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Investigating the role of Fuzzy as confirmatory tool for service quality assessment (Case study: Comparison of Fuzzy SERVQUAL and SERVQUAL in hotel service evaluation)

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Abstract. The problem was because of some indicators qualitatively assessed had been discussed in engineering field. Whereas, qualitative assessment was presently used in certain occasion including in engineering field, for instance, the assessment of service satisfaction. Probably, understanding of satisfaction definition caused bias if customers had their own definition of satisfactory level of service. Therefore, the use of fuzzy logic in SERVQUAL as service satisfaction measurement tool would probably be useful. This paper aimed to investigate the role of fuzzy in SERVQUAL by comparing result measurement of SERVQUAL and fuzzy SERVQUAL for study case of hotel service evaluation. Based on data processing, initial result showed that there was no significant different between them. Thus, either implementation of fuzzy SERVQUAL in different case or study about the role of fuzzy logic in SERVQUAL would be interesting further discussed topic.

Keywords: Fuzzy logic; SERVQUAL; Fuzzy SERVQUAL; Service Evaluation

1. Introduction

It is recently known that service is increasingly important so that it is even blended with product. Therefore, company pays attention in service improvement strategy as much as in product development strategy. The difference is that product tends to be a tangible stuff, while service tends to be intangible stuff. Consequently, assessing the service performance for customer satisfaction is increasingly difficult because it is linguistic variable and relatively subjective. Meanwhile, assessing the product performance is relatively easier than the service performance because it is able to be conducted using measurable variable, for an instance, durability of product used for product performance.

In term of measuring service performance, customer satisfaction is able to be used as indicator since every customer may have different either standard or definition of satisfaction. Therefore, many strategies should be formulated by company to avoid the misleading because of interpreting the customer satisfaction. For an instance, a company defines that assessing service performance is conducted using Likert scale of 1-5 in which the higher the value is, the higher the satisfaction is. However, the number of 3 may have different interpretation among customers. Some customers interpret that 3 is satisfactory, but some other customers may interpret that 3 is mostly satisfactory.

Probably, company anticipates aforementioned condition by defining that 3 is used for satisfactory situation. However, every customer still has different standard of satisfaction. Certainly, it would be very important in determining poor service needed to be improved. Misleading in interpretation of customer assessment for service performance causes mistake in decision making. Furthermore, it raises some cost to improve probably wrong service.

In many cases, evaluating service performance is conducted by using SERVQUAL as a tool. By using SERVQUAL, company understands the gap derived from the difference between expected service and perceived service. Based on the gap value, company arranges the service improvement priority. The raised problem is that expected and perceived services are linguistic and subjective variables, so that aforementioned problem probably occurs. In term of solving that problem, integrating fuzzy logic into interpretation of expected and perceived service assessment is initiated. Lately, aforementioned idea is called as Fuzzy SERVQUAL.

Fuzzy logic set is commonly used for helping customer giving more objective value by analyzing the ambiguous value. In Fuzzy logic, the ambiguous value is solved by calculating Triangular Fuzzy Numbers (TFN) using centroid method. By its application, Fuzzy has been used for many cases asserting the linguistics variable such as satisfaction assessment, temperature setting, patient recovery assessment in hospital, obsolescence assessment, and so forth. Based on this benefit, investigation about the role of fuzzy in determining SERVQUAL gap is indeed needed. Thus, the purpose of this paper is to compare Fuzzy SERVQUAL and common SERVQUAL in detail.

