EMITTER International Journal of Engineering Technology
ISSN: 2443-1168, Vol. 8, No. 1, June 2020, pp. 126~139
DOI : 10.24003/emitter.v7i2.423

Comparation of SAW Method and Topsis in Assesing The Best Area Using HSE Standards

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Received November 27, 2019; Revised December 26, 2019; Accepted January 26, 2020

Abstract

PT. Pertamina Gas is a company engaged in the midstream and downstream industry sectors of Indonesian gas. Currently, the process to access the best areas in PT. Pertamina Gas has not been computerizedand it is still doing manually. In assessing the area itself, this method is considered less effective and efficient to determine the best area. Area Assessment according to PT. Pertamina Gas itself is important to iincrease the performance and safety in improving PT. Pertamina Gas Health, Safety, Environment quality. Therefore, we need a system to determine which areas are the best in the PT. Pertamina Gas environment, using predetermined criteria. To create a system commenting on the area in PT. Pertamina Gas Environment, the author used the method Simple Additive Weighting (SAW) and Techniques for Other References With Similarities to Ideal Solutions (TOPSIS) for the best process of conversation and area testing.This study suggests finding the best method for reporting and helping to make decisions based on the best alternative value. The results obtained from this study show that the testing using SAW method is more optimal than using TOPSIS method, with the value of sensitivity change for SAW is 2.4 and TOPSIS is 0.7754.

Keywords: PT. Pertamina Gas, SAW, Topsis, Sensitivity Test, Best Area.

1. INTRODUCTION

Health, Safety and Environmental Protection (K3LL) or also known as Health, Safety and Environment (HSE) become an important part that never escapes the attention of the Company [1]. The Company's line of business is very easy to dispute by removing what is rejected by its employees considering the nature of the gas released is highly flammable. Pertamina is very concerned about safety aspects for workers, therefore it is a given

necessity the company has developed into a strong commitment to make Pertamina Gas always make efforts to improve HSE.

The implementation of HSE is not only carried out by companies, but also all workers, without exception. HSE applies to all matters relating to all activities and the impact of these activities on employees, the environment and the communities in which the company operates [2]. Good coordination between employees and field officers is believed to be able to make all parties aware of the dangers that are always threatening in every operational process. As an effort to increase HSE, one of the efforts carried out by Pertamina gas is to carry out a process of assessing the best areas each year of the areas that are within the scope of the company. The problem with Pertamina gas at this case is conducting an assessment process that has not been computerized with an appropriate system. In the application, there are many obstacles that occur in the assessment of the area, such as errors in inputting values, and in ranking the area still using a simple formula in Excel and there is no system to assist the assessment, they do the assessment manually, without any system or method used in helping in the assessment of decision making. This process will require quite a long time to do the decision system [3].

To facilitate calculations in determining the best area assessment, it is necessary to have a computerized system [4] in assisting the appraisers to assess areas based on existing criteria, and assess which areas are the best [5]. Therefore, the authors try to solve the problem by applying a computer-based decision-making method in processing data areas and criteria to get the decision in accordance with what is expected. In information technology, decision support systems determine one branch of science including information systems and intelligent systems [6]. The SAW method is used because it has a basic concept of weighting and performance rating for each alternative on each attribute [7]. The selection of the SAW method is based because it can determine the value of each weight for various attributes, then proceed with the ranking process which will choose alternatives the best of the number of alternatives, in this case the intended alternative is feasible or not to be awarded as the best area based predicate some criteria predetermined criteria [8]. With the ranking process, it is expected that the assessment will be more precise because it is based on the value of existing criteria and the weighted value predetermined so that you will get more precise results on the area which will be the best in PT.Pertamina Gas [9]. Method Technique for Order Performance of Similarity to Ideal Solution (Topsis) has the provision that the alternative chosen must have the farthest distance from solving positive and negative ideals from the different points of view we see by using a relative closeness of an alternative that is in the case study [10]. By using a TOPSIS method based on a decision-making system that classifies web services according to non-functional needs [11]. The TOPSIS decision method of the linguistic lattice implications of algebra based on the weighted normalization method is proposed to determine the

decision-making process [12]. Therefore, the writer will try to apply the Comparison of SAW and Topsis Methods in the Best Area Assessment Using HSE Standards at PT. Pertamina Gas.

