Designing The Improvement of SPAM UNS Water Dispenser Service Quality

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Abstract. SPAM (Sistem Pengolahan Air Minum or Drinking Water Treatment System) UNS was established in 2015 to meet the drinking water needs of the UNS academic community by providing 129 dispensers and water tap machines spread across buildings at UNS. A survey conducted by UNS students in 2017 showed that 54 % of students were not sure of UNS SPAM water quality. So the service quality questionnaire was distributed to 160 UNS students randomly, and it was found that only 3 % of respondents stated that they used SPAM UNS water dispenser very often. Processing results have shown the highest gap value is in the reliability dimension, with CTS, namely cleanliness and flow of water. From the survey regarding the cleanliness and flow of the water carried out, the DPMO value of the process was 332,589 (1.930 sigmas). Recommendations for improvement are in the form of several SOPs to improve the cleanliness and quality of SPAM UNS water dispenser services.

Keywords: service quality, six sigma, water services

I. INTRODUCTION

Humans need water in various aspects of their lives, and water consumption cannot be separated from one's daily activities (Rahayu, 2004). Biologically, water plays a role in all processes in the human body, such as digestion, metabolism, transportation, regulating body balance (Guyton, 1987).

SPAM UNS or UNS Drinking Water Treatment System was established in 2015 to provide UNS academics with ready to drink water needs through water dispensers spread over 129 points on UNS. In addition, the existence of SPAM UNS is also in line with the green campus principles adopted by UNS by reducing the waste of disposable bottled drinking water.

A survey showed that 54% of students were unsure of UNS SPAM water, so an initial study was conducted to find out how many students still used UNS SPAM water dispensers. The survey showed that only 3% of students are very often used water dispenser SPAM UNS, as in Figure 1.

From the diagram, it can be seen that the use of SPAM UNS water dispensers in the UNS campus environment is not yet optimal, which is caused by the mismatch of consumer expectations with the services received.

![Frequency of Use of Water Dispenser SPAM UNS](image)

Figure 1. Frequency of Use

Service quality cannot be separated from customer satisfaction. According to Crosby (1979), quality is "conformance to requirements," i.e., conformity to what is required or standardized. In 1993 Lewis and Booms define that service quality was a measure of how well the level of service provided was in line with customer expectations.

Sulistyowati et al. (2008) examined consumer satisfaction with the services provided by PT. PLN...
APJ Surabaya Selatan-UPJ Ngagel by integrating the servqual, lean, and six sigma methods. From the research conducted, it is known that the most significant gap value in the 24-hour disturbance officer alert attribute is a value of -0.0479. The 24-hour disturbance officer alert attributes are further analyzed using process capability analysis and waste analysis.

Nurwulan et al. (2014) conducted a PAM JAYA consumer satisfaction study by compiling a questionnaire consisting of 39 variables and distributed to 100 respondents. By using gap analysis, 11 variables with negative values are obtained to indicate consumer dissatisfaction with the services provided, so that the proposed improvement is based on the 11 improvement priorities.

Setyawan et al. (2017) develop research variables from 5 service quality dimensions on PDAM service quality in Kab. Cianjur. By distributing questionnaires obtained servqual values in each dimension, which are then plotted in a Cartesian diagram with importance-performance analysis.

The Servaqua concept was mentioned by Peter Prevos (2015) as a service quality model that has been developed for reticulated water services. In this model, the dimensions of reticulated water service are divided into two types, core services, and supplementary services. Core services are services provided to customers in the form of tangible water quality. In contrast, supplementary services complement the primary services offered, where Prevos mentions supplementary services using a uni-dimensional model by Babakus (1993).

Some of the above studies use six sigma and servqual in various service industries. In comparison, this study uses six sigma and servqual in examining consumer satisfaction to SPAM UNS water dispenser services and reducing defects that cause consumer dissatisfaction.

**II. RESEARCH METHOD**

In this study, a questionnaire prepared based on the Servaqua model was distributed to UNS students to determine the level of consumer satisfaction to SPAM UNS water dispenser services.

Application of Six Sigma uses four steps: (1) Define, (2) Measure, (3) Analyze, and (4) Improve. This step is used to reduce the number of defects in the service, resulting in low customer satisfaction.

Table 1 explains that interviews and observations are needed to identify the observed service processes in the define phase.

