GEOGRAPHIC INFORMATION SYSTEM INFRASTRUCTURE DAMAGE HANDLING IN PDAM TIRTA ANOM KOTA BANJAR

Arif Muhamad N[1], Tati Harihayati M[2]

[1,2] Teknik Informatika – Universitas Komputer Indonesia
Jl. Dipatiukur 112-114 Bandung
Email : arifmuhamadnurdin25@gmail.com [1], tati.harihayati@email.unikom.ac.id [2]

ABSTRACT

Perusahaan Daerah Air Minum (PDAM) Tirta Anom Banjar city has services to meet the needs of clean water and drinking water for the people of Banjar City. In meeting the needs of clean water PDAM Tirta Anom has several water treatment infrastructure, piping, reservoir, pipes and office buildings. PDAM Tirta Anom Kota Banjar has the responsibility to handle infrastructure damage based on reports of damage from the community as well as on schedule of periodic maintenance of infrastructure. Monitoring of PDAM Tirta Anom infrastructure is conducted based on monthly report and grouping of location is still in general in Banjar City area only, so that there are constraints in the accuracy of handling damage. Head of Distribution Section requires a system that can monitor all activities handling infrastructure damage, and assist Head of Sub Division of Planning in determining the main priority of handling infrastructure damage.

The proposed solution based on the problems that have been described is building a geographic information system that handles damaged PDAM infrastructure of Tirta Anom City Banjar. The software development analysis approach used is object-oriented analysis, and geographic information system is built on the website, and for the determination of the main priority of handling infrastructure damage using TOPSIS method

Based on the results of testing black box, beta and User Acceptance Test (UAT) that has been done, it can be concluded that the built system has been able to assist the Chief of Distribution Section monitor the handling of infrastructure damage and assist Head of Planning Sub-division in determining the main priority in handling infrastructure damage.

Keywords: Geographic Information System (GIS), Geographic, PDAM, Priority, Handling of Infratructure Damage

1. INTRODUCTION

Tirta Anom Regional Water Company Banjar City was established based on Banjar City Regional Regulation No. 23 of 2004 dated June 24, 2004, and promulgated in Banjar City Goverment Number 24 of 2004, series C. PDAM Tirta Anom Kota Banjar has services to meet the needs of clean water And drinking water for the people of Banjar City. Based on data in August 2016, PDAM Tirta Anom Kota Banjar serves 9,838 customers spread across four sub-districts, with details of Purwaharja sub-district 1,859 subscribers, Banjar 4,220 sub-districts, Pataruman sub-districts 2,995 subscribers and Langensari Sub-district 764 customers. PDAM Tirta Anom Banjar has several infrastructures, such as water treatment plant, reservoir, pipeline and also PDAM office building itself.

Based on interviews with Head of PDAM Tirta Anom Distribution Department of Banjar City, Mr. Edi Muradi, ST that for handling PDAM infrastructure damages in PDAM Tirta Anom Banjar area at this time is started from the existence of complaints of society / customers to PDAM, after the complaint process Head of Section Distribution will send a team from the distribution department to ensure damage to the infrastructure that occurs and if there is damage to the officer will record the tools and materials needed to deal with the damage. After that new Head Distibusi Section sent a team to make improvements. In the process of repair, handling is done by technicians from the PDAM itself and involves PLH (Daily Worker). Sometimes the handling of infrastructure damage is hampered by the ignorance of the PLHs to locate the damage location in detail resulting in delays in the handling of infrastructure damage and sometimes the reported damage location is not appropriate between the time reported with the survey results. In addition, the number of handling of damage done by the PDAM has an impact on the process of monitoring and evaluating the results of damage handling. This resulted in the Chief of Distribution Division having problems in monitoring the work of handling infrastructure damage in PDAM Tirta Anom service area of Banjar City, resulting in less rapid decision making to be taken.

In addition, according to the Head of Sub Division Planning Tattoo Hendarto, S.T at this time to determine the main priority in dealing with infrastructure damage is only based on the time of reporting damage to infrastructure.

Based on the problems that have been described, PDAM Tirta Anom Banjar City needs an information system that can map, present data and information Banjar City, where this system will be expected to assist the Chief of Distribution Division in monitoring the work of handling infrastructure damage and assist Head of Sub Division in determining The main priority in handling infrastructure damage.

