Multi Criteria Decision Making for Integrated Assessment of Indonesian Water Company

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Abstract--- In this research, the quality of water drinking assessment is based on Analytical Network Process that compared with traditional assessment system which is provided by BPPSPAM, has been done. This assessment and decision-making process have been done to evaluate the new indicator performance of Indonesian PDAM which is an infrastructure aspect. There are existing criteria that have been used in BPPSPAM assessment such 25% factor affected by the financial condition, 25% aspect is the quality of service, 35% aspect is an operational problem, and 15% is human resource capability. BPPSPAM parameter becomes a benchmarking parameter because it has been used for 10 years. Although BPPSPAM parameter has been used in the long decade, there is a problem when an infrastructure aspect is not scaled and adjusted with real field assessment. The new aspect which is an infrastructure changes the priority of each existing aspect and becomes one important aspect that needs to be considered in the water drinking quality assessment process. The new percentage of each aspect is 15% for financial, 20% for services, 12% for operational, 28% for human resources, and 25% for infrastructure aspect built using ANP process. The distribution of importance of each aspect is tested using the compatibility index by "Saaty" for ANP. The result shows that the "Saaty" compatibility index is 1.0436 which is below 1.1. When the result is below 1.1, it shows that the new priority vector is close to the BPPSPAM parameter vector before.

Keywords--- Water Quality Assessment, ANP, BPPSPAM, Saaty, Compatibility Index.

I. Introduction

Drinking water has an important role in human life that is absolutely necessary and cannot be delayed. Drinking water needs will increase along with the increase in a population (Rode, 2009). Therefore, the supply of drinking water is a priority and is a concern of various groups in the community. Chapter 1 verse (6), the government regulation (Permen) number 27 of 2016 in ministry of public work (PUPR) states that Drinking Water Supply is an activity of providing drinking water to meet the needs of the community in order to obtain a healthy, clean and productive life. The provision of drinking water is a compulsory concurrent government affair related to basic services and is the authority of the regional government (chapter 12 verse (1) of Law Number 23 of 2014).

Nowadays drinking water supply experiences various problems, both in terms of quality, quantity, and continuity. In terms of quality, existing drinking water contains heavy metals or excessive chemical substances, so that within a certain period of time the human body cannot be tolerated. In terms of quantity, the availability of drinking water for households is far less than the need. Performance of water drinking company must be carried out as a whole to measure the services provided, in order to achieve the company's goal of providing high-quality services and can be relied on by consumers to meet their needs (Ofwat, 2010). To monitor the success or failure of SPAM using performance indicators with quantitative data forms that reflect the performance of various components of SPAM, so that it can help the government as the owner of the company in making decisions (Shinde et al., 2013).

There are 2 guidelines to evaluate PDAM's performance in Indonesia based on the rule by ministry of home affairs number 47, year 1999 concerning Guidelines for Performance Assessment of PDAMs and Decree of the Chairperson of the Supporting Body for the Development of Drinking Water Supply Systems (BPPSPAM) Number 002 / KPTS / K-6/2010 about Performance Assessment Services for Implementing SPAM Development in PDAMs.

Performance of water drinking company in accordance with the Ministry of Home Affairs 47/1999 produces assessment results in categories of very good, good, sufficient, less, and not good; whereas assessment based on

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BPPSPAM uses criteria of healthy, less healthy and sick. However, assessments based on the Ministry of Home Affairs are too long and not in accordance with the times.

Based on the results of the PDAM performance assessment by BPPSPAM in 2017, it shows that out of a total of 35 PDAMs in Central Java Province, there are still 2 PDAMs that are declared unhealthy, namely PDAM Banjarnegara and Grobogan. PDAM Kota Magelang and Surakarta are ranked 31st (with a performance value of 3.07) and 32nd order (a performance value of 3.03) out of 35 district/city PDAMs in Central Java Province. Whereas in the two cities, the system used uses the dominant raw water sourced from the springs, the high level of network density to the region and customers, should be able to obtain higher performance values. This shows that the value generated from the current performance water drinking company does not reflect the actual condition of the PDAM.

According to Mazumder et al. (2018), factors that influence hydraulic performance are reliability, availability, serviceability (Kun et al., 2007), performance assessment indicators in Malaysia: management of water resources, human resources, physical assets, operations, service quality, finance. While the performance evaluation conducted by BPPSPAM Indonesia is based on 4 aspects, namely: financial, service, operational, human resource aspects, not taking into account the overall physical / infrastructure aspects of the system (starting from raw water sources, piping networks, water treatment plants, reservoirs, to customers).

PDAM performance assessment indicators in other countries from the International Water Association (IWA) include service quality, human resources (HR), finance, water resources, physical, operational (Kanakoudis et al., 2011). Assessment indicators, according to the United Kingdom's Office of Water Services, include customer billing, customer service levels, water quality and environmental performance, water distribution, leakage, water efficiency, cost per unit and relative efficiency, network performance, and financial performance (Schouten, 2009).

