



Decision Support System at PDAM Tirta Sari City of Binjai Using the Decision Tree Method in Determining Maintenance Actions for Clean Water Distribution Networks

Imam Hidayat^{1*}, Rusmin Saragih², Magdalena Simanjuntak³

^{1,2,3}STMIK Kapuama Binjai

imamh5754@gmail.com^{1*}, fevitha12014@gmail.com², magdalena.simanjuntak84@gmail.com³

Abstract

Water is a very important need for human survival, without water there would be no life on earth. Every region should have clean water service management for community needs, especially in Binjai City which is managed by PDAM Tirta Sari, a company owned by the Binjai City government. Problems that often occur during this time are that water distributed to residents sometimes experiences problems such as difficulty in flowing water to residents' homes, leaks in distribution pipes, dirty water or smelly water if there is heavy rain. Based on the problems above, it is necessary to observe the causes of problems that occur in the distribution of clean water in the city of Binjai. As the community grows and the increasing number of people requesting the installation of new drinking water meters causes pressure on water distribution in the Binjai area, there is a problem of not being able to distribute water normally, therefore it is necessary to examine which areas need to be improved so that water distribution can be even by applying algorithms. DecisionTree. Based on the problem of maintaining the clean water distribution network, it requires a decision-making method that is able to accommodate complex problems, which provides a value to support a decision. One method that can be used is a decision tree. This method is a method that tries to find discrete approximation functions, and was built using the ID3 algorithm (Iterative Dychotomizer Version 3), and for ranking using risk analysis. The system is designed using the PHP programming language with a MySQL database. From the results of the decision tree above, it is known that node 1.1 is routine inspection, routine maintenance is carried out to check problems that occur in the field with the aim of ensuring that water distribution can flow normally to residents' homes, node 1.2 monitors water quality, node 1.3 pipe maintenance, node 1.4 changes equipment and nodes 1.5 checking water pressure, where the PDAM will check the water pressure if it is known that the water in the reservoir has decreased, then it is ensured that the distributed water pressure reaches the minimum standard so that the water can reach residents' homes.

Keywords: Decision Support Systems, Distribution, Clean Water, Decision Tree Method, PHP Programming, MySQL Database

1. Introduction

Water is a very important need for human survival, without water there would be no life on earth. 65% of the human body consists of water. The Earth contains a large amount of water, approximately 1.4 x 10⁹ km³, consisting of oceans, seas, rivers, lakes, icebergs, and so on. However, of all the water contained on earth, only 3% is fresh water found in rivers, lakes and groundwater [1].

Each region should have clean water service management for community needs, especially in Binjai City which is managed by PDAM Tirta Sari, which is a company owned by the government of Binjai City. The problem that often occurs so far is that the water that is distributed to residents sometimes experiences problems such as difficulty flowing water to residents' homes, leaks in distribution pipes, dirty water or water that smells bad when there is heavy rain. From the problems above, it is necessary to observe the causes of the problems that occur in the distribution of clean water in Binjai City.

The growing community and the increasing number of enthusiasts requesting the installation of a new drinking water meter has caused pressure on the distribution of water in the Binjai area to experience the problem of not being able to distribute water normally, therefore it is necessary to analyze which areas must be repaired so that the distribution of water can be evenly distributed by implementing an algorithm Decision Trees.

Based on the problems regarding the maintenance of clean water distribution networks, it requires a decision-making method that is able to accommodate complex problems, which provides a value to support a decision. One method that can be used is a decision tree (Decision Tree). This method is a method that seeks to find discrete approach functions, and is built using the ID3 algorithm (Iterative Dychotomizer Version 3), and for ranking using risk analysis [2].

The aim of this research is to find out the procedures for determining the clean water distribution network maintenance system at PDAM Tirta Sari Kota Binjai, to apply the decision tree method to a decision support system to determine the clean water distribution network maintenance system and to analyze, design and build a system. decision support for determining the clean water distribution network maintenance system at PDAM Tirta Sari Binjai City. The benefits of the research made are to provide solutions in determining the clean water distribution network maintenance system at PDAM Tirta Sari Kota Binjai, provide objective decisions on the maintenance of clean water distribution networks and produce decision support system software in maintaining clean water distribution networks by applying the Decision Tree method .

