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Water Losses Analysis and Performance of Perusahaan Daerah Air Minum (PDAM) in Kutai Kartanegara - East Borneo Indonesia

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Abstract

The purpose PDAM is service and satisfy clean water and source of regional revenue. In the implementation of water distribution, PDAM have some problems such as loss water or contaminants the outside. The purpose of research are: Analyze clean water needs based on population and number of subscribers; Analyze prediction rate of loss water; Analyze level of importance and performance matrix. Type of research method is descriptive, data have been obtained and analyzed based on literature related to the issue: analyze water loss, type of customer, water flow, number of subscribers and number of population and spread questionnaire to analyze level of importance and performance. Based on research results, water needs years of 2020 according the prediction total population is 1162.326 liters/second and prediction of clean water needs is 1,140,880 liters/second; Calculated prediction rate of loss water is 29.61%; After validity and reliability, calculate avarege all indicators, based on level of importance and level of performance. Factors that influence level of importance and level of performance of PDAM is quadrant A (top priority) and quadrant B (preserve achievements) at importance and performance matrix. Have a value larger 4.19 for importance and larger 3.39 for performance matrix.

Keywords: clean water and loss water, importance and performance matrix

INTRODUCTION

Water is one of the natural resources abundant natural resources available from rain water, surface water and ground water. Clean water is the main component of human activities and all living things, use for drinking water, household needs, other life supporting activities for the benefit of human, social and commercial interests. Indonesia is the country most of its territory consists of water. Water is a natural resource owned by every country, this natural resource plays a very important role in life.

The availability of water in terms of quality and quantity is necessary. The presence of Perusahaan Daerah Air Minum (Water Supply Company) in Indonesia is made possible through regulation Constitution Republic of Indonesia Number 5 Year 1962 as a unity belongs to the local government which provides services and conducts public benefit in the field of water. According to the regulation Decree of Home Affairs Ministry Number: 690-069 Year 1992 about Technical Instructions management of PDAM, confirmed that PDAM had duty public service to the community, in which in the exercise of its functions PDAM are expected to self-financing and should strive to develop the level of his Ministry, PDAM are also expected to contribute to the development of local government.

In the implementation process of the distribution of clean water, PDAM has some problems that reduce degree of efficiency of distribution such as water loss, as well as entry of contaminants from outside. Water loss is the difference between the amount of water produced by the manufacturer of the water amount of water sold to consumers, the level of non-revenue water can be defined as water lost, can be measured and known the magnitude of the statement but cannot be income, but it can be accountable. The level of net water loss due to leakage of water distribution pipe network system clean so suffered contamination and resulting in the amount of water that is not distributed as it should, otherwise it may cause losses that must be borne by the company itself, due to a high water loss numbers not recorded in metres of water customers. (Rita and Nugraha. 2010)

The research objectives are: Analyze clean water needs based on population and number of subscribers; Analyze prediction rate of loss water; Analyze level of importance and performance matrix.

METHODOLOGY

Types of Research and Research Objects

Research conducted is research deskriptif, is a research that serves to deskriptif or give an idea against the object examined for said problem solving there is based on existing data, also presents data, analyze and interpret. (Sugiono, 2004). Whereas the object of this research is PDAM Tirta Mahakam Kutai Kartanegara East Borneo.

Processing and Data Analysis

At this stage of the analysis having done by calculating data to find the rate of change of each element. Data addition according to PDAM customers from variable and number of inhabitants during the last 5 years and then the data is analyzed using formulas to find the need of clean water and lose water PDAM period to 5 years forward.

Identifying the level of importance and level of performance using a scale of 5 rating scales (likert) with type of data is ordinal. A total assessment of importance of each variable is obtained by way of summing results of multiplication score each scale with the number of respondents who chose the scale. To interpret how a variable is judged by the rest of respondents according to level of importance and level of performance, used the range scale. Having obtained the results of the level of importance and level of performance of each variable measured from the entire sample, the next is condition the results of the calculations into a matrix level of importance and level of performance, namely by linking the value of the performance on the X axis and Y axis on the importance. The matrix level of importance and level of performance according is as shown in Figure 1. (Rangkuti. 2003).

