A fuzzy SERVQUAL based method for evaluated of service quality in the hotel industry

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Abstract

Quality affects the performance of the product or service as well as customer satisfaction. This fact is genuinely important when it comes to how the consumer interprets the satisfaction that service provides and the judgment of the buying process as a whole. Considering that, service quality is an abstract and elusive construct due to three characteristics of services: intangibility, heterogeneity, and inseparability of production and consumption. In that way, we define service quality as perceived by the customer. In addition, the perceived quality is the comparison between the perception and customer expectation. Customer expectations are the expected service, arising from needs. However, these can be more or less demanding than the real needs. Perceptions are how the customer perceives the service provided, assessing whether this was appropriate or not. Thus, for service providing organizations the interpretation of customer needs is critical. Superior performance in services strengthens competitiveness and establishes a relationship with the customer, consolidating the brand and communication with the market, etc.

This paper aims to evaluate the quality of a large hotel through the fuzzy SERVQUAL and fuzzy AHP. The results showed that the services have many gaps to be improved.

1. Introduction

The importance of service quality for business performance has been recognized in literature through the direct effect on customer satisfaction and the indirect effect on customer loyalty [1-2]. Quality is a term that is considered indicative of a high level of customer satisfaction and refers to factors that characterize a product or service. Service quality [3] is an elusive and abstract construct that is difficult to define and measure. The quality of service could be considered as a composite of multiple attributes. It is not only composed of tangible attributes, but also the intangible and subjective attributes such as safety, comfort, and satisfaction, which are difficult to measure accurately. Considering the characteristics of services (intangibility, inseparability, heterogeneity and perishability), it becomes difficult to measure its quality.

Thus, one of the definitions found in the literature describes the service quality as the ability to meet customer needs. The assessment of perceived [4-7] quality is realized by the customer during or after the service delivery process; and is determined by comparing perceived quality and that expected by the customer. In this way, to measure the quality of service, conventional measurement makes use of cardinal or ordinal scales. Criticism of scale based on the measurement is that the score does not necessarily represent the user's preference. Humans and preference judgments are often vague and cannot estimate their preference with an exact numerical value.

Therefore, the usage of linguistic terms to describe the desired value and the weight of importance of the criteria (i.e. very low, low, fair, high, etc.) is recommended. Because of the existing imprecision in this process, fuzzy set theory is an appropriate method for dealing with uncertainty. Fuzzy logic

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provides tools able to capture vague information, generally described in a natural language, and convert it to a numeric format, easily manipulated by computers. The systems are based on fuzzy reasoning ability similar to the human form.

This paper aimed to evaluate the quality of a large hotel located in Santa Catarina, Brazil. The first step involves development of a SERVQUAL based questionnaire to collect data for evaluated service quality in the hotel industry. Fuzzy SERVQUAL was used to calculate the Gap5 (discrepancy between perception and expectation – perceived quality). The FAHP method was applied to calculate the relative weights of the criteria/sub-criteria selected that affect services quality.

This paper is organized into five sessions. The context of the research is described in session 1. Session 2 explains the background; session 3 shows methodology. In session 4, its application and results (case study) are described. And finally, session 5 consists of the found conclusions.

2. Background

The subsequent literature review addresses firstly the determinants of service quality. In a second step, SERVQUAL Scale.

2.1. Determinants of service quality

For each type of service [8-10], there can be a specific set of quality determinants. Various authors have tried to define a generic set of determinants that applies to all types of service. It can be defined as a set of parameters for service quality based on some authors [1][11-18]:

- **Tangibles** – these include the state of facilitating goods, physical condition of the buildings and the environment, appearance of personnel, and condition of equipment.
- **Customization** – the willingness and ability to adjust the service to meet the needs of the customer.
- **Access** – the ease of approachability and contact.
- **Communication** – keeping customers informed about the service in a language that they can understand and listening to the customers.
- **Understanding/knowing the customer** – this involves trying to understand the customer’s needs and specific requirements, providing individualized attention, and recognizing the regular customer (an important determinant of quality in high-contact customized services).
- **Security** – the freedom from danger, risk and doubt. It involves physical safety, financial security and confidentiality.
- **Courtesy** – the politeness, respect, consideration and friendliness shown to the customers by the contact personnel.
- **Competence** – employees should possess the necessary skills, knowledge and information to perform the service effectively.
- **Credibility** – the extent to which the service is believed and trusted. The service provider’s name and reputation, and the personal traits of front line employees all contribute to credibility.