2. Metodologi Penelitian

This section discusses the research methodology along with its stages. This research methodology aims to describe all the stages of activities carried out during the research so that they are in accordance with the objectives that have been determined. The stages carried out can be seen in the following picture:

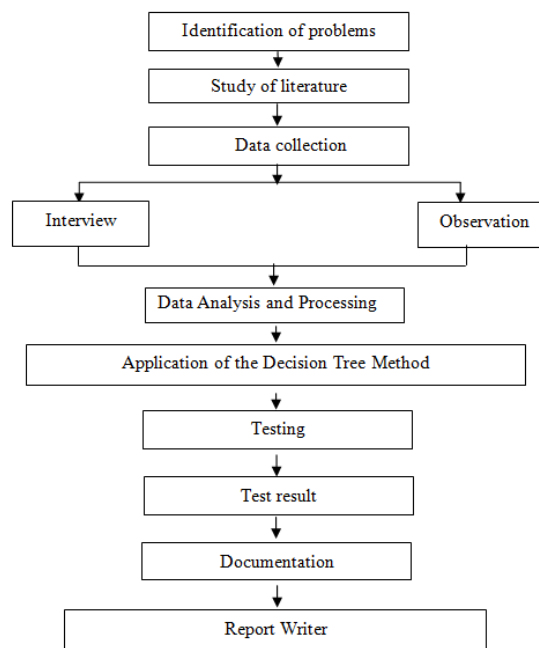


Fig. 1: The structure of the research methodology

Based on the research framework that has been described previously, it can be described the discussion of each stage in the research as follows:

1. Identify the Problem
The problem identification stage is the author's way of being able to predict, estimate and describe what is currently the problem in determining the maintenance actions of the clean water distribution network at PDAM Tirta Sari Binjai.
2. Literature Study
The Literature Study Stage is an understanding of the object to be studied, by reading various reference sources such as books, journals, and other reading sources.
3. Data Collection
This data collection stage will be used in conducting research by searching for data to obtain the information needed by this researcher, namely by means of interviews and observations that aim to support the research to be carried out.
 - a. Interview
This interview was conducted to obtain additional information from the parties concerned, such as checking clean water to carry out maintenance of the distribution network at PDAM Tirta Sari Binjai.
 - b. Observation
Observation is a data collection technique by conducting direct observation of PDAM Tirta Sari Binjai.
4. Data Analysis and Processing
After collecting the data, at this stage the data will be analyzed to find out whether the data can be used to determine maintenance actions for the clean water distribution network at PDAM Tirta Sari Binjai, after being analyzed, the data processing stage is used to determine the work to be done .
5. Application of the Decision Tree Method
After carrying out analysis and identification, the next stage is the application of the Decision Tree method to determine maintenance actions for the clean water distribution network at PDAM Tirta Sari Binjai.
6. Testing
The testing stage is to test the system that has been designed to determine maintenance actions for the clean water distribution network at PDAM Tirta Sari Binjai by applying the Decision Tree method. This stage is carried out to find out whether the system built is running or not.
7. Analysis of Test Results
Stages of Test Results carried out the testing process then the results of the test are re-analyzed to ensure whether these results are in accordance with the objectives of this research.
8. Documentation
The documentation stage is the stage that will display the results of the application of the Decision Tree method for determining maintenance actions for the clean water distribution network at PDAM Tirta Sari Binjai for the system built and also research reports from research made.
9. Report Writer
The last stage in this research is writing a research report. At this stage, the process and problems encountered in the research will be described in the form of a report. The research results can be used in the future.

2.1. Decision Support System

Decision Support Systems (DSS) are a way of organizing information intended for use in making decisions. Some define that a decision support system is an approach to supporting decision making. Decision support systems use data, provide an easy user interface and can combine the thinking of decision makers (Simorangkir, Saidah, et al., 2022). Decision Support Systems are interactive information systems that provide information, modeling and data manipulation. The system is used to assist decision making in semi-structured situations and unstructured situations.

Decision Support System (DSS) is an information system that helps decision makers to make decisions in conditions that are not patterned and unstructured. DSS itself is a system that can be instructed to make an ideal decision in a structured and programmed situation, to expand capabilities and decisions that cannot be supported by a series of ordinary algorithms [3], [4].

