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Quality Service Measurement using Fuzzy Service Quality (Fuzzy Servqual) Method

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***Abstract*—Service quality can provide an effect on the level of customer satisfaction to the services provided so that in addition to creating consumer loyalty, service quality will also be able to add to the market or consumers. Customer satisfaction improvement program can be done by improving service quality which can be measured by using Service Quality (SERVQUAL) concept through five dimensions, which are tangible, reliability, responsiveness, assurance and empathy. Through this SERVQUAL, gap between expectations with consumer perceptions will be known. To accommodate the uncertainty of the subjective respondent's appraisal, a fuzzy concept is used. The fuzzy method will be used in determining the level of consumer perception and expectation as a liaison between the subjective consumer assessment estimates with the data being processed. This research will measure the service quality by using Fuzzy SERVQUAL by determining the gap between expectations with consumer perception, determining the level of significance between expectations with consumer perceptions, determining the level of service quality and suggesting improvement based on priority by looking at the gap of each quality dimension. Based on the results of data processing, it can be seen that the level of service quality is still low seen from the value of Q <1 of 0.8606 and the gap between perceptions and expectations which is less than one is - 0.12. Based on the results of significance test it can be seen that there is a difference between expectations and perceptions indicated by the value of t-count > t-table (21,640> 2.07961).**

Keywords: Service, SERVQUAL, Fuzzy

I. INTRODUCTION

Competition in the industrial world today is increasingly competitive, especially in terms of quality. This is because consumer behavior has changed where consumers are oriented to quality. Service quality can provide an effect on the level of customer satisfaction with the services provided so that in addition to creating consumer loyalty, service quality will also be able to add the market or consumers.

To know the level of service qualitys provided by the company, it is necessary to measure the quality level by conducting an analysis between expectations and the reality received by consumers. The results of this quality level measurement can be used as a reference for companies in an effort to improve the service quality to consumers.

There are several methods in measuring the service quality, one of which is with service quality (SERVQUAL) method in which there are five dimensions of quality measured; they are tangible, reliability, responsiveness, assurance and empathy. Through this SERVQUAL, gap between expectations and consumer perceptions that indicate the condition of service quality provided by the company will be known. To accommodate the uncertainty of the subjective respondent's appraisal, a fuzzy concept is used. The fuzzy method will be used in determining the level of consumer perception and expectation as a liaison between the subjective consumer assessment estimates with the data being processed.

Several studies related to service quality have been done. Reference [5] conducted research on the service quality at *bajaj* workshop to determine the level of customer satisfaction with the service that has been provided by using SERVQUAL and fuzzy. In this study also identification of service factors that need to be improved. Reference [9] conducted research on measuring the service quality in hospitals with Fuzzy SERVQUAL method and determined the main factors that become consumer ratings on the service quality. Reference [3] measured the service quality in the Bank with Fuzzy SERVQUAL and determined the service quality dimension that needs to get the attention of priority improvement. Reference [2] measured the level of service quality by using Fuzzy SERVQUAL method in the hospital by paying attention to expectation gap with perception of each attribute.

Based on the description above, this research will measure the service quality by using Fuzzy SERVQUAL by determining the gap between expectations and consumer perceptions, determining the level of significance between expectations and consumer perceptions and determining the level of service quality.

II. SERVICE QUALITY

Service quality is a comparison between perceived service (perception) of consumers and the service quality expected by consumers [9]. Service quality from an industry will affect consumer satisfaction. Consumer expectation is service expectation based on consumers' need in which the result can be less or more than reality. While consumer perception is how consumers perceive the services provided that can be measured from the suitability or not [12]. Business companies, both engaged in manufacturing and services, should consider the quality factor as the main objective in the face of competition to maintain and increase market share [4].

The dimension of service quality is expressed by Parasuraman in [13] who divides those into 5 big dimensions, which are:

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1. Tangibles, including physical facilities, equipment, personnel and means of communication.
2. Reliability which is the ability to provide services promised immediately, accurately, and satisfactorily.
3. Responsiveness which is the desire of the staff to help the customers and provide services with responsiveness.
4. Assurance, including knowledge, ability, courtesy, and credibility of staff, free of danger, risk or doubt.
5. Empathy, including the ease of doing relationships, good communication, personal attention, and understanding the needs of the customers.

According to [15], service quality (SERVQUAL) model is used to recognize the gap of service that occurs and find a way out to reduce or even eliminate the service gap.

The difference between perception and expectation is called a gap or service quality gap, formulated as follows: [9].