Through this research, a PDAM performance evaluation formula will be produced that better describes the condition of the company. The solution is by developing a mathematical model that provides quantitative results of the influence of infrastructure aspects on PDAM performance evaluation.

Multi-criteria decision-making techniques (MCDM) are widely used in water assessment not especially in water drinking companies. The calculation in MCDM is to determine are the performance criteria is appropriately describe water drinking conditions. Analytical Hierarchy Process (AHP)/ analytical network process (ANP) is one kind of MCDM widely used to solve complex comparison vector problem. This method is preferably used by many researchers because could describe the importance of parameter by rank. There is a linear relationship between the accuracy of AHP results and decision-maker preferences (Kavurmacı & Karakuş, 2020).

AHP performs the ranking of the parameters by taking into account the significance levels of the parameters with a binary comparison. AHP and ANP are essentially ways to measure especially intangible factors by using pairwise comparisons with judgments that represent the dominance of one element over another concerning a property that they share (Görener, 2012). ANP is a generalization AHP because all network is influenced by each other. Many interactions especially don’t have a hierarchy like water drinking assessment. ANP allows complex interrelationships among decision levels and attributes.

In this research, there is a two-factor analysis done. The result obtained from the first analysis was drinking water company positively influenced by network density, raw water resources, and also a pumping system which is part of the infrastructure aspect (Intani et al., 2019).

The second-factor analysis is to ensure that a new parameter from the previous research is to have a comparative relation based on the network built by ANP criteria. Comparative relation is built using a comparative survey of water drinking employees, water drinking experts, and also lecturer expertise in the water system.

ANP technique is used in this research because enable the management of the interdependence between the components and the network (Islami et al., 2018).

The main contribution of this research is to develop a new assessment model that combines numerous old factors and new factors using the wisdom of many expertise backgrounds. After producing a new priority, this research also makes judgment comparison with the appropriate model vector closeness test.

II. Methodology

The location of the research will be 35 district/city PDAMs in Central Java Province. General description of Central Java Province administration based on BPS (2017). Central Java is an Indonesian province located in the central part of Java Island. The province is bordered by the Province of West Java to the west, the Indian Ocean and

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the Special Region of Yogyakarta to the south, East Java to the east, and the Java Sea to the north. Central Java Province consists of 29 districts and 6 cities, which are divided into 573 sub-districts, 7809 villages, and 750 villages.

Understanding the water supply system according to Hickey (2008), is a water distribution system from the Water Treatment Plant (IPA) for consumers that are used to meet the needs of drinking water, water for cooking, sanitation and other users in the household environment. So it can be concluded that the understanding of the drinking water supply system is a unified water supply infrastructure that meets the quantity, quality, continuity and aims to meet the needs of drinking water for the community.

SPAM as one of the infrastructure systems is defined as physical facilities aimed at meeting the needs of community drinking water, and as a major supporter of the function of the socio-economic system, and also developed for government functions. So that the design of each infrastructure component as well as the whole must be done in the context of integration and overall (Sumiarsih et al., 2018). Management and Process of PDAM Water Supply Infrastructure shown in Figure 1. The goal is that if infrastructure facilities are properly built, and the provision of public services has been guaranteed in accordance with the established plan, the pattern of community development can be effectively controlled.

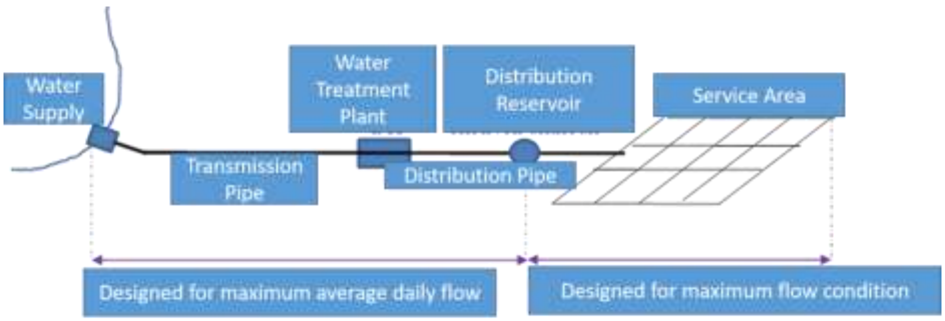

Figure 1: Management and Process of PDAM Water Supply Infrastructure

Mathematical models of water distribution systems can be determined from topology, mass balance (flow continuity) in joints and energy conservation (pressure loss continuity) around hydraulic loops and branches, as well as component equations (Paluszczyszyn, 2015). The basic requirements of water distribution systems must be able to meet the quantity and quality requirements according to their objectives during their technical life and must be able to accommodate abnormal conditions such as breaks in pipes, mechanical failure of pumps, valves, control systems, including storage facility malfunctions and inaccurate demand projections (Giustolisi et al., 2009).