2. RESEARCH CONTENTS

2.1 Research Methodology

Research methodology is a process used to solve a logical problem, which requires data to support the implementation of a study. The research methodology that will be used is qualitative method. Qualitative methods guide the research process to focus on the facts in the field. Where the steps will be explained in Figure 1 Research Flow:

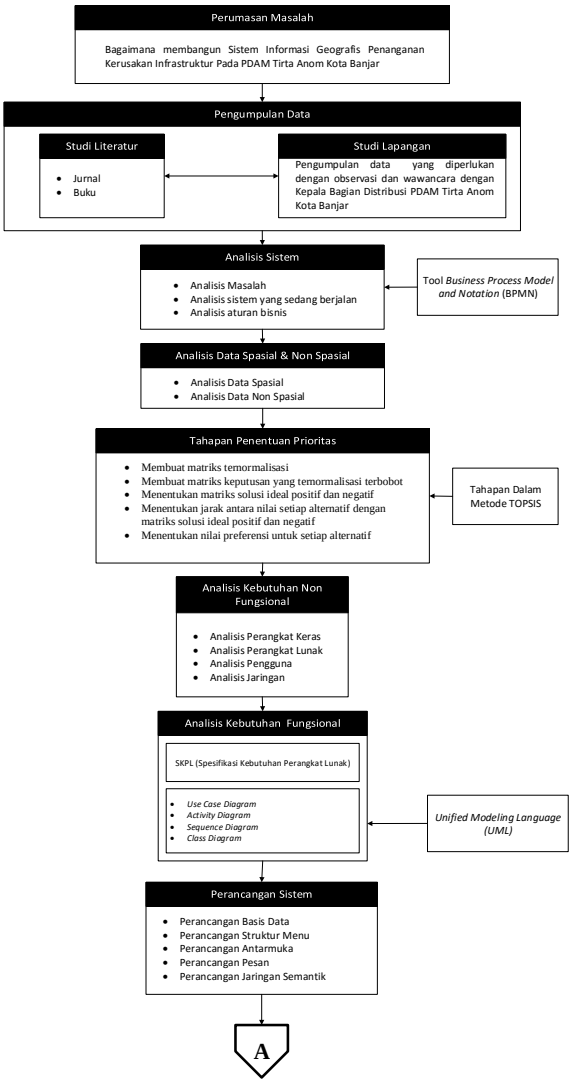


Figure 1. Research Flow (1)

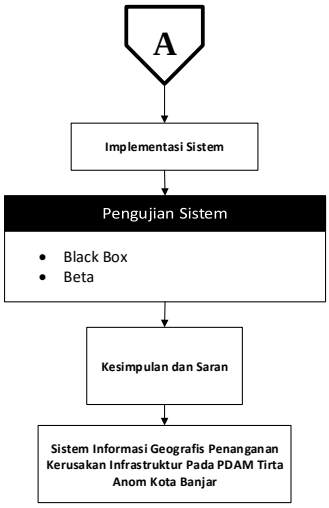


Figure 2. Research Flow (2)

2.3 Theoretical Basis

Theoretical basis used in preparing the final report Geographical Information System Handling Damage Infrastruktrur At Tirta Anom PDAM Banjar City is as follows:

2.2.1 Information System

An information system is a system that receives input or input data and instructions, processes the data in accordance with the instructions and outputs the results. [2]

2.2.2 Geographic Information System

Geographic information systems are computer systems for collecting, examining, integrating, and analyzing information related to the Earth's surface.

Geographic information systems can be broken down into several sub-systems as follows: [2]

a. Data *Input*
b. Data *Output*
c. Data *Management*
d. Data *Manipulation & Analysis*

2.2.3 Spatial Data

The data model is a representation of the recorded geographical objects that can be recognized and processed by the computer. The spatial data model used in the geographic information system is divided into two, namely: [2]

a. Vektor Data Model

The vector data model is the most widely used data model, it is based on points with coordinate values (x, y) to construct its spatial objects. The object built is divided into three parts:

- Point
- Line
- Polygon

b. Raster Data Model

Raster data (also known as grid cells) is data generated from remote sensing systems. In raster data, geographic objects are represented as grid cell structures called pixels (Picture Element). In raster data, the resolution depends on the size of the pixel.