Gap = Perception– Expectation, or

Gap = P – H (1)

In addition to gap analysis or gap between expectations and consumer perceptions, SERVQUAL concepts can also do quality analysis of services that determine the level of service quality provided by using the formula: [1]

$$Quality\,(Q) = \frac{Assessment}{Expectation}, \quad (2)$$

If Q ≥ 1, the service quality is said to be good.

III. FUZZY

Fuzzy logic is a good way to map an input space into an output space. In the fuzzy set the membership value lies in the range 0 to 1. If x has a fuzzy membership value of μA [x] = 1, it means that x becomes a full member in set A [7].

The fuzzy concept also recognizes the set of α-level or α-cut that are the set of crisp with Ã fuzzy set elements with a membership degree of at least a, written with $\tilde{A}\alpha = \{(x \in X \mid \mu_{\tilde{A}}(x) > \alpha\}, \alpha \in [0,1]$. [10].

Fuzzy logic is one of the components of soft computing. The basis of fuzzy logic is the fuzzy set theory. In the fuzzy set theory, the role of membership degree as the determinant of the existence of elements in a set is very important. Membership value or degree of membership becomes the main characteristic of fuzzy logic reasoning [8].

Defuzification is the processing of fuzzy numbers in this case TFN (a, b, c) becomeing a real number. In processing this data, the Geometric Mean of defuzification method will be used which will be formulated as: [2]

$$Defuzzyfikasi = (axbxc)^{1/3} \quad (3)$$

IV. SIGNIFICANCE TEST

Two groups have an average difference if the distribution of data or variability differs from one another. To test the difference t test analysis can be used [11].

Using paired sample t-test to test samples with the same object with two different treatments or measurements occurs if: [1]

p > 0,05 and t-count < t-table, so it is not significant and positive

p < 0,05 and t-count > t-table, so it is significant and positive.

V. RESEARCH METHOD

The method used in this research was fuzzy SERVQUAL with questionnaire instrument whose validity and reliability will be tested after the spread. Validity test is used to determine how accurate a questionnaire can measure a concept to be measured [6], while a reliability test is used to test the degree of consistency of the questionnaire [14]. The reliability test used in this research was internal consistency technique with alpha cronbach's technique. Furthermore, the calculation of service quality was done by finding the gap value of service quality of each dimension obtained from the difference of perception level with expectations that indicate the level of service quality in providing services based on customers' expectations or desires. The next stage was Defuzification by processing fuzzy numbers in this case TFN (a, b, c) into real numbers. The significance test was conducted to test the level of significance between perceptions and consumer expectations. For this purpose, we will use paired sample t-test to test gap that is testing two paired samples between assessment and consumer expectation whether there is difference or not.

VI. FINDING AND DISCUSSION

A. *Respondents' Data*

From the results of questionnaires spread then obtained the number of respondents by job, vehicle type, and interests of motor vehicle owners which are shown in table 1. below:

TABLE 1. RESPONDENT DATA

No	Job							Vehicle Type			Interests			
1	Businessman	Retired Man	Civil Servant	Neighborhood Association	Entrepreneur	University Student	Student	Motorcycle	Car	Others	Vehicle Registration Letter	Tax	Title transferring	Others
2	77	1	6	6	2	5	3	98	1	1	58	39	1	2
Total	100							100			100			

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B. Validity Test

TABLE 2. VALIDITY TEST

Statement		Correlation Value		r Table (100;0,1)	Notes
		Perception	Expectation		
Tangible/T	T 1	0.673	0.683	0.1654	Valid
	T 2	0.793	0.797	0.1654	Valid
	T 3	0.642	0.717	0.1654	Valid
	T 4	0.695	0.772	0.1654	Valid
Reliability/R	R 1	0.762	0.744	0.1654	Valid
	R 2	0.630	0.718	0.1654	Valid
	R 3	0.734	0.831	0.1654	Valid
	R 4	0.737	0.854	0.1654	Valid
	R 5	0.653	0.717	0.1654	Valid
Responsiveness/RV	RV 1	0.602	0.742	0.1654	Valid
	RV 2	0.741	0.775	0.1654	Valid
	RV3	0.613	0.822	0.1654	Valid
	RV4	0.722	0.758	0.1654	Valid
Assurance/A	A1	0.556	0.724	0.1654	Valid
	A2	0.658	0.779	0.1654	Valid
	A3	0.6520	0.745	0.1654	Valid
	A4	0.613	0.627	0.1654	Valid
(Empathy/E	E 1	0.664	0.698	0.1654	Valid
	E2	0.684	0.715	0.1654	Valid
	E 3	0.774	0.777	0.1654	Valid
	E4	0.677	0.799	0.1654	Valid
	E 5	0.726	0.794	0.1654	Valid

Testing the validity uses correlation done by calculating the correlation between the score of each item statement and the total score of the variable, with the provision of correlation value > r table (0.1654).