2. RELATED WORKS

In the previous study, SAW and TOPSIS methods are used to implement GIS and multi-criteria decision analysis (MCDA) technique as a multi-criteria method enhance decision making to evaluate areas suitable for planning priority plan for planting corn, and soybean plants [13]. and this method is also used in making decision support systems for help managers choose database management software (DBM) which right for their company, using Simple Additive Weighting (SAW) and (TOPSIS) [14].

3. ORIGINALITY

In this study, it was agreed to create a regional assessment system in PT. Pertamina Gas. Area Assessment according to PT. Pertamina Gas itself fulfills its importance for Improve performance and increase security, Safety, Environment PT.Pertamina Gas. Therefore we need a system, which can determine which areas are the best in the PT. Pertamina Gas environment, using predetermined criteria. This study uses the method of Simple Additive Weighting (SAW) and Techniques For Others. This research is to find the best method in this case and help make decisions about the best alternative value.

4. SYSTEM DESIGN

In this study, the waterfal method is needed so that the research can proceed as expected. The research method is an experimental method that uses the decision support system method in its activities. The flow of research methodology can be seen in Figure 1, which is as follows:

Based on the research Methodology Flow Diagram at Figure 1, the research method is not far from the formulation of the problem, literature study, data collection techniques, analysis of the current system and the system to be built, after which design and coding are done which includes the application of the saw and topsis methods therein. After testing the system and drawing conclusions generated from these trials.

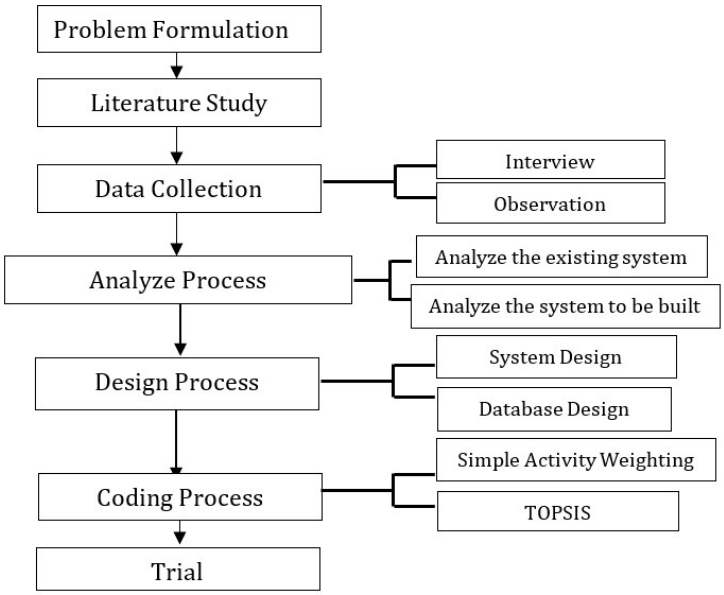

Figure 1. Research Methodology

4.1 Data Set

At this stage steps are needed to gather data needed to achieve research objectives. Successful data collection to start even in data processing. Data collection is done is registration on-going activities. Apart from that also seen several lots documents that must be recorded in the book during the observations made.

4.1.1 Primary Data

Interview: Interview conducted with one of the people HSE part Kuswana who discussed about how to move in the area assessment best, and what problems are common.

Observation: Observation technique is a technique of collecting data by means of researchers make observations directly in the field. Observation method is a method of data collection that is done by observing and record systematically the symptoms investigated. Observation done according to certain procedures and rules so that it can be repeated again by researchers and observations provide the possibility to be interpreted in a manner scientific.

