi University, Patiala) and Dr. Manjeet Singh Virk (Retired Professor, Punjab Agricultural University, Ludhiana). Based on their recommendation, the suggestions were deliberated and due changes were made in the questionnaire.

Pilot Study

A pilot study was conducted in which 30 passengers were chosen to administer the questionnaires at sectors 17 and sector 43 bus terminals, Chandigarh. The responses of the respondents and the time involved in filling the questionnaire were thoroughly observed during the pilot survey. Going through these observations, some questions, especially those which created confusion or the questions which the respondents were unable to answer, were amended/deleted during the process

CONFIRMATORY FACTOR ANALYSIS (RELIABILITY AND VALIDITY OF CONSTRUCTS OF SERVICE QUALITY)

Reliability is the degree to which the methods used in the research produces consistent results. It is very important to check the reliability of the scale since only then the measurements would be true. However at the time of the pilot survey, reliability of the questionnaire was checked but to ensure a high degree of data reliability, reliability tests were carried out again. The statements in the questionnaire were examined thoroughly to

ascertain that it related to the purpose of the study. Confirmatory Factor Analysis (CFA) was conducted using Smart PLS to test the reliability and validity of the data. CFA is a statistical procedure that is used to test whether the confirmed relationship between the variables of the construct and their underlying construct exists.

While conducting a pilot survey there were five statements for each construct. Few items were dropped which turned out to be unreliable. While conducting CFA some insignificant questions were further deleted due to poor factor loading as depicted in **Table 1.**

Table 1: Statements in the Questionnaire

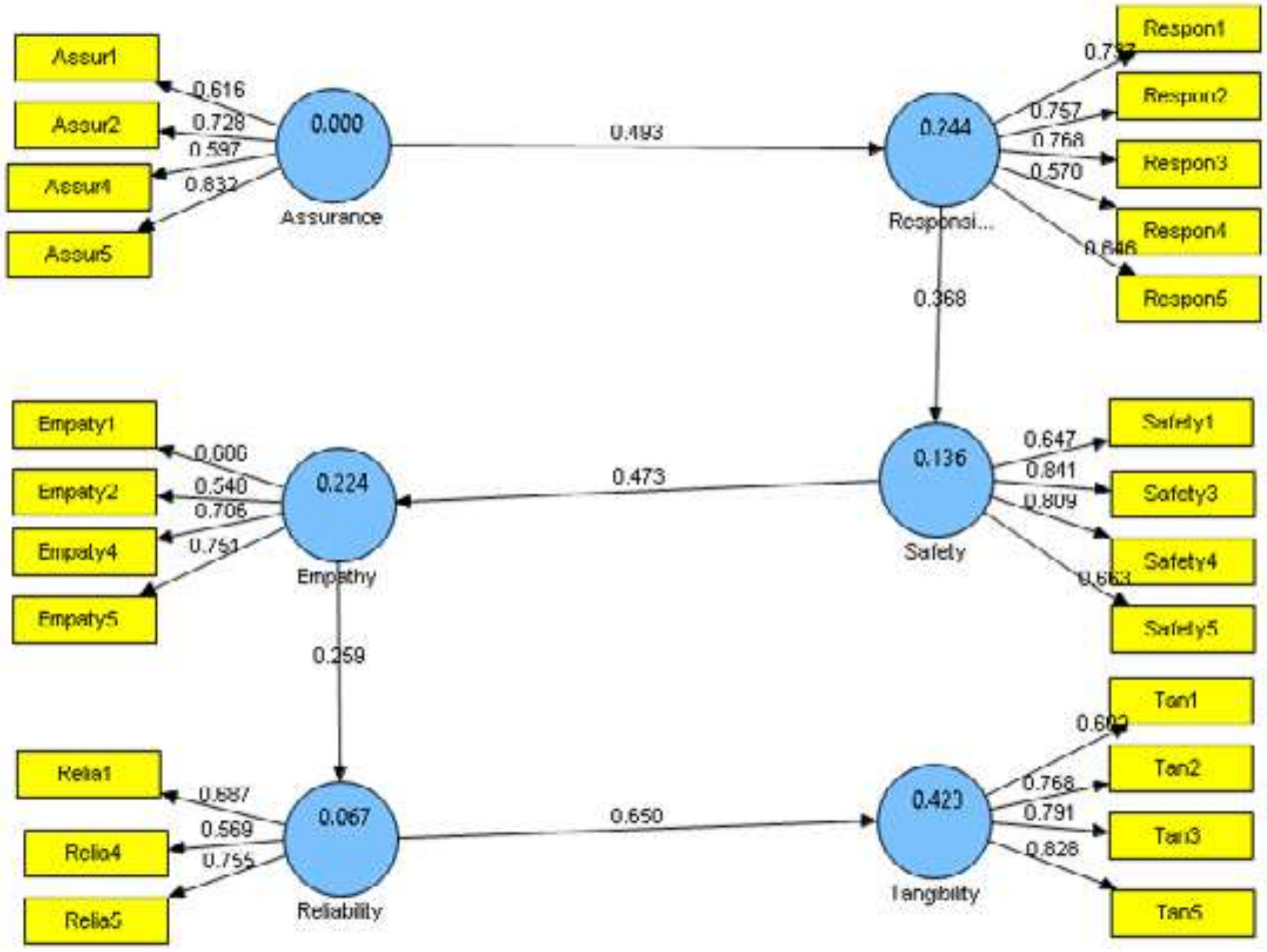
S.No.	Constructs	Original Items	Deleted Items	Retained Items
1.	Assurance	5	1	4
2.	Empathy	5	1	4
3.	Reliability	5	2	3
4.	Responsiveness	5	----	5
5.	Tangibility	5	1	4
6.	Safety	5	1	4
7.	Total	30	6	24