2.2.2.1 *Non-Spatial Data*

Non-spatial data or attribute data is data that represents the description aspect of a modeled phenomenon that includes items and properties. [2]

2.2.2.2 *Layer*

Layers are layers of data so that various types of data in the form of maps, data tables and graphs can be displayed simultaneously in Geographic Information System (GIS) format. Layer can be a polygon image, line, text, symbol or other. [3]

2.2.3 SIG Berbasis Web dan *Platform* Google

Web-based GIS or also often referred to as WebGIS or InternetGIS, is defined as a network (network) based geographic information services that utilize the internet either using wired or wireless network to access geographic information or as a tool to perform spatial analysis. [3]

Google Maps is a form of service from Google that offers the latest mapping technology that can be used for a variety of needs. Google Maps has an open source platform that can be used freely but must comply with the conditions set. Google Maps also gives developers the freedom to develop mapping technology based on Google Maps, enabling features that previously existed on Google Maps. For this development, Google has 2 platform options, namely opensource platform (free) and Enterprise Platform (paid). In this case the development of the Google Maps platform uses a programming language called the Maps API Java Script programming. [3]

2.2.2.3 *Web Based GIS*

The system outline consists of two parts of the home screen as the main screen and Web-based GIS screen (WebGIS). The main discussion in this paper is specific to the discussion of Web-based GIS. In the GIS Web menu, there are several features of spatial analysis that can be used such as route length measurement analysis, area measurement analysis and other supporting features (zoom, pan, scale, search, minimimap), and custom maps in the form of basic maps, Satellite and hybrid (combined base maps and satellite imagery). [3]

2.2.3.1 *Advantages Web Bases GIS*

1. Web-based GIS, can provide spatial information to the public about the spread of areas prone to fire, hydrant, hospitals, fire stations and flood-prone points.
2. Web-based GIS enables people to find out whether their area of residence has been reached with the coverage of firefighting stations, hydrants, police stations and hospitals.
3. With GIS, the spatial and non spatial data presented are more organized and can be updated according to the latest developments. [3]

2.2.4 Decision Support System

Decision Support System (DSS) is an interactive information system that provides information modeling and data manipulation. The system is used to assist decision making in semi-structured situations and unstructured situations, where no one knows exactly how decisions should be made. [4]

2.2.5 TOPSIS Method

The TOPSIS (Ideology Solution) method is based on the concept that the best chosen alternative not only has the shortest distance from a positive ideal solution, but must also have the longest distance from the ideal negative solution. In general the Topsis procedure follows the following steps: [6]

1. Create a normalized matrix

Topsis requires rating on every normalized criteria. The normalized matrix is formed from equation (1) below:

$$rij = \frac{xij}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (1)$$

Symbol Description:

Rij: Performancealized performance rating of each alternative (i) on each criterion (j) with i = 1, 2, ..., m; And j = 1, 2, ..., n.

Xij: The value of each alternative (i) on each criterion (j) with i = 1, 2, ..., m; And j = 1, 2, ..., n.

$\sqrt{\sum_{i=1}^{m} x_{ij}^2}$: The root value of the sum from the starting of the lower boundary is 1 to the upper limit (m) for each of the two-point x to ij which is lifted two.

Where: i = row

J = column

2. Create a normalized weighted decision matrix

After calculating the normalized value, the next step is to calculate the normalized weighted rating by multiplying the value at each preference weight of the normalized matrix by the weights given by the decision maker. The equation in use is equation (2).

Yij = wi. Rij` (2)

Where :

Yij: Normalized weight rating

Wi: The value of each preference weight

Rij: The value of the normalized matrix of each alternative where rij is the normalization value of each alternative (i) to criterion (j) with i = 1, 2, ..., m; And j = 1, 2, ..., n.

3. Determine the matrix of positive ideal solutions and ideal negative solutions..

Solusi ideal positif dan solusi ideal negatif dapat dihitung berdasakan nilai normalisasi terbobot sebagai berikut. Solusi Ideal Positif dapat dilihat pada persamaan (3).

A+ = (y+1,y+2,...,y+n) (3)

Dengan :

yi+ : Max yij : jika j adalah atribut keuntungan

yi- : Min yij : jika j adalah atribut biaya

A+ : Solusi Ideal Positif

(y+1,y+2,...,y+n) : nilai terbesar dari setiap alternatif terhadap setiap kriteria berdasarkan matriks ternormalisasi terbobot (Y).

The Negative Ideal Solution can be seen in (4).

