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ANALYSIS OF THE LOCATION OF THE INSTALLATION OF CELLULAR TOWERS BY THE METHOD SIMPLE MULTI ATTRIBUTE RATING TECHNIQUE EXPLOITING RANK (SMARTER)

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Abstract

Cellular is the most important thing for today's society. For this reason, a strong signal is a priority as a means that must exist to support the cellular to work properly. Installation of cellular towers for the need for strong signal is important. PT. Solusi Tunas Pertama is a company engaged in cellular tower construction services. The problem found is that it is difficult to determine the right tower installation due to the conditions and environment as well as the impact of the cellular tower. For this reason, an analysis is needed in determining the right area for the installation of the cellular tower. In this study, the authors use the criteria of population density, distance, access, existing towers and costs. These five criteria are often used by companies for location assessment. The author uses the SMARTER method in analyzing the determination of the location of the cellular tower installation of PT. Solusi Tunas Pertama. The results obtained are that the Gunung Kiri Village area is the right location for the installation of cellular towers with a value of 60,58929 compared to other locations, namely Sisiran Forest and Balunga Rice Fields. The author conducted this research with the aim of assisting the company in determining the location of tower installation with the right confidence without the need to just guess so that the decision is not right.

Keywords: Location; Setting, Tower, Selular, SMARTER, Company

1. INTRODUCTION

The development of human life which is increasingly complex and dynamic indirectly demands the advancement of telecommunications technology that can connect every human being to one another wherever they are in carrying out their daily activities. These demands have resulted in the need for communication only with the existence of fixed telephone network telecommunications, thus requiring other means of communication that can be used anywhere without space restrictions. One way is to increase the Base Transceiver Station (BTS) tower so that the coverage area is wider and can meet the needs of the community. Each operator company builds its tower separately according to the needs and plans of each operator. This makes the BTS tower growth uncontrollable. PT. Solusi Tunas Pratama is one of the founding companies for BTS towers for the surrounding terrain.

The problem that is often faced is the difficulty of determining a strategic tower location. In general, the location of the tower is on an empty land devoted to the construction of the tower, but what has happened until now is that the location of the tower can be in any place. The location of the tower is in a densely populated residential area. This is a warning as well as a problem for the government. Because if it is not immediately addressed, then the construction of the tower will change the aesthetics of the city. Therefore, researchers consider it necessary to make an application to help the company PT. The Tunas Pratama solution in determining the location of the BTS tower so that the operator's signal can reach all areas but is safe for residents and friendly to the surrounding environment. Therefore, in this study, we will use the SMART (Simple Multi Attribute Rating Technique) method, which is a multi-criteria decision-making method developed by Edward in 1977[1].

This multi-criteria decision-making technique is taken based on the theory that each alternative consists of a number of criteria that have a value and each criterion has a weight that describes how important it is compared to other criteria. This weighting is used to assess each alternative in order to obtain the best alternative [2].

SMART uses linear additive model 2 to determine the value of each alternative. SMART is a flexible decision-making method and is more widely used because of its simplicity in responding to the needs of decision makers and the way it analyzes responses [3].

One of the studies made using the SMARTER method is the selection of extracurriculars by Magrisa, T., Wardhani, K. D. K., & Saf, M. R. I. A. (2018) [4]. The resulting research contribution is a research case study that the author does different from previous research. And the SMARTER method can be used effectively and precisely where the results of the selection of the location for the construction of the cellular tower are in a location that does not have a large negative impact on the surrounding environment.

2. METHOD

The research methodology used in this research is:

2.1 Research methods

In research design, a method is needed to determine system requirements. The purpose of this research method is to provide an overview of the system to be designed. This stage describes the needs that are useful for designing the system so that the system built is in accordance with the problem to be solved.

The main problem to be solved in this research is how to determine the location of the cellular tower installation at PT. First Shoot Solution with predetermined criteria using the Simple Multi Attribute Rating Technique Exploiting Rank (SMARTER) method. The research method in determining the location of the installation of cellular towers at PT. The First Shoot Solution uses the Waterfall method. The waterfall method has the following stages:

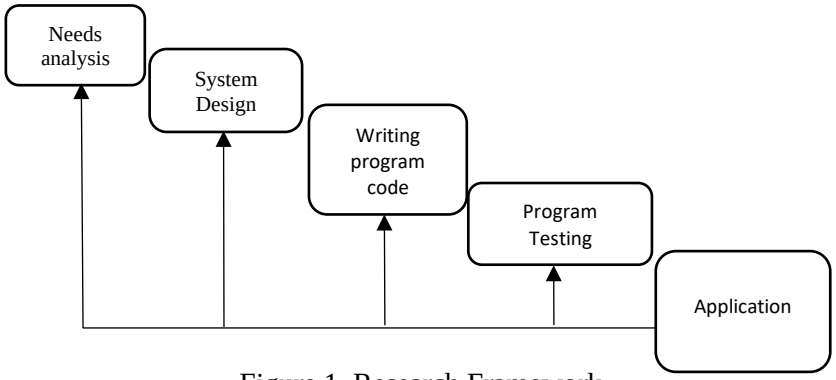

Figure 1. Research Framework

2.2 Data Type

Data is a fact, a number or something that can be believed to be true in drawing a conclusion[5]. Collecting data related to field conditions for reporting reports, has 2 main parts:

1. Primary Data Data collected in groups or privately, directly from the object under study. The interview is a question and answer with the party concerned with this study.
2. 2. Secondary Data Secondary Data is data obtained through referesi journals, books, which are related to the study of the problem under study, for example data on the Simple Multi Attribute Rating Technique Exploiting Rank (SMARTER) method[7].

2.3 Data Collection Techniques

Data collection techniques are carried out by making direct observations by visiting PT. The First Tunas Solution on Jl. Brigjend Katamso No.53, A U R, Kec. Medan Maimun, Medan City, North Sumatra 20151, to obtain the information needed to achieve research goals, and use several media, namely journals and books to obtain additional information. There are 3 techniques carried out for data collection techniques in this study are as follows:

1. Interview Method
2. Literature Study Method
3. Observation Methods

2.4 Decision Making Methods

2.4.1 Simple Multi-Attribute Rating Technique Exploiting Rank (SMARTER) Method

The SMARTER (Simple Multi Attribute Rating Technique Exploiting Rank) method is a development of the SMART (Simple Multi-Attribute Rating Technique) method[9]. The SMART method was first introduced by Edward in 1971 and was only named the SMART method in 1977. Since its inception, the SMART method has been developed into the SMARTS (Simple Multi-Attribute Rating Technique Swing) method after being modified and improved by Edward and Baron in 1994 into the SMARTER (Simple MultiAttribute Rating Technique Exploiting Rank) method[11]. The difference between the SMARTER method and the SMART and SMARTS methods lies in the way they are weighted[13].

The linear utility function model used by the Simple Multi Attribute Rating Technique (SMART) is as follows (Edward, 1977):

$$\text{SMART} = \sum_{j=1}^{k} (\omega_j \upsilon_{ij}) \quad \text{.....(1)}$$

Where:

1. wj is the weighting value of the j criterion of the k criterion.
2. uij is an alternative utility value i on the j criterion

Decision selection is to identify which of the alternative n has the greatest function value. The value of this function can also be used to rank alternatives.

Calculates the normalized value of weights:

$$nw_j = \frac{\omega_j}{\sum_{n}^{k} = 1^{\omega n}} \quad \text{.....(2)}$$

Where:

1. nwj is the normalization of the weight of the j criterion.
2. wj is the weight value of the j criterion.
3. k is the sum of the criteria.
4. wn is the weight of the nth criterion.

3. RESULTS AND DISCUSSION

In this chapter, the calculation of the SMARTER method is carried out to analyze the construction site of pt. First Bud Solution.

3.1. Results

Steps - steps of the Simple Multi Attribute Rating Technique method for the analysis of pt. First Bud Solution.

1. Determine the subject matter of the company.
2. Analyze the necessary Criteria.
3. Determine a viable alternative region to enter into the calculation stage (i). Here is taken an example of 3 regions.
4. Make a ranking.

Table 1 Criteria table

No	Criteria
1	Population Density
2	Cost
3	Distance
4	Access
5	Existing towers

Give weight based on the most important criteria and the least important criteria. The most important criterion is set with a weight of 100 and the least important criterion is set with a value of 10.

After weighting the criteria based on the order of importance, the next stage is to find the normalization of weights. At this stage the weights of each criterion will be shared with the result of the sum of the entire weights based on the most important criteria. The same is also done on weighting based on the least important criteria where each criterion weight is shared with the result of the number of weighting criteria based on the least important. The result of the normalization of the two weights will be searched for their average value which will be the weight used in the SMART calculation.

Below will be shown the results of the normalization table of the two weighting criteria.