4.1.2 Secondary Data

Secondary data is data taken directly from the company. In this research the company provides alternative data to be assessed, and criteria data as a support in decision making.

Table 1. PT. Pertamina Gas Area

Code	Area Name	Address
A01	North Sumatera Area	Jl. Dr. Wahidin No. 1 Pangkalan Brandan North Sumatera - 20857
A02	Central Sumatera Area	Jl. AKBP Cek Agus No 10, Kenten, Palembang 30114
A03	Southern Sumatera Area	Jl. AKBP Cek Agus No 10, Kenten, Palembang 30114
A04	West Java Area	Komplek Perumahan Dinas Distrik TGD Jl. Raya Industri Tegalgede South Cikarang, Bekasi - 17550
A05	Eastern Java Area	Jl. Darmo Kali No. 40-42 Surabaya 60241
A06	Kalimantan Area	KNE Building, Jl. Pupuk Raya No.55, Bontang Barat, Bontang, East Kalimantan Timur 75313

Table 2. Assessment Criteria

Code	Criteria Name	Weight
C01	HSE Meeting	30%
C02	Fire Drill	20%
C03	Simulasi Tanggap Darurat	20%
C04	Management Walk Throught	15%
C05	Training Aspek QC dan HSE	15%

4.2 SAW Method

The Simple Additive Weighting (SAW) method is often also known as the weighted sum method. one of the basic concepts used in the SAW method is to find the number of rankings for each alternative to all the attributes contained in the data used. The SAW method requires a decision matrix normalization step (X) for a scale that can be compared with all alternative rankings available therein. The SAW method is very well known and is very widely used in facing the challenges of MADM. The steps in completing the SAW Method are:

$$r_{ij}\begin{cases}\dfrac{x_{ij}}{\underset{i}{Max}\, x_{ij}} \\ \dfrac{\underset{i}{Min}\, x_{ij}}{x_{ij}}\end{cases} \quad (1)$$

1. Provide criteria that will be used as a goal in decision-making. Determines the suitability rating of each alternative on each criterion.
2. The next step is to describe the matrix in accordance with existing criteria, then normalize the matrix based on the equation specified by the attribute type so that the obtained matrix image is sought.
3. After that obtained from the ranking process, which is the sum of the multiplications of the normalized vector R matrix, the weight so the

highest value is chosen as the highest or best alternative (Ai) as the solution obtained to take a decision.

4.3 TOPSIS Method

TOPSIS method is a method of decision making with a model of the number of distances between alternatives and ideal solutions. The TOPSIS method was chosen because it is able to choose the best from alternative choices. In this case the alternative is adjusted to the researcher's research, then calculated based on the criteria determined by steps the The TOPSIS method is very simple, very easy to understand, very effective and efficient in its use [15]. Troubleshooting steps with TOPSIS [16] :

1. The first step is to make a normalized decision matrix for usage needs.

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

2. Form a normalized weighted decision matrix.

$$yij = w_{ij} r_{ij} \quad (3)$$

3. Making a matrix of solutions to the ideal ideal problem & the matrix of the ideal ideal solution.

$$y_j^+ = Max\, y_{ij}$$
$$y_j^- = Min\, y_{ij} \quad (4)$$

4. Make the distance between the values of each alternative with a positive ideal matrix & a negative ideal solution matrix.

