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# 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

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Submited: 02-12-2019 Revised: 10-06-2020 Accepted: 16-06-2020 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





■ Never ■ Rarely ■ Sometimes ■ Often ■ Very Often

#### 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 24hour disturbance officer alert attribute is a value of -0.0479. The 24hour 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 valuesare 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 importanceperformance 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

Phase	Activity	Tools
Define	- Identification of observed service processes	Interview and Observation
Measure	<ul> <li>Calculating the gap from the value of expectations and perceived of customer</li> </ul>	Servaqua, Gap Analysis
	<ul> <li>Identify the most influential attributes found in the dimensions of consumer satisfaction</li> </ul>	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	_

 Table 1. Six Sigma Framework

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.





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.

 $n=N/(1+Ne^{2})$ (1) Where, N = 33282 e = 0,1 n=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					
Т3	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					
Т6	Water dispenser at UNS has an attractive design					
T7	Water dispenser at UNS has an attractive color					
Т8	Water dispenser at UNS is clean					
Т9	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					
T13	water dispenser 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					
<b>C</b> 2	There is information on the dispenser machine					

c2 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 <sub>table</sub>	R <sub>count</sub>	Validity
T1		0,419	Valid
T2		0,414	Valid
Т3		0,683	Valid
T4		0,733	Valid
T5		0,865	Valid
Т6		0,42	Valid
Т7		0,444	Valid
Т8		0,768	Valid
Т9		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.



Figure 3. Pareto Diagram

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

 $n=129/(1+(129) [(0,1)^2)]$ 

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	Expected	Gap	Weight	Weighted		
	values	values			Servquai		
Tangible							
T1	2,8400	3,3667	-0,5267	0,0212	-0,0112		
T2	3,0533	3,2067	-0,1533	0,0062	-0,0009		
Т3	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		
Т6	2,4067	2,7533	-0,3467	0,0139	-0,0048		
Τ7	2,2667	2,5667	-0,3000	0,0121	-0,0036		
Т8	2,2333	3,7467	-1,5133	0,0609	-0,0921		
Т9	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		
		Relia	bility				
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		
	·	Repons	iveness		,		
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		
E1	2,1067	3,4733	-1.3667	0.0550	-0.0751		
	2,1067	3,4733	-1,3667	0,0550	-0,0751		
	,	Comur	nication	-,	-,		
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		

#### **Table 4.** Weighted Servgual Calculation



Figure 4. Dirty Dispenser Fishbone Diagram



Figure 5. Dispenser Machine's Water Flow 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.

#### 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

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

Table 5. DPMO Calculation

- 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.

# References

- Babakus, E. (1993). Measuring service quality in the public utilities: the case of electric, gas and water services. *Journal of Nonprofit & Public Sector Marketing, 1* (1), 33-49.,
- Berry, L.L., Zeithaml, V.A., Parasuraman, A. (1985). Quality counts in services too. *Business Horizons, 28* (3), 44-52.
- Budihardjo, I.M. (2014). *Panduan Praktis Menyusun SOP*. RAS.
- Firdian, E., Santoso, P.B. (2013). Aplikasi Metode Servqual dan Six Sigma Dalam Menganalisis Kualitas Layanan PT. PLN (Persero) Unit Pelayanan Jaringan (UPJ) Dinoyo Malang. Magister Thesis, Universitas Brawijaya.
- Franceschini, F., Galetto, M., Turina, E. (2010). Water and sewage service quality: a proposal of a new multiquestionnaire monitoring tool. *Water Resources Management, 24* (12), 3033-3050.
- Furterer, S.L. (2016). *Lean Six Sigma in service: applications and case studies*. CRC press.

Grönroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, *18* (4), 36-44.

Guyton. A.C. 1987. *Fisiologi Kedokteran*. Jakarta: EGC.

- Han, S., Koo, D., Kim, Y., Kim, S., Park, J. (2017). Gap analysis based decision support methodology to improve level of service of water services. *Sustainability, 9* (9), 1578.
- Lewis, R.C., Booms, B.H. (1983). 'The Marketing Aspects of Service Quality,' in L. Berry, L. Shostack and G. Upah, (eds), *Emerging Perspectives on Services Marketing*, Chicago, IL.
- Nurwulan, F.A., Desrianty, A., Fitria, L. (2014). Analisis pelayanan jasa pada perusahaan daerah air minum (PDAM) DKI Jakarta dengan menggunakan metode service quality. *Reka Integra, 2* (1).
- Parasuraman, A., Zeithaml, V.A., Berry, L.L. (1985). A Conceptual Model of Service Quality and its Implications for Future Research. *Journal of Marketing*, 49 (1), 41 - 50.
- Prevos, P. (2016). *Servaqua: Towards a Model for Service Quality in Potable Reticulated Water Services.* In Looking Forward, Looking Back: Drawing on the Past to Shape the Future of Marketing. Springer, Cham.
- Setyawan, W., Sutoni, A., Erfasa, N.Z. (2017). Analisis kepuasan pelanggan terhadap kualitas pelayanan menggunakan metode service quality dan importance performance analysis. *Jurnal Industrial Servicess*, *3* (1a).
- Sugiyono. (2014). *Memahami Penelitian Kualitatif*. Bandung: Alfabeta.
- Sulistiyowati, W., Supriyanto, H., Suef, M. (2008). Integrasi Metode Servqual, Lean dan Six Sigma Implementasi: PT. PLN (Persero) Distribusi Jawa Timur, APJ Surabaya Selatan–UPJ Ngagel. In Prosiding Seminar Nasional Manajemen Teknlogi
- Sutrisno, T., Sucianstuti, E. 1991. *Teknologi Penyediaan Air Bersih.* Jakarta: Bina Aksara.
- Tjiptono, F., Chandra, G. (2011). *Service, Quality & Satisfaction* (3). Yogyakarta: ANDI.
- Voehl, F., Harrington, H.J., Mignosa, C.; Charron, R. (2013). *The Lean Six Sigma Black Belt Handbook: Tools and Methods for Process Acceleration*. Productivity Press.