Analysis of Customer Satisfaction in a Selected Bank: Signal-To-Noise Ratio Approach

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Abstract— **This paper presents an investigation about the level of customer satisfaction at the selected bank in Indonesia on basis five dimensions of service quality. They are reliability, responsiveness, assurance, empathy, and tangible. It is noteworthy for banks to provide the high quality of service but a few of a certain bank experiencing matters on service performance which is more and more declining. Thus, some improvements should be done on each attribute that has not achieved a quality target. Taguchi Signal-to-Noise Ratio approach is applied to assess service quality performance referring to the Ordered Categorical Data obtained from the paper-based survey with distributing questionnaire containing 21 attributes. The results of this study show that there are some attributes of dimensions respectively not satisfying the quality standard of the bank. They are Rel3 attribute: customer expectation-based service) of reliability dimension, Res1: understanding needs and wants of the customers of responsiveness dimension, A1 attribute: provide a clear explanation of bank's product to customer of assurance dimension, E1 attribute: polite and friendly staff of empathy dimension, and T1 attribute: modern looking equipment of tangible dimension.**

Index Terms—**Taguchi signal-to-noise ratio, service quality, customer satisfaction, bank**

I. INTRODUCTION

Nowadays, in globalization era, liberalization of banking services changes a way of the banking business to satisfy the customers expectation on quality of service. According to Parasuraman et al., service quality dimension consists of reliability, responsiveness, assurance, empathy, and tangible [1]. Furthermore, it is explained there are three characteristics of service should be acknowledged for a full understanding of service quality. They are intangibility, inseparability, and heterogeneity [2]. Thus, this is critical to evaluate service of bank continuously such that customer satisfaction will be fulfilled.

The high customer satisfaction can lead to the greater customer loyalty [3] which effecting future revenue [4]. Consequently, many business organizations including bank are compelled to improve the quality of services provided based on the prior evaluation continuously.

However, the fact presented that a lot of the national banking performance in Indonesia was experiencing a decline in 2013-2016 [5]. Referring to Financial Services Authority of Indonesia in 2013 the growth of the national banks' assets especially in Yogyakarta reached 16% but decreasing to 14% in 2014. And this condition was continuing to decline 10.6% in 2015 and 2.5% in 2016. While, mass reduction was also occurred on the credit side. It began to decline in early 2014 as much 0.8% and in 2015 was as much 10.5%. As for in 2016 declined as much 3.1%. This situation can be caused by the unstable global economy condition and a dissatisfactory bank service quality.

According to preliminary study at several competitive banks in Yogyakarta as case study showed that the level of customer satisfaction was still poor which was complaint experienced as much 16% to 37% of dissatisfaction of service. It indicated that the condition should be improved. However, what attributes of the bank service were required to be improved?

There have been many previous studies to investigate the service quality applying SERVQUAL scale in the bank such as Blanchard and Galloway [6], Newman [7], and Lau et al. [8]. They found that some limitations and inconsistencies of SERVQUAL scale were identified when assessing reliability and performance. While Shahin et al. [9], Mishra and Gangele [10], and Ho et al [11] introduced the use of Taguchi's Signal-to-Noise Ratio scale to assess customer satisfaction of service in airport, retail outlet, and hotel. Result of their study claimed that S/N ratio provided the quality attribute improvement direction, lowering service quality variation, and improving satisfaction average. Thus, S/N ratio is better in assessing service performance than SERVQUAL scale. It is in accordance with Taguchi's point of view stated that

S/N ratio has ability to measure relative quality and the use of S/N ratio is simple and with additive capability [12].

Objective of this study is to analyze the customer satisfaction of the selected bank and to determine the attributes improved using Taguchi's Signal-to-Noise Ratio.