• Reliability – the ability to provide the pledged service on time, accurately and dependably.
• Responsiveness – the ability to deal effectively with complaints and promptness of the service.
• Cost – the price paid for the service. Although the price is a competitive criteria that has a strong influence on the strategic positioning of an organization which may consider price and quality as distinct characteristics.

Each type of service may have determinants that are considered critical to the organization. The perception of quality and the subsequent evaluation of the service are given regarding the determinants considered most important to the client in each moment of truth. Service quality is influenced by expected service and perceived service. If services are received as expected, the service quality is satisfactory, but if the services received exceed their expectations, customers will be delighted, and will perceive service quality as excellent. The opposite can be said for customers who receive less than satisfactory service quality.

Measuring the quality of services is a challenge, because satisfaction is determined by many intangibles instead of products with tangibles characteristics objectively measured. Hence, the importance and the utility value of each determinant of quality is dependent on the nature of the service.

2.2. SERVQUAL Scale

The most commonly used measure of service quality has been the SERVQUAL scale [19], [20] originally developed and refined (see Parasuraman et al., [1] [11-12]). The resultant assessment instrument is SERVQUAL (for service quality), created as a means of tracking service quality across industries and determining the importance of key consumer perceptions and expectations [3]. SERVQUAL [1] has five main dimensions to measure service quality: tangibles, reliability, responsiveness, assurance, and empathy.

The items are presented in a five, seven or nine-point response format with anchors ‘strongly agree’ and ‘strongly disagree’ (Likert-type) [21]. Service quality is then measured by calculating the “gaps” between corresponding items, the difference between customers' perception and expectation (concise multiple item scale that contains 22 pairs) of service, as well as the dimensions of service. The first step involves development of a questionnaire survey for measuring service quality. The questions were prepared using the service quality criteria proposed in SERVQUAL. To paper were using to this paper quality dimensions (to business hotels”):

• Tangibles – physical facilities, equipment, and appearance of personnel.
• Reliability – ability to perform the promised service dependably and accurately.
• Assurance – knowledge and courtesy of employees and their ability to inspire trust and confidence.
• Empathy – the amount of caring, individualized attention the firm provides its customers.
• Access – involves approachability and case contact.
So for hotel services the following can be considered: a Product-Service System (PSS) [22-25], consists of tangible products and intangible services designed and combined so that they are capable of fulfilling specific customer needs. Therefore, a PSS should be defined as a system of products, services, supporting networks and infrastructure that is designed to be: competitive, to satisfy customer needs and to have a lower environmental impact than traditional business models. For the study we used the Gap model [1] to compare the perception and expectation. In fact, the SERVQUAL instrument is based on the 5 Gaps. These gaps on the service provider’s side, which can impede delivery of services that consumers perceive to be of high quality, are:

• Gap 1 – difference between consumer expectations and management perceptions of consumer expectations.
• Gap 2 – difference between management perceptions of consumer expectations and service quality specifications.
• Gap 3 – discrepancy between service quality specifications and the service actually delivered.
• Gap 4 – discrepancy between service delivery and what is communicated about the service to consumers.
• Gap 5 (service quality) Gap 5 = f (Gap 1, Gap 2, Gap 3, Gap 4) – difference between consumer expectations and perceptions. I.e. the quality that the consumer perceives in services is a function of the magnitude and direction of the gap between expected service and perceived service. This occurs when the expectation is not exceeded.

The SERVQUAL scale used as a diagnostic technique for identifying, in various types of services, the strengths and weaknesses of the company, providing the basis for continuous improvement. It can also be used for various applications, including the identification of trends in service quality when applied regularly with customers. Another application is in marketing to compare a service of its competitors, identifying dimensions of quality are superior to those competitors and which need improvement.