The establishment of drinking water distribution network patterns is based on priority service areas closest to the source and preferably densely populated areas. In the distribution of drinking water, there are 5 (five) basic elements that influence, including PDAM, customers, the quantity of clean water, pipelines, and reservoirs. The concept of a water distribution system model is explained in Figure 2.

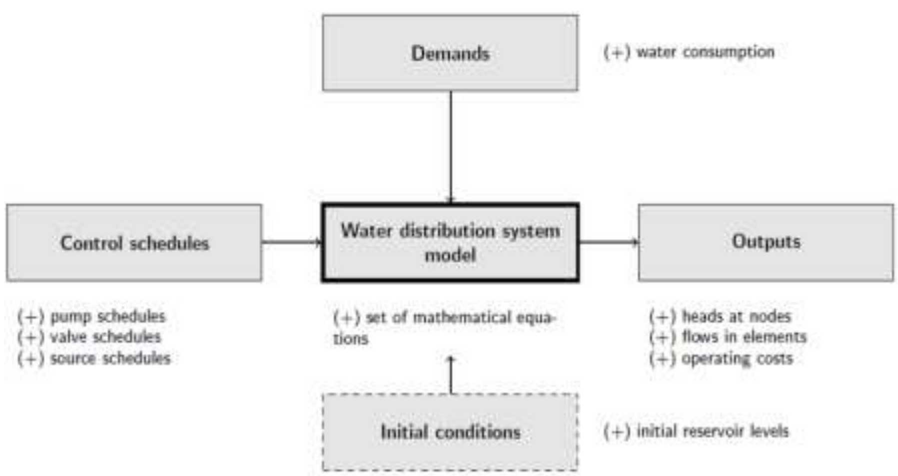

Figure 2: Conceptual Model of a Water Distribution System

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This research is using 2 types of variables, the dependent variable, and the independent variable. The dependent variable (dependent variable) is a variable that is included in the research hypothesis, the diversity of which is influenced by other variables. While the independent variable (independent variable) is a variable that affects the dependent variable and is included in the research hypothesis. The diversity of independent variables is influenced by the researcher's intervention, conditions or phenomena to be studied.

The model developed in the study is expected to explain the effect of the infrastructure aspect with the research hypothesis, the infrastructure aspect influences PDAM performance. Factors taken into account that affects network patterns include:

1) Network density (IA1), based on Wenban-Smith (2009), can be defined as the ratio of the total length of the pipeline to the service area of the PDAM.
2) Raw water source (IA2a). The installed capacity of dominant raw water sources, after weighted (Kun, 2007).
3) The total installed capacity of a pumping system (IA4) (Haider, 2017).

This research as the dependent variable is PDAM performance. While the independent variable is the infrastructure aspect plus aspects of PDAM performance assessment from BPPSPAM, among others: service aspect, operational aspect, financial aspect, HR aspect. Aspects that influence BPPSPAM's performance assessment include:

1) Service Aspect (SA)

The service factor is the ability of the PDAM to serve its customers. PDAM customers are domestic (house connection, yard connection, public hydrants, and water terminals), and non-domestic, namely small industries, large industries, restaurants, hotels, offices, hospitals, and fire hydrants (Permen PUPR number 18 of 2007). In this study only takes into account PDAM customers who come from house connections. Service factor indicator variables in this study include:

a. The scope of technical services (SA1), to find out the percentage of the population served by the PDAM compared to the population in the service area of the PDAM;
b. Customer growth (SA2), to find out the percentage increase in the number of PDAM customers in one year.
c. Customer water quality (SA4), this indicator is to find out whether the quality of water that has been distributed by the PDAM has met the drinking water quality requirements in accordance with the provisions in Permenkes.
d. Domestic water consumption (SA5), describes the level of consumption of household customers to PDAM water per month per customer.

2) Operational Aspect (OA)

Operational factors are the activities and results of PDAM activities related to the operation of the network, as well as those which are monitoring activities. Operational factor indicator variables in this study include:

a. Production efficiency (OA1), to measure efficiency in a production system
b. The level of water loss (OA2), to measure the efficiency of the distribution system against the flow of water sold
c. Water pressure at the customer's connection (OA4), to measure whether the customer has been served with pressure according to minimum standards
d. Replacement/calibration of the customer's water meter (OA5), measuring the accuracy of the customer's water meter

3) Financial Aspect (FA)

Financial aspect are the results of PDAM activities that are financial in nature from the results of operating the network in providing water for customers. Financial factors variables in this study include:

a. Return on equity (FA1) is a ratio to measure the ability of the rate of return to total equity
b. Cash ratio (FA3) measures the ability of cash in order to guarantee short-term obligations
c. Solvability (FA5), to determine the ability of PDAMs to pay off existing long-term debt using all / total assets owned by the company

4) Human Resource Aspect (HA), Including

a. The ratio of employees to 1000 customers (HA1), to measure the efficient use of labor in serving 1000 customers;

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b. The ratio of the cost of education and training (HA2), measuring the concern of the company to fund employee competency improvement.

The hypothesis used in this study is that each independent variable has an influence on PDAM performance, and the magnitude of the influence of each variable is different.