Table 2 WeightIng Against Criteria

No	Criteria	Weight
1	Population Density	100
2	Cost	75
3	Distance	50
4	Access	25
5	Existing towers	10
	Total	260

Table 3 Normalization of criteria weight values

No	Criteria	Weight	Relative Weight (wj1)
1	Population Density	100/260	0,385
2	Cost	75/260	0,289
3	Distance	50/260	0,192
4	Access	25/260	0,096
5	Existing towers	10/260	0,039

The results of normalization of the weight of the criteria based on the most important criteria have been obtained. Next is to look for the normalization of the weight of the criteria based on the least important criteria. The result of the weighting is.

Table 4. Weighting of Criteria With Reverse Importance

No	Criteria	Weight
1	Existing towers	90
2	Access	70
3	Distance	50
4	Cost	30
5	Population Density	10
	Total	250

Table 5 Normalization of criteria weights with Inverse Importance

No	Criteria	Weight	Relative Weight (wj1)
1	Existing towers	90/250	0,36
2	Access	70/250	0,28
3	Distance	50/250	0,2
4	Cost	30/250	0,12
5	Population Density	10/250	0,04

Look for the average value of the weight of the criteria based on the most important and least important (normalization). From table 3.5 has been obtained the normalization of the weight of the criteria based on the least important criteria. Next is to find the average values of the two weight normalizations above.

Table 6 The average weight of the two normalizations above.

No	Criteria	Relative Weight (wj1)	Relative Weight (wj2)	Average Weight (wj)
1	Existing towers	0,385	0,04	0,2125
2	Access	0,289	0,12	0,2045
3	Distance	0,192	0,2	0,196
4	Cost	0,096	0,28	0,188
5	Population Density	0,039	0,36	0,1995

From table 3.6 has been obtained the average weight of both normalizations. The next stage is to determine an alternative value based on each criterion. Then the rating of interests from most panting to unimportant can be seen in table 3.7

Table 7 Weighting Criteria

No	Criteria	Weight
1	Population Density	0,2125
2	Cost	0,2045
3	Existing towers	0,1995
4	Distance	0,196
5	Access	0,188

Give weight to each alternative based on each criterion. Alternative weights on a scale of 0 – 100 . Zero as the minimum value and 100 as the maximum value.

Table 8 Alternative values against each criterion

No	Alternative	Population Density	Costs	existing Tower	Distance	Access
1	Desa Gunung Kiri	85	95	88	98	95
2	Hutan Sisiran	90	92	85	96	90
3	Sawah Balunga	92	90	85	98	92

In alternative weighting use the conversion formula to search for the alternative weight of personnel based on the criteria specified by using Formula 2.3 and adjusted to the case.

Population Density

The calculation of the value of the criteria for population density is carried out as follows.

Population Density Value (uij) = (Earned Value – minimum) x 100
(maximum – minimum)

Value for Left Mountain Village = (85-80 / (100-80) x 100 = 25
Value for Sisiran Forest Village = (90-80 / (100-80) x 100 = 50
Value for Balunga Rice Field Village = (92-80 / (100-80) x 100 = 60

Cost

The calculation of the value of the Cost criterion is carried out as follows.

Cost Value (uij) = (Earned Value – minimum) x 100
(maximum – minimum)

Value for Left Mountain Village = (95-80 / (100-80) x 100 = 75
Value for Sisiran Forest Village = (92-80 / (100-80) x 100 = 60
Value for Balunga Rice Field Village = (90-80 / (100-80) x 100 = 50

Existing Towers

The calculation of the criteria value of the Existing Tower is carried out as follows.

Existing Tower Value (uij) = (Earned Value – minimum) x 100
(maximum – minimum)

Value for Left Mountain Village = (95-80 / (100-80) x 100 = 75
Value for Sisiran Forest Village = (92-80 / (100-80) x 100 = 60
Value for Balunga Rice Field Village = (90-80 / (100-80) x 100 = 50

Distance

The calculation of the value of the Distance criterion is carried out as follows.

Distance Value (uij) = (Earned Value – minimum) x 100
(maximum – minimum)

Value for Left Mountain Village = (98-80 / (100-80) x 100 = 90
Value for Sisiran Forest Village = (96-80 / (100-80) x 100 = 80
Value for Balunga Rice Field Village = (98-80 / (100-80) x 100 = 90

Access

The calculation of the value of the Access criteria is carried out as follows.