3. Methodology

The fuzzy set theory used in this paper was introduced (see Zadeh [26]) first. In this paper, a fuzzy SERVQUAL method and fuzzy AHP will be used to evaluate service quality in the hotel industry.

3.1. The arithmetic operations on fuzzy numbers

The basic arithmetic operations [20] [27-28] on fuzzy numbers are introduced as follows. Let $A_1 = (a_1, a_2, b_1)$ is triangular fuzzy number and $A_2 = (c_2, a_2, b_2)$ is also triangular fuzzy number.

• Addition Operation ($A_1$ and $A_2$) (Equation 1)
\[
A_1 + A_2 = (a_1 + a_2, a_1 + b_2, c_1 + c_2)
\]
• Subtraction Operation ($A_1$ and $A_2$) (Equation 2)
\[
A_1 - A_2 = (a_1 - c_2, a_1 - b_2, c_1 - a_2)
\]
• Division Operation ($r$ is real number) (Equation 3)
\[
\frac{A_1}{r} = \left( \frac{a_1}{r}, \frac{b_1}{r}, \frac{c_1}{r} \right)
\]

3.2. Questionnaire design

In this paper, the design questionnaire is based on the previous literatures and the interviews. The SERVQUAL questionnaire is the main base (Table 1).

| Criteria   | Sub-criteria (S.) |
|------------|-------------------|
| Tangible   | 1. Visually appealing (buildings and facilities). |
|            | 2. Adequate capacity of the hotel units (dining rooms, meeting rooms, swimming pools, etc.). |
|            | 3. Modern equipment to looking good (air conditioning, furniture, elevator, communication devices, etc.). |
|            | 4. The atmosphere and equipment are comfortable and appropriate for stay (beds, chairs, lounges, etc. comfortable, clean and tranquil). |
|            | 5. Works properly of equipment without causing breakdowns. |
|            | 6. Adequate and sufficient of materials to services (soap, shampoo, towel, etc.). |
|            | 7. Food and beverages served and prepared hygienically adequate and sufficient. |
|            | 8. Good appearance of hotel employees (as uniforms and personal hygiene). |
|            | 9. Services realized as promised and accurate. |
|            | 10. The hotel provides the services at the time it promises to do so. |
|            | 11. It keeps accurate records (reservations, guest records, bills, orders, etc.). |
|            | 12. Of the employees whenever necessary. |
| Reliability| 13. The hotel to resolve guests complaints and compensates for the inconveniences. |
| Assuranc e| 14. The hotel provides flexibility in services according to guests demands. |
|            | 15. Consistency of services provided. |
|            | 16. Knowledge of employees about the work that are doing (professional abilities, foreign language, communication abilities, etc.), provide information and assistance to guests. |
| Empathy    | 17. Employees give guests individualized attention that makes them feel special. |
|            | 18. Employees understand the specific needs of guests |
|            | 19. The hotel is convenient for disabled guests (necessary arrangements made for the disabled). |
| Access     | 20. The hotel and its facilities have convenient hours to all their guests. |
|            | 21. Easy access to the hotel (transportation, loading and unloading area, car parking area, etc.). |
|            | 22. Getting information about the facilities and services of the hotel is easy (reaching information via phone, Internet, etc., direction signs, etc.) |

Source: Adapted from from literature (see Akhaba [29])

Linguistic variables are used to rate the SERVQUAL questionnaire addressing expectation and perception. Specially, the linguistic variables for interviewee’s perceptions consist of 'Very Poor; Poor; Fair; Good; Very Good'. In actual quantitative analysis process, we should
convert the linguistic variables into triangular fuzzy numbers, as shown in Table 2.