Analytical Network Process is the improvement of the Analytic Hierarchy Process by Saaty where internal and external relationships between and among elements of the decision are considered. The linear and AHP relationships are turned into the network model. In this case, the internal and external dependencies are included in weight scoring not like in the AHP process.

This model is needed minimal three pairwise items so it could be compared if there are internal and external dependencies. If pairwise between internal and external is less than three, then there is one item needs to be reorganized and reweighted because there is one relation that has different dependencies relation.

Problem-solving steps by the network analysis methods include the formation of network structure, pairwise comparisons, adaption control of judgments, formulation supermatrix, and the limit matrix, prioritization of criteria and alternatives. Figure 3 shows the ANP structure of water drinking healthy measurement.

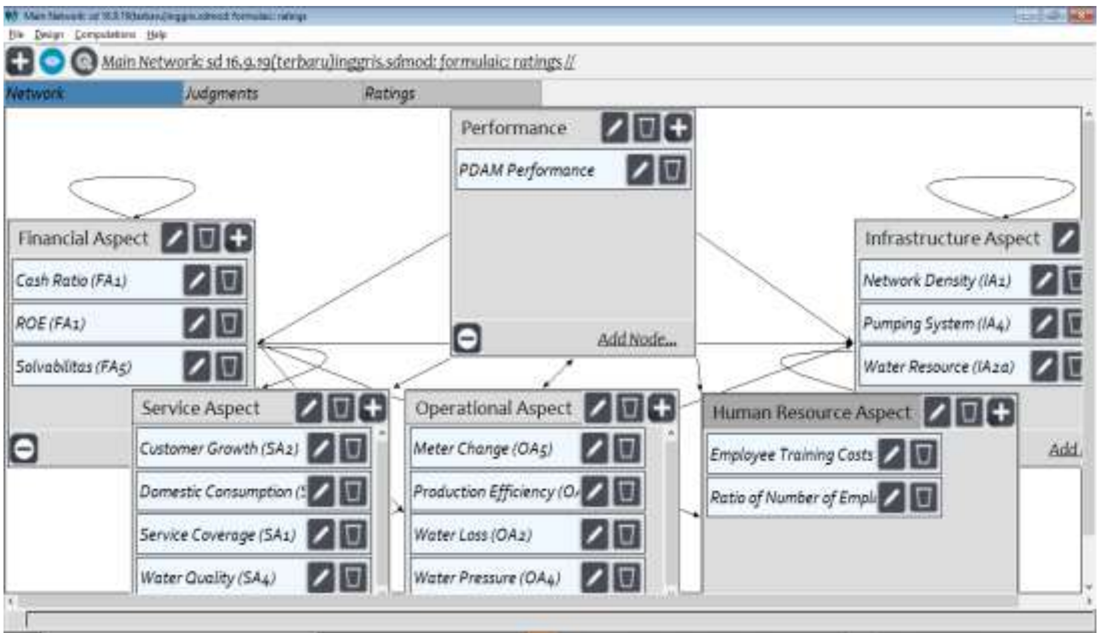

Figure 3: ANP Model of Water Drinking Healthy Measurement

The second step is to make a pairwise comparison between the decision factors that were obtained from the questionnaire. The questionnaire uses a scale from 1 to 5. Judgments were obtained from employee work at PDAM, expertise in the water system, and also lecturer expertise water system. Expert judgment is combined with geometric means because the range could be considered negative to some aspect and positive to some aspect.

An important point that should be considered is compatibility control and inconsistency. Super Decision software is matrix-based software that could handle large volume data which has more dimension of the matrix. Inconsistency rate must maintain to be below 0.1 to make the pairwise fair.

III. Results

After questionnaire is filled, we must insert values obtained to matrix in Super Decision. Figure 4 shows pairwise comparison in questionnaire mode from Super Decision. Weight values obtained through pairwise comparison included in large matrix called super matrix.

The supermatrix obtained from the first step is called the unweighted supermatrix. The weighted supermatrix is obtained through multiplying the corresponding weights of clusters by the unweighted supermatrix. Corresponding weights come from internal and external relationships. Weighted supermatrix is multiplied by itself until having constant value and not have a far range between each weight.