At the measure phase, the Servaqua questionnaire and gap analysis are used to determine the value of the gap in services. The questionnaire was compiled from a combination of several previous studies and real case observations that occurred in the SPAM UNS water dispenser service. Pareto diagrams are needed to obtain improvement priorities in this service, where the dimension has the highest negative gap value. Furthermore, critical to satisfaction was developed in the SPAM UNS water dispenser service based on the priority of improvements obtained in the Pareto diagram.

In the analysis phase, the defect per million

**Table 1. Six Sigma Framework**

| Phase | Activity | Tools |
|-------|----------|-------|
| Define | Identification of observed service processes | Interview and Observation |
| Measure | Calculating the gap from the value of expectations and perceived of customer | Servaqua, Gap Analysis |
| | Identify the most influential attributes found in the dimensions of consumer satisfaction | Pareto Diagram |
| | Determine the critical to satisfaction | |
| Analyze | Capability Process Analysis | DPMO |
| | Build a root cause analysis | Fishbone Diagram |
| Improve | Provide suggestions for improving service quality | |
opportunities (DPMO) calculation is used to calculate the capacity of the process, and the fishbone diagram is used to develop the root cause analysis.

In the improvement phase, the researchers compiled an improvement plan based on priority problems that occur in the SPAM UNS water dispenser service.

III. RESULT AND DISCUSSION

Step 1: Define

At the defined stage, the service process observed is observed along with the limitations of the problem to be examined. In this study, researchers focused on water dispenser services provided by SPAM UNS.

| SPAM UNS | Consumer |
|----------|----------|
| Start    |          |
| Ground Water |        |
| Pumping  |          |
| Media Filter |       |
| Carbon Filter |   |
| Break Tank |         |
| Micro Filter |     |
| Ultra Filter |     |
| UV Radiation |    |
| Pumping to the water tower |        |
| Distribution to machines dispenser at UNS | |
| UV radiation |     |
| Water is ready to drink by consumers | Turn on the water dispenser |
| Water flows from the water dispenser | |

Figure 2. SPAM UNS Water Treatment Flowchart

The processed water from SPAM UNS is distributed through a free dispenser service throughout the UNS campus, and bottled drinking water is traded on the UNS campus.

The SPAM UNS drinking water treatment process is carried out independently in an office, which is also a production site within the UNS campus. The explanation process is presented in Figure 2.

The picture above shows that there are three main processes in SPAM UNS water treatment: the process of pumping water from the ground, the filtering process, and the process of distributing it to the dispenser machines spread across the UNS campus.

Step 2: Measure

To measure the gap, a questionnaire was prepared with statements combined from various previous studies and the real case in the SPAM UNS service. Table 2. displays the questionnaire design that has been developed.

In the questionnaire, there were 17 statements tangibles (code T), 2 statements of reliability (code RE), 3 statements of responsiveness (code RP), 1 statement of empathy (code E), and 2 statements of communication (code C).

Furthermore, the questionnaire was tested for validity and reliability by distributing questionnaires to 30 respondents. The validity test results show as in Table 3.

From the results of the validity test, all attributes in the questionnaire are valid because they have Rcount>Rtable.

Whereas the reliability test with SPSS shows that all the attributes of the questionnaire are reliable because they have a Cronbachs Alpha>Rtable value of 0.951.

By using the Slovin formula, obtained a minimum sample size of respondents as many as 100 people.

\[ n = \frac{N}{1 + Ne^2} \]

Where,

\[ N = 33282 \]
\[ e = 0.1 \]
\[ n = \frac{33282}{1 + (33282) (0.1)^2} \]
\[ n = 99.7 \]
Table 2. Questionnaire Design