Factor Loading

Factor loading shows the relationship between the variables and the constructs. Factor loading also depicts the strength and importance of how high and how low indicator item is related to latent constructs. The estimates for standardized loading as a rule of thumb should be 0.5 or higher and ideally 0.7 or higher (Hair et al. 2010).

Figure.1 depicted that all the factor loadings for the latent constructs were more than 0.5. For example, among assurance fifth statement (0.832) was highly loaded concerning its construct whereas the fourth statement (0.597) had the lowest loading. The factor loading of tangibility ranged between 0.602 and 0.828 which was acceptable as all factor loadings were above 0.6.

Figure 1: Factor Loading



Cross Loading

Cross loading ensured that every single indicator variable must be highly loaded on the latent construct whether it is across or vertical. As revealed by the **table 2** indicator item Assurance 1,2,4 and 5 loads highest (0.616, 0.728, 0.597, 0.832) with the construct Assurance either seen vertically or across. Similarly, indicator Empathy 1, 2, 4 and 5 loaded highest with construct Empathy and so on for other indicator items as shown by highlighting the figures in **table 2.** It further signified that the scale used in the questionnaire was reliable.

Table 2:Cross Loadings

Indicator	Assurance	Empathy	Reliability	Responsiveness	Safety	Tangibility
Assur1	0.616	0.235	0.433	0.263	0.352	0.333
Assur2	0.728	0.358	0.162	0.335	0.225	0.173
Assur4	0.597	0.256	0.234	0.363	0.218	0.460
Assur5	0.832	0.357	0.159	0.396	0.261	0.259
Empaty1	0.320	0.686	0.278	0.359	0.331	0.135
Empaty2	0.377	0.548	0.045	0.335	0.171	0.228
Empaty4	0.238	0.706	0.098	0.355	0.348	0.119
Empaty5	0.311	0.751	0.204	0.322	0.373	0.152
Relia1	0.142	0.103	0.687	0.451	0.157	0.353
Relia4	0.109	0.201	0.569	0.313	0.104	0.204
Relia5	0.332	0.216	0.755	0.177	0.525	0.611
Respon1	0.523	0.371	0.512	0.7371	0.290	0.342
Respon2	0.283	0.260	0.323	0.757	0.266	0.296
Respon3	0.235	0.455	0.261	0.7676	0.343	0.155
Respon4	0.233	0.245	0.171	0.5702	0.134	0.267
Respon5	0.344	0.372	0.028	0.6463	0.215	0.064
Safety1	0.236	0.486	0.332	0.203	0.647	0.220
Safety3	0.343	0.306	0.410	0.351	0.841	0.421
Safety4	0.389	0.333	0.281	0.334	0.809	0.415
Safety5	0.046	0.224	0.434	0.182	0.663	0.477
Tan1	0.437	0.053	0.273	0.174	0.284	0.6018
Tan2	0.236	0.243	0.471	0.200	0.485	0.7675
Tan3	0.320	0.185	0.541	0.364	0.247	0.7914
Tan5	0.382	0.133	0.592	0.229	0.466	0.8281

Construct Reliability

Reliability is measured using Composite Reliability (CR) and Cronbach's Alpha. Cronbach's Alpha is a measure of internal consistency whereas CR is a measure of construct reliability. According to (Fornell & Larcker, 1981) CR should be more than 0.7. In surveys, Cronbach's Alpha value of more than 0.6 is acceptable (Malhotra, 2008). All the six constructs used in measuring passenger satisfaction have CR between 0.712 and 0.837 and Cronbach's Alpha value more than 0.6 as depicted in **table 3.** Hence, the constructs used for the indicator

items hold good and reliable.