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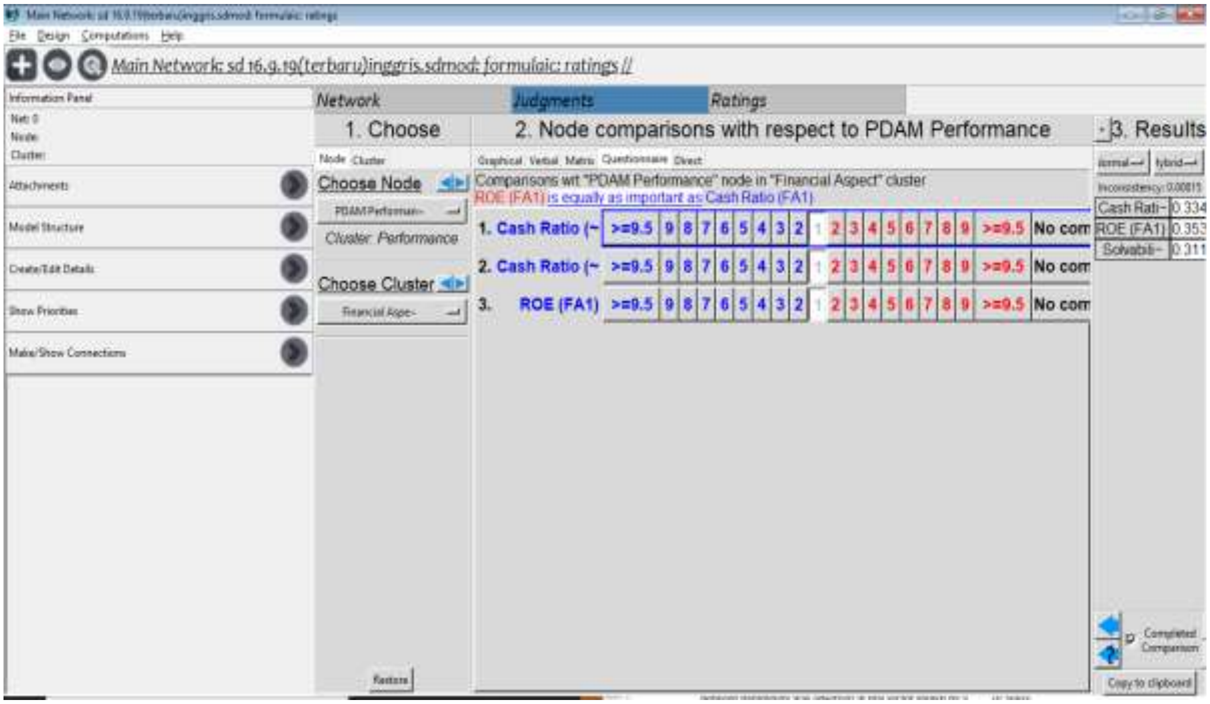

Figure 4: Pairwise Comparison Example in Questionnaire Mode

The last matrix that used to rank alternatives is the limit supermatrix. Limit matrix use probability matrix and based on Markov chain. The final weight gained in this matrix is standardized so have a fixed length for each weight. Limit supermatrix provides the last weighting criteria for each alternative. This is the equation to gain standardized weight.

$$W = \text{Lim } w^{2k+1} \quad (1)$$

The standard of the scoring system of each pairwise comparison is shown in Table 1. Geometric means used in this criteria makes the pairwise comparison is not scaled up to optimal but from range 1 to 2 only. Geometric means is the terminology to gain fairness from the subjectivity in making the pairwise comparison.

Table 1: Standard Scoring System in Network Process

Preferences	Number
Having equal importance	1
Having equal to moderate more important	2
Having moderate more important	3

ANP allows internal and external relations between network relations. The most connected criteria are financial aspect especially ROE in this research. ROE has a connection to service aspects in terms of customer growth and service coverage. ROE also has a relation in the operational aspect of water loss. ROE network to water loss cannot be compared directly because not have alternative criteria to be compared. ROE network to human resource affect all criteria and in infrastructure aspect affect pumping system and water resources.

Another network aspect that has a connection is service coverage in the service aspect. Service coverage has a connection with cash ratio and ROE in the financial aspect and network density and pumping system in the infrastructure aspect.

Another aspect only has an internal relation. ROE has internal relation with cash ratio, and service coverage has an internal relation with customer growth. Employee training costs has a connection with the ratio of the number of the employee. The pumping system has a relation with network density and water resources.

Table 2 is a comparison of each major aspect of PDAM performance. Inconsistency rate among each aspect is the same at 0.00815 and below 0.1 showed that pairwise judgment is fair. Specific criteria that have relation have each ideal weighting multiplier. For example, in the financial aspect, ROE criteria have a higher weighting multiplier because considered more important than other criteria like cash ratio and solvability.