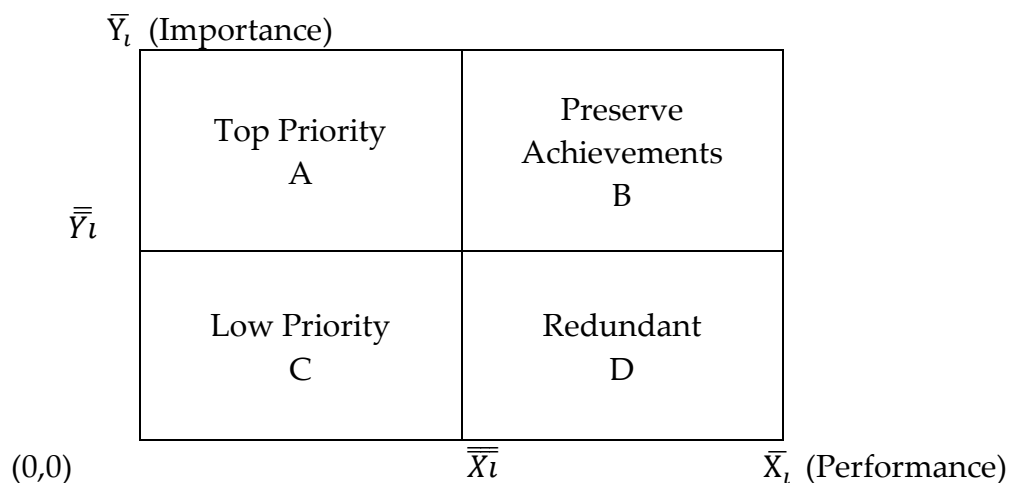$\overline{Y}_i$ (Importance)

Top Priority A	Preserve Achievements B
Low Priority C	Redundant D

$\overline{\overline{Y}}_i$ (left axis label)

(0,0) $\overline{\overline{X}}_i$ $\overline{X}_i$ (Performance)

Figure 1. Importance and Performance Matrix

RESULTS AND DISCUSSIONS

Prediction of Clean Water Years 2020

Prediction of needs for clean water years 2020 is calculated in two ways, referring to the results of a prediction for the increase of population and increase of each type of customer. Then compared, so will get two different input data that can be used as consideration for such a plan.

Analysis of the results obtained water nead in Kutai Kartanegara years 2020 according to the prediction of the number of inhabitants was 1,162,326 liters/second. (Table 1).

Table 1. Clean Water Needs Prediction Based On Population

No	Description	Total Neads (liter/detik)
1	Domestic	614.517
2	Social/general	153.629
3	Non domestic	115.222
4	Loss water	278.958
	Total Neads	1.162.326

Source: Analysis Results

The results of analysis obtained water neads in Kutai Kartanegara years 2020 according to the prediction of the number of customers is 1,140,880 liters/second. (Table 2).

Table 2. Clean Water Needs Prediction Based On Number of Subscribers

No	Description	Total Neads (liter/detik)
1	Domestic	757.257
2	Social/general	15.555
3	Non domestic	94.257
4	Loss water	273.811
	Total Neads	1.140.880

Source: Analysis Results

From the results of analysis obtained value prediction customers to 5 years forward to each variable and predicted amount of clean water needs based on the number of

customers as well as the level of water loss that occurs in the coming year 2020 of 29.61%. (Table 3).

Table 3. Estimates of Total Loss Water Years 2020

No	Description	Years 2015 (m³)
1	Water production	2.528.365,47
2	Wash out	408.982,72
3	Water is distributed (1 – 2)	2.119.382,75
4	Sales water	1.428.357,00
5	Water for others	63.492,10
6	Water loss (3 – 4 – 5)	627.515,65
7	Tolerance	423.876,55
8	More then tolerance (6 – 7)	203.639,10
9	Loss water (6:3 x 100%)	29,608 %

Source: Analysis Results

Validity and Reliability Test

The results of sampling of consumer is valid if all variables have a count greater than r table. The value of r table is 0.1292 (obtained from r tables, single sided with df = n-2 = 98). The results from this sampling it is reliability if Cronbach Alpha value is greater than 0.5.

