EFA-FTOPSIS-Based Assessment of Service Quality: Case of Shopping Websites

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1 Introduction

Technology is narrowing the gap between physical and online shopping environment. The customers are becoming very selective in choosing the products. This is easily possible in online shopping. Consumers are keen to search online shopping, online booking, online financial transactions, etc., and their offerings.

It raises the Internet users and growth in electronic commerce (e-commerce). Enterprises are attempting to gain a competitive advantage by using e-commerce for interacting with the customers [33]. These types of businesses are commencing to realize that success of any business is not only the low price of the product, but service quality of their website is equally important. But service quality is an intangible and theoretical construct that is not easily elucidated and evaluated.

In India, the growth has been forecasted in the online retail market from 2012 to 2018 (in billion US dollars) as shown in Fig. 1.

This shows that there is a need of research which can explore the factors affecting the service quality of online shopping sites so that sites can be compared and ranked.

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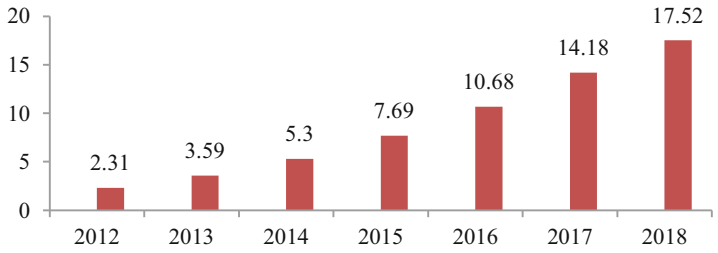

Fig. 1 Growth in sales in online retail from 2012 to 2018 (Source: Ref. [40])

2 Literature Review

Literature in domain of service quality and e-service quality has been reviewed for the present study and has been categorized as follows:

(a) Service quality
(b) Service quality measurement
(c) E-service quality
(d) E-Service quality measurement

2.1 Service Quality

Service quality has drawn a major attention of researchers; as a result, numerous studies are available in the literature. Gummesson [15] was first to suggest the concept of service quality and its strong association to the trust and perception. Oliver [25] conceptualized the service quality based on his disconfirmation model. Thus, service quality is generally considered to be a measure of how soundly the level of service delivery matched the expectation of customer.

The previous studies have also revealed that there is less managerial control over the service quality due to higher involvement of customers in the process [26]. Many researchers considered service quality as economies of services as it is playing a significant role in economic environment. Thus, Table 1 presents the select compilation of definitions on service quality.

2.2 Service Quality Measurement

There are various measures available to measure the service quality; SERVQUAL is the most popular scale for measuring service quality used by various researchers among all other measures [5, 9, 32].

Table 1 Definitions of service quality

S. no.	Authors	Definition of service quality
1	[13]	The outcome of an evaluation process, where the consumer compares his expectations with the service he perceives he has received
2	[26]	The comparison between customer expectations and perceptions of service
3	[10]	Based on the customers' perceptions of how well the service matches their needs and expectations
4	[30]	It is a function of the difference in scores or gaps between expectations and perception
5	[33]	The attitude or belief about the excellence of degree of service offered in service provider location

This area of research has been very rich in terms of basic concepts and models [13], applications [1], linkages with customer satisfaction, customer loyalty, and profitability.

The previous studies have [17, 19, 31, 34, 35, 39] well documented the critique and application in different contexts and also highlight that subject of service quality is not generic and its measurement varies with respect to specific service as shown in Table 2.

2.3 E-Service Quality

The studies in the field of service quality have been admired for more than three decades, but recently it has been applied to the e-commerce environment [19]. The beginning of "e-service" emerged upon the expansion of Internet applications [23]. Information technology (IT) is used by e-commerce organizations to gain a competitive advantage around the world. IT is used to elaborate the interaction with customers more friendly. It is an efficient means at minimal cost to expand a vast market share. With the increase of e-service acceptance in business environment, the significance of measuring e-service quality in the virtual world has been acknowledged.

With more use of e-services in business, many studies have been conducted to better understand its dynamics [6]. The previous studies have focused on various conceptual definitions of e-service quality [36] which have been presented in Table 3.