| Code | Attribute                                                                 |
|------|---------------------------------------------------------------------------|
| T1   | I can easily find a water dispenser at UNS                                |
| T2   | Water dispenser at UNS is located in a shady place                        |
| T3   | Water dispenser at UNS is located in a dust-free place                    |
| T4   | Water dispenser at UNS works well                                         |
| T5   | Water dispensers at UNS are well cared                                    |
| T6   | Water dispenser at UNS has an attractive design                           |
| T7   | Water dispenser at UNS has an attractive color                            |
| T8   | Water dispenser at UNS is clean                                          |
| T9   | There is information about using a water dispenser                        |
| T10  | Existing features on the dispenser machine are interesting                |
| T11  | Water dispenser at UNS can be used easily                                 |
| T12  | There is always available drinking water in a water dispenser             |
| T13  | Discharge of water that comes out of the normal dispenser machine         |
| T14  | Water from the water dispenser does not smell                            |
| T15  | The water from the water dispenser is colorless                           |
| T16  | The water from the water dispenser is tasteless                           |
| T17  | Drinking water from a dispenser is healthy                                |
| RE1  | There are officers who do engine maintenance                              |
| RE2  | There are officers who routinely clean the engine                         |
| RP1  | SPAM UNS is swift in responding to consumer complaints                    |
| RP2  | SPAM UNS is swift in repairing and maintaining pipes/dispenser machines  |
| RP3  | Officials from SPAM UNS are able to answer information related to drinking water that is channeled |
| E1   | If water does not come out of the dispenser or other disturbances, I can easily contact UNS SPAM |
| C1   | There is information on the dispenser machine in case of damage or interference |
| C2   | There is information on the dispenser machine related to drinking water quality assurance |

The questionnaire was filled out by 160 UNS students. The recapitulation of the questionnaire, along with the weighted servqual value calculation, is explained in Table 4.

From this table, the priority of improvement is determined by using the Pareto diagram. Pareto diagrams are presented in Figure 3. The Pareto diagram shows that the reliability dimension occupies the number 1 improvement priority in SPAM UNS services with an effect of 28%.

Table 3. Validity Test

| Code | $R_{table}$ | $R_{count}$ | Validity |
|------|-------------|-------------|----------|
| T1   | 0.419       |             | Valid    |
| T2   | 0.414       |             | Valid    |
| T3   | 0.683       |             | Valid    |
| T4   | 0.733       |             | Valid    |
| T5   | 0.865       |             | Valid    |
| T6   | 0.42        |             | Valid    |
| T7   | 0.444       |             | Valid    |
| T8   | 0.768       |             | Valid    |
| T9   | 0.366       |             | Valid    |
| T10  | 0.483       |             | Valid    |
| T11  | 0.567       |             | Valid    |
| T12  | 0.795       |             | Valid    |
| T13  | 0.3061      | 0.618       | Valid    |
| T14  | 0.617       |             | Valid    |
| T15  | 0.633       |             | Valid    |
| T16  | 0.639       |             | Valid    |
| T17  | 0.688       |             | Valid    |
| RE1  | 0.787       |             | Valid    |
| RE2  | 0.764       |             | Valid    |
| RP1  | 0.833       |             | Valid    |
| RP2  | 0.836       |             | Valid    |
| RP3  | 0.574       |             | Valid    |
| E1   | 0.679       |             | Valid    |
| C1   | 0.765       |             | Valid    |
| C2   | 0.768       |             | Valid    |

The reliability dimension has two attributes: some officers do engine maintenance, and there are officers who routinely clean dispenser machines. From these two attributes, it is developed critical to satisfaction.
From the development of critical to satisfaction, the flow of water, and the cleanliness of the dispenser machine are chosen to be a defect that will be calculated on the DPMO calculation.

Researchers conducted a sampling survey on the dispenser machine at UNS, with the following sampling calculations,

\[ N = 129 \]
\[ e = 0.1 \]
\[ n = \frac{129}{1 + (129)(0.1)^2} \]

n = 56

By generating 56 random numbers from 1-129, 56 samples of dispenser machines at UNS were obtained randomly. The survey was conducted by asking directly to people around the dispenser machine or people who often use the dispenser machine to find out how they think about the cleanliness of the dispenser machine and the smooth flow of water.

**Step 3: Analyze**

Data on consumer's perceptions of the impurity of dispenser machines and irregular flow of water is a defect in DPMO processing. After the processing, DPMO results are converted into a sigma level to determine the process's ability. DPMO processing is shown in Table 5.