Table 4. Results Validity and Reliability Test of Importance

Variabel	Indicator	Corrected item-total correlation	Alpha if item deleted	Cronbach Alpha
Distribution of water quality	Clear water	0.711	0.677	0.771
	Taste of water	0.688	0.583	
	Smelly of water	0.712	0.646	
	Content of chemical substances	0.601	0.570	
Continuity of the water	Availability of water at the activities of life	0.556	0.663	0.832
	Smooth water	0.646	0.654	
Installation speed of new connection	Alacrity operator	0.710	0.723	0.845
	Ready skill of the operator	0.654	0.627	
	Good skill of the operator	0.738	0.768	

Table 4. Results Validity and Reliability Test of Importance

Variabel	Indicator	Corrected item-total correlation	Alpha if item deleted	Cronbach Alpha
Water meters	Reading of water meters	0.724	0.625	
	Replacement of water meters	0.709	0.693	0.731
	Repair damage of water meter	0.783	0.746	
Complaints about the piping.	Promptness of handling/speed	0.784	0.666	
	Ready skill of the operator	0.666	0.788	0.777
	Good skill of the operator	0.695	0.658	

Source: Analysis Results

The test results of validity can be known that all variables have r count (Corrected Item-Total Correlation) is greater than 0.1292 so it can be inferred that these variables are already understood by the respondent.

Reliability test results of may note that all variables have the value of Cronbach Alpha is greater than 0.5 so it can be inferred that the variables that exist in this section already reliability.

Table 5. Results Validity and Reliability Test of Performance

Variabel	Indikator	Corrected item-total correlation	Alpha if item deleted	Cronbach Alpha
Distribution of water quality	Clear water	0.853	0.715	
	Taste of water	0.779	0.899	
	Smelly of water	0.750	0.721	0.725
	Content of chemical substances	0.834	0.771	
Continuity of the water	Availability of water at the activities of life	0.717	0.689	0.656
	Smooth water	0.717	0.663	
	Alacrity operator	0.650	0.816	0.613
	Ready skill of the operator	0.759	0.779	

Installation speed of new connection	Good skill of the operator	0.776	0.733	
Water meters	Reading of water meters	0.515	0.653	0.782
	Replacement of water meters	0.590	0.724	
	Repair damage of water meter	0.629	0.739	

Table 5. Results Validity and Reliability Test of Performance

Variabel	Indikator	Corrected item-total correlation	Alpha if item deleted	Cronbach Alpha
Complaints about the piping.	Promptness of handling/speed	0.765	0.525	0.642
	Ready skill of the operator	0.692	0.726	
	Good skill of the operator	0.641	0.649	

Source: Analysis Results

The test results of validity can be known that all variables have r count (Corrected Item-Total Correlation) is greater than 0.1292 so it can be inferred that these variables are already understood by the respondent.

Reliability test results of may note that all variables have the value of Cronbach Alpha is greater than 0.5 so it can be inferred that the variables that exist in this section already reliability.

Importance and Performance Analysis

After the test the validity and reabilitas of indicators of technical aspects, then calculations the average overall indicators based on level of importance and the level of performance. The results of the overall assessment of respondent's customers PDAM visible on Table 6.

Table 6. Average Level of Importance and Level of Performance

No	Indicator	Importance	Performance
1	Clear water	4.56	3.84
2	Taste of water	4.29	3.42
3	Smelly of water	4.26	3.41
4	Content of chemical substances	4.39	3.40
5	Availability of water at the activities of life	4.47	3.43
6	Smooth water	4.20	3.38
7	Alacrity operator	3.93	3.07
8	Ready skill of the operator	4.11	3.26
9	Repair damage of water meter	4.44	3.34
10	Reading of water meters	4.38	3.31
11	Replacement of water meters	4.09	3.57
12	Repair damage of water meter	4.46	3.04
13	Promptness of handling/speed	4.47	3.04
14	Ready skill of the operator	4.24	3.38
15	Good skill of the operator	4.10	3.23
	Total Average	4.29	3.34