2.4 E-Service Quality Measurement

SERVQUAL instrument is used to measure the traditional service quality of the company according to the five dimensions: tangibles, reliability, responsiveness,

Table 2 Compilation of measures of service quality

[13]	[14]	[26]	[21]	[28]	[8]
				Reliability	Reliability
Technical quality	Recovery	Credibility	Physical quality (physical product + physical environment)	Responsiveness	Comfort
Functional quality	Attitude and behavior	Access		Tangibles	Features
		Reliability			
Corporate image	Accessibility and flexibility	Communication	Interactive quality (interaction with persons and equipments)	Access	Personal attention
	Reputation and credibility	Understanding the customer			
	Professionalism and skills reliability and	Courtesy		Knowing the customers	
				Assurance	
		Competence	Corporate quality		
	Trustworthiness	Responsiveness	Process quality		
		Tangibles	Output quality		
		Security			

Source: Modified from [32]

Table 3 Definitions of e-service quality

S No.	Authors	Definitions
1	[27]	Effectiveness and efficiency of online browse, online purchase, and delivery of goods and service
2	[11]	The degree to which an electronic service is able to effectively and efficiently fulfil relevant customer needs
3	[2]	The entire stages of a customer's interactions with the Internet, website

Table 4 E-service quality instrument

SN	Author	Instrument	Dimensions
1	[22]	WebQual	Visual appeal, integrated communication, business processes, informational fit to task, interaction, trust, response time, design, intuitiveness, and substitutability
2	[38]	SITE-QUAL	Processing speed, ease of use, aesthetic design, and security
3	[4]	WebQual	Usability, design, information, trust, and empathy
4	[37]	eTailQ	Website design, reliability/fulfilment, privacy/security, and customer service
5	[27]	E-S-QUAL	Efficiency, system availability, fulfilment, and privacy
		E-RecS-QUAL	Responsiveness, compensation, and contact
6	[20]	Revised SERVQUAL	Website design, reliability, responsiveness, trust, and personalization

empathy, and assurance. The measurement of e-service quality emerged on the basis of SERVQUAL. For measuring the e-service quality, Gefen [12] combined the SERVQUAL five dimensions into three. But various researchers also realized that there is a need of another instrument for measuring e-service quality and SERVQUAL cannot be considered for measuring the e-service quality [27]. Since then, many researches are addressed in account of e-service quality and explored different measurements (different dimensions) for measuring e-service quality. Some of them are presented in Table 4.

After an extensive literature review, an instrument called E-S-QUAL and E-RecS-Qual was developed to measure the service quality of online shopping websites by Parasuraman [27]. According to his study, service quality has provided online services an effective and efficient way for online browse, online purchase, and delivery of goods and service. In the present research, context E-S-QUAL has been adopted to measure the service quality of online shopping sites.

Taking insights and gap from the literature, the following objectives are framed:

- To explore the factors of service quality affecting the service quality of online shopping websites
- To propose the methodology for comparing the performance of online shopping sites

3 Research Methodology

In the present study, E-S-QUAL scale was adopted for measuring the service quality of online shoppers. The responses were collected from the respondents on 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A total of 320 questionnaires were circulated in North India region, and 232 were received in the decided time period. Out of this, 157 questionnaires were used, and the rest were eliminated because they did not have any online shopping experience. The number of responses was considered suitable for exploratory factor analysis as suggested ratio (1:5) according to Hair [16]. The reliability of the instrument was found to be 0.698, which is to be considered acceptable according to Nunnally [24]. The value of KMO was 0.732 which shows the sample is adequate [3]. Five factors were identified on the basis of their eigenvalue and factor loading, since it is more than 1 and 0.5, respectively. These five factors were named as efficiency (F1), system availability (F2), fulfilment (F3), contact (F4), and privacy (F5). On the basis of this, expert opinions were taken to develop a methodology for making the comparison of online shopping sites by using fuzzy technique for order performance by similarity to ideal solution (FTOPSIS).