II. RESEARCH METHOD

A. Survey

Paper-based survey was conducted in two stages. They were preliminary survey and final survey. The preliminary survey was to identify some complaints of customers in several competitive banks by distributing questionnaires. The questionnaire for preliminary survey contained 5 items of question that applied the five bank service quality dimensions, such as reliability, responsiveness, assurance, empathy, and tangible. The total respondent of preliminary survey was 90 bank customers. The final survey was conducted to investigate the service performance in the certain bank that had the largest number of complaint. The participated respondents in this final survey were 30 bank customers. Their age was in range between 17 to 60 years old who were familiar with the bank service. The questionnaire for final survey contained 21 items of question based on 21 service quality attributes, as written in Table I. The whole survey was carried out under supervision of the researcher to avoid missing data.

B. Apparatus

In this study, some equipment was used as follows:

- Statistical Package for the Social Science (SPSS) software version 23 was used to analyze and run the statistical data.
- Questionnaires was developed to identify complaints of customers in the selected bank and to investigate the service performance in the certain bank. In order to ensure the validity and reliability of the study, the questionnaire was made based on literature and a translated questionnaire was available to make sure respondents who use local language are involved without any problem.

C. Experimental Design

1) Subject of Research

The national bank is chosen as the subject of research to be analyzed on service quality, especially to the level of satisfaction about bank service and to the investigation of bank's service performance based on customer opinion.

2) Design of Experiment

Design of experiment in this study refers to Taguchi's Signal-to-Noise Ratio. The satisfaction data was measured in the form of Ordered Categorical Data to differentiate value of S/N ratio into the Smaller the Better, the Larger the Better, or Nominal the Best [12]. Subsequently the Larger the Better and the Smaller the Better attributes will be used to evaluate the performance of bank service quality considering the data of satisfaction and dissatisfaction of bank customer.

Based on the five service quality dimensions proposed by Parasuraman et al [1] [13], this study constructed the

service quality attributes with involving 21 items of question. The attributes may be seen in Table I.

TABLE I. ATTRIBUTES OF BANK SERVICE QUALITY

Dimension	No	Service Quality Attribute
Reliability	1	Accurate order fulfillment
	2	Accurate record
	3	Customer expectation-based service
	4	Keep services promise
Responsiveness	5	Understanding needs and wants of the customers
	6	Convenient operating hours
	7	Ability to solve customers' problem
	8	Attention to problems
Assurance	9	Provide a clear explanation of bank's product to Customers
	10	Eases of access to account information
	11	Knowledgeable and experienced management team
	12	Customers' safety in their transaction
Empathy	13	Polite and friendly staff
	14	Giving individual attention
	15	Good communication skill with customer
	16	Bank call center is easy to be reached
Tangible	17	Modern looking equipment
	18	Comprehensive physical facility
	19	Well-dressed employees
	20	Materials are visually appealing
	21	Building is visually appealing

In the assessment of customer satisfaction, Likert Scale is generally used in the design of paper-based survey to prioritize the actual customer perception of service quality by level [14]. The Likert five-point scale applied in this study is consisting five level which are 1, 2, 3, 4, 5, with "1" standing for "strongly dissatisfied", 5 standing for "strongly satisfied".

The priority level data will be used to distinguish the satisfied and dissatisfied service quality performance. Define level 4 (satisfied) and level 5 (strongly satisfied) as levels of customer satisfaction about service quality; define level 2 (dissatisfied) and level 1 (strongly dissatisfied) as customer dissatisfaction of service quality attributes. Hence, the service quality attribute i's customer satisfaction value was $s_i = y_{i4} + y_{i5}$, while the service quality attribute i's customer dissatisfaction value was $d_i = y_{i1} + y_{i2}$. For considering the satisfied and dissatisfied information S/N ratio analysis, the satisfaction coefficient ρ_{si} and the dissatisfaction coefficient ρ_{di} should be calculated as shown in (1) and (2).

$$\rho_{si} = \frac{(y_{i4} + y_{i5})}{y_t} \tag{1}$$

$$\rho_{di} = \frac{(y_{i1} + y_{i2})}{y_t} \tag{2}$$

where, $i = 1, 2, 3, \ldots, n$ denotes n service quality attributes.