A- = (y-1,y-2,...,y-n) (4)

By:

Yi-: Min yij: if j is an attribute of profit

Yi-: Max yij: if j is a cost attribute

A-: Ideal Negative Solution

(y-1,y-2,...,y-n) : The smallest value of each alternative against each criterion based on a weighted normalized matrix (Y).

4. Determine the distance between the value of each alternative with the positive and negative ideal solution matrix

To determine the distance between the alternatives with the ideal ideal solution can be seen in (5).

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(yij - yi^+)^2} \quad (5)$$

To determine the distance between alternatives with the ideal ideal solution can be seen in equation (6).

$$D_i^- = \sqrt{\sum_{j=1}^{n}(yij + yi^-)^2} \quad (6)$$

Where: i = 1, 2, ..., m; And j = 1, 2, ..., m.

Symbol Description:

The distance between alternatives Ai with the positive ideal solution (yj +) expressed in the symbol Di + is derived from the root value of the sum of values of each alternative obtained with the weighted normalization value for each alternative (yij) minus the positive ideal solution (yi +) then in the second.

The distance between alternatives Ai with the ideal ideal solution (yj-) expressed in symbols obtained from the root value of the sum of values of each alternative obtained with the weighted normalization value for each alternative (yij) minus the positive ideal solution (yi) two.

Specifies the preference value for each alternative

The preference value for each alternative (Vi) can be seen in (7).

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (7)$$

Symbol Description :

Vi : (Nilai preferensi untuk setiap alternatif) di peroleh dari nilai jarak solusi ideal negatif (Di-) dibagi dengan jumlah nilai jarak solusi ideal negatif (Di-) di tambah jumlah nilai jarak solusi ideal negatif (Di+).

2.3 System Analysis

System analysis is a stage that aims to identify the problems contained in the system and determine the needs of the system to be built. The analysis includes problem analysis, ongoing system analysis, business rule analysis, spatial data analysis, non spatial data analysis, decision support system analysis, non-functional analysis.

2.3.1 Spatial Data Analysis

Spatial data is spatial data type, spatial data object consists of three types, namely point form, line, and area. Spatial data is used to provide information about Banjar City area. Spatial data is based on the depiction of As Built Drawing given by the PDAM Tirta Anom Banjar. For more details can be seen in Table 1:

Table 1. Spatial Data Analysis

No	Deskription	Spatial Data	Example
1.	Water Treatment Plant	Coordinate Point / icon	
2.	Reservoir	Coordinate Point / icon	
3.	Pumps	Coordinate Point / icon	
4.	PDAM Tirta Anom Office	Coordinate Point / icon	
5.	Location of undetermined destruction	Coordinate Point / icon	
6.	Main Priority of handling infrastructure damage	Coordinate Point / icon	
7.	Main Priority of handling infrastructure damage	Coordinate Point / icon	
8.	Third Priority handling infrastructure damage	Coordinate Point / icon	
9.	Transmission Pipes	Polyline	
10.	Distribution Pipes	Polyline	

2.3.2 Non Spatial Data Analysis

Non-spatial data (attributes) are individual information of each digital map vector data, non-spatial data is required in this GIS, which will contain information on spatial data. Nonspasial data analysis used to build this system can be seen in Table 2 Non Spatial Data Analysis.

Table 2. Non Spatial Data Analysis

No	Name	Deskription	Atribut
1.	PDAM Tirta Anom Office	Contains about the location of PDAM Tirta Anom Banjar City.	Name, Address, Description.
2.	Pipes	Contains about the data pipe located in PDAM Tirta Anom Banjar City.	Name, Length, Diameter

			and Description
3.	Reservoir	Contains about the reservoir data located at PDAM Tirta Anom Banjar City.	Reservoir name, Reservoir code
4.	Water Treatment Plant	Contains about the data source of spring located in PDAM Tirta Anom Banjar City.	Name, address, description
5.	Pumps	Contains about the pump data located at PDAM Tirta Anom Banjar City	Name, address, description

2.3.2 Priority Analysis of Damage Analysis

The analysis of prioritizing the damage handling aims to find out the priority value of damage handling based on the criteria. In the analysis of prioritizing the handling of the damage is used Topsis calculation method in assessing the criteria on which the priority is determined. Stages in the analysis of prioritization of handling can be seen in the flowchart in Figure 3 Flowchart Determination of the following Priority Handling Damage.