From this conversion, it is known that the

| Code | Perceived Values | Expected Values | Gap | Weight | Weighted Servqual |
|------|------------------|----------------|-----|--------|-----------------|
| Tangible |
| T1 | 2,8400 | 3,3667 | -0,5267 | 0,0212 | -0,0112 |
| T2 | 3,0533 | 3,2067 | -0,1533 | 0,0062 | -0,0009 |
| T3 | 2,3200 | 3,6000 | -1,2800 | 0,0515 | -0,0659 |
| T4 | 2,3000 | 3,5467 | -1,2467 | 0,0501 | -0,0625 |
| T5 | 2,0200 | 3,6867 | -1,6667 | 0,0670 | -0,1117 |
| T6 | 2,4067 | 2,7533 | -0,3467 | 0,0139 | -0,0048 |
| T7 | 2,2667 | 2,5667 | -0,3000 | 0,0121 | -0,0036 |
| T8 | 2,2333 | 3,7467 | -1,5133 | 0,0609 | -0,0921 |
| T9 | 2,7333 | 3,2667 | -0,5333 | 0,0214 | -0,0114 |
| T10 | 2,4133 | 2,8200 | -0,4067 | 0,0164 | -0,0067 |
| T11 | 3,0800 | 3,4333 | -0,3533 | 0,0142 | -0,0050 |
| T12 | 2,2333 | 3,6667 | -1,4333 | 0,0576 | -0,0826 |
| T13 | 2,6733 | 3,6667 | -0,9933 | 0,0399 | -0,0397 |
| T14 | 2,8333 | 3,7000 | -0,8667 | 0,0349 | -0,0302 |
| T15 | 3,0400 | 3,6933 | -0,6533 | 0,0263 | -0,0172 |
| T16 | 2,7133 | 3,7000 | -0,9867 | 0,0397 | -0,0391 |
| T17 | 2,4600 | 3,7200 | -1,2600 | 0,0507 | -0,0638 |
| | 43,6200 | 58,1400 | -14,5200 | 0,5839 | -0,0381 |
| Reliability |
| RE1 | 2,1133 | 3,5800 | -1,4667 | 0,0590 | -0,0865 |
| RE2 | 2,0933 | 3,6200 | -1,5267 | 0,0614 | -0,0937 |
| | 4,2067 | 7,2000 | -2,9933 | 0,1204 | -0,0901 |
| Responsiveness |
| RP1 | 2,2067 | 3,4333 | -1,2267 | 0,0493 | -0,0605 |
| RP2 | 2,1400 | 3,5133 | -1,3733 | 0,0552 | -0,0758 |
| RP3 | 2,3467 | 3,2200 | -0,8733 | 0,0351 | -0,0307 |
| | 6,6933 | 10,1667 | -3,4733 | 0,1397 | -0,0557 |
| Empathy |
| E1 | 2,1067 | 3,4733 | -1,3667 | 0,0550 | -0,0751 |
| | 2,1067 | 3,4733 | -1,3667 | 0,0550 | -0,0751 |
| Communication |
| C1 | 2,2267 | 3,4133 | -1,1867 | 0,0477 | -0,0566 |
| C2 | 2,2067 | 3,5333 | -1,3267 | 0,0534 | -0,0708 |
| | 4,4333 | 6,9467 | -2,5133 | 0,1011 | -0,0637 |
Dirty Dispenser Machine

Lack of communication between SPAM UNS with the authorities
Documents which are containing the transfer of authority does not reach the authorities
There is no cleanliness control card on the dispenser machine
There is no cleaning SOP for dispenser machine

Machine

Lack of communication between SPAM UNS and the authorities
Documents which are containing the transfer of authority do not reach the authorities
There is no cleanliness control card on the dispenser machine
There is no cleaning SOP for dispenser machine

Machine

Unconsciousness of the importance of cleanliness of dispenser machine
Janitors not clean the dispenser machine
Do not know how to clean dispenser machine

Unconsciousness of the importance of cleanliness of dispenser machine

Machine

Environment

Dirt of SPAM water
The use of dispenser machines for purposes other than take drinking water
Absence of regulations or appeal for use

Environment

Man

Figure 4. Dirty Dispenser Fishbone Diagram

SPAM UNS water dispenser service has a 1.930 sigma level. This value indicates that the company's ability to carry out the process following the required standards and does not produce defects is still low.

Because of the low capability of the service process, a fishbone diagram was developed to find out the cause of the problems experienced in this service. The development of the problem is done by conducting discussions with related parties on this issue. Fishbone diagrams are presented in Figure 4 and Figure 5.