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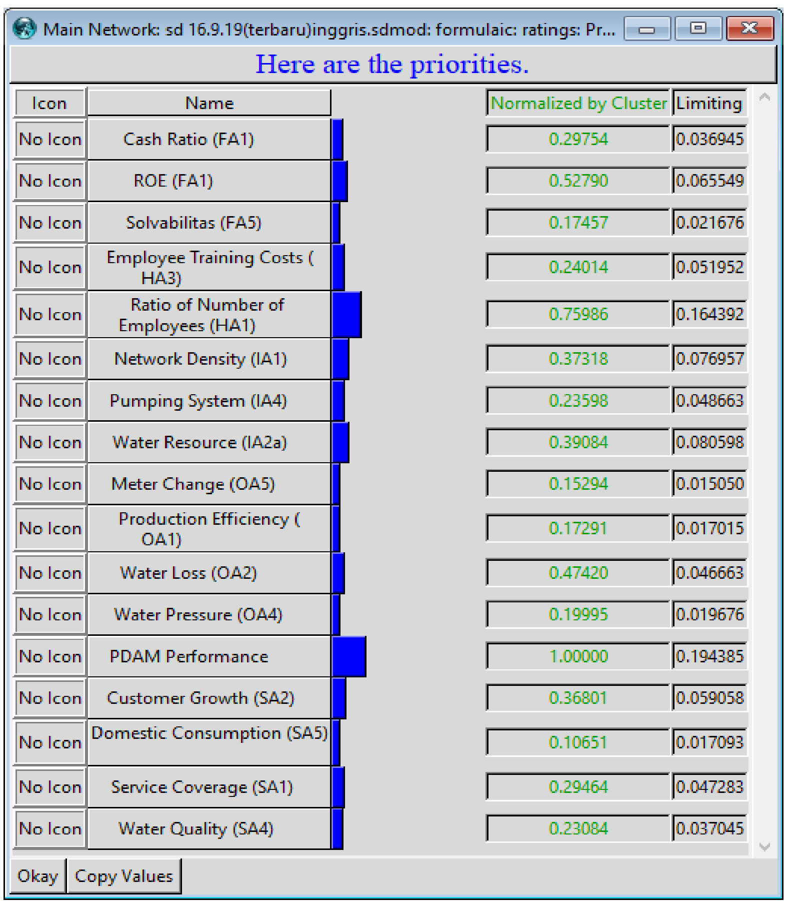
Table 2: Comparison of each Aspect Affecting PDAM Performance and Inconsistency

Node	**PDAM Performance**	**Node**	**PDAM Performance**
Cluster	Financial Aspect	Cluster	Human Resource
Incosistency	0.00815	Incosistency	0.00815
Cash Ratio	0.9476	Employee Training	0.793
ROE	1	Ratio of Number of Employee	1
Solvability	0.8812		
Node	**PDAM Performance**	**Node**	**PDAM Performance**
Cluster	Infrastructure Aspect	Cluster	Operational Aspect
Incosistency	0.00815	Incosistency	0.00815
Network Density	0.4667	Meter Change	0.688
Pumping System	0.6012	Production Efficiency	0.7787
Water Resource	1	Water Loss	0.8812
		Water Pressure	0.9006

The relative weight was estimated after all relations has decided. Through the formation of the matrix, the importance of each criterion was compared to defined criteria and relation. Figure 5 shows the priority after weighted by the relation of each criterion.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Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Cash Ratio (FA1)	0.29754	0.036945
No Icon	ROE (FA1)	0.52790	0.065549
No Icon	Solvabilitas (FA5)	0.17457	0.021676
No Icon	Employee Training Costs (HA3)	0.24014	0.051952
No Icon	Ratio of Number of Employees (HA1)	0.75986	0.164392
No Icon	Network Density (IA1)	0.37318	0.076957
No Icon	Pumping System (IA4)	0.23598	0.048663
No Icon	Water Resource (IA2a)	0.39084	0.080598
No Icon	Meter Change (OA5)	0.15294	0.015050
No Icon	Production Efficiency (OA1)	0.17291	0.017015
No Icon	Water Loss (OA2)	0.47420	0.046663
No Icon	Water Pressure (OA4)	0.19995	0.019676
No Icon	PDAM Performance	1.00000	0.194385
No Icon	Customer Growth (SA2)	0.36801	0.059058
No Icon	Domestic Consumption (SA5)	0.10651	0.017093
No Icon	Service Coverage (SA1)	0.29464	0.047283
No Icon	Water Quality (SA4)	0.23084	0.037045

Okay Copy Values

Figure 5: Priorities Comparison of each Criteria

The limit supermatrix as mentioned before gained through multiplication between weighting supermatrix with itself. Figure 6 shows the limit super matrixes gained in this questionnaire. As shown in Figure 6, we can see that not all matrix is filled especially when not have equal relation with another aspect.

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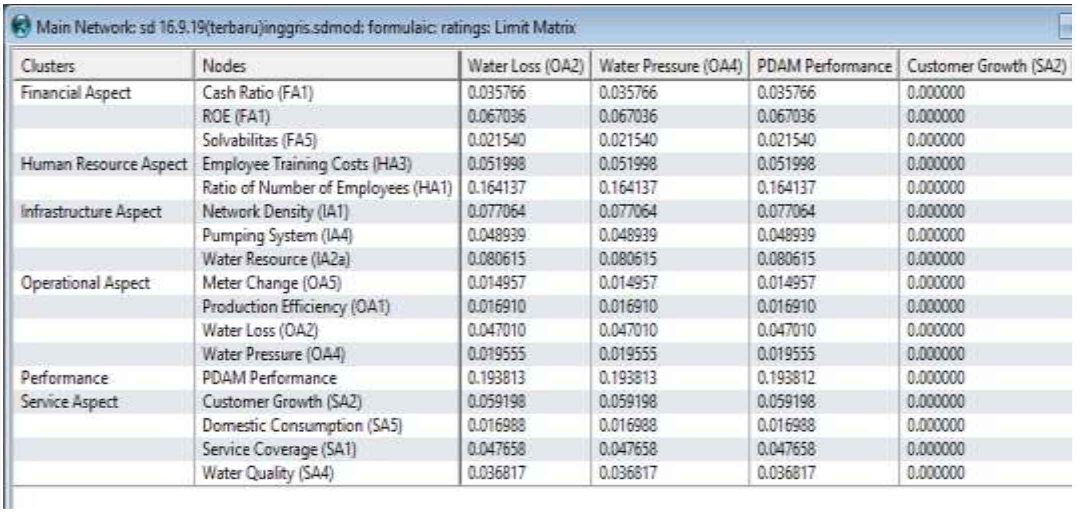