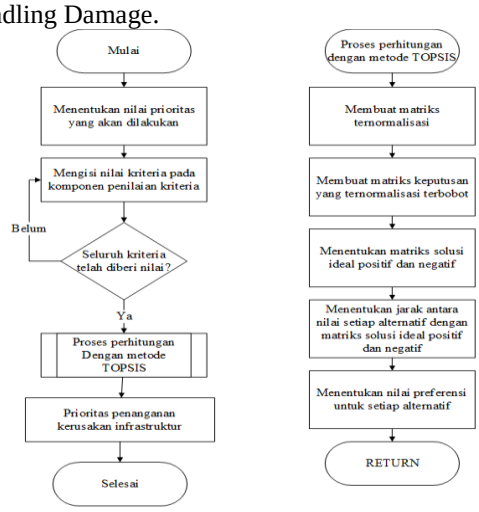


Figure 3. Flowchart Priority Determination Handling Damage

1. Determining Weights and Criteria

Before entering the stage of the topsis calculation, first of the priority determination is to determine the weight and criteria, here are the weights and criteria based on the scale of importance. The scale of interest is obtained from an interview with Mr. Tato Hendarto, S.T as Head of Sub Division of PDAM Tirta Anom Planning Banjar City. The Interest Scale can be seen in Table 3 of the following Interest Scale Table.

Table 3. Interest Scale

Level of Interest	Weight
Very important	3
Important	2
Not important	1

For assessment criteria / criteria for each criterion are given values with a range of values of 1 (one) to 3 (three) values, as shown in Table 4 Damage Level Assessment Criteria, Table 5 Damage Impact Assessment Criteria, Table 6 Criteria for Assessment of Intensity Damage and Table 7 Criteria Assessment Customer Type.

Table 4. Criteria for Rating of Damage Level

Weight Criteria	Criteria
3	Rusak Berat (>= 70%)
2	Rusak (>= 30% - < 70%)
1	Rendah (< 30%)

Table 5. Damage Impact Assessment Criteria

Weight Criteria	Criteria
3	Berdampak Langsung
2	Tidak Berdampak Langsung
1	Tidak Berdampak

Table 6. Criteria for Assessment of Damage Intensity

Weight Criteria	Criteria
3	Sering (> 5x Kejadian)
2	Jarang (> 1x - <= 5x Kejadian)
1	Belum pernah

Table 7. Customer Type Assessment Criteria

Weight Criteria	Criteria
3	Niaga
2	Sosial
1	Rumah Tangga

2. Determining the Alternatives and Criteria to Be Assessed

The next stage is the stage of determining alternatives and criteria that will be used as reference calculations based on data damage reports. Testing using 4 criteria. Criteria that become the reference in making decisions to determine the priority of handling infrastructure damage, namely:

a. C1 = Level of Damage
b. C2 = Impact of Damage
c. C3 = Intensity of Damage
d. C4= Customer Type

3. Case study with damage report on November 3, 2016

The data used are damage report data on November 3, 2016. Based on the criteria of assessment of each parameter criteria, then obtained values for each alternative criteria that can be seen in Table 9 Assessment Criteria.

Table 8. Damage Report Data November 3, 2016

No.	Date	TIme	Report From
			Name
1.	03/11/2016	09.00	Rudi
2.	03/11/2016	09.00	Toto
3.	03/11/2016	09.00	Sarman
Report From		Prolems	

Address		Implementer of improvement
Katapang	pipa pvc Ø pecah kena galian	Toyib
Jl. Brigjen M Isha	pipa jalur bocor	Topik
Haurmukti	Reservoir bocor	Ujang K

From the damage report data on November 3, 2016, it is known that there are three reports at the same time, the three reports are surveyed first and later the report will be selected which of the three reports must be done first.

Table 9. Assessment criteria

Alternative	Criteria	
	C1	C2
Rudi (A1)	35%	Berdampak langsung
Toto (A2)	5%	Berdampak langsung
Sarman (A3)	70%	Tidak berdampak langsung

Criteria	
C3	C4
1x	Rumah Tangga
6x	Rumah Tangga
1x	Niaga

From the data in table 9 the assessment criteria are changed to the weight assessment of each criterion

Table 10. Weight Criteria of each alternative

Alternative	Criteria			
	C1	C2	C3	C4
A1	1	3	1	1
A2	1	3	3	1
A3	3	2	1	3

Weight of Preference (wi) or Weight for each Criterion in case of crash report, it gives the following value which can be seen in Table 10 Assessment for Weight of Preference or Weight for each Criteria.