2.2. Maintenance of Clean Water

Water is a basic need in human life, which is usually used by humans. Drinking water for the community is the responsibility of the Regional Drinking Water Company (PDAM). Regional Drinking Water Companies can make a very important contribution to helping provide safe drinking water for communities in all corners of Indonesia for consumption. as well as in carrying out their daily activities (Suratmojo et al., 2022).

Periodic maintenance requires a longer period of time in monthly, quarterly or yearly periods. Periodic maintenance is carried out on raw water units, production units and transmission networks, distribution units and service units and their components based on applicable regulations. Maintenance can be done with the following steps:

- a. Always keep the raw water area clean from rubbish, aquatic plants, water weeds, water hyacinth, animal carcasses, tree trunks.
- b. Aesthetically, this rubbish is unsightly and can affect raw water extraction capacity.
- c. Fallen tree trunks are also dangerous, if they are swept away by floodwater they can hit bridges, pontoons, pipe stands.
- d. The gabions at the front and sides of the intake building must remain intact to protect against landslides.

2.3. Decision Tree Method

The Decision Tree method is based on a divide-and-conquer approach for classifying a problem (Solehuddin et al., 2022). The algorithm works from top to bottom, searching at each stage for attributes to divide them into the best parts of that class, and processing recursively the subproblems resulting from that division [5]. This strategy produces a Decision Tree which can be converted into a set of classification rules.

Decision Tree is a classification method that uses a tree structure representation where each node represents an attribute, the branches represent the value of the attribute, and the leaves represent the class. The topmost node of the Decision Tree is called the root . In the Decision Tree there are 3 types of nodes, namely:

1. Root Node, is the top node, at this node there is no input and can have no output or have more than one output.
2. Internal Node, is a branching node, this node only has one input and has a minimum of two outputs.
3. Leaf node or terminal node, is the final node, at this node there is only one input and no output.

Building a classification with a Decision Tree goes through several stages as follows:

1. First, prepare training data which is usually taken from historical data or past data which is then created into certain classes.
2. Calculate the entropy value which will be used to calculate the gain value for each attribute so that the attribute with the highest gain value is obtained which will then be used as the root of the tree. The formula for calculating entropy and gain is as shown in equations (1) and (2):

$$\text{Entropy (s)} = \sum_{n=1}^n - p_i \text{Log} \quad (1)$$

Information:

S= Set of cases

n = number of S partitions

Pi = proportion of Si to S

$$\text{Gain (S,A)} = \text{Entropy (s)} - \sum_{n=1}^n - \text{Entropy}_{p_i} \quad (2)$$

Information:

S = Case Set

A = Features

n = number of attribute A partitions

|Si| = Proportion of Si to S

|S| = number of cases in S

3. Continue to repeat the previous step, namely calculating the value of each attribute based on the highest gain value until all records are partitioned.
4. The process of this Decision Tree will stop if all records in node N have the same class, there are no attributes in the records that are partitioned anymore, and there are no records in the branch that are empty.

3. Analysis and Design

3.1. Process analysis of the Decision Tree method

As for some sample data obtained during research and interviews at the PDAM Tirta Sari Binjai office regarding the determination of maintenance actions for the clean water distribution network, by determining several criteria including:

Table 1: Research data

No	Pipeline	Routine Checkup	Pipe Maintenance	Equipment Change	Water Quality Monitoring	Water Pressure Check	Decision
1	Jl.Sudirman	Yes	No	Yes	Clean	>0,7 bar	Repair
2	Jl. Ahmad Yani	Yes	No	No	Clean	>0,7 bar	Maintenance
3	Jl. Diponegoro	Yes	No	Yes	Dirty	<0,5 bar	Maintenance
4	Jl. Pahlawan	Yes	No	Yes	Dirty	<0,5 bar	Maintenance
5	Jl. Gatot Subroto	No	Yes	No	Dirty	>0,7 bar	Repair
6	Jl. Patimura	No	Yes	No	Dirty	>0,7 bar	Repair