According to data conversion of (2), dissatisfaction coefficient p_{di} was a the Smaller the Better quality

attribute, as customer dissatisfaction was not expected during the service providing process, hence the smaller dissatisfaction coefficient was the better. The satisfaction coefficient p_{si} is the Larger the Better quality attribute as larger number represented more satisfied customers. After data conversion, *i*-th dissatisfaction coefficient's S/N ratio can be represented by (3) while *i*-th satisfaction coefficient S/N ratio was represented by (4). Equations (3) and (4) considered the differences in perception of different customers in addition to consider the average values.

$$S/N_{si} = \eta_{si} = -10 \, Log \left(\frac{1 - \rho_{si}}{\rho_{si}} \right) \quad (3)$$

$$S/N_{si} = \eta_{si} = -10 \, Log \left(\frac{1 - \rho_{si}}{\rho_{si}} \right) \quad (4)$$

The purpose of the log functions of (3) and (4) was to get the additive capability, and the "−" was to make the quality decision-making consistent while i = 1, 2, 3, …, n represented n service quality attributes. The greater η_{si} value represented better quality, namely the higher customer satisfaction of service quality attributes [15]. Meanwhile, the greater η_{di} value represented higher quality, namely, the lower customer dissatisfaction level about the service quality attributes. Fowlkes and Creveling [16] suggested that the S/N has the advantage of addition. Hence, when measuring two groups of data under same conditions and calculating their S/N ratios, the results can be added up when maximizing S/N ratio [17]. As a result, (5) Integrated with the *i*-th satisfaction and dissatisfaction data was applied to assess service quality performance.

$$\eta_{ti} = \eta_{si} + \eta_{di} \quad (5)$$

Similarly, a greater $\eta_{ti} = \eta_{si} + \eta_{di}$ denotes better service quality of *i*-th attribute, therefore, this study used it to analyze the service quality attribute performance.

III. RESULT

Before analyzing the data using Taguchi S/N Ratio, it was necessary to conduct a validity and reliability test to measure how truthful the research results were and to measure the consistency of data over time [18]. With a significance level of 5%, degrees of freedom (*df*)=*n-2*, or

in this study *df*=30-2=28. The value of r_{table} can be determined from table *r* namely: *df* = 28, r_{table}: 0.361.

TABLE II. VALIDITY TEST RESULT

Dimension	Attribute	r_{count}	Status
Reliability	Rel1	0.772	Valid
	Rel2	0.477	Valid
	Rel3	0.606	Valid
	Rel4	0.562	Valid
Responsive-ness	Res1	0.672	Valid
	Res2	0.512	Valid
	Res3	0.730	Valid
	Res4	0.590	Valid
Assurance	A1	0.443	Valid
	A2	0.585	Valid
	A3	0.423	Valid
	A4	0.651	Valid
Empathy	E1	0.759	Valid
	E2	0.609	Valid
	E3	0.605	Valid
	E4	0.361	Valid
Tangible	T1	0.403	Valid
	T2	0.404	Valid
	T3	0.454	Valid
	T4	0.462	Valid
	T5	0.513	Valid

To obtain an accurate result, the value of r_{count} can be obtained by using SPSS 23.0 software, the results may be seen in Table II. Based on Table II, all attributes are said to be valid because $r_{count} \geq r_{table}$: 0.361. Thus, there is no attribute should be removed or deleted.

For the reliability test, Cronbach's Alpha value was also calculated using SPSS 23.0. The obtained value of Cronbach's alpha for 21 items of attribute on the reliability test was 0.694. Hair et al. [19] stated that a common threshold for sufficient values of Cronbach's alpha is 0.6. Thus, the result indicated that the answers to the questionnaire items were consigned or reliable since the value of Cronbach's alpha $\geq 0.6 = 0.694$.

The analysis result of customer satisfaction at the selected bank in Indonesia may be seen in Table III. The standard deviation was shown in the 12th (Std) column of Table III. For example, the standard deviation of accurate order fulfillment (Rel1) was 0.776. When standard deviation was used as the benchmark of comparison in the case of same total S/N ratio value, the smaller standard deviation represented better quality performance [20] [21].