Source: Analysis Results

Average rating based on level of importance and level of performance on table 6 above will be disallowed quadrants of the matrix on importance for placing each indicator. The value of the total average for level of importance that is 4.29 and the total average for level of performance that is amounted to 3.34. The distribution of the values of the indicators matrix of quadrants in PDAM importance performance seen in Figure 2.
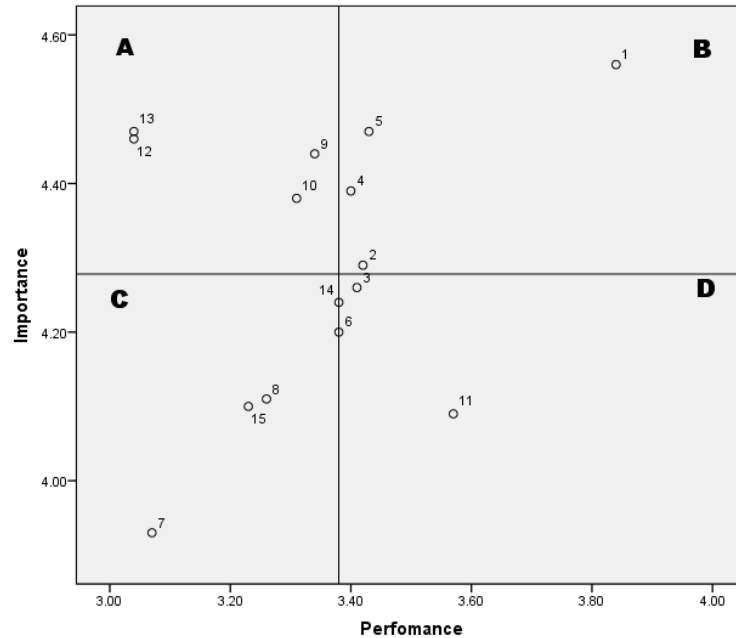
Figure 2. Importance and Performance Matrix
Source: Analysis Results

Importance and performance matrix is divided into four quadrants. Each quadrant describes different conditions. An explanation of each aspect of the assessment are as follows:

Quadrant A (Top Priority)

Quadrant A is a region that contains the indicators that are important but in reality this indicator has not been in accordance with expectations. From the results of the calculation of average assessment indicators of service technical aspects there are some indicators that are included in this quadrant, so need to be held to increase in this indicator. As for the indicators included in the quadrants of A is as follows: 1) expertise of the operators, replacement of water meters, water meters, damage repair alacrity/speed handling complaints about piping.

Quadrant B (Preserve Achievements)

Quadrant B is a region that contains indicators that are considered already as they expect. the indicators included in this quadrant should remain because this has become the leading product/service. As for the aspects that are included in this quadrant are aspects of water quality and continuity aspects of water. The whole of the indicators in the technical aspects of water quality is already as expected. So it can be inferred that technical aspects of the quality of the water distributed is a superior

product. The indicators included in the quadrant B are as follows: clear water, taste of water, content of chemical substances, availability of water at the activities of life.

Quadrant C (Low Priority)

Quadrant C is a region that contains indicators that are considered less important and in fact not too satisfactory performance/special. From the results of average calculation that is included in this quadrant is aspect of the new installation, mounting the speed aspect of handling complaints regarding piping and aspects of water meters. Aspects of water meters are among the quadrants of quadrant C and D, as it is located on the line dividing level of performance. The improvement of the indicators included in this quadrant needs to be reconsidered because of the effect on benefits perceived by customers is very small. The indicators included in the quadrant C are as follows: smooth water, promptness of handling/speed, operator's skills in installing new connections, expertise of operators in installation the installation of new connection, operator skills in dealing with a complaint concerning the piping.

Quadrant D (Redundant)

Quadrant D is a region that contains indicators that are considered less important and it felt redundant. Reduction for performance indicators that are included in this quadrant can be done as it can save costs. The indicators included in the quadrant D is replacement of water meters.

Importance and Performance Levels Ranking

Importance and performance level ranking is useful to know the order of judgment rendered against customer existing indicators. As for the rankings of each indicator on importance and level of performance can be seen from Table 7 and Table 8.

