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Comparative Analysis Of Decision Support Systems Determining The Right Food Business Location In Binjai City Using Topsis And Saw Methods

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Abstract

Every year, the development of the business world continues to increase. The location to open a business in accordance with the sales target in accordance with the market share is very difficult. In order to provide the right decision in choosing a business location, a method is needed in making decisions. Materials (data) and Methods: The business locations processed in this study were 6 types of criteria, namely the number of competitors, the level of population density, the number of supporting businesses around the location, business location permits, business position and traffic access. The method used in processing the data is SAW and Topsis. The stages of processing the SAW and Topsis methods in this research are initializing the wood data. The result of dividing and then multiplying all the criteria according to the weights. Then in the end, the highest preference value will be obtained for each alternative. The result of testing this method is ranking. The best ranking is the ninth alternative. This result has 90% accuracy. The choice of business location can be done optimally. So that the results of the decisions that have been obtained can be used as a guide for choosing a business location that is in accordance with the target market to be achieved.

Keywords: Decision support system, Topsis, Saw

INTRODUCTION

The selection of the location of an organization or company will affect the risks and profits of the company as a whole, considering that location greatly affects fixed costs and variable costs, both in the medium and long term. There are differences in the success of organizations and differences in organizational strengths or weaknesses, often due to location factors. In a competitive situation, location factors can be critical factors that make it very important, so that the business being run can compete effectively, the business location must be strategic and easily accessible.

Many factors determine the success of a business. One of these factors is the accuracy of site selection. The accuracy of site selection is one of the factors considered by an entrepreneur before opening his business. This happens because the selection of the right location often determines the success of a business. This also applies to service businesses because service businesses are required to maintain close relationships with customers. Businesses engaged in services must be closer to all their customers so that they can provide better service to customers.

Binjai City is a very potential market for business. This is what causes the phenomenon of the proliferation of service businesses established around the city of Binjai.

For service businesses, strategic location is often more important than other factors. This means that entrepreneurs are willing to pay higher costs for selecting the right location. This also happens to service businesses that stand around Binjai City, because Binjai City is in the city center. They are willing to pay a high price to open a business in this location by expecting a large income given the potential market in Binjai City.

Besides the cost factor, the proximity factor to the business environment is something that entrepreneurs consider before setting up a business around the suburbs of Binjai.

The decision support system for determining the location of a food business opportunity is a method or method that aims to classify in detail in order to prevent errors in choosing the location of a food business opportunity that is not in line with expectations due to the fact that in the field when determining the location does not match expectations and predictions. The result of the decision support system process for determining the location of this business is in the form of location classification as a recommendation for decision making to choose a suitable location to be used as a place of business in accordance with existing criteria. Each place has a different value to the desired aspect, determining which location is desired requires an appropriate tool, namely by using a computer as a tool that can help.

smartphone selection decision support system by applying the simple additive weighting (SAW) method, so that it can provide solutions for consumers to choose smartphones. predetermined criteria (Harsiti, 2017).

This study aims to build a decision support system (DSS). The TOPSIS method will provide an alternative ranking that ensures closeness to the benefit criteria and distances it from the cost criteria. The system that was built was tested using 17 alternatives and 3 criteria consisting of 1 cost and 2 benefit criteria. The experiments carried out succeeded in giving different rankings to 15 alternatives and only 2 alternatives with the same ranking, namely in the 5th and 6th ranks because both scores were the same on each criterion (Sureeyatanapas, 2018).

Due to the intense competition among business firms, supplier selection is becoming more significant for business success. However, the problem of supplier selection is complex because a large number of criteria need to be considered and, often, some criteria cannot be assessed accurately. The TOPSIS method was chosen to be the basis for this development. The degree of order ranking method was chosen to determine the weighting of the criteria to reduce the level of subjectivity required of decision makers as well as heavy task uncertainty. The egg supplier selection case is given to demonstrate the implementation procedure of the proposed method (Santiary, 2018).