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_i^+ - y_{ij})^2}$$

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_i^- - y_{ij})^2} \quad (5)$$

5. Make the preference value for each alternative.

$$RC = \frac{D_i^-}{D_i^- + D_i^+} \quad (6)$$

4.4 Sensitivity Test SAW Method and TOPSIS Method

Sensitivity testing is a process of knowing and getting results from a comparison of the two methods. This is done in research to find out how sensitive the method is if applied in a case study, increasingly sensitive value obtained from each ranking change in each method, then the method will be chosen. The degree of sensitivity of each attribute is obtained through the steps as follows [17]:

1. Determine all attribute weights, wj = 1 (initial weight), with j = 1,2, ... number attribute.
2. Change the weight of one criterion while the weight of the other criteria is fixed.
3. Normalize the weight value.
4. Apply the two methods (SAW and Topsis) to weights the attributes formed in step 3.
5. Calculate percentage change in rank by comparing how many a lot of ranking changes that occur when compared with the current conditions the same weight.

5. EXPERIMENT AND ANALYSIS

5.1 Experiment

Area assessment is considered very important for increasing the area and pertamina gas itself. Area assessment is also important as a management tool for assessing area efficiency. In order to improve the performance of areas (including human resource development) the company must pay great attention to the areas covered by employees in it. Therefore the PT. Pertamina gas area is the main target in this assessment.

5.1.1 Saw Method

Based on the steps to determine the best area of PT.Pertamina Gas by using the SAW Method, then what must be done give the value of each Alternative that is in each assessment that has been determined to produce a value that suits your needs.

Table 3. Match Table Ratings of Each Criteria

Alternative	**Provision Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
North Sumatera Area	3	4	4	5	1
Central Sumatera Area	5	3	4	1	5
Southern Sumatera Area	4	5	5	5	1
West Java Area	4	5	4	1	5
Eastern Java Area	3	4	5	5	1
Kalimantan Area	4	5	3	1	1

Then from the above calculation, the normalization matrix value is obtained. Value These will be made into the matrix. The following are the results of the calculation Normalization matrix

Table 4. Normalization Matrix

Alternative	Provision Criteria				
	PC1	PC2	PC3	PC4	PC5
North Sumatera Area	0.6	0.8	0.8	1.0	0.2
Central Sumatera Area	1.0	0.6	0.8	0.2	1.0
Southern Sumatera Area	0.8	1.0	1.0	1.0	0.2
West Java Area	0.8	1.0	0.8	0.2	1.0
Eastern Java Area	0.6	0.8	1.0	1.0	0.2
Kalimantan Area	0.8	1.0	0.6	0.2	0.2

Based on the ranking results, the highest value is the Southern Sumatra Area, and the lowest value is Kalimantan Area.

Table 5. Ranking Results

Alternative	Value	Rangking
North Sumatera Area	0.68	5
Central Sumatera Area	0.76	3
Southern Sumatera Area	0.82	1
West Java Area	0.78	2
Eastern Java Area	0.72	4
Kalimantan Area	0.62	6

5.1.2 TOPSIS Method

Based on the steps to determine the best area of PT.Pertamina Gas by using the TOPSIS Method, then what must be done gives the value of each Alternative on each predetermined criterion.

Table 6. Value Comparation

Alternative	Provision Criteria				
	PC1	PC2	PC3	PC4	PC5
North Sumatera Area	3	4	4	5	1
Central Sumatera Area	5	3	4	1	5
Southern Sumatera Area	4	5	5	5	1
West Java Area	4	5	4	1	5
Eastern Java Area	3	4	5	5	1
Kalimantan Area	4	5	3	1	1

Table 7. Value Divider

Divider	9.5394	10.7703	10.3441	8.8318	7.3845

Table 8. Nomalizaton Matrix

Alternative	Provision Criteria				
	PC1	PC2	PC3	PC4	PC5
North Sumatera Area	0.3145	0.3714	0.3867	0.5661	0.1361
Central Sumatera Area	0.5241	0.2785	0.3867	0.1132	0.6804
Southern Sumatera Area	0.4193	0.4642	0.4834	0.5661	0.1361

West Java Area	0.4193	0.4642	0.3867	0.1132	0.6804
Eastern Java Area	0.3145	0.3714	0.4834	0.5661	0.1361
Kalimantan Area	0.4193	0.4642	0.2900	0.1132	0.1361