C. Reliability Test

TABLE 3. RELIABILITY TEST

Dimension	Cronbach's Alpha		Notes
	Perception	Expectation	
Tangible	0.776 > 0.60	0.796 > 0.60	Reliable
Reliability	0.778 > 0.60	0.800> 0.60	Reliable
Responsiveness	0.763 > 0.60	0.807 > 0.60	Reliable
Assurance	0.779 > 0.60	0.786 > 0.60	Reliable
Empathy	0.779 > 0.60	0.795 > 0.60	Reliable

Data from respondent questionnaires were tested for reliability level using SPSS 17.0 software, if the value of cronbach's alpha (α) of a variable ≥ □ 0.60, the indicator used by the variable is reliable, while the value of cronbach's alpha (α) of a variable <0.60, the indicators used by these variables are not reliable [6].

D. Fuzzy SERVQUAL

1) Determination of Fuzzy Set

Determination of fuzzy sets is done to determine the score that should be given by the respondent for each criterion proposed in the questionnaire.

The definitions of the linguistic variables and the linguistic estimates (aj, bj, cj) used for perception and expectation, are as follows:

STS = extremely disagree (0; 0; 0,25)
TS = disagree (0; 0,25; 0,5)
N = neutral (0,25; 0,5; 0,75)
S = agree (0,5; 0,75; 1)
SS = extremely agree (0,75; 1; 1)
STD = extremely unexpected (0; 0; 0,25)
N = neutral (0,25; 0,5; 0,75)
D = expected (0,5; 0,75; 1)
SD = extremely expected (0,75; 1; 1)

2) Fuzzification

The result of fuzzification of customers perception is shown in Table 4 and the result of customers expetation. Fuzzification calculation using OEM (Overall Effectiveness Measure) method is shown in table 5.

TABLE 4. FUZZIFICATION OF CUSTOMERS' PERCEPTION

No	Statement	OEM		
		A	B	C
1	The company has the latest equipment and technology.	0,41	0,65	0,87
2	Interesting physical facilities	0,46	0,70	0,91
3	Employees are dressed and well groomed.	0,53	0,78	0,95
4	Appearance of physical facilities is based on the type of services provided.	0,49	0,73	0,94
5	When promising to do something at the agreed time they keep it.	0,46	0,70	0,90
6	When you get into trouble, employees are sympathetic and able to calm you down.	0,44	0,68	0,88
7	Employees are reliable/ trustworthy.	0,51	0,76	0,94
8	Employees deliver their services according to the time promised	0,48	0,73	0,93
9	Employees work accurately.	0,47	0,72	0,93
10	Employees tell you when exactly the services will be delivered.	0,41	0,66	0,89
11	You receive prompt services from employees.	0,47	0,72	0,93
12	Employees are always willing to help you.	0,48	0,73	0,94
13	Employees are able to respond to your requests quickly.	0,39	0,71	0,91
14	You trust employees.	0,39	0,70	0,91
15	You feel secure transacting in the Company's service system.	0,49	0,73	0,93
16	The employees are polite to you.	0,52	0,77	0,95
17	Employees receive adequate support from the institution so that they can perform their duties well.	0,48	0,73	0,93
18	Company profiles are easily accessible	0,44	0,69	0,90
19	The company has a safe and clean place.	0,53	0,78	0,96
20	Employees understand your needs.	0,46	0,71	0,92
21	The company has good facilities for you.	0,50	0,75	0,95
22	The company has an operating time that suits you.	0,50	0,75	0,94