4 Fuzzy TOPSIS

TOPSIS is a multi-criteria decision-making technique which is used for ranking and comparing the alternatives among various alternatives by the numerical evaluations and calculations with respect to certain attributes/criterion. In this technique, weights will be specified for each criterion for measuring the relative importance which is felt by the decision maker. The basic principle of the fuzzy TOPSIS is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative-ideal solution in a geometrical (i.e., Euclidean) sense [18].

This study has considered three shopping sites as SS-I, SS-II, and SS-III. For the rating purpose of these three shopping sites, as suggested by Saaty and Vargas [29], five customers were selected as experts.

This group of five customers was asked to assign the weights to the three shopping sites. The steps for the methodology using FTOPSIS are as follows.

Step 1: Defining Fuzzy Decision Matrix

Five customers as experts are selected assessing the selection of shopping sites, since Saaty and Vargas [29] suggest that three to seven experts are suitable.

In the linguistic language, the item weightings are assessed from Table 5 by the team of decision makers and converted into TFN (shown in Table 6).

The linguistic ratings and values (Table 7) are expressed in exact numerical values [7]. This rating of alternatives is formulated based on decision makers' judgments as shown in Table 7 after conversion of linguistic terms into TFN.

Table 5 Linguistic variable set

Linguistic terms		
Weightings	Ratings	Triangular fuzzy numbers (TFN)
Very low (VL)	Very poor (VP)	(0,0,1)
Low (L)	Poor (P)	(0,1,3)
Medium low (ML)	Medium poor (MP)	(1,3,5)
Medium (M)	Fair (F)	(3,5,7)
Medium high (MH)	Medium good (MG)	(5,7,9)
High (H)	Good (G)	(7,9,10)
Very high (VH)	Very Good (VG)	(9,10,10)

Table 6 Decision makers' judgment on item weightings

	F1	F2	F3	F4	F5
DM_1	7,9,10	3,5,7	3,5,7	7,9,10	7,9,10
DM_2	5,7,9	3,5,7	3,5,7	5,7,9	3,5,7
DM_3	5,7,9	7,9,10	5,7,9	7,9,10	5,7,9
DM_4	3,5,7	7,9,10	7,9,10	7,9,10	7,9,10
DM_5	7,9,10	5,7,9	3,5,7	5,7,9	7,9,10

Table 7 Decision makers' judgments on rating for alternative (shopping sites)

		F1	**F2**	**F3**	**F4**	**F5**
DM_1	**SS-I**	1,3,5	3,5,7	5,7,9	5,7,9	3,5,7
	SS-II	5,7,9	5,7,9	7,9,10	7,9,10	3,5,7
	SS-III	5,7,9	7,9,10	5,7,9	5,7,9	5,7,9
DM_2		**F1**	**F2**	**F3**	**F4**	**F5**
	SS-I	3,5,7	3,5,7	7,9,10	1,3,5	7,9,10
	SS-II	5,7,9	3,5,7	5,7,9	7,9,10	1,3,5
	SS-III	7,9,10	5,7,9	5,7,9	7,9,10	5,7,9
DM_3		**F1**	**F2**	**F3**	**F4**	**F5**
	SS-I	3,5,7	1,3,5	3,5,7	3,5,7	1,3,5
	SS-II	1,3,5	5,7,9	3,5,7	1,3,5	1,3,5
	SS-III	1,3,5	5,7,9	7,9,10	7,9,10	5,7,9
DM_4		**F1**	**F2**	**F3**	**F4**	**F5**
	SS-I	5,7,9	7,9,10	7,9,10	3,5,7	7,9,10
	SS-II	1,3,5	1,3,5	1,3,5	7,9,10	5,7,9
	SS-III	1,3,5	3,5,7	1,3,5	5,7,9	1,3,5
DM_5		**F1**	**F2**	**F3**	**F4**	**F5**
	SS-I	1,3,5	1,3,5	7,9,10	1,3,5	5,7,9
	SS-II	5,7,9	7,9,10	1,3,5	7,9,10	5,7,9
	SS-III	1,3,5	1,3,5	7,9,10	5,7,9	3,5,7