RESEARCH METHODS

The research methodology is carried out to search for something systematically using scientific methods and applicable sources. In the process of this research, it is shown to provide more meaningful results for parties in dealing with relationships so that there are no errors in connecting the causes of divorce to reduce errors that occur in seeing the most dominant causes of divorce.

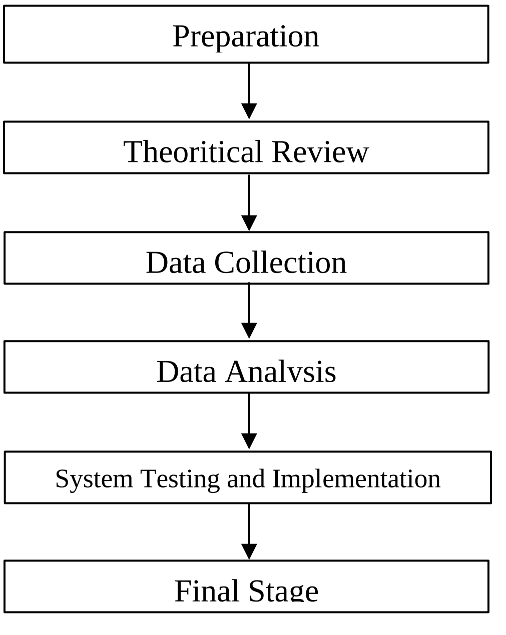

Figure 1. Research Workflow

1. Preparation
   This stage is the initial activity, namely by determining the research from the background of the problem, then the problem definition is carried out, then the objectives and benefits are determined in the preparation of the support system process.
2. Theoritical review
   At this stage, a theoretical study of the existing problems is carried out. The study was conducted to determine the concept to be used in the research.
3. Data collection
   This stage is the collection of supporting data needed in the process of designing this decision support system. These data can be obtained from research results, books, journals and information from the internet.
4. Data analysis
   This stage will analyze the supporting data that has been obtained in the previous stage.
5. System Testing and Implementation
   This stage performs validation testing and implementation of data that has been previously analyzed and program preparation.
6. Final Stage
   At this final stage, the design of a decision support system will discuss the conclusions and suggestions needed for further program development

RESULTS AND DISCUSSION

In a good business location decision support system using the Topsis and Saw method, criteria and weights are needed to carry out the calculations so that the best alternative can be obtained.

Determination of Criteria

The determination of the criteria for the number of business selections is as follows:

Table 1. List of criteria

Code	Criteria
X1	number of competitors
X2	population density level
X3	number of supporting businesses around the site
X4	business location permit
X5	business position
X6	traffic access

In the initialization the values that exist in each criterion are initialized in Table 2. in order to facilitate the calculation process.

Table 2 Importance of Criteria Initialization Value

Criteria	Level of Interest	Weight
number of competitors	Important	4
population density level	Very important	5
number of supporting businesses around the site	Very important	5

business location permit	Important	4
business position	Important	3
traffic access	Quite important	4

In determining the best business location, the criteria used to determine the success of a business are selected. Fewer competitors in the location can be advantageous.

Table 3. Number of Competitors

Number of Competitors	Score
> 20 attempts	5
15 - 20 attempts	4
10 - 15 attempts	3
5 - 10 attempts	2
<5 attempts	1

Table 4 Number of supporting businesses

Number of Supporting Efforts	Score
>30 attempts	5
25 - 30 attempts	4
20 - 25 attempts	3
10 - 20 attempts	2
<10 attempts	1

Table 5. Business Position

Business position	Score
Supermarket	4
Shops	3
Complex	2
Side of the road	1

Table 6. Initialization of Length Criteria

Business location permit	Score
Certificate	2
Non-Certificate	1

Table 7. Initialization of Condition Criteria

Access traffic	Score
Highway	3
Gang Street	2
Complex Street	1

Alternative Determination

Alternative Ai with i=1,2,...,m are different objects and have the same chance to be chosen by the decision maker.