Main Network: sd 16.9.19(terbaru)inggris.sdmod: formulaic: ratings: Limit Matrix

Clusters	Nodes	Water Loss (OA2)	Water Pressure (OA4)	PDAM Performance	Customer Growth (SA2)
Financial Aspect	Cash Ratio (FA1)	0.035766	0.035766	0.035766	0.000000
	ROE (FA1)	0.067036	0.067036	0.067036	0.000000
	Solvabilitas (FA5)	0.021540	0.021540	0.021540	0.000000
Human Resource Aspect	Employee Training Costs (HA3)	0.051998	0.051998	0.051998	0.000000
	Ratio of Number of Employees (HA1)	0.164137	0.164137	0.164137	0.000000
Infrastructure Aspect	Network Density (IA1)	0.077064	0.077064	0.077064	0.000000
	Pumping System (IA4)	0.048939	0.048939	0.048939	0.000000
	Water Resource (IA2a)	0.080615	0.080615	0.080615	0.000000
Operational Aspect	Meter Change (OA5)	0.014957	0.014957	0.014957	0.000000
	Production Efficiency (OA1)	0.016910	0.016910	0.016910	0.000000
	Water Loss (OA2)	0.047010	0.047010	0.047010	0.000000
	Water Pressure (OA4)	0.019555	0.019555	0.019555	0.000000
Performance	PDAM Performance	0.193813	0.193813	0.193812	0.000000
Service Aspect	Customer Growth (SA2)	0.059198	0.059198	0.059198	0.000000
	Domestic Consumption (SA5)	0.016988	0.016988	0.016988	0.000000
	Service Coverage (SA1)	0.047658	0.047658	0.047658	0.000000
	Water Quality (SA4)	0.036817	0.036817	0.036817	0.000000

Figure 6: Limit Supermatrix of ANP Model

After getting the limit matrix, we could obtain the final result of the weighted attribute of ANP. Prioritization of the parameters affects the quality of water drinking could be rearranged and reconsidered. Table 3 shows the priority of each alternatives using ANP.

Table 3: Prioritization between Alternatives after Getting the Weight from Criteria

Name	Ideals	Normals	Raw
Kab. Grobogan	0.223226	0.010257	0.010257
Kab. Wonogiri	0.426252	0.019585	0.019585
Kab. Banjarnegara	0.439207	0.020181	0.020181
Kab. Magelang	0.486326	0.022346	0.022346
Kab. Banyumas	0.49225	0.022618	0.022618
Kab. Karanganyar	0.520558	0.023918	0.023918
Kab. Boyolali	0.521871	0.023979	0.023979
Kab. Purworejo	0.523848	0.02407	0.02407
Kab. Semarang	0.535869	0.024622	0.024622
Kab. Sukoharjo	0.551886	0.025358	0.025358
Kab. Sragen	0.555393	0.025519	0.025519
Kab. Kendal	0.556926	0.025589	0.025589
Kab. Cilacap	0.575277	0.026433	0.026433
Kab. Pekalongan	0.589314	0.027078	0.027078
Kota Pekalongan	0.589314	0.027078	0.027078
Kota Surakarta	0.595782	0.027375	0.027375
Kab. Pati	0.601421	0.027634	0.027634
Kab. Blora	0.602204	0.02767	0.02767
Kota Magelang	0.608234	0.027947	0.027947
Kab. Brebes	0.613222	0.028176	0.028176
Kab. Purbalingga	0.639692	0.029392	0.029392
Kab. Kebumen	0.641648	0.029482	0.029482
Kab. Pemalang	0.668435	0.030713	0.030713
Kab. Jepara	0.67462	0.030997	0.030997
Kab. Klaten	0.684843	0.031467	0.031467
Kab. Kudus	0.688669	0.031643	0.031643
Kab. Demak	0.695774	0.031969	0.031969
Kab. Rembang	0.696308	0.031994	0.031994
Kota Semarang	0.728229	0.03346	0.03346
Kab. Temanggung	0.766371	0.035213	0.035213
Kab. Tegal	0.768936	0.035331	0.035331
Kota Tegal	0.772419	0.035491	0.035491
Kota Salatiga	0.809802	0.037209	0.037209
Kab. Batang	0.919772	0.042261	0.042261
Kab. Wonosobo	1	0.045948	0.045948

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As a comparison with BPPSPAM assessment, we could get Table 4. Table 4 shows different ranking orders from the result gained from ANP. This result shows that the infrastructure aspect changes the order of healthy ranking because it also has a relation with another aspect.