Table 10. Assessment For Weight Preference or Weight for each Criterion

W1	W2	W3	W4
3	3	2	3

Step calculation using TOPSIS method

1. Create a normalized matrix

The first step in making a normalized matrix is to find the Value of the sum roots of each of the two lift criteria. Where can be seen in Table 11 Matrix Normalized.

Table 11. Normalized Matrix

Alternative	Criteria			
	C1	C2	C3	C4
A1	1	3	1	1
A2	1	3	3	1
A3	3	2	1	3
$\sqrt{\sum_{i=1}^{m} x_{ij}^2}$	3,3166	4,6904	3,3166	3,3166

The next step is to divide the value of each alternative on each criterion with the sum value of the sum of each of the two raised criteria and the acquisition of a finalized decision. Can be seen in Table 12 Results of Decommissioned Decisions

Table 12. The Results of Decisions are Normalized

Alternative	Criteria			
	C1	C2	C3	C4
A1	0,3015	0,6396	0,3015	0,3015
A2	0,3015	0,6396	0,9045	0,3015
A3	0,9045	0,4264	0,3015	0,9045

2. Create a weighted normalized decision matrix

After calculating the normalized value, the next step is to calculate the normalized weighted rating by multiplying the value at each preference weight of the normalized matrix by the weights given by the decision maker. The result of weighted Normalization can be seen in Table 13 Result of weighted Normalization.

Table 13. Weighted Normalization Results

Alternative	Criteria			
	C1	C2	C3	C4
A1	0,9045	1,9188	0,603	0,9045
A2	0,9045	1,9188	1,809	0,9045
A3	2,7135	1,2792	0,603	2,7135

3. Determine the matrix of positive and negative ideal solutions

Positive and negative ideal solutions can be calculated based on the value of weighted normalization. Where the formula used is if the attribute of profit because all existing data is an attribute of profit. The first step is to look for Max and Min of any weighted normalization, can be seen in Table 14 Positive and Negative Ideal Solution Matrices.

Table 14. Positive and Negative Ideal Solution Matrices

Alternative	Criteria			
	C1	C2	C3	C4
A1	0,9045	1,9188	0,603	0,9045
A2	0,9045	1,9188	1,809	0,9045
A3	2,7135	1,2792	0,603	2,7135
A+	2,7135	1,9188	1,809	2,7135
A-	0,9045	1,2792	0,603	0,9045

4. Determine the distance between the value of each alternative with the positive and negative ideal solution matrix

To determine the distance between alternatives with a positive ideal solution to determine the distance between alternatives with the ideal ideal solution. Where the results can be seen in Table 15 Finding the Distance Between Nilat any alternative with the ideal positive and negative solution matrix.

Tabel 15. Finding the Distance Between Any alternative nilate with the ideal positive and negative solution matrix

Search Results D+	
$D1^+$	7,9994
$D2^+$	6,545
$D3^+$	1,8635
Search Results D-	
$D1^-$	2,8387
$D2^-$	1,8635
$D3^-$	6,545

5. Determine the preference value for each alternative

The preference value for each alternative (Vi) where (the preference value for each alternative) is obtained from the value of the ideal ideal solution distance (Di-) divided by the number of negative ideal solution distance value (Di-) plus the value of the ideal ideal solution distance (Di +). The results of the preference values for each alternative can be seen in Table 16 Determining the Value of Preferences for Each Alternative.

Where in this case, the value of i is as follows:
i = 1 for the result of prioritization from Rudi's report
i = 2 for the result of priority determination from Mr.toto's report
i = 3 for the priority determination from Mr Sarman's report

Table 15. Determining the Preference Value for Any Alternative

No	Results of Preference Value For Any Alternative	
1	V1	0,2616
2	V2	0,2216
3	V3	0,7783

Once sorted from the largest to the smallest, then the value of the preference is obtained :

Table 15. Preference Value For Each Alternative

No	Preference value for each alternative	
1	V3	0,7783
2	V1	0,2616
3	V2	0,2216

From result of calculation by using TOPSIS found that report of damage that need to be done first handling is for the main priority handling of bapak sarman (v3), given red point. For the second priority is the handling of Mr. Rudi (v1), given the yellow point and for the third priority is the handling of Mr. Toto (v2), given the green point.