Table 3: Internal Consistency Reliability Statistics

Constructs	Average Variance Extracted (AVE)	Composite Reliability (CR)	Cronbach's Alpha
Assurance	0.501	0.790	0.645
Empathy	0.508	0.770	0.621
Reliability	0.505	0.712	0.610
Responsiveness	0.521	0.826	0.745
Safety	0.555	0.831	0.731
Tangibility	0.566	0.837	0.748

Convergent Validity

Validity refers to the accuracy of the research. Convergent Validity means that the indicator items of a particular construct should share a substantial part in common. It is a parameter that is used to measure the degree of correlation between indicator variables of the same construct. It further depicts that the multiple indicators of a construct that are related in theory are related in fact. To determine Convergent Validity: factor loading, AVE and CR must be considered (Bagozzi et al. 1991). AVE is a measure that depicts the variance extracted by the latent constructs to the amount of variance caused by the measurement error. The larger the AVE, smaller is the measurement error. It also signifies that larger the AVE, larger is the interpretation of indicator variance by the latent constructs. However for the constructs to have better reliability, AVE must be more than 0.5 (Hair et al. 2010). Further, since AVE was more than 0.5 for all the six constructs, .m/used for measuring passenger satisfaction and thus, it was adequate for convergent validity (Table 3).

Discriminant Validity (Fornell and Larcker Criterion, 1981)

The criterion used to access discriminant validity is Fornell-Larcker Criterion (1981). Discriminant validity depicts the distinctiveness of the constructs. It meant that the latent constructs that are empirically not related to each other are actually unrelated. It is the comparison of the square root of AVE with the correlation of other latent constructs. If the square root of AVE of every latent construct has a higher value than the inter construct correlations, then there is discriminant validity. In other words, the topmost value of any construct column must be greater than the numbers below it. The on-diagonals values must be greater than off diagonals. As revealed by **table 4,** on-diagonals values in bold are the square root of (AVE) and off-diagonals values are inter-construct correlations.

Table 4: Discriminant Validity

Constructs	Assurance	Empathy	Reliability	Responsiveness	Safety	Tangibility
Assurance	**0.708**					
Empathy	0.437	**0.713**				
Reliability	0.332	0.259	**0.711**			
Responsiveness	0.494	0.495	0.407	**0.722**		
Safety	0.368	0.473	0.477	0.368	**0.745**	
Tangibility	0.436	0.213	0.650	0.329	0.495	**0.752**

Referring to **table 4** the square root of AVE of each construct (on-diagonal) was higher than the correlation of other latent constructs (off-diagonal). As depicted by highlighted areas in table 5.15, the construct Reliability value 0.711 was higher than correlations of every construct whether seen vertically or horizontally in relative rows and columns. Similar was for other constructs also. Henceforth, discriminant validity was supported between the constructs of passenger satisfaction. It was thus concluded that the scale was reliable and valid and therefore the measurements or responses measure the true form of service quality.

Table 5 revealed that the mean score of safety was highest (M= 4.05, SD = 0.75) indicating that the passengers were more concerned about being safe. If the passengers felt personally secure, only then they would prefer travelling through CTU buses. As such, highest rating was given to the construct safety followed by empathy (M =3.99, SD = 0.58) and assurance (M =3.89, SD = 0.66).

Table 5: Descriptive Statistics

Construct	Mean	Std. Deviation	Skewness	Kurtosis	Rating
Tangibility	3.87	0.84	-1.41	2.60	4.00
Reliability	3.87	0.73	-0.68	-0.29	4.00
Responsiveness	3.65	0.72	-0.79	0.21	5.00
Assurance	3.89	0.66	-0.35	-0.46	3.00
Empathy	3.99	0.58	0.19	-0.88	2.00
Safety	4.05	0.75	-1.14	1.27	1.00

Tangibility and reliability had equal mean scores and were rated the same. Concerning the construct responsiveness, many passengers who had not undergone any need to interact with the inquiry staff didn't have problems making complaints etc and thus, in that case, they were unaware of how the staff and management responded in such cases. Therefore

Responsiveness had minimum mean scores (M= 3.65, SD= 0.72) and rated the lowest.

FINDINGS

The following major findings emerged from the analysis:

- It was found that the conventional SERVQUAL model consists of five constructs but in the present study one more additional construct safety is included as a dimension of service quality.
- The study revealed that all the six constructs were found to be highly consistent and reliable.
- It also evidenced that the present six construct model can be applied in transport sector, as the passengers will avail the public transport only if they found it safe, secure and protective.

LIMITATIONS OF THE STUDY

- The analysis and interpretation based on the sample of the responses may not reflect the responses of the whole universe.
- For the convenience of the researcher, purposive sampling is used which may have its own limitations.

CONCLUSION

The questionnaire on passenger satisfaction was verified through confirmatory factor analysis. It emphasized the reliability and validity in all the latent constructs and was found to be acceptable. All the indices were thoroughly examined and were in reasonable range. Hence, the collected data served the passenger satisfaction survey. The items in the developed questionnaire formed good quality measurement tool and was fit to be proceeded further.

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