Figure 5. Dispenser Machine's Water Flow Fishbone Diagram

Step 4: Improve

The various causes that have been compiled on the fishbone diagram have proposed improvements to improve service quality, so that customer satisfaction to the SPAM UNS water dispenser service also increases.

Some suggested improvements are as follows:
1. SOP for SPAM UNS Dispenser Cleaning Machine
2. SOP for Warning Letter regarding Cleanliness of SPAM UNS Dispenser Machine
3. SOP for Checking the water flow of SPAM UNS Dispenser Machine
4. SOP Installation of "In Repair" Sign for the Dispenser Machine that is damaged.

IV. CONCLUSION

The case study of this research identified the dissatisfaction of SPAM UNS consumers, as indicated by the gap value of the five dimensions used in the questionnaire.

The highest gap value is in the reliability dimension as supplementary services with critical to satisfaction cleanliness and smooth flow of SPAM UNS water dispenser. From the survey conducted, it was found that the capability of the process in the freshness and smooth flow of water was only 1,930 sigma. So it can be concluded that consumers are still not satisfied with the SPAM UNS water dispenser service.

### Table 5. DPMO Calculation

| No. | Defect | DPMO  | Sigma Level |
|-----|--------|-------|-------------|
|     |        |       |             |
| 2   | 8      | 500000 | 1,500       |
| 3   | 7      | 437500 | 1,657       |
| 4   | 7      | 437500 | 1,657       |
| 7   | 8      | 500000 | 1,500       |
| 10  | 5      | 312500 | 1,989       |
| 11  | 7      | 437500 | 1,657       |
| 12  | 8      | 500000 | 1,500       |
| 14  | 5      | 312500 | 1,989       |
| 17  | 8      | 500000 | 1,500       |
| 21  | 5      | 312500 | 1,989       |
| 23  | 5      | 312500 | 1,989       |
| 25  | 5      | 312500 | 1,989       |
| 26  | 5      | 312500 | 1,989       |
| 28  | 5      | 312500 | 1,989       |
| 32  | 5      | 312500 | 1,989       |
| 34  | 4      | 250000 | 2,174       |
| 38  | 7      | 437500 | 1,657       |
| 39  | 6      | 375000 | 1,819       |
| 42  | 3      | 187500 | 2,387       |
| 43  | 1      | 62500  | 3,034       |
| 46  | 1      | 62500  | 3,034       |
| 47  | 4      | 250000 | 2,174       |
| 50  | 7      | 437500 | 1,657       |
| 52  | 7      | 437500 | 1,657       |
| 53  | 7      | 437500 | 1,657       |
| 56  | 6      | 375000 | 1,819       |
| 58  | 4      | 250000 | 2,174       |
| 59  | 8      | 500000 | 1,500       |
|     |        |       |             |
| 60  | 8      | 500000 | 1,500       |
| 65  | 2      | 125000 | 2,650       |
| 67  | 6      | 375000 | 1,819       |
| 69  | 2      | 125000 | 2,650       |
| 70  | 7      | 437500 | 1,657       |
| 71  | 7      | 437500 | 1,657       |
| 72  | 8      | 500000 | 1,500       |
| 73  | 8      | 500000 | 1,500       |
| 75  | 8      | 500000 | 1,500       |
| 76  | 4      | 250000 | 2,174       |
| 79  | 5      | 312500 | 1,989       |
| 87  | 4      | 250000 | 2,174       |
| 92  | 4      | 250000 | 2,174       |
| 93  | 5      | 312500 | 1,989       |
| 98  | 6      | 375000 | 1,819       |
| 99  | 6      | 375000 | 1,819       |
| 100 | 4      | 250000 | 2,174       |
| 101 | 4      | 250000 | 2,174       |
| 102 | 3      | 187500 | 2,387       |
| 105 | 5      | 312500 | 1,989       |
| 106 | 4      | 250000 | 2,174       |
| 110 | 5      | 312500 | 1,989       |
| 112 | 7      | 437500 | 1,657       |
| 115 | 3      | 187500 | 2,387       |
| 117 | 1      | 62500  | 3,034       |
| 118 | 5      | 312500 | 1,989       |
| 123 | 5      | 312500 | 1,989       |
| 129 | 4      | 250000 | 2,174       |
|     |        |       |             |
| Average | 332589 | 1,930 |

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