TABLE III. TAGUCHI'S S/N RATIO ANALYSIS RESULT

Dim.	Att.	Service Quality Attribute	y_1	y_2	y_3	y_4	y_5	ρ_{di}	ρ_{si}	η_{ti}	Std	R (η)
Reliability	Rel1	Accurate order fulfillment	0	1	8	15	6	0.033	0.700	18.304	0.776	5
	Rel2	Accurate record	0	2	11	11	6	0.067	0.567	12.626	0.877	10
	Rel3	Customer expectation-based service	1	5	15	7	2	0.200	0.300	2.341	0.900	18
	Rel4	Keep services promise	0	7	6	9	8	0.233	0.567	6.331	1.133	16
Responsive-ness	Res1	Understanding needs and wants of the customers	0	2	15	11	2	0.067	0.433	10.296	0.728	13
	Res2	Convenient operating hours	0	1	12	15	2	0.033	0.567	15.789	0.675	6

Dim.	Att.	Service Quality Attribute	y_1	y_2	y_3	y_4	y_5	ρ_{di}	ρ_{si}	η_{ti}	Std	R (η)
	Res3	Ability to solve customers' problem	0	2	8	12	8	0.067	0.667	14.472	0.900	7
	Res4	Attention to problems	0	2	10	10	8	0.067	0.600	13.222	0.925	8
Assurance	A1	Provide a clear explanation of bank's product to customer	0	8	12	10	0	0.267	0.333	1.383	0.785	21
	A2	Eases of access to account information	0	3	6	11	10	0.100	0.700	13.222	0.980	9
	A3	Knowledgeable and experienced management team	0	7	11	8	4	0.233	0.400	3.405	0.988	17
	A4	Customers' safety in their transaction	0	4	8	11	7	0.133	0.600	9.890	0.988	14
Empathy	E1	Polite and friendly staff	0	10	7	11	2	0.333	0.433	1.845	0.986	20
	E2	Giving individual attention	0	1	9	13	8	0.033	0.700	18.304	0.765	4
	E3	Good communication skill with customer	0	2	17	9	2	0.067	0.367	9.088	0.718	15
	E4	Bank call center is easy to be reached	0	2	14	10	4	0.067	0.467	10.881	0.819	12
Tangible	T1	Modern looking equipment	0	8	11	8	3	0.267	0.367	2.020	0.961	19
	T2	Comprehensive physical facility	0	1	8	13	9	0.033	0.733	19.017	0.765	3
	T3	Employees are well dressed	0	2	2	13	13	0.067	0.867	19.590	0.858	1
	T4	Materials are visually appealing	0	1	7	18	4	0.033	0.733	19.017	0.699	2
	T5	Building is visually appealing	0	2	12	12	4	0.067	0.533	12.041	0.814	11

Meanwhile, customer satisfaction level at i attribute had y_i times of response as shown from the 4rd column to the 8th column of Table III. With accurate order fulfillment (Rel1) as an example, $y_1 = 0$, $y_2 = 1$, $y_3 = 8$, $y_4 = 15$, $y_5 = 6$. Level 4 and 5 were customer satisfaction level, the satisfaction number can be calculated by $s_i = y_{i4} + y_{i5}$, where $i = 1, 2, 3, …, 21$. With accurate order fulfillment (Rel1) as an example, the satisfaction number were $y_{Rel14} + y_{Rel15} = 15 + 6 = 21$. Then, calculate satisfaction coefficient ρ_{si} by (1), accurate order fulfillment (Rel1) satisfaction coefficient $\rho_{sRel1} = (y_{Rel14} + y_{Rel15})/y_t = 21/30 = 0.700$. Similarly, the dissatisfaction number can be calculated by $d_i = y_{i1} + y_{i2}$, with accurate order fulfillment (Rel1) as an example, the dissatisfaction number was $y_{Rel11} + y_{Rel12} = 0 + 1 = 1$. According to (1), dissatisfaction coefficient of accurate order fulfillment (Rel1) was $\rho_{dRel1} = (y_{Rel11} + y_{Rel12})/y_t = 1/30 = 0.033$. Use (2) and (3) to calculate S/N ratio, with accurate order fulfillment (Rel1) as example, input ρ_{dRel1} into (2) to calculate S/N ratio (η_{dRel1}),