2.4 Monitoring Analysis

The monitoring analysis of the handling of infrastructure damage is carried out to monitor and evaluate the results of the infrastructure damage handling activities undertaken by the Distribution Section. Monitoring and evaluation activities are needed so that the company can prepare everything like raw material needs to be used in the process of handling infrastructure damage.

In the geographic information system that is built, the monitoring is based on data handling damage. The target of each destruction handling in PDAM Tirta Anom Banjar City is 3 working days for handling every 1 infrastructure damage. For detail monitoring per day can be seen in table 16-18 below

Table 16. Monitoring results on the first day

No.	Nama	Alamat	Kegiatan	Tahapan	Hari			Status			Keterangan
					1	2	3	Selesai	Dalam proses	Belum	
1.	Rudi	Katapang	Penanganan Kerusakan Pipa	1. Pengecekan kerusakan 2. Perbaikan pipa	30 %	-	-	-	✓	-	-
2.	Toto	Jl. Brigjen M. Isha	Penanganan Kerusakan Pipa	1. Pengecekan kerusakan 2. Perbaikan pipa	100%	-	-	✓	-	-	-
3.	Sarman	Haurmukti	Penanganan Kerusakan Reservoir	1. Pengecekan kerusakan 2. Perbaikan Reservoir	-	-	-	-	-	✓	-

Table 17. Monitoring results on the second day

No.	Nama	Alamat	Kegiatan	Tahapan	Hari			Status			Keterangan
					1	2	3	Selesai	Dalam proses	Belum	
1.	Rudi	Katapang	Penanganan Kerusakan Pipa	1. Pengecekan kerusakan 2. Perbaikan pipa	30 %	70%	-	✓	-	-	-
2.	Toto	Jl. Brigjen M. Isha	Penanganan Kerusakan Pipa	1. Pengecekan kerusakan 2. Perbaikan pipa	100%	-	-	✓	-	-	-
3.	Sarman	Haurmukti	Penanganan Kerusakan Reservoir	1. Pengecekan kerusakan 2. Perbaikan Reservoir	-	60%	-	-	✓	-	-

Table 18. Monitoring results on the third day

No.	Nama	Alamat	Kegiatan	Tahapan	Hari			Status			Keterangan
					1	2	3	Selesai	Dalam proses	Belum	
1.	Rudi	Katapang	Penanganan Kerusakan Pipa	3. Pengecekan kerusakan 4. Perbaikan pipa	30 %	70%	-	✓	-	-	-
2.	Toto	Jl. Brigjen M. Isha	Penanganan Kerusakan Pipa	3. Pengecekan kerusakan 4. Perbaikan pipa	100%	-	-	✓	-	-	-
3.	Sarman	Haurmukti	Penanganan Kerusakan Reservoir	3. Pengecekan kerusakan 4. Perbaikan Reservoir	-	60%	40%	✓	-	-	-

Based on the monitoring result on the third day it can be concluded that for handling reservoir damage from the report of Mr. Sarman on the third day has reached 100%, it has reached the target in handling the damage.

It can be concluded that all damage handling activities have reached the target as well as for the evaluation material is the level of timeliness for handling the reservoir near the end of the target, so in the future there should be special attention to the handling of reservoir damage by adding officers to carry out the handling of reservoir damage because it has A higher degree of difficulty than handling pipe damage.

2.5 Use Case Diagram

Use case Diagram is a visual representation that represents the interaction between the user and the system, in this case will explain what the system reacts to the role that the user is doing to the system. Use case diagram of the system to be built can be seen in Figure 4 Use Case Diagram.

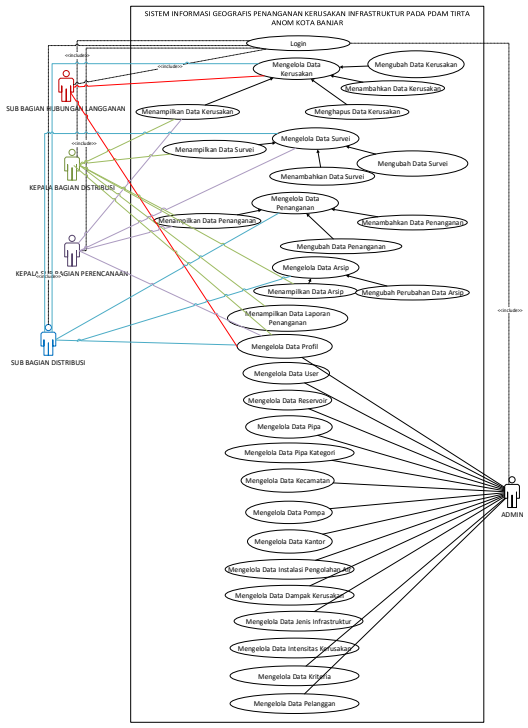


Figure 4. Use Case Diagram Geographic Information System Handling Infrastructure Damage In Tirta Anom PDAM Banjar City