Table 8 Averaged frequency weightings and ratings of three shopping sites

	F1	F2	F3	F4	F5
Weights	5.4, 7.4, 9	5, 7, 8.6	4.2, 6.2, 8	6.2, 8.2, 9.6	5.8, 7.8, 9.2
SS-I	2.6, 4.6, 6.6	3, 5, 6.8	5.8, 7.8, 9.2	2.6, 4.6, 6.6	4.6, 6.6, 8.2
SS-II	3.4, 5.4, 7.4	4.2, 6.2, 8	3.4, 5.4, 7.2	5.8, 7.8, 9	3, 5, 7
SS-III	3, 5, 6.8	4.2, 6.2, 8	5, 7, 8.6	5.8, 7.8, 9.4	3.8, 5.8, 7.8

Table 9 Normalized fuzzy decision matrix

	F1	F2	F3	F4	F5
SS-I	0.2708, 0.4792, 0.6875	0.3125, 0.5208, 0.7083	0.6042, 0.8125, 0.9583	0.2708, 0.4792, 0.6875	0.4792, 0.6875, 0.8542
SS-II	0.3778, 0.6, 0.8222	0.4667, 0.6889, 0.8889	0.3778, 0.6, 0.8	0.6444, 0.8667, 1	0.3333, 0.5556, 0.7778
SS-III	0.3125, 0.5208, 0.7083	0.4375, 0.6458, 0.8333	0.5208, 0.7292, 0.8958	0.6042, 0.8125, 0.9792	0.3958, 0.6042, 0.8125

Step 2: Formulating the Complex Fuzzy Decision Matrix
The fuzzy item weightings and fuzzy decision matrix are formulated by converting the linguistic terms into TFN [Tables 6 and 7]. After TFN, convert this into complex decision matrix (Table 8) by using following formulas:

$$\tilde{a}_{\mathrm{ij}} = 1/\mathrm{t}\left[\tilde{a}_{ij}^{1} + \tilde{a}_{ij}^{2} + \ldots\ldots\ldots + \tilde{a}_{ij}^{t}\right], i = 1, 2, \ldots\ldots\ldots, s; j = 1, 2, \ldots$$

$$\tilde{w} = 1/\mathrm{t}\left[\tilde{w}_{i}^{1} + \tilde{w}_{i}^{2} + \ldots\ldots\cdots + \tilde{w}_{i}^{t}\right], i = 1, 2, \ldots\ldots, s$$

Step 3: Normalizing the Complex Fuzzy Decision Matrix
The fuzzy decision matrix now is normalized (Table 9) by using the following formulas:

$$\tilde{\mathrm{r}}_{ij} = \left(\frac{a_{lij}}{a_{uij}^{*}}, \frac{a_{mij}}{a_{uij}^{*}}, \frac{a_{uij}}{a_{uij}^{*}}\right) i \in \mathrm{B}$$

$$\tilde{\mathrm{r}}_{ij} = \left(\frac{\bar{a_{li}}}{a_{uij}}, \frac{\bar{a_{li}}}{a_{mij}}, \frac{\bar{a_{li}}}{a_{lij}}\right) i \in \mathrm{C}$$

Step 4: Construction of Weighted Normalized Fuzzy Decision Matrix
With the normalized fuzzy numbers, now construct the weighted normalized fuzzy decision matrix (Table 10) by using the formula:

$$\tilde{\mathrm{v}}_{ij} = \tilde{\mathrm{w}}_{\mathrm{I}} * \mathrm{r}_{ij}, i = 1, 2, 3 - - - - - s, j = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots, n$$

Table 10 Weighted normalized fuzzy decision matrix

	F1	F2	F3	F4	F5
SS-I	1.4625, 3.5458, 6.1875	1.5625, 3.6458, 6.0917	2.5375, 5.0375, 7.6667	1.6792, 3.9292, 6.6	2.7792, 5.3625, 7.8583
SS-II	2.04, 4.44, 7.4	2.3333, 4.8222, 7.6444	1.5867, 3.72, 6.4	3.9956, 7.1067, 9.6	1.9333, 4.3333, 7.1556
SS-III	1.6875, 3.8542, 6.375	2.1875, 4.5208, 7.1667	2.1875, 4.5208, 7.1667	3.7458, 6.6625, 9.4	2.2958, 4.7125, 7.475