2. Methodology

In accordance with aforementioned background and purpose, a few steps were conducted. First of all, generating service attribute was needed by doing initial survey to customer and reviewing previous research. Then, questionnaire regarding expected and perceived service was arranged based on customer experiences. In this paper, the raw data used was obtained from previous research held by Gondowidjaja et al. [1]. Based on this raw data, the gap between expected and perceived service for common SERVQUAL could be calculated. Meanwhile, gap for fuzzy SERVQUAL was calculated by integrating fuzzy logic set into expected and perceived service. Commonly, fuzzy methodology is sequentially conducted as linguistic input, fuzzification, fuzzy output, defuzzification and crisp output. All of sequence is implemented for every linguistic input of expected and perceived service data. Thus, there would be two types of gap which would be further compared each other. Comparison result was used for investigating the role of Fuzzy in SERVQUAL. In a flowchart, methodology of this research is described as follows:
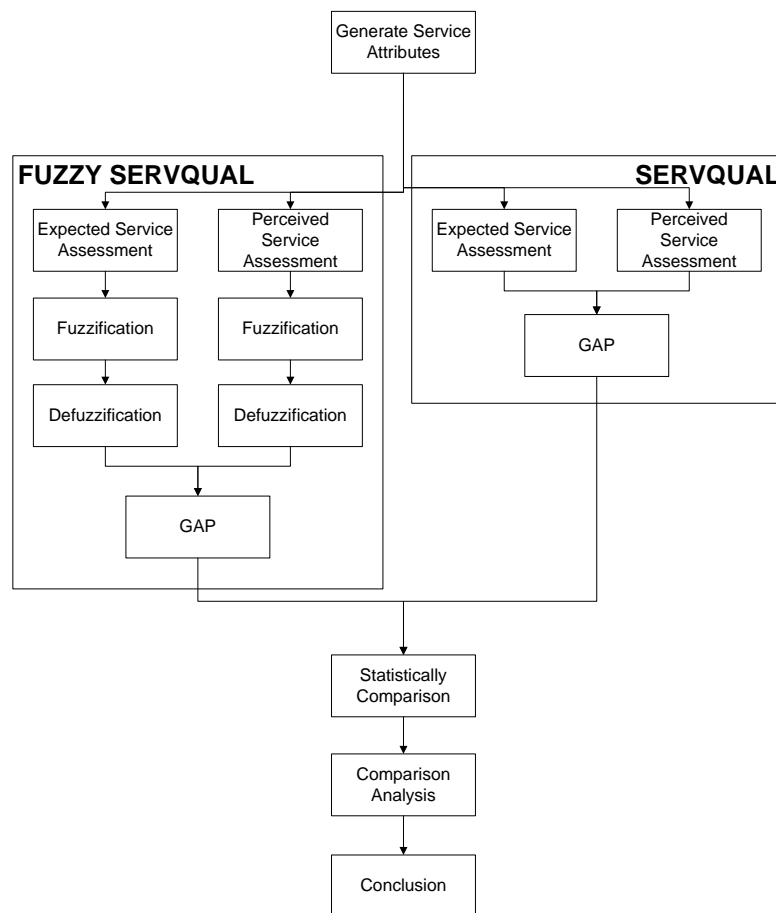
Figure 1. Research flowchart.

3. Literature review

SERVQUAL is a common tool used for measuring a service performance whether the service satisfies customer successfully or not. At first, SERVQUAL is initiated from definition of quality in service itself which many notions defining the definition of quality. One of those notions mentions that quality is a condition when output of process conforms to certain specification. Likewise quality in service, service is qualified when given service conforms to customer satisfaction as certain specification. Then, SERVQUAL as a tool measuring service performance understands that customer satisfaction can be achieved if expected service equals to perceived service. The difference coming from expected service and perceived service is called as Gap 5. Meanwhile, Gap 1-Gap 4 are associated with company's internal process in order to provide excellent service. On the whole process, the occurrence of gaps is presented in figure below.
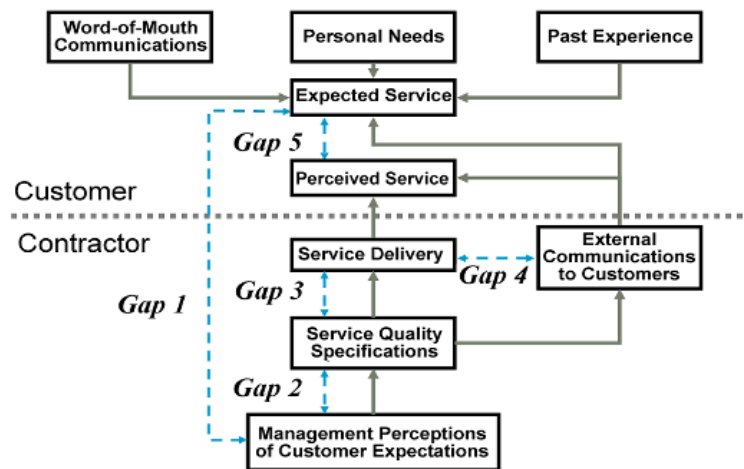
Figure 2. Gaps in SERVQUAL [2].