Table 9. Chip weight

Criteria	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**
Weightt	0.3	0.2	0.2	0.15	0.15
Cost/Benetfit	Benetfit	Benetfit	Benetfit	Benetfit	Benetfit

Table 10. Weighted Normalized Matrix

Alternative	**Provision Criteria**				
	PC1	**PC2**	**PC3**	**PC4**	**PC5**
North Sumatera Area	0.0943	0.0743	0.0773	0.0849	0.0204
Central Sumatera Area	0.1572	0.0557	0.0773	0.0170	0.1021
Southern Sumatera Area	0.1258	0.0928	0.0967	0.0849	0.0204
West Java Area	0.1258	0.0928	0.0773	0.0170	0.1021
Eastern Java Area	0.0943	0.0743	0.0967	0.0849	0.0204
Kalimantan Area	0.1258	0.0928	0.0580	0.0170	0.0204

Table 11. Value of Positive and Negative Ideal Solutions

Provision Criteria	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**
Yij+	0.1572	0.0928	0.0967	0.0849	0.1021
Yij-	0.0943	0.0557	0.0580	0.0170	0.0204

Table 12. Distance Positive and Negative Ideal Solution

Alternative/Criteria	**S+**	**S-**
North Sumatera Area	0.1065	0.0730
Central Sumatera Area	0.0798	0.1049
Southern Sumatera Area	0.0875	0.0921
West Java Area	0.0773	0.0970
Eastern Java Area	0.1047	0.0803
Kalimantan Area	0.1173	0.0487

Table 13. Relative Proximity Calculation

Alternative/Criteria	**S+**	**S-**	**RC**	**Rangking**
North Sumatera Area	0.1065	0.0730	0.4068	5
Central Sumatera Area	0.0798	0.1049	0.5679	1
Southern Sumatera Area	0.0875	0.0921	0.5128	3
West Java Area	0.0773	0.0970	0.5564	2
Eastern Java Area	0.1047	0.0803	0.4341	4
Kalimantan Area	0.1173	0.0487	0.2932	6

5.1.3 Comparison of SAW and TOPSIS methods

Based on the ranking results with the SAW Method, the highest value is Southern Sumatra Area, and the lowest value is Kalimantan Area.

Table 14. Rangking Result SAW Method

Alternative	Value	Rangking
North Sumatera Area	0.68	5
Central Sumatera Area	0.76	3
Southern Sumatera Area	0.82	1
West Java Area	0.78	2
Eastern Java Area	0.72	4
Kalimantan Area	0.62	6

Whereas in Ranking Results with Topsis Method, the highest value is Central Sumatra Area, and the lowest value is Kalimantan area.

Table 15. Rangking Result Topsis Method

Alternative/Criteria	RC	Rangking
North Sumatera Area	0.4068	5
Central Sumatera Area	0.5679	1
Southern Sumatera Area	0.5128	3
West Java Area	0.5564	2
Eastern Java Area	0.4341	4
Kalimantan Area	0.2932	6

5.1.4 Sensitivity Test

Using the determined value W (weight) = (0.3, 0.2, 0.2. 0.15, 0.15), the resulting comparison of the SAW method and TOPSIS at table 16.

Table 16. Comparison of SAW and TOPSIS methods

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	0.68	0.4068
Central Sumatera Area	0.76	0.5679
Southern Sumatera Area	0.82	0.5128
West Java Area	0.78	0.5564
Eastern Java Area	0.72	0.4341
Kalimantan Area	0.62	0.2932
MAX	0.82	0.5679

Tested by raising the criteria weight by 0.5. Weight (w) = (0.8, 0.2, 0.2, 0.15, 0.15) the value of w in criterion 1 is increased by 0.5.

From the sensitivity test results on the first criteria, it produces the following comparison data at table 17.