Table 11 Distance measurement of alternatives

Alternative	d*	d^-
SS-I	29.62822	24.03577
SS-II	27.36385	26.97287
SS-III	27.37666	26.64665

Table 12 Closeness coefficient (CC) of shopping sites

Alternative	CC
SS-I	0.44789
SS-II	0.4964
SS-III	0.49324

Step 5: Calculate the FPIS and FNIS

$$A^* = [(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1)]$$

$$A^- = [(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0)]$$

Step 6: Calculate the Distance (Tables 11 and 12)
The distance for each alternative form FNIS and FPIS can be calculated according to the following formulas:

$$d_j^* = \sum_{i=1}^{s} d\left(\tilde{v}_{ij}\tilde{v}_i^*\right) j = 1,2,\ldots\ldots s$$

$$d_j^- = \sum_{i=1}^{s} d\left(\tilde{v}_{ij}\tilde{v}_i^-\right) j = 1,2,\ldots\ldots s$$

Step 7: Calculate the Closeness Coefficient of Each Alternative Using the Following Formula

$$CC_i = \frac{d_j^-}{d_j^* + d_j^-} = j = 1,2\ldots.n$$

According to the closeness coefficient, three online shopping sites can be ranked as SS-II > SS-III > SS-I, from highest to the lowest. The results indicate that SS-II is outstanding one. SS-I performs worse than SS-II and SS-III. So SS-I has some more gaps to improve their service quality to their customers while purchasing online through his sites.

5 Discussion and Conclusion

In today's scenario, the uses of online shopping sites are increasing day by day; thus, it requires more improvement in their services in an effective and efficient way. Improved service quality can reduce so many problems. In this paper, an integrated approach of EFA- FTOPSIS and E-S-QUAL scale is presented to evaluate the service quality, by the online shopping sites, which they are providing to their online customers. The present methodology can be applied for ranking more online shopping websites. Online companies can also use this methodology for comparing their performance with their competitors and hence make enhancement in providing the services to their online customers.

6 Limitations and Future Research

The practical difficulties have confined the study only for measuring the service quality of online shopping sites; future research may focus on the measuring quality of service in other service sectors. The dimensions and items of service quality have been only taken from E-S-QUAL. These items and factors/criterions can be varying. Another limitation for this research is number of respondents. Future research can be conducted by more number of respondents to get more generalized result.

As this case has been solved by using Fuzzy TOPSIS approach, so it is recommended that future research can be conducted in the same area by considering more items and factors with same methodology or by some other approach like analytical hierarchy process (AHP), analytical network process (ANP), etc.

References

1. Aktas A, Akin AA, Cizel B (2003) Tourist profile research: Antalya region example 2001. Tour Rev 58(1):34–40
2. Al-Nasser M, Yusoff RZ, Islam R, Alnasser A (2013) E-service quality and its effect on consumers' perceptions trust. Am J Econ Bus Adm 5(2):47–55
3. Bajpai N (2011) Business research methods. Pearson Publication, Delhi
4. Barnes S, Vidgen RT (2002) An integrative approach to the assessment of e-commerce. J Electron Commerce Res 3(3):114–126