Certainly, measured gap is related to identified service attributes. Facilitating the data analysis, service attributes are categorized into certain dimension, for instance, there are 5 service dimensions for hotel industry such as tangibility, adequacy in service supply, understanding in service supply, understanding and caring, assurance, convenience [3].

In practice, expected and perceived service assessment is expressed in linguistic variable. Conventionally designed questionnaire frequently uses Likert scale to describe the feeling of respondents. Owing to the fuzziness of human thinking, this approach is inadequate and too simple to rule subject's way and measure complex human thinking and cognition [4].Thus, integration of Fuzzy logic and SERVQUAL will give many benefits. That fuzzy logic is integrated by doing fuzzification and defuzzification into expected and perceived service. Fuzzification of data is carried out on the transformed data by selecting input parameters into the horizontal axis and projecting vertically to the upper boundary of membership function to determine the degree of membership [5].

The efforts to use fuzzy for evaluating customers' satisfaction have been conducted in previous research [6]. It provides a new method of measuring perceived service quality based on triangular fuzzy numbers by replacing perceptions with satisfaction degree as well as expectations with importance degree. Then, inducing general solutions by computing the intersection area between two triangular fuzzy numbers was conducted to determine the worst service attribute. However, inducing general solutions by computing the intersection area between was based on possibility theory so it needed to reinterpret the voice of customers. Other studies tried to fuse fuzzy into several tools to evaluate service such as grey-fuzzy to model the customer expectation [7], fuzzy-AHP [8], fuzzy-AHP-TOPSIS to model the voice of customer [9], and fuzzy linguistics SERVQUAL to recognize the service quality assessment verbally [4]. However, discussion regarding the use of fuzzy in SERVQUAL by comparing common SERVQUAL and fuzzy SERVQUAL directly is important.

4. Data processing

In accordance with the research flowchart, firstly service attributes are generated by doing survey and reviewing the previous researches. Based on the obtained raw data from Gondowidjaja et al. [1], there were 24 service attributes generated. Then, data were processed and Gap 5 was obtained. Gap 5 for SERVQUAL was calculated by subtracting the weighted average of every perceived and expected service attributes. Meanwhile, Gap 5 calculation for Fuzzy SERVQUAL was started by doing fuzzification. In this stage, linguistic variable represented by Likert scale was converted to Triangular Fuzzy Number (TFN). Determining membership set will affect to scalar value in defuzzification stage which is calculated by using its geometric mean.

In this research, the membership sets were dissatisfied, quite satisfied, and satisfied. The value for dissatisfied was 1, 2 and 3; satisfied was 2, 3, and 4; strongly satisfied was 3, 4, and 5. Based on the membership set, TFN for every service attribute was obtained. Furthermore, Gap 5 was calculated by subtracting the defuzzification TFN of perceived service and the defuzzification TFN of expected service. The result of Gap 5 calculation is presented as follow:

Table 1. Gap 5 Calculation of SERVQUAL and of Fuzzy SERVQUAL.