No	Pipeline	Routine Checkup	Pipe Maintenance	Equipment Change	Water Quality Monitoring	Water Pressure Check	Decision
7	Jl. Veteran	No	Yes	No	Dirty	<0,5 bar	Maintenance
8	Jl. A.H Nasution	No	Yes	No	Dirty	>0,7 bar	Repair
9	Jl. Pemuda	No	No	No	Dirty	<0,5 bar	Maintenance
10	Jl. Imam Bonjol	Yes	No	Yes	Clean	>0,7 bar	Repair
11	Jl. Merdeka	No	No	Yes	Clean	<0,5 bar	Maintenance
12	Jl. Haji Mursyid	No	Yes	Yes	Clean	<0,5 bar	Maintenance
13	Jl. Khatib Sulaiman	Yes	Yes	Yes	Clean	>0,7 bar	Maintenance
14	Jl. Sisingamangaraja	Yes	Yes	Yes	Clean	>0,7 bar	Maintenance
15	Jl. Ahmad Dahlan	Yes	Yes	Yes	Clean	<0,5 bar	Maintenance
16	Jl. Sutomo	Yes	No	Yes	Clean	>0,7 bar	Maintenance
17	Jl. Sisingamangaraja	Yes	No	Yes	Clean	<0,5 bar	Maintenance
18	Jl. Veteran	Yes	Yes	Yes	Clean	>0,7 bar	Maintenance
19	Jl. Martimbang	Yes	Yes	Yes	Clean	<0,5 bar	Maintenance
20	Jl. Sultan Agung	Yes	No	Yes	Clean	<0,5 bar	Maintenance
21	Jl. Merdeka	Yes	No	Yes	Clean	>0,7 Bar	Repair
22	Jl. Haji Mursyid	Yes	No	No	Clean	>0,7 Bar	Repair
23	Jl. Khatib Sulaiman	Yes	No	Yes	Dirty	<0,5 Bar	Repair
24	Jl. Sisingamangaraja	Yes	No	Yes	Dirty	<0,5 Bar	Repair
25	Jl. Ahmad Dahlan	No	Yes	No	Dirty	>0,7 Bar	Repair
26	Jl. Sutomo	No	Yes	No	Dirty	>0,7 Bar	Repair
27	Jl. Sisingamangaraja	No	Yes	No	Dirty	<0,5 Bar	Repair
28	Jl. Veteran	No	Yes	No	Dirty	>0,7 Bar	Repair
29	Jl. Martimbang	No	No	No	Dirty	<0,5 Bar	Repair
30	Jl. Sultan Agung	Yes	No	Yes	Clean	>0,7 Bar	Repair
31	Jl. Teuku Umar	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
32	Jl. Sari Rejo	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
33	Jl. Lintas Sumatra	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
34	Jl. Perintis Kemerdekaan	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
35	Jl. Hang Tuah	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
36	Jl. Hamidah	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
37	Jl. Jawa	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
38	Jl. Minangkabau	No	Yes	Yes	Dirty	>0,7 Bar	Maintenance
39	Jl. Siti Khadijah	No	Yes	Yes	Dirty	>0,7 Bar	Maintenance
40	Jl. Padang Sidempuan	No	Yes	Yes	Clean	>0,7 Bar	Maintenance
41	Jl. Irian	Yes	No	Yes	Clean	>0,7 Bar	Repair
42	Jl. Yos Sudarso	Yes	No	No	Clean	>0,7 Bar	Repair
43	Jl. Dr. Sutomo	Yes	No	Yes	Dirty	<0,5 Bar	Repair
44	Jl. Bunga Raya	Yes	No	Yes	Dirty	<0,5 Bar	Repair
45	Jl. Suka Jaya	No	Yes	No	Dirty	>0,7 Bar	Repair
46	Jl. Setia Negara	No	Yes	No	Dirty	>0,7 Bar	Repair
47	Jl. Cut Nyak Dien	No	Yes	No	Dirty	<0,5 Bar	Repair
48	Jl. Hang Jebat	No	Yes	No	Dirty	>0,7 Bar	Repair
49	Jl. Sei Mencirim	No	No	No	Dirty	<0,5 Bar	Repair
50	Jl. Pelajar	Yes	No	Yes	Clean	>0,7 Bar	Maintenance
51	Jl. Bung Tomo	Yes	No	Yes	Clean	<0,5 Bar	Maintenance
52	Jl. Cempaka	Yes	Yes	Yes	Clean	>0,7 Bar	Maintenance
53	Jl. Sibolga	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
54	Jl. Moh. Jamal Noor	Yes	Yes	Yes	Clean	<0,5 Bar	Maintenance
55	Jl. Samudera	Yes	Yes	Yes	Clean	>0,7 Bar	Maintenance
56	Jl. Letjen Peremboeang	Yes	No	Yes	Clean	<0,5 Bar	Maintenance
57	Jl. Ratulangi	Yes	Yes	Yes	Dirty	<0,5 Bar	Maintenance