Table 2. Linguistic variables for expectation and perception

| Scale | Linguistic variable | Membership function | Linguistic variable | Membership function |
|-------|--------------------|---------------------|--------------------|---------------------|
| 1     | Very Low           | (0,1,2)             | Very Good          | (0,1,2)             |
| 2     | Low                | (1,2,3)             | Poor               | (1,2,3)             |
| 3     | Fair               | (2,3,4)             | Fair               | (2,3,4)             |
| 4     | High               | (3,4,5)             | Good               | (3,4,5)             |
| 5     | Very High          | (4,5,5)             | Very Good          | (4,5,5)             |

In the questionnaire, there are 5 dimensions and 22 items. The size of the sample is 187 (n) and is characterized as simple random sampling. This sample provides accuracy and efficiency as well as being an easy procedure to be applied (because all elements of the population have the same probability of belonging to the sample). The internal consistency test was performed by means of Cronbach’s alpha. Internal consistency [30] describes the extent to which all the items in a test measure the same concept or construct and hence, it connected to the inter-relatedness of the items within the test. Internal consistency should be determined before a test can be employed for research or examination purposes to ensure validity.

3.3. Fuzzy SERVQUAL method

The calculation procedure of fuzzy SERVQUAL introduce three steps [20] [28].

3.4. Calculating the total scores

Let fuzzy number $A_{ei}$ be the expectation of service quality from $n^{th}$ interviewee under the service item $i$. Suppose fuzzy number $A_{pi}$ is the perception of service quality from $n^{th}$ interviewee under the service item $i$ (Equation 1 and 2).

In addition, let fuzzy number $TA_{ei}$ be the expectation of total service quality from all interviewees under the service item $i$. Suppose fuzzy number $TA_{pi}$ is the perception of total service quality from all interviewees under the service item $i$ (Equation 4 and 5).

$$TA_{ei} = \sum_{i} A_{ei}$$

(4)

$$TA_{pi} = \sum_{i} A_{pi}$$

(5)

By using the Equations (1) and (4), the expectation of total service quality can be taken from all interviewees of service item $i$. Similarly, by the Equations (1) and (5), the perception of total service quality can be taken from all interviewees of service item $i$.

3.5. Calculating the mean scores

Considering fuzzy number $MA_{ei}$ as the average service quality expectations from all interviewees of service item $i$. Let fuzzy number $MA_{pi}$ be the average service quality perceptions from all interviewees of service item $i$ (Equations 6 and 7).

$$MA_{ei} = \frac{TA_{ei}}{N}$$

(6)

$$MA_{pi} = \frac{TA_{pi}}{N}$$

(7)

By using the Equations (3) and (6) the expectation of mean service quality can be calculated from all interviewees the service item $i$. Also, Equations (3) and (7) can be used to calculate the perception service.

3.6. Calculating the gap between perceptions and expectation

Let fuzzy number Gap be the service quality gap between the expectation and perception from all interviewees of item $i$.

$$Gap = MA_{ei} \otimes MA_{pi}$$

(8)

By using the Equation (2) and (8) the gap between perception and expectation of service quality can be calculated from all interviewees of service $i$.

3.7. The fuzzy AHP methodology (FAHP)

In this research, though the AHP is to capture the expert’s knowledge by perception or preference, the AHP is still able to reflect the human thoughts totally with crisp numbers. Therefore, fuzzy AHP, which is a fuzzy extension of AHP, is applied to solve the hierarchical fuzzy decision making problems with fuzzy scales instead of crisp numbers [31]. The fuzzy triangular scale of preference used in this paper. The approach used for this was (see Chang [32]), who developed the application of TFNs for the linguistic variables of the comparison scale paired to the FAHP and the extended analysis method (analytical measurement) to the values of the paired comparison. A comparison of pairs is performed using a ratio scale. The scale used is a nine-point scale with the use of TFNs. The TFNs are used to indicate the relative strength of each pair of elements in the same hierarchy. The scores from the paired comparisons are transformed into linguistic variables, which are represented by TFNs. We used the method fuzzy AHP proposed by (see Chang [32], Kahraman et al. [33], Kutlu & Ekmekcioğlu [34], Cho & Lee [35], Stefano [36]) among many other researchers.