5. Bebko CP, Garg RK (1995) Perceptions of responsiveness in service delivery. J Hosp Mark 9(2):35–45
6. Burgess L (2014), A conceptual model of B2B online service quality. In: Hasan H (ed) Being practical with theory: a window into business research, pp 87–90
7. Chen SJ, Hwang CL (1992) Fuzzy multiple attribute decision making: methods and applications. Springer, Berlin
8. Dabholkar PA, Shepherd CD, Thorpe DI (2000) A comprehensive framework for service quality: an investigation of critical conceptual and measurement issues through a longitudinal study. J Retail 76(2):131–139
9. Einasto O (2014) Investigating e-service quality criteria for university library: a focus group study. New Libr World 115(1/2):4–14
10. Ennew C, Waite N (2007) Financial services marketing: an International guide to principles and practice. Elsevier, Oxford
11. Fassnacht M, Koese I (2006) Quality of electronic services: conceptualizing and testing a hierarchical model. J Serv Res 9(1):19–37
12. Gefen D (2002) Customer loyalty in e-commerce. J Assoc Inf Syst 3(1):27–51
13. Grönroos C (1984) A service quality model and its marketing implications. Eur J Mark 18(4):36–44
14. Grönroos C (1988) Service quality: the six criteria of good service quality. Rev Bus 9(3):10–13
15. Gummesson E (1979) The marketing of professional services—an organizational dilemma. Eur J Mark 13(5):308–318
16. Hair JF, Black WC, Babin BJ, Anderson RE (2015) Multivariate data analysis, 7th edn. Pearson, Edinburg
17. Haywood-Farmer J (1988) A conceptual model of service quality. Int J Oper Prod Manag 8(6):19–29
18. Hwang CL, Yoon KP (1981) Multiple attribute decision making: methods and applications. Springer-Verlag, New York
19. Ladhari R (2008) Alternative measures of service quality: a review. Manag Serv Qual 18(1): 65–86
20. Lee G, Lin H (2005) Customer perceptions of e-service quality in online shopping. Int J Retail Distrib Manag 33(2):161–176
21. Lehtinen U, Lehtinen JR (1991) Two approaches to service quality dimensions. Serv Ind J 11(3):287–305
22. Loiacono ET, Watson RT, Goodhue DL (2000) WebQual: a web site quality instrument. Working Paper No. 2000-126-0, University of Georgia, Athens
23. Mary L, O'Loughlin D (2008) An observation analysis of e-service quality in online banking. J Financ Serv Mark 13(2):164–178
24. Nunnally J (1978) Psychometric theory. McGraw-Hill, New York, NY
25. Oliver RL (1980) A cognitive model of the antecedents and consequences of satisfaction decisions. J Mark Res 17(4):460–469
26. Parasuraman A, Zeithaml VA, Berry LL (1985) A conceptual model of service quality and its implications for the future research. J Mark 49(1):41–50
27. Parasuraman A, Zeithaml VA, Malhotra A (2005) E-S-Qual: a multiple-item scale for assessing electronic service quality. J Serv Res 7(3):213–233
28. Rosen LD, Karwan KR (1994) Prioritizing the dimensions of service quality. Int J Serv Ind Manag 5(4):39–52
29. Saaty TL, Vargas LG (1994) Decision making in economic, political, social and technological environment with the analytic hierarchy process. RWS Publications, Pittsburgh
30. Santhiyavalli G, Sandhya B (2011) Service quality evaluation in select commercial banks. IUP J Oper Manag 10(1):43–62
31. Seth N, Deshmukh SG, Vrat P (2005) Service quality models: a review. Int J Qual Reliab Manag 22(9):913–949
32. Seth N, Deshmukh SG, Vrat P (2006) A framework for measurement of quality of service in supply chains. Supply Chain Manag 11(1):82–94

33. Shabbir MF, Aslam DH, Capusneanu S, Barbu CM, Tanveer MA (2012) Perceived service quality of Islamic and non Islamic banks operating in Pakistan. Am J Sci Res 51:27–36
34. Soteriou AC, Stavrinides Y (2000) An internal customer service quality data envelope analysis model for bank branches. Int J Bank Market 18(5):246–252
35. Sweeney JC, Soutar GN, Johnson LW (1997) Retail service quality and perceived value. J Consum Serv 4(1):39–48
36. Sylvie R, Ina F (2010) A new measure of e-service quality in France. Int J Retail Distrib Manag 38(7):497–517
37. Wolfinbarger M, Gilly MC (2003) eTailQ: dimensionalizing, measuring, and predicting etail quality. J Retail 79(3):183–198
38. Yoo B, Donthu N (2001) Developing a scale to measure the perceived quality of an internet shopping site (Sitequal). Q J Electron Commerce 2(1):31–46
39. Zeithaml VA (1988) Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. J Mark 52(3):2–22
40. http://www.statista.com/statistics/289770/india-retail-e-commerce-sales/