Based on the training data of the clean water distribution maintenance network at PDMA Tirta Sari Binjai, calculations were carried out using a Decision Tree as follows:

- a. Determines the initial or output entropy

Is known :

Total number of Instances = 57

Number of Repair Instances = 24

Number of Maintenance Instances = 33

$$\begin{aligned}
 \text{Entropy}(S) &= -P_{\text{Repair}} \log_2 P_{\text{Repair}} - P_{\text{Maintenance}} \log_2 P_{\text{Maintenance}} \\
 &= -\frac{24}{57} \log_2 \frac{24}{57} - \frac{33}{57} \log_2 \frac{33}{57} \\
 &= -0,42 \log_2(0,42) - 0,58 \log_2(0,58) \\
 &= -0,42 * (-1,25) - 0,58 * (-0,79) \\
 &= 0,53 + 0,46 \\
 &= 0,99
 \end{aligned}$$

b. Calculate the Entropy and Information Gain for each attribute to determine the initial node (Note: Log2 value is 0.301).

1. Routine Check Attributes

Table 2: Routine check attributes

Attribute	Status	
	Repair	Maintenance
Yes	12	26
No	12	7

$$\begin{aligned} \text{Entropy (ya)} &= -P_{\text{Repair}} \log_2 P_{\text{Repair}} \\ &\quad - P_{\text{Maintenance}} \log_2 P_{\text{Maintenance}} \\ [\text{Yes}] &= -\frac{12}{38} \log_2 \frac{12}{38} - \frac{26}{38} \log_2 \frac{26}{38} \\ &= -0,32 (-1,64) - 0,68 (-0,56) \\ &= 0,52 + 0,38 \\ &= 0,90 \end{aligned}$$

$$\begin{aligned} [\text{Entropy No}] &= -\frac{12}{19} \log_2 \frac{12}{19} - \frac{7}{19} \log_2 \frac{7}{19} \\ &= -0,63 (-0,67) - 0,37 (-1,43) \\ &= 0,42 + 0,53 \\ &= 0,95 \end{aligned}$$

Calculate the gain with the formula $\text{Gain}(S, A) = \text{Entropy}(S) - \sum_{i=1}^n \frac{|S_i|}{|S|} * \text{Entropy}(S_i)$, so you can get:

[Information Gain, Routine Maintenance Attribute]

$$\begin{aligned} &= 0,99 - \left(\left(\frac{38}{57} \times 0,90 \right) + \left(\frac{19}{57} \times 0,95 \right) \right) \\ &= 0,99 - (0,60 + 0,31) \\ &= 0,99 - 0,91 \\ &= 0,08 \end{aligned}$$

2. Attribute Pipe Maintenance

Table 3: Attribute pipe maintenance

Attribute	Status	
	Repair	Maintenance
Ya	14	12
Tidak	10	21

$$\begin{aligned} [\text{Entropy Value Yes}] &= -\frac{14}{26} \log_2 \frac{14}{26} - \frac{12}{26} \log_2 \frac{12}{26} \\ &= -0,54 (-0,89) - 0,46 (-1,12) \\ &= 0,48 + 0,52 \\ &= 1 \end{aligned}$$

$$\begin{aligned} [\text{Entropy Value No}] &= -\frac{10}{31} \log_2 \frac{10}{31} - \frac{21}{31} \log_2 \frac{21}{31} \\ &= -0,32 (-1,64) - 0,68 (-0,56) \\ &= 0,52 + 0,38 \\ &= 0,90 \end{aligned}$$

$$\begin{aligned} [\text{Information Gain, Pipe Maintenance}] &= 0,99 - \left(\left(\frac{26}{57} \times 1 \right) + \left(\frac{31}{57} \times 0,90 \right) \right) \\ &= 0,99 - (0,46 + 0,49) \\ &= 0,99 - 0,95 \\ &= 0,04 \end{aligned}$$