4. Results

Data collection was realized during the summer months (December/February) in Camboriú/Santa Catarina, Brazil. Interviews were conducted with 187 guests in a large hotel (by request, the company’s name will not be revealed). Of the interviewees, 57% were female and 43% male. 17% have high school, 48% graduate and 35% postgraduate qualifications respectfully. The internal consistency test, Cronbach’s alpha, which presented a value equal to 0.8852, was realized. A value of at least 0.70 (between 0 to 1) [37] reflects an acceptable reliability, while recognizing that this value is not an absolute standard. Cronbach’s alpha values below 0.70 are accepted if the research is exploratory.
considering, the cut-off value to be considered is 0.60, below this value the author considers that the reliability is poor.

4.1. Fuzzy SERVQUAL and comparison of gap and global weighted fuzzy AHP

The result of the scores of expectations (Expec.) and perceptions (Perc.), and the gap between expectation and perception are shown in Appendix 1. Comparing the global weight of fuzzy AHP (sub-criteria) with the score of expectation and perception it can be observed that the highest and lowest expectations coincide with the weight value. This demonstrated that the two methods could be used simultaneously and thus show satisfactory results. Understanding customers’ [39-41] service expectations is a prerequisite for delivering superior service because they are implicit performance standards that customers use in assessing service quality.

And so, customer’s expectations for a particular service builds their assessment of the quality of that service. Because, when there is a discrepancy between customers’ expectations and management's understanding of customer expectations, perceived service quality will be affected. Management's accuracy is one kind of quality gap. Even when management fully understands customer expectations, service quality problems may still occur.

Many organizations seeking to improve quality concentrate most of their efforts on techniques and instruments behavior that cannot lead to the desired results. These service organizations need to understand the culture for quality. I.e., the most important values for quality acquired by managers and employees. Values can be identified by observing the management process, technological system, and the human relationship in the organization.

5. Conclusions

This paper aimed to exhibit the importance of services quality in a hotel, considering the perception versus the expectation, through the fuzzy SERVQUAL and fuzzy AHP. The results showed that the quality of services provided in various items that expectation is above perception (negative gaps – gaps). From these findings, the company may act in areas related to their points of difference between expectation and perception of quality of services provided. Investing in the maintenance of positive factors considered and reassessment of the procedures conflicting aspects.

However, it was also shown in this study that it is especially important for service companies to monitor the quality in meeting the needs and expectations of its customers, thereby creating competitive advantage. Companies first must examine the impact of their service quality provision on customer's response, including intentions signaling behaviors that are potentially favorable or unfavorable to the company. Regarding the use methods (fuzzy SERVQUAL and fuzzy AHP), these proved to be adequate for assessing the quality of services. For future research, the use of multicriteria methods associated with fuzzy logic and the proposal of indicators to assess the quality of services is suggested.

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### Appendix I. The fuzzy scores of expectations and perceptions