2.6 Relationship Diagram

Geographical information system relation diagram of handling infrastructure damage on PDAM Tirta Anom consists of tables consisting of employee table, survey, goods, complaints, damage, priority, handling. Can dilihata in figure Figure 3. 76 GIS Relation Diagram Handling Infrastructure Damage At Tirta Anom PDAM Banjar City.

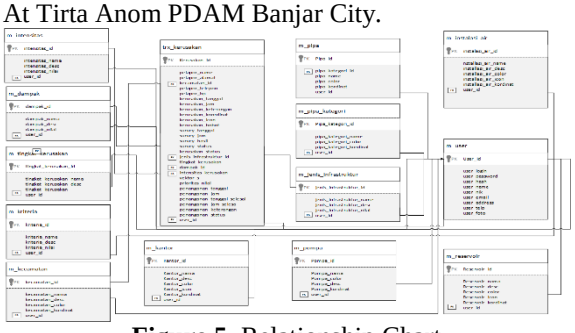


Figure 5. Relationship Chart

3. CLOSING

3.1 Conclusions

Based on the results of the tests and discussions that have been made then got the following conclusion:

1. The system has been able to facilitate the Chief of Distribution Section in terms of monitoring and evaluating the handling of infrastructure damage in the form of visual and geographical facts of the region.
2. The system can assist the Head of Sub Division of Planning in determining the priority of handling infrastructure damage.

3.2 Recommendations

Based on the results achieved in establishing geographic information system for handling infrastructure damage to PDAM Tirta Anom Banjar City still has some shortcomings, therefore there are some suggestions that can complement and develop this system in the future, such as:

1. Geographic Information System Handling of Infrastructure Damage to Tirta Anom PDAM Banjar City must always be monitored continuously so that the data collected is always uptodate and covers all parts of Banjar City for handling better infrastructure damage.
2. Further development of this application system is needed in terms of back-up automatically, so as to reduce the likelihood of occurrence of things that are desired such as data loss due to damage to computers and so on.

ACKNOWLEDGMENTS

The authors would like to thank Regional Water Company of Tirta Anom Banjar City which has been pleased to cooperate in this research.

BIBLIOGRAPHY

[1] W. Banjar, Peraturan Walikota Banjar Nomor 27 Tahun 2015, Banjar, 2015.
[2] E. Prahasta, Sistem Informasi Geografis, Bandung: Informatika, 2014.
[3] Kadir, Pengenalan Sistem Informasi Edisi Revisi, Yogyakarta: Andi Offset, 2014.
[4] E. Irwansyah, Sistem Informasi Geografis : Prinsip Dasar dan Pengembangan Aplikasi, Yogyakarta: Digibooks, 2013.
[5] Turban, E. &. Aronson dan J. E, Decision Support System and Intelligent System. 6th Edition, Prentice Hall : Upper Sadle River, NJ, 2001.
[6] A. Sachdeva, Multi-Factor Mode Critically Analysis Using TOPSIS vol.5, 2009.
[7] Ladjamudin, Rekayasa Perangkat Lunak, Yogyakarta: Graha Ilmu, 2006.
[8] Sutarman, Membangun Aplikasi Web Dengan PHP dan MySQL, Yogyakarta: Graha Ilmu, 2007.
[9] I. B. Sidiq, Pemrograman Web PHP Edisi Revisi, Bandung: Informatika, 2012.
[10] Kadir, Sistem Informasi : Pengenalan Sistem Informasi, Yogyakarta: Andi, 2003.
[11] Rosa, Rekayasa Perangkat Lunak Terstruktur dan Berorientasi Objek, Bandung: Informatika, 2014.
[12] J. Simarmata, Rekayasa Perangkat Lunak, Yogyakarta: ANDI, 2009.