Tabel 7. Importance Levels Ranking

No	Indicator	Description	Importance	Description
1	1	Clear water	4.56	Very Important
2	5	Availability of water at the activities of life	4.47	Very Important
3	13	Promptness of handling/speed	4.47	Very Important
4	12	Repair damage of water meter	4.46	Very Important
5	9	Ready skill of the operator	4.44	Very Important
6	4	Content of chemical substances	4.39	Very Important
7	10	Reading of water meters	4.38	Very Important
8	2	Taste of water	4.29	Very Important

Tabel 7. Importance Levels Ranking

No	Indicator	Description	Importance	Description
9	3	Smelly of water	4.26	Very Important
10	14	Good skill of the operator	4.24	Very Important
11	6	Smelly of water	4.20	Very Important
12	8	Good skill of the operator	4.11	Important
13	15	Ready skill of the operator	4.10	Important
14	11	Replacement of water meters	4.09	Important
15	7	Alacrity operator	3.93	Important

Source: Analysis Results

In table 7 above to see indicator that clear water is distributed by PDAM has the highest average rating with an average rating of 4.56, this indicates these indicators are very important (values between 4.20-5). The indicators according to the customers is very important there are 11 (eleven) i.e. clear water, availability of water at the activities of life, promptness of handling/speed, repair damage of water meter, ready skill of the operator, content of chemical substances, reading of water meters, taste of water, smelly of water, good skill of the operator, smelly of water.

Indicators are judged important (values between 3.40-4.19) by the customer PDAM there are four (4) i.e good skill of the operator, ready skill of the operator, replacement of water meters, alacrity operator.

Tabel 8. Performance Level Ranking

No	Indicator	Description	Performance	Description
1	1	Clear water	3.84	Good
2	11	Replacement of water meters	3.57	Good
3	5	Availability of water at the activities of life	3.43	Good
4	2	Content of chemical substances	3.42	Good
5	3	Smelly of water	3.41	Good
6	4	Content of chemical substances	3.40	Good
7	6	Smooth water	3.38	Enough
8	14	Ready skill of the operator	3.38	Enough
9	9	Repair damage of water meter	3.34	Enough
10	10	Reading of water meters	3.31	Enough
11	8	Ready skill of the operator	3.26	Enough

12	15	Good skill of the operator	3.23	Enough
13	7	Alacrity operator	3.07	Enough
14	12	Repair damage of water meter	3.04	Enough
15	13	Promptness of handling/speed	3.04	Enough

Source: Analysis Results

In table 8. above to seen that clear water is distributed by PDAM has the highest average rating with an average rating of 3.84, it does show this indicator was rated good by the customer. Indicators that are rated good (a value between 3.40-4.19) by customers amounted to 6 (six) i.e. clear water, replacement of water meters, availability of water at the activities of life, content of chemical substances, smelly of water, content of chemical substances.

Indicators are judged important (value between 2.60-3.39) by the customer PDAM there are 9 (nine) i.e. smooth water, ready skill of the operator, repair damage of water meter, reading of water meters, ready skill of the operator, good skill of the operator, alacrity operator, repair damage of water meter, promptness of handling/speed.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Calculated prediction of clean water needs based on population years 2020 is 1,162,326 liters/second. Calculated prediction of clean water needs based on number of subscribers years 2020 is 1,140,880 liters/second.
2. Calculated prediction rate of loss water year 2020 is 29.61%.
3. Factors that influence level of importance and level of performance of PDAM is quadrant A (top priority) and quadrant B (preserve achievements) at importance and performance matrix. Have a value larger 4.19 for importance and larger 3.39 for performance matrix.

Recommendations

1. Should be create a work plan consisting of administrative and technical activities, such as setting the District of leaks, making research unit, prepare data leak, replacement of the meter increments, observations on distribution network control leaks, repair and replacement of metered customers and detection of leaks in water pipes.
2. Should be improve services in the handling of complaints about the piping by means of increased number of operators and increase human resources (alacrity, expertise and skills of the operator). Another thing to note is aspect

of quality of water distribution (clear water) while the aspect of continuity to be aware the availability of water at the activities of life between the hours of 6 am to 6 pm and the promptness of the operator in the installation of the new connection and repair the damage meter in water.

3. Need research periodically and more to find out the level of importance and level of performance, primarily on technical aspects. This can be a reference company in providing the best service to customers.

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