Table 4: Prioritization from BPPSPAM

Name	Rating
Kab. Wonogiri	0.36
Kab. Banjarnegara	0.36
Kab. Temanggung	0.43
Kab. Kendal	0.43
Kab. Kudus	0.43
Kab. Pekalongan	0.43
Kab. Purbalingga	0.43
Kab. Karanganyar	0.43
Kab. Demak	0.43
Kab. Pati	0.43
Kota surakarta	0.43
Kab. Grobogan	0.45
Kab. Tegal	0.47
Kota semarang	0.47
Kab. Sukoharjo	0.47
Kab. Rembang	0.47
Kota pekalongan	0.47
Kab. Boyolali	0.47
Kab. Batang	0.51
Kab. Wonosobo	0.51
Kab. Semarang	0.51
Kab. Pemalang	0.51
Kab. Purworejo	0.51
Kab. Sragen	0.55
Kab. Magelang	0.55
Kota magelang	0.55
Kota salatiga	0.59
Kab. Klaten	0.59
Kab. Blora	0.59
Kab. Jepara	0.59
Kab. Brebes	0.59
Kab. Cilacap	0.59
Kota tegal	0.59
Kab. Kebumen	0.63
Kab. Banyumas	0.63

For example Kab. Temanggung which is one region in Central Java has a better performance in the ANP network than in BPPSPAM assessment. The infrastructure aspect has a relation to the financial aspect so there is some assessment criteria that increasing together.

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To make sure about ranking reordering, needed some adjustment in terms of vector distance between all criteria to the previous assessment. Saaty compatibility index is one adjustment that needed in ANP new weighting priority. To get Saaty compatibility index, S, between two vectors which are x and y is obtained with Hadamard Product Operator (Garuti & Salomon, 2017).

$$S = (1/n^2)\mathbf{e}^T\mathbf{A}\bullet\mathbf{B}^T\mathbf{e} \qquad (2)$$

Where n is the number of elements of the vectors, e is a column-matrix with all elements equal to 1,$a_{ij} = x_i/x_j$, $b_{ij} = y_i/y_j$, and $\bullet$ is the Hadamard product. Table 5 shows an example compatibility index for six regions.

Table 5: Hadamard Product of Saaty Compatibility Index

	A1	**A2**	**A3**	**A4**	**A5**	**A6**
A1	1	1.03	1.05	1.04	1.05	1.03
A2	0.968	1.00	1.01	1.00	1.01	0.99
A3	0.951	0.98	1.00	0.99	1.00	0.98
A4	0.958	0.99	1.00	1	1.01	0.99
A5	0.948	0.98	0.99	0.98	1	0.98
A6	0.967	1.00	1.01	1.00	1.01	1

Cell sum of the previous matrix	**1278.487082**
Number of Alternatives	**35**
Saaty Compatibility Index = Sum/n2**	**1.043662924**

Saaty compatibility index between the eigenvector and the vector of distance is 1.04. This is an indication that these vectors are still narrow from the BPPSPAM although ranking is reordered. The index shown in Table 5 from each alternative does not have the same distance as the BPPSPAM rating. Elements from the eigenvector are the sum to 1, since the normalized eigenvector gives the relative priority of its elements, although the elements from the BPPSPAM vector sum ranging from 0.1 to 1 in Table 4.

IV. Conclusion

The important result of this research is the inner relation and external relation of its criteria is affecting the ranking judgment. Therefore, a total weighting of infrastructure aspect is affected by the financial aspect which is in the previous assessment weight 25%, but in the ANP only about 15%. The financial aspect also affects the human resource aspect and operational aspect which in previous assessment gained almost 25% and 15%, now becoming only 12% and for human resources absolutely changing to 30%. ANP network is changing the previous alternatives with good financial with bad human resources to the lower the ranking rather than bad financial with good human resources. Alternatives that stay in the position is the good in infrastructure as its alternative and also have a better human resource than financial. This research that based on ANP helped to identify not only the new factor need to be considered but also the old factor need to be reconsidered. So for the conclusion, it would be a lot of challenge to make a healthy water drinking company. There is one aspect could be determined but there is one aspect affected by the hidden criteria must be reorganized. From the network of the ANP, we could show that relation is the important point to affect the known aspect. From previous research, we could know that several aspects is having not positive influence so we need to remove them to make the judgment in the new network becomes more accurate. Although the ranking is changing, the closeness from the BPPSPAM assessment could be proved that have close relationships with pure matrix, eigenvector, and also vector relation distance measurement. From this point, we could consider that there is a lot of hidden factor rather found in purely base vector.

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