$S/N_{dRel1} = \eta_{dRel1} = −10Log[0.033/(1-0.033)] = 14.624$; input p_{sRel1} into (3) to calculate S/N ratio (η_{sRel1}),

$S/N_{sRel1} = \eta_{sRel1} = −10Log[(1-0.700)/0.700] = 3.680$. According to (4), calculate total performance of satisfaction and dissatisfaction of service quality attributes $\eta_{ti} = \eta_{si} + \eta_{di}$, with room comfort and atmosphere (T1) as an example, $\eta_{tRel1} = \eta_{sRel1} + \eta_{dRel1} = 14.624 + 3.680 = 18.304$, as shown in the 10th column of Table III.

Higher S/N ratio represented better service quality. As shown in the 13th column [R (η)] of Table III, accurate order fulfillment (Rel1) ranked the 5th in overall. Bank service quality performance was assessed by considering the average and standard deviation of quality attributes as well as integrating satisfaction and dissatisfaction information.

IV. DISCUSSION

In this study, the method of Taguchi's S/N Ratio was applied to investigate the level of customer satisfaction at the selected bank in Indonesia. By using the S/N ratio, an appropriate level of customer satisfaction were determined with minimun deviation from satisfaction data. According to the result of analysis, the S/N ratio values were computed for each attribute of five service quality dimensions. By comparing each attribute of the dimensions, the best and worst attributes can be addressed. For example, the values of S/N ratio for 4 attributes (Rel1, Rel2, Rel3, and Rel4) of Reliability dimension were respectively 18.304, 12.626, 2.341, and 6.331. Thus, the best satisfaction level was accurate order fulfillment (Rel1) and the worst satisfaction level was customer expectation-based service (Rel3). It is important to note that such analysis helps in recognizing dissatisfaction of service quality dimensions.

However, the through calculation result of S/N ratio in Table II indicated that employees are well dressed (T3) with S/N ratio value at 19.017 was found as higher than other 20 attributes, while provide a clear explanation of bank's product to customer (A1) was found as the highest value of dissatisfaction.

Although the S/N ratio value of materials are visually appealing (T4) was equal to the comprehensive physical facility (T2) at 19.017, however, due to lower standard deviation of materials are visually appealing (T4), the customer perception was highly consistent, namely, the selected bank provided stable and consistent service quality. Hence, after the S/N ratio analysis, the performance of materials are visually appealing (T4) was better to be ranked 2nd while the comprehensive physical facility (T2) became the 3rd.

In this study, Taguchi's S/N ratio analysis result indicates that there are some attributes of dimensions respectively not satisfying the quality standard of bank.

They are Rel3 attribute: customer expectation-based service) of Reliability dimension, Res1: understanding needs and wants of the customers of Responsiveness dimension, A1 attribute: provide a clear explanation of bank's product to customer of Assurance dimension, E1 attribute: polite and friendly staff of Empathy dimension, and T1 attribute: modern looking equipment of Tangible dimension.

This result is in line with studies conducted by Lau et al. [8] and Felix [22] who found customer dissatisfaction on bank service quality and indicated that the investigated banks should improve the performance of several bank service quality attributes especially handle customer problems in good manner and understand specific needs of individual customers.

This study suggests that customer satisfaction can be used as an evaluation of bank service quality and performance. Thus can help bank to improve the quality of its services in order reduce dissatisfaction of actual bank service performance. This view has been supported by several other studies by Fornell et al. [23], Giese & Cote [24], and Arokiasamy & Kanesanbin [25].

V. CONCLUSION

It may be concluded as follows:
1. There are some attributes of dimensions respectively not satisfying the quality standard of bank. They are Rel3 attribute: customer expectation-based service) of reliability dimension, Res1: understanding needs and wants of the customers of responsiveness dimension, A1 attribute: provide a clear explanation of bank's product to customer of assurance dimension, E1 attribute: polite and friendly staff of empathy dimension, and T1 attribute: modern looking equipment of tangible dimension.
2. This study found that service quality of bank has not still satisfied the customer satisfaction generally. Thus, the attributes of service quality dimensions should be improved.

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