| Criteria/Sc. | Fuzzy Perc. | Fuzzy Exp. | Fuzzy gap | Perc. | Expect. Gap. | Global Weight (%) (Expect. %) | Global Weight (%) (Perc. %) |
|--------------|-------------|------------|-----------|-------|-------------|-------------------------------|----------------------------|
| **Tangibles** | | | | | | | |
| SC01 | (3.78,4.50,4.94) | (3.77,4.49,4.94) | (-1.16,0.01,1.17) | 4.51 | 4.50 | 0.01 | 4.67 |
| SC02 | (3.76,4.48,4.91) | (3.56,3.44,4.89) | (-1.13,0.14,1.36) | 4.48 | 4.34 | 0.14 | 4.67 |
| SC03 | (3.93,4.61,4.98) | (3.89,5.64,4.90) | (-0.97,0.05,1.09) | 4.61 | 4.56 | 0.05 | 6.52 |
| SC04 | (3.81,4.51,4.91) | (3.63,4.00,4.95) | (-1.14,0.11,2.28) | 4.51 | 4.40 | 0.11 | 5.59 |
| SC05 | (3.61,4.35,4.83) | (3.89,5.48,4.96) | (-1.36,-0.23,0.94) | 4.35 | 4.58 | -0.23 | 2.73 |
| SC06 | (3.84,4.53,4.91) | (3.79,5.14,4.96) | (-1.11,0.21,1.12) | 4.53 | 4.51 | 0.02 | 4.91 |
| SC07 | (3.52,4.30,4.88) | (3.67,4.41,4.89) | (-1.37,-0.10,1.21) | 4.30 | 4.41 | -0.10 | 3.75 |
| SC08 | (4.08,4.71,4.97) | (4.05,4.70,4.99) | (-0.92,0.01,1.09) | 4.73 | 4.70 | 0.03 | 8.69 |
| SC09 | (3.81,4.52,4.91) | (3.71,4.45,4.94) | (-1.12,0.07,1.22) | 4.52 | 4.45 | 0.07 | 5.89 |
| **Reliability** | | | | | | | |
| SC10 | (3.71,4.43,4.87) | (3.80,4.52,4.94) | (-1.23,-0.09,1.07) | 4.41 | 4.51 | -0.10 | - |
| SC11 | (3.56,4.30,4.78) | (3.86,4.56,4.95) | (-1.39,-0.26,0.92) | 4.30 | 4.56 | -0.25 | 6.23 |
| SC12 | (3.60,4.35,4.86) | (3.70,4.43,4.89) | (-1.29,-0.07,1.16) | 4.35 | 4.43 | -0.07 | 3.49 |
| SC13 | (3.89,4.57,4.93) | (3.92,4.61,4.98) | (-1.16,0.04,1.00) | 4.57 | 4.61 | -0.04 | 8.12 |
| SC14 | (3.70,4.41,4.84) | (3.74,4.47,4.94) | (-1.24,-0.06,1.11) | 4.41 | 4.47 | -0.06 | 4.35 |
| **Assurance** | | | | | | | |
| SC15 | (3.60,4.37,4.87) | (3.84,4.53,4.93) | (-1.33,-0.16,1.03) | 4.38 | 4.53 | -0.15 | - |
| SC16 | (3.79,4.50,4.91) | (3.98,4.65,5.00) | (-1.21,-0.16,0.94) | 4.50 | 4.65 | -0.15 | 8.33 |
| SC17 | (3.40,4.20,4.79) | (3.64,3.99,4.89) | (-1.49,-0.19,1.15) | 4.19 | 4.39 | -0.20 | 2.30 |
| SC18 | (3.83,4.52,4.92) | (3.83,4.50,4.83) | (-1.01,0.03,1.09) | 4.52 | 4.50 | 0.02 | 4.63 |
| SC19 | (3.69,4.38,4.84) | (3.91,4.60,4.98) | (-1.49,-0.32,0.94) | 4.28 | 4.59 | -0.31 | 7.60 |
| **Empathy** | | | | | | | |
| SC20 | (3.48,4.27,4.87) | (3.74,3.28,4.82) | (-1.35,-0.05,1.30) | 4.26 | 4.32 | -0.06 | 1.86 |
| SC21 | (3.02,3.90,4.65) | (3.14,4.14,4.81) | (-1.79,-0.25,1.34) | 3.90 | 4.14 | -0.24 | 1.42 |
| SC22 | (3.65,4.40,4.89) | (3.64,3.63,4.81) | (-1.17,0.03,1.25) | 4.40 | 4.36 | 0.04 | 3.76 |
| SC23 | (3.77,4.49,4.91) | (3.64,3.34,4.88) | (-1.10,0.10,1.28) | 4.49 | 4.39 | 0.10 | 4.98 |
| **Access** | | | | | | | |
| SC24 | (3.85,4.55,4.94) | (3.80,4.49,4.89) | (-1.04,0.06,1.14) | 4.54 | 4.49 | 0.05 | - |
| SC25 | (3.91,4.61,5.00) | (3.84,5.44,4.93) | (-1.02,0.07,1.16) | 4.61 | 4.54 | 0.07 | 5.20 |
| SC26 | (3.79,4.49,4.88) | (3.75,4.45,4.84) | (-1.05,0.04,1.13) | 4.48 | 4.44 | 0.04 | 3.78 |
| **Mean** | | | | | | | |
| | (3.69,4.42,4.80) | (3.75,4.47,4.91) | (-1.12,-0.05,1.13) | 4.42 | 4.47 | -0.05 | - |