Access Value (uij) = (Earned Value – minimum) x 100

(maximum – minimum)
Value for Left Mountain Village = (95-80 / (100-80) x 100 = 75
Value for Sisiran Forest Village = (90-80 / (100-80) x 100 = 50
Value for Balunga Rice Field Village = (92-80 / (100-80) x 100 = 60

After obtaining an alternative weight value, it then uses the linear utility function model by SMART
Values for Mount Kiri Village = ((25 x 0.2125) + (75 x 0.2045) + (75 x 0.1995) + (90 x 0.196) + (75 x 0.188))
= 60.58929
The value for Sisiran Forest Village = ((50 x 0.2125) + (60 x 0.2045) + (60 x 0.1995) + (80 x 0.196) + (50 x 0.188))
= 57.55655
Value for Balunga Rice Field Village = ((60 x 0.2125) + (50 x 0.2045) + (50 x 0.1995) + (90 x 0.196) + (60 x 0.188))
= 58.74554

Get the order of alternative importance based on the highest value.

Table 3.9 Alternative ranking of all criteria

No	Alternative	Overall Value	rank
1	Desa Gunung Kiri	60.58929	1
2	Hutan Sisiran	58.74554	2
3	Desa Sawah Balunga	57.55655	3

3.2. Discussion

From the calculations that have been made, it can be obtained that the location of the Gunung Kiri Village Area is a qualification that is worthy of being used as a cellular tower installation at PT. The First Tunas Solution with the highest score was 60.58929. then the Sisiran Forest area and the last to be qualified is the Balunga Rice Field Village area. The calculation is based on the values of the criteria, namely Population Density, Cost, Existing Towers, Distance and Access. These five critreria have also been classified in the order of priority that has been taken into account.

4. Conclusions

From the discussion and calculations that have been carried out in the previous Chapters, the author draws conclusions. The criteria used in the analysis of the selection of cellular tower installation areas are criteria that match the order of importance that has been taken into account. The alternatives taken are 3 (three) namely the Gunung Kiri Village area, the Sisiran Forest area and the Balunga Rice Field Village area. The Gunung Kiri Village area is qualified as a suitable area to be used as a place for the construction of cellular towers for PT. Gunung Kiri. First Bud Solution. The Gunung Kiri Village area got the highest score of 60.58929. In this case, the author concludes that the use of the SMARTER method in analyzing the installation area of cellular towers is categorized as suitable and helpful.

Reference

[1.] Sesnika, Nandik et al. (2016). Application of Multipurpose Building Selection Decision Support System in Bengkulu City Using the Android-Based SMART Method. Recursive Journal Vol. 4(1). ISSN: 2303-0755

[2.] Setyowulan, Hani et al. (2012). Decision Support System for Accepting New Employees at PT Abadi Express (TIKI) Yogyakarta. Journal of DASI Vol. 13(1). ISSN: 1411-3201
[3.] Http:// www.google.co.id. Chapter ii theoretical foundation – Main Potential University Repository. PDF repository.potens-utama.ac.id > bitstream. May 19, 2018.
[4.] Apriandala, R., Efendi, R. and Andreswari, D., 2017. Class Division of Smarter Dan Students (Case Study of Smpn 1 Bengkulu City). Recursive Journal , 5(2), pp.209–219.
[5.] Septiana Razak, R., Sutardi and LM, T., 2016. Decision Support System for Providing Industrial Tool Assistance Using the SMARTER Method Based on GIS Web. semanTICS, 2(1), pp.297–308.
[6.] Yunita, Y., 2017. Implementation of the Simple Multi-Attribute Rating Technique Exploiting Rank (Smarter) Method in the Housing Location Selection Decision Support System. National Conference on Information Technology & Its Applications, pp.57–60.
[7.] Magrisa, T., Wardhani, K. D. K., & Saf, M. R. I. A. (2018). Implementation of the SMART Method on the Decision Support System for The Selection of Extracurricular Activities for High School Students. Mulawarman Informatics: A Scientific Journal of Computer Science, 13(1), 49-55.

[8.] Sesnika, N., Andreswari, D., & Efendi, R. (2016). Application of Multipurpose Building Selection Decision Support System in Bengkulu City Using Android-Based Smart Method. Recursive: Journal of Informatics, 4(1).
[9.] Hutagalung, B. T., Siregar, E. T., & Lubis, J. H. (2021). Application of the SMART Method in the Selection of Recipients of Social Assistance for Residents of Communities Affected by COVID-19. Journal of Informatics Media Budidarma, 5(1), 170-185.
[10.] Yasin, V. (2021). The application of a system of learning and teaching activities in professional lecturer certification instruments using the SMART method. TRIDHARMADIMAS: Jayakarta Journal of Community Service, 1(1), 37-55.