Table 17. Sensitivity Criteria 1

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	0.98	0.2793
Central Sumatera Area	1.26	0.7015
Southern Sumatera Area	1.22	0.5073
West Java Area	1.18	0.5313
Eastern Java Area	1.02	0.3
Kalimantan Area	1.02	0.3945
MAX	1.26	0.7015
Change	0.44	0.1336

Using the determined weight (w) = (0.5, 0.7, 0.2, 0.15, 0.15) the value of w in criterion 2 is increased to 0.5. From the sensitivity test results on the second criterion, it produces a comparison at table 18.

Table 18. Sensitivity Criteria 2

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	1.08	0.4376
Central Sumatera Area	1.06	0.4148
Southern Sumatera Area	1.32	0.6390
West Java Area	1.28	0.6713
Eastern Java Area	1.12	0.4548
Kalimantan Area	1.12	0.5327
MAX	1.32	0.6713
Change	0.5	0.1034

Using weight (w) = (0.3, 0.2, 0.7, 0.15, 0.15) the value of w in criterion 3 is increased to 0.5. From the sensitivity test results on the third criterion, it produces a comparison at table 19.

Table 19. Sensitivity Criteria 3

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	1.08	0.4393
Central Sumatera Area	1.16	0.5453
Southern Sumatera Area	1.32	0.6451
West Java Area	1.18	0.5362
Eastern Java Area	1.22	0.5930
Kalimantan Area	0.92	0.2177
MAX	1.32	0.6451
Change	0.5	0.0722

Using weight (w) = (0.3, 0.2, 0.2, 0.65, 0.15) the value of w in criterion 4 is increased to 0.5. From the sensitivity test results on the fourth criterion, it produces a comparison at table 20.

Table 20. Sensitivity Criteria 4

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	1.18	0.7352
Central Sumatera Area	0.86	0.2607
Southern Sumatera Area	1.32	0.7747
West Java Area	0.88	0.2464
Eastern Java Area	1.22	0.7396
Kalimantan Area	0.72	0.1359
MAX	1.32	0.7747
Change	0.5	0.2068

Using weight (w) = (0.3, 0.2, 0.2, 0.15, 0.65) the value of w in criterion 5 is increased to 0.5. From the sensitivity test results on the fifth criterion, it results in the data a comparison at table 21.

Table 21. Sensitivity Criteria 5

Alternative/Criteria	SAW	TOPSIS
North Sumatera Area	0.78	0.1685
Central Sumatera Area	1.26	0.8185
Southern Sumatera Area	0.92	0.2059
West Java Area	1.28	0.8223
Eastern Java Area	0.82	0.1825
Kalimantan Area	0.72	0.1180
MAX	1.28	0.8223
Change	0.46	0.2544

5.2 Result

The percentage of change in rank using the SAW and TOPSIS methodsmin the best area is as shown at Table 22.

Table 22. Percentage of Sensitivity

Alternative/Criteria	SAW	TOPSIS
K1+0.5	0.1336	0.44
K2+0.5	0.1034	0.5
K3+0.5	0.0772	0.5
K4+0.5	0.2068	0.5
K5+0.5	0.2544	0.46
Count	0.7754	2.4

Based on the results of the summation above, it can be concluded that the method of SAW has a sensitivity value of 2.4 meanwhile Topsis is 0.7754. Thus, for this case an alternative solution or the recommended method is to use the SAW Method.

6. CONCLUSION

After doing the research, we can conclude that using the provided process, the best area in PT. Pertamina Gas can be assisted and provided in

Health, Safety and Environment case in the assessment of existing areas for distribution of PT. Pertamina Gas. Based on several criteria and applying the SAW and Topsis methods, the process of announcing areas in PT. Pertamina Gas could be made easily. According to the results of the sensivity test, it can be concluded that the method of SAW has a sensitivity value of 2.4 meanwhile Topsis is 0.7754.

Acknowledgements

This research was supported by the Healt Safety and Environment (HSE) Division of PT. Pertamina Gas Head Office.

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