No	Service Attributes	SERVQUAL			FUZZY SERVQUAL								
		Expected Service	Perceived Service	Gap 5	Triangular Number			Expexted Service	Triangular Number			Perceived Service	Gap 5
Tangible													
1	Provided facilities (such as: gym center, spa, restaurant, etc) are clean, comfortable and reliable	4.38	3.44	-0.94	3	3.9	4.4	3.7	2.6	3.1	3.8	3.14	-0.56
2	Parking area is large enough	4.48	3.55	-0.93	3	3.9	4.5	3.76	2.7	3.3	3.8	3.22	-0.54
3	Employee Apparel is clean and tidy	4.56	4.72	0.16	3	4	4.6	3.79	2.4	3.7	4.8	3.5	-0.29
4	Food presentattion in restaurant is satisfied	4.6	4.46	-0.14	3	4	4.6	3.79	2.9	3.3	4.5	3.49	-0.3
5	Material related to service (such as soap, shampoo, towel, etc) are proper	4.67	4.7	0.03	3	3.9	4.7	3.81	3	3.7	4.7	3.74	-0.07
6	Room is clean and tidy	4.59	3.74	-0.85	3	4	4.6	3.79	2.7	3.3	4	3.29	-0.5
7	Toilet (both in lobby and room) is clean, quite large and comfortable)	4.49	3.76	-0.73	3	3.9	4.5	3.74	2.7	3.2	4.1	3.25	-0.49
Adequacy in Service Supply													
8	Employee is helpful and available	4.41	4.68	0.27	3	3.9	4.4	3.71	2.9	3.5	4.7	3.62	-0.09
9	Employee is perceptive and deft	4.43	4.42	-0.01	3	3.9	4.4	3.72	3	3.4	4.4	3.57	-0.15
10	Wifi connection is proper and easy to access	4.47	4.55	0.08	3	3.9	4.5	3.72	2.8	3.5	4.6	3.56	-0.16
11	Provided services are conform with promises	4.43	4.54	0.11	3	3.9	4.4	3.73	3	3.6	4.5	3.66	-0.07
Understanding and Caring													
12	Hotel provides flexible service as suitable as customer order	4.36	4.43	0.07	3	3.8	4.4	3.66	2.9	3.3	4.5	3.49	-0.17
13	Employee treats customer kindly	4.41	4.55	0.14	3	3.9	4.4	3.71	2.8	3.6	4.6	3.59	-0.12
14	Employee gives special empathy to customer (such as: greets the by name)	4.61	3.81	-0.8	3	4	4.6	3.8	2.7	3.3	4	3.31	-0.49
15	Employee has knowledge and information regarding to potensial nearby tourism object (shppoing mall, museum)	4.4	3.57	-0.83	3	3.8	4.4	3.68	2.8	3.3	3.8	3.24	-0.44
16	Employe asks for apology is any inconvience	4.53	4.62	0.09	3	3.9	4.5	3.77	3	3.9	4.6	3.79	0.02
17	Food menu in restaurant is various	4.56	3.81	-0.75	3	3.9	4.6	3.75	2.6	3.3	4.1	3.29	-0.46
Assurance													
18	Hotel provides secure and comfortable environment for customer	4.59	4.68	0.09	3	4	4.6	3.8	3	3.6	4.7	3.7	-0.1
19	Employee has good working knowledge (such as foreign language, professionalism, communication skill)	4.41	3.5	-0.91	3	3.8	4.4	3.7	2.5	3.2	3.9	3.15	-0.55
20	Hotel provides 24 hours of service	4.51	4.63	0.12	3	4	4.5	3.77	2.6	3.2	4.8	3.38	-0.39
Convenience													
21	Reservation is easily done	4.62	3.76	-0.86	3	3.9	4.6	3.79	2.8	3.4	3.9	3.33	-0.46
22	Hotel can be easily accessed	4.6	3.81	-0.79	3	4	4.6	3.79	2.7	3.3	4	3.3	-0.49
23	Information regarding facilities and services is easily gotten	4.66	4.66	0	0	4	4.7	4.32	2.8	3.6	4.7	3.59	-0.73
24	Hotel is able to handle and solve the complaint	4.61	4.68	0.07	3	4	4.6	3.8	2.8	3.4	4.7	3.56	-0.24

Briefly, it is presented that there is different value of Gap 5 between SERVQUAL and FUZZY SERVQUAL. In addition, descending sorting for gap data above results different priority for service improvement. For SERQUAL, the top 5 of the biggest gap needing to be improved are as follows:

1. Provided facilities (such as: gym center, spa, restaurant, etc.) are clean, comfortable and reliable
2. Parking area is large enough
3. Employee has good working knowledge (such as foreign language, professionalism, communication skill)
4. Reservation is easily done
5. Room is clean and tidy

For Fuzzy SERQUAL, the top 5 of the biggest gap needing to be improved are as follows:
1. Information regarding facilities and services is easily gotten
2. Provided facilities (such as: gym center, spa, restaurant, etc.) are clean, comfortable and reliable
3. Employee has good working knowledge (such as foreign language, professionalism, communication skill)
4. Parking area is large enough
5. Room is clean and tidy

Based on the information above, it is known that there are the same four service attributes with different value of gap. However, the aforementioned difference is not necessarily considered as something statistically significant different. Therefore, statistical testing is conducted to state whether there is significant difference among the value of gaps or not. If the result shows that they are the same, then the difference of priority is not significant. Furthermore, if the improving service is conducted with different priority, then the final result is probably not significant different. ANOVA is the tool used for learning whether any significant difference among gaps. The hypothesis test is formulated are built as follows:

H_0: There is no significant different for gap 5
H_1: At least there is significant different for a pair of gap 5
By using Minitab, ANOVA testing results are presented as follows:

One-way ANOVA: S-Gap, F-Gap
Source DF   SS   MS   F   P
Factor 1 0.006 0.006 0.04 0.834
Error 46 6.028 0.131
Total 47 6.034
S = 0.3620   R-Sq = 0.10%   R-Sq(adj) = 0.00%

                    Individual 95% CIs For Mean Based on Pooled StDev
Level N   Mean   StDev ---------+---------+---------+---------+
S-Gap 24 -0.3046 0.4690 (------------------*------------------)
F-Gap 24 -0.3267 0.2054 (----------------*------------------)
                   ---------+---------+---------+---------+
                    -0.400   -0.320   -0.240   -0.160

5. Results and discussion
The ANOVA result above shows that p-value was0.834 which was greater than alpha 0.05, so the decision for this test did not reject H0. Thus, it was concluded that there was no significant difference between gap 5 of SERVQUAL and gap 5 of Fuzzy SERVQUAL. Probably, it was caused by the assessment among customers which was relatively indifferent. This reason was supported by descriptive statistics above titled individual 95% CIs For Mean Based on Pooled ST Dev in which both of data were relatively in the same position. Other possible influencing the result was definition

of fuzzy membership which was not really varied and had a large subtraction area, so the conversion value was not strongly bold. However, it was too early to establish hypothesis that the use of fuzzy in SERVQUAL was not significantly powerful. It was necessary to compare and analyze the result for various case studies. Therefore, understanding of nature of faced case study became important.

The insignificant result of ANOVA in this case was influenced by the nature of service in hotel. In this case, the satisfaction assessment for the hotel was easily done with a result which was relatively equal between customers and the data source were domestic customers who were satisfied for service hotel gave. It was supported by survey data showing that the customer's assessment was not significantly varied. In addition, the hotel offered some facilities which were quite complete, well maintained and reliable, so that definition of satisfaction level between customers was relatively the same because they had the same perception about service standard in hotel. The insignificant result was also probably caused by defined Likert scale. Based on obtained data for SERVQUAL, satisfaction level of the customer revolves in Likert scale of 4 to 5 which belongs to the category of satisfied and strongly satisfied in linguistics variable. This range was not significantly wide. One of the consequences was that the value was not significantly sensitive. Likewise, obtained data for fuzzy SERVQUAL revolved in category of strongly satisfied. Thus, the use of fuzzy in SERVQUAL was necessary to be explored based on nature of the case so it would be more powerful. However, the use of fuzzy had already assisted to confirm something ambiguous.

6. Conclusion

In this case, it was obtained that the use of fuzzy in SERVQUAL was not significantly powerful. However, it is not easily stereotyped that the use of fuzzy in SERVQUAL is not significantly powerful for other cases. It is necessary to compare and analyze the result for various case studies. Therefore, understanding of nature of faced case study, data tendency, range of Likert scale and kind of linguistic variable are increasingly important to be considered.

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