3. Equipment Change Attribute

Table 4: Equipment change attribute

Attribute	Status	
	Repair	Maintenance
Yes	15	18
No	9	15

$$\begin{aligned} [\text{Entropy Value Yes}] &= -\frac{15}{33} \log_2 \frac{15}{33} - \frac{18}{33} \log_2 \frac{18}{33} \\ &= -0,45 (-1,15) - 0,55 (-0,86) \\ &= 0,52 + 0,47 \\ &= 0,99 \end{aligned}$$

$$[\text{Entropy Value No}] = -\frac{9}{24} \log_2 \frac{9}{24} - \frac{15}{24} \log_2 \frac{15}{24}$$

$$\begin{aligned}
&= -0,38 (-1,40) - 0,63 (-0,67) \\
&= 0,53 + 0,42 \\
&= 0,95
\end{aligned}$$

[Information Gain , Equipment change]

$$\begin{aligned}
&= 0,99 - \left(\left(\frac{33}{57} \times 0,99 \right) + \left(\frac{24}{57} \times 0,95 \right) \right) \\
&= 0,99 - (0,57 + 0,40) \\
&= 0,99 - 0,97 \\
&= 0,02
\end{aligned}$$

4. Water Quality Monitoring Attribute

Table 5: Water quality monitoring attribute

Attribute	Status	
	Repair	Maintenance
Clean	10	16
Dirty	14	17

$$\begin{aligned}
[\text{Entropy Value Yes}] &= -\frac{10}{26} \log_2 \frac{10}{26} - \frac{16}{26} \times \log_2 \frac{16}{26} \\
&= -0,38 (-1,40) - 0,62 (-0,69) \\
&= 0,53 + 0,38 \\
&= 0,91
\end{aligned}$$

$$\begin{aligned}
[\text{Entropy Value No}] &= -\frac{14}{31} \log_2 \frac{14}{31} - \frac{17}{31} \times \log_2 \frac{17}{31} \\
&= -0,45 (-1,15) - 0,55 (-0,86) \\
&= 0,52 + 0,47 \\
&= 0,99
\end{aligned}$$

[Information Gain , Water Quality Monitoring]

$$\begin{aligned}
&= 0,99 - \left(\left(\frac{26}{57} \times 0,91 \right) + \left(\frac{31}{57} \times 0,99 \right) \right) \\
&= 0,99 - (0,42 + 0,53) \\
&= 0,99 - 0,95 \\
&= 0,04
\end{aligned}$$

5. Water Pressure Check Attribute

Table 6: Water pressure check attribute

Attribute	Status	
	Repair	Maintenance
> 7 bar	15	20
< 5 Bar	9	13

$$\begin{aligned}
[\text{Entropy Value Yes}] &= -\frac{15}{35} \log_2 \frac{15}{35} - \frac{20}{35} \times \log_2 \frac{20}{35} \\
&= -0,43 (-1,22) - 0,57 (-0,81) \\
&= 0,52 + 0,46 \\
&= 0,98
\end{aligned}$$

$$\begin{aligned}
[\text{Entropy Value No}] &= -\frac{9}{22} \log_2 \frac{9}{22} - \frac{13}{22} \times \log_2 \frac{13}{22} \\
&= -0,41 (-1,29) - 0,59 (-0,76) \\
&= 0,53 + 0,45 \\
&= 0,98
\end{aligned}$$

[Information Gain , Checking Water Pressure]

$$\begin{aligned}
&= 0,99 - \left(\left(\frac{35}{57} \times 0,98 \right) + \left(\frac{22}{57} \times 0,98 \right) \right) \\
&= 0,99 - (0,60 + 0,38) \\
&= 0,99 - 0,98 \\
&= 0,01
\end{aligned}$$

6. Information Gain Results

The results of the Information Gain for all Attributes to determine the initial node are as follows:

Table 7: Information gain initial node

Attribute	Gain Information
Regular check-ups	0,08
Pipe maintenance	0,04
Equipment change	0,02
Water Quality Monitoring	0,04
Checking Water Pressure	0,01

Based on the results of the highest Information Gain value in the table above, it is known that the attribute used as the initial node is a routine check with an information gain value of 0.08, so the decision tree is depicted as below:

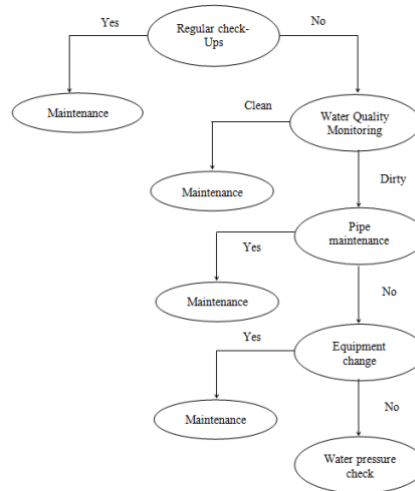


Fig. 2: Decision tree

From the results of the decision tree above, it is known that node 1.1 is a routine inspection, routine maintenance is carried out to check problems that occur in the field with the aim of ensuring that water distribution can flow normally to residents' homes. Node 1.2 Monitoring water quality, PDAM Tirta Sari carries out water monitoring with the aim that the quality distributed to residents' homes must be of good quality and clean, without experiencing water pollution such as chlorine or dirty smells. Node 1.3 Pipe maintenance, the aim of pipe maintenance is to ensure that leaks do not occur along the pipes planted along the side of the road, and also to ensure the capacity of the pipes to distribute water to residents' homes. Node 1.4 equipment replacement, where PDAM Tirta Sari must carry out maintenance on required components such as pipes, water meters, water pumps and so on, with the aim of ensuring that the distribution of clean water is as expected and node 1.5 checking water pressure, where PDAM will carry out Checking the water pressure, if it is found that the water in the reservoir has decreased, ensures that the distributed water pressure reaches the minimum standard so that the water can reach residents' homes.

3.2. System flow design

System design is the initial design in designing applications that will be built with UML system modeling, while the system modeling that will be built is as follows:

1. Use Case Diagrams

Use case diagrams present interactions between use cases and actors. Where, actors can be people, equipment, or other systems that interact with the system being built. Use cases describe the system functionality or requirements that the system must fulfill from the user's perspective:

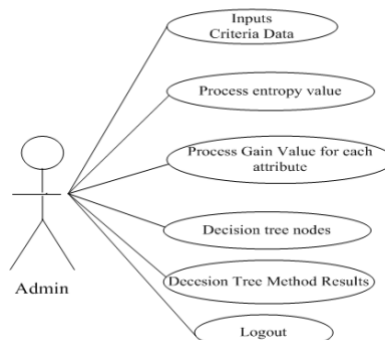


Fig. 3: Designing Use Case Diagrams

To understand more clearly, what will be done by the user in the use case diagram above, it will be explained in the use case scenario as follows:

- a Use Case Data Criteria
Use Case Name : Criteria data

- Actor : Admin
- Description : Imports criteria data
- Precondition : The software has been run
- Process : Admin inputs criteria data
- Final Conditions : The application displays criteria data.
- c. Use Case Process for calculating the Entropy value
 - Use Case Name : Entropy Value
 - Actor : Admin
 - Description : Enter Attribute data on each criterion
 - Precondition : The software has been run
 - Process : Admin processes the entropy value
 - Final Condition : The application displays the results of the entropy value for each criterion
- d. Use Case Process the total Gain value
 - Use Case Name : Process gain value
 - Actor : Admin
 - Description : Process entropy values
 - Precondition : Entropy data is combined from each Attribute
 - Process : Admin processes the results of each Attribute
 - Final Condition : Displays the highest gain value of each criterion and creates a decision tree nood

2. Activity Diagrams

Activity diagrams describe the flow of system functionality. At the business modeling stage, activity diagrams can be used to show business work flow. Can also be used to describe the flow of events in a use case:

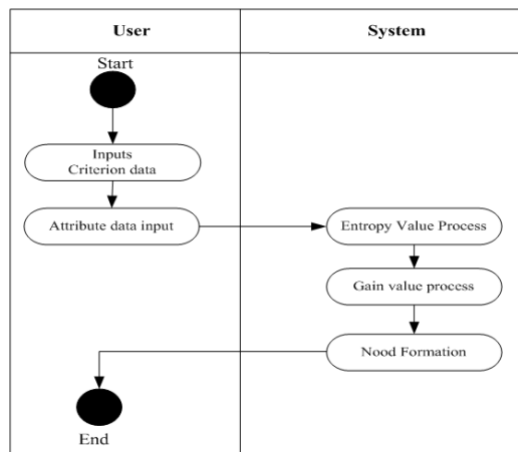


Fig. 4: Perancangan Activity Diagram

3. Program Flowchart

The program flowchart is a more detailed description of how the actual procedure is carried out by a program. This flowchart illustrates the logical sequence of a problem solving procedure. The program flowchart for determining the maximum room rate is shown in the image below:

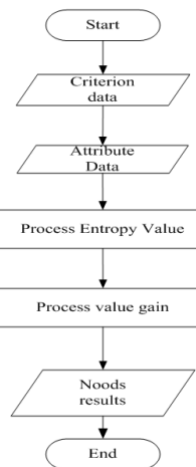


Fig. 5: Perancangan Flowchart

4. Conclusion

The following are the conclusions that the authors wrote in this study related to the decision support system at PDAM Tirta Sari Kota Binjai using the Decision Tree method in determining maintenance actions for clean water distribution networks, namely:

1. The system design will be built using the PHP programming language with a MySQL database. It has succeeded in determining maintenance actions for the clean water distribution network by implementing the Decision Tree method in decision support in the system.
2. In the system being built, the appropriate criteria to be used to support the final results of decisions that are successfully analyzed and applied to the system are routine inspections, pipe maintenance, equipment replacement, water quality monitoring, water pressure checking.
3. Application of the Decision Tree method for a decision support system for selecting the best potential village produce was successful in determining maintenance actions for the clean water distribution network at PDAM Tirta Sari, Binjai City by utilizing the research data provided. Based on the results of the highest Information Gain value in the research results, it is known that the attribute used as the initial node is a routine check with an information gain value of 0.08.

Acknowledgement

In preparing this research, the authors received a lot of help, suggestions and guidance in completing this research, both in the form of guidance and constructive criticism. Through this opportunity, the author would like to express his deepest gratitude to:

1. Mr. Dr. Relita Buaton, S.Kom., M.Kom., as chairman of STMIK Kaputama.
2. Mrs. Yani Maulita, S.Kom., M.Kom., as head of the Information Systems Study Program.
3. Mrs. Rusmin Saragih, S. Kom., M. Kom., as Supervisor I lecturer who provided input that helped the author in completing this research during his guidance.
4. Mrs. Magdalena Simanjuntak, S.Kom., M.Kom., as Supervisor II lecturer who has provided input that helped the author in completing this research during his guidance.
5. All STMIK Kaputama teaching lecturers who have provided a lot of knowledge while the author was attending lectures.
6. All staff and employees of STMIK Kaputama who have provided enthusiasm and good administrative services, while the author completes his lectures.
7. Especially for my father, mother and the entire family who have provided enthusiasm, affection, support and sincere prayers while the author was attending lectures at STMIK Kaputama.
8. And also all friends from the Information Systems Study Program class of 2019, who have provided support, sincere prayers and encouragement to the author during his lectures at STMIK Kaputama.

References

- [1] A. Damayanti, G. Z. Mulki, and R. A. Ayuningtyas, "Analisis kebutuhan air bersih domestik di desa kedamin darat dan desa kedamin hilir," *J. Muara Sains, Teknol. Kedokt. dan Ilmu Kesehat.*, vol. 2, no. 1, 2018.
- [2] M. A. Amri, D. Hartama, and A. P. Windarto, "Penerapan Data Mining Pada Presentasi Penerimaan Imunisasi Anak-Anak Menurut Provinsi Menggunakan K-Means Clustering," *Semin. Nas. Teknol. Komput. Sains*, vol. 9, no. 2, 2020, doi: 10.31294/swabumi.v9i1.8363.
- [3] S. Sunarti, "Sistem Pendukung Keputusan Untuk Promosi Jabatan Menggunakan Metode SMART (Simple Multi Attribute Rating Technique)," *JOINS (Journal Inf. Syst.)*, vol. 5, no. 2, 2020, doi: 10.33633/joins.v5i2.3616.
- [4] R. Maulana, N. Suryani, and D. C. P. Buani, "Sistem Pendukung Keputusan Pemilihan Alat Kontrasepsi Terbaik Metode SMART (Simple Multi Attribute Rating Technique) Bagi Keluarga Berencana," *EVOLUSI J. Sains dan Manaj.*, vol. 9, no. 1, 2021, doi: 10.31294/evolusi.v9i1.9940.
- [5] Y. Partogi and A. Pasariibu, "Perancangan Metode Decision Tree Terhadap Sistem Perpustakaan STMIK Kuwera," *J. Sist. Inf. dan Teknol.*, vol. 1, no. 2, 2022, doi: 10.56995/sintek.v1i2.4.