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TABLE 5. FUZZIFICATION OF CUSTOMERS' EXPECTATION

No	Statement	OEM		
		A	B	C
1	The company has the latest equipment and technology.	0,64	0,89	0,98
2	Interesting physical facilities	0,62	0,87	0,97
3	Employees are dressed and well groomed.	0,64	0,89	0,98
4	Appearance of physical facilities is based on the type of services provided.	0,61	0,86	0,97
5	When promising to do something at the agreed time they keep it.	0,64	0,89	0,97
6	When you get into trouble, employees are sympathetic and able to calm you down.	0,63	0,88	0,97
7	Employees are reliable/ trustworthy.	0,64	0,89	0,97
8	Employees deliver their services according to the time promised	0,64	0,89	0,97
9	Employees work accurately.	0,64	0,89	0,98
10	Employees tell you when exactly the services will be delivered.	0,62	0,87	0,98
11	You receive prompt services from employees.	0,63	0,87	0,97
12	Employees are always willing to help you.	0,64	0,89	0,98
13	Employees are able to respond to your requests quickly.	0,62	0,87	0,97
14	You trust employees.	0,61	0,86	0,97
15	You feel secure transacting in the Company's service system.	0,62	0,87	0,97
16	The employees are polite to you.	0,65	0,90	0,98
17	Employees receive adequate support from the institution so that they can perform their duties well.	0,62	0,87	0,98
18	Company profiles are easily accessible	0,62	0,87	0,97
19	The company has a safe and clean place.	0,66	0,91	0,98
20	Employees understand your needs.	0,61	0,86	0,97
21	The company has good facilities for you.	0,65	0,90	0,97
22	The company has an operating time that suits you.	0,64	0,89	0,98

3) Defuzzification

After performing fuzzification calculations, defuzzification is done using Arithmetic Mean method.

TABLE 6. DEFUZZIFICATION

Dimension	Statement	Defuzzifcation		Gap
		Perception	Expectation	
Tangible	The company has the latest equipment and technology.	0.64	0.84	-0.20
	Interesting physical facilities	0.69	0.82	-0.13
	Employees are dressed and well groomed.	0.75	0.84	-0.08
	Appearance of physical facilities is based on the type of services provided.	0.72	0.81	-0.09
Reliability	When promising to do something at the agreed time they keep it.	0.69	0.83	-0.15
	When you get into trouble, employees are sympathetic and able to calm you down.	0.67	0.83	-0.16
	Employees are reliable/ trustworthy.	0.74	0.83	-0.10
	Employees deliver their services according to the time promised	0.71	0.83	-0.12
	Employees work accurately.	0.71	0.84	-0.13
Responsive	Employees tell you when exactly the services will be delivered.	0.65	0.82	-0.17
	You receive prompt services from employees.	0.71	0.82	-0.12
	Employees are always willing to help you.	0.72	0.84	-0.12
	Employees are able to respond to your requests quickly.	0.67	0.82	-0.15
Assurance	You trust employees.	0.67	0.81	-0.15
	You feel secure transacting in the Company's service system.	0.72	0.82	-0.10
	The employees are polite to you.	0.75	0.84	-0.10
	Employees receive adequate support from the institution so that they can perform their duties well.	0.71	0.82	-0.11
Empathy	Company profiles are easily accessible	0.68	0.82	-0.14
	The company has a safe and clean place.	0.76	0.85	-0.09
	Employees understand your needs.	0.70	0.81	-0.12
	The company has good facilities for you.	0.73	0.84	-0.11
	The company has an operating time that suits you.	0.73	0.84	-0.11

4) SERVQUAL

To analyze the service quality that have been given, the analysis of the level of service quality is done.

Based on table 7, it can be seen that all dimensions which are tangible, reliability, responsiveness, assurance and empathy have value < 1, which means that the service quality of each dimension (One-Stop Administration Service Office) can be said to be less good and has an average value of all dimensions of 0.84.

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TABLE 7. SERVICE QUALITY

Dimension	Score for Assessment of Perception (P)	Score for Assessment of Expectation (E)	Q=P/E
Tangible	0,7	0,83	0.84
Reliability	0,7	0,83	0.84
Responsive	0,69	0,83	0.83
Assurance	0,71	0,82	0.87
Empathy	0,72	0,83	0.87
Rata - Rata	0,70	0,83	0.84

VII. CONCLUSION

Based on the analysis that has been done, it can be drawn some conclusions as follows:

1. The service quality valued at 0.84 or less than the value 1 means that the service quality of the companies have not met expectations. The level of satisfaction of motor vehicle owners to the service quality of company is still low with the gap in every variable and SERVQUAL dimension.
2. Tangible dimension has -0.13 gap, Reliability dimension has -0.13 gap, Responsive dimension has -0.14 gap, Assurance dimension has -0.11 gap and Empathy dimension has -0.11 gap.
3. Overall, the gap between perception and expectation is -0.13, which means that service quality is still low.
4. Based on the results of significance test, it can be seen that there is a difference between expectations and perceptions.

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