Table 8. Alternative Table

No	Location Name	Address
1	Location 1	Jl. Mount Sinabung III No.5 LK.II, South Binjai
2	Location 2	Jl. Gen. Ahmad Yani GG. Lk's work. V, Binjai City
3	Location 3	Jl. Mount Jaya Wijaya LK. X, South Binjai
4	Location 4	Jl. Gunung Jaya Wijaya LK.X, South Binjai

Weight Determination

Determination of the weight value used to determine the importance of each criterion that is already owned is done by looking at how important the criteria are. So that by using the level of importance it can help in calculating the importance of each criterion that is needed

Table 9. Table of Interests Weight

Criteria	Level of Interest	Weight
number of competitors	Important	4
population density level	Very important	5
number of supporting businesses around the site	Very important	5
business location permit	Important	4
business position	Important	5
traffic access	Quite important	3

Topsis Calculation:

Normalization Decision Matrix Pembuatan

In this process, the alternative data initialization stage is carried out in the form of number normalization so that it can be calculated using the topsis method.

Table 10. Table of Alternative Initialization Values

No	Location Name	number of competitors	population density level	number of supporting businesses around the site	business location permit	business position	traffic access
1	Location 1	5	4	3	1	1	3
2	Location 2	4	5	4	1	2	3
3	Location 3	2	3	3	1	2	2
4	Location 4	2	5	4	1	1	2

$$r_{11} = \frac{5}{\sqrt{5^2} + 4^2 + 2^2 + 2^2} = 0{,}7413$$
$$r_{12} = \frac{4}{\sqrt{5^2} + 4^2 + 2^2 + 2^2} = 0{,}5714$$
$$r_{13} = \frac{2}{\sqrt{5^2} + 4^2 + 2^2 + 2^2} = 0{,}2857$$
$$r_{14} = \frac{2}{\sqrt{5^2} + 4^2 + 2^2 + 2^2} = 0{,}2857$$
$$r_{64} = \frac{4}{\sqrt{3^2} + 3^2 + 2^2 + 2^2} = 0{,}3922$$

And so on for each of the existing criteria. Until all alternatives are completed in the calculation on the criterion value. so that the results of the normalization matrix are obtained as follows:

Table 11. Normalization Matrix Table

R=	0.7143	0.4619	0.4243	0.5000	0.3162	0.5883
	0.5714	0.5774	0.5657	0.5000	0.6325	0.5883
	0.2857	0.3464	0.4243	0.5000	0.6325	0.3922
	0.2857	0.5774	0.5657	0.5000	0.3162	0.3922

1. Weighted Normalized Decision Matrices Pembuatan

Calculate the normalized weight rating decision matrix, with the equation yij = wi.rij in this case, the weight value (w) for each alternative is determined as follows W = (0.16 0.2 0.16 0.2 0.12 0.16)

The calculation is carried out onwards for each of the other criteria, so that the value of the normalized weight rating matrix is obtained as follows:

Table 12. Weighted Normalization Matrix Table

R=	0.11429	0.09238	0.06788	0.10000	0.03795	0.09414
	0.09143	0.11547	0.09051	0.10000	0.07589	0.09414
	0.04571	0.06928	0.06788	0.10000	0.07589	0.06276
	0.04571	0.11547	0.09051	0.10000	0.03795	0.06276

Determination of Positive Ideal Solution Matrix and Negative Ideal Solution

Determine the positive ideal solution (A+) and negative ideal solution (A-) based on the weighted rating matrix value

y1+ = Max (0.11429 0.09143 0.04571 0.04571)
y2+ = Max (0.09238 0.11547 0.06928 0.11547)
y3+ = Max (0.06788 0.09051 0.06788 0.09051)
y4+ = Max (0.10000 0.10000 0.10000 0.10000)
y5+ = Max (0.03795 0.07589 0.07589 0.03795)
y6+ = Max (0.09414 0.09414 0.06276 0.06276)

so that the value of the positive ideal solution is as follows:
A+ = (0.11429 0.11547 0.09051 0.10000 0.07589 0.09414)

y1- = Max (0.11429 0.09143 0.04571 0.04571)

y2- = Max (0.09238 0.11547 0.06928 0.11547)
y3- = Max (0.06788 0.09051 0.06788 0.09051)
y4- = Max (0.10000 0.10000 0.10000 0.10000)
y5- = Max (0.03795 0.07589 0.07589 0.03795)
y6- = Max (0.09414 0.09414 0.06276 0.06276)

so that the value of the negative ideal solution is as follows:

A-= (0.04571 0.06928 0.06788 0.10000 0.03795 0.06276)

To determine the distance between the weighted value of each alternative to the positive ideal solution, the following equation is used

$$D_i^+ = \sqrt{\sum_{i=1}^{n}\left(y_-^+ - y_{ij}\right)^2} \text{ .... (4.1)}$$

Calculations are carried out for each alternative row, so that the following calculation results are obtained:

$$D1^+ = \sqrt{(0.11429 - 0,11429)^2 + (011547 - 0,09328)^2 + (0.09051 - 0,06788)^2 + (0.1 - 0,1)^2 + (0.03795 - 0,03795)^2 + (0.09414 - 0,09414)^2} = 0,0499$$

Furthermore, the positive values obtained from the above calculations can be seen in Table 12.

Table 13. Table of Positive Ideal Solution Matrix

D1+	0.0499
D2+	0.0229
D3+	0.0913
D4+	0.0844

$$D1^- = \sqrt{(0.11429 - 0,04571)^2 + (0,09238 - 0,06928)^2 + (0,06788 - 0,06788)^2 + (0,1 - 0,1)^2 + (0,03795 - 0,03795)^2 + (0,09414 - 0,06276)^2} = 0,0499$$

Furthermore, the value of the negative ideal solution is obtained from the calculations above

Table 14. Matrix Table of Negative Ideal Solutions

D1-	0.0789
D2-	0.0846
D3-	0.0379
D4-	0.0514

Calculation of the Relative Closeness to the Positive Ideal Solution and the Negative Ideal Solution

Calculating the preference value for each alternative with the relative proximity equation according to the matrix results.

$$V_i = \frac{D^-}{D^- + D^+} \text{ .... (4.2)}$$

So that the results of the calculation of the positive and negative values are as follows:

$$v1 = \frac{0,0499}{0,0499 + 0,0789} = 0,6127$$

$$v2 = \frac{0,0229}{0,0229 + 0,0846} = 0,7873$$

$$v3 = \frac{0,0913}{0,0913 + 0,0379} = 0,2937$$

$$v4 = \frac{0,0844}{0,0844 + 0,0514} = 0,3786$$

Table 15. Alternative Results Ranking Table

Alternative	Location Name	Score
V1	Location 1	0.6127
V2	Location 2	0.7873
V3	Location 3	0.2937
V4	Location 4	0.3786

From the results of the above calculation, the value of alternative V2 with the name alternative location shows the largest value so that in other words alternative V2 or location is the best alternative choice that deserves to be determined as the best location selection in accordance with the weight given by decision making.

Saw Calculation:

1. From the three data in table 7, the decision matrix is rounded (X)

Table 16. matrix

X	5	4	3	1	1	3
	4	5	4	1	2	3
	2	3	3	1	2	2
	2	5	4	1	1	2

2. Then normalization of the X matrix is carried out based on the following equation:

$$\mathrm{R11} = \frac{5}{\max\{5,4,2,2\}} = 1$$
$$\mathrm{R21} = \frac{4}{\max\{5,4,2,2\}} = 0,8$$
$$\mathrm{R31} = \frac{2}{\max\{5,4,2,2\}} = 0,4$$
$$\mathrm{R41} = \frac{2}{\max\{5,4,2,2\}} = 0,4$$
$$\mathrm{R21} = \frac{4}{\max\{4,5,3,5\}} = 0,8$$
$$\mathrm{R22} = \frac{5}{\max\{4,5,3,5\}} = 1$$
$$\mathrm{R23} = \frac{3}{\max\{4,5,3,5\}} = 0,6$$
$$\mathrm{R24} = \frac{5}{\max\{4,5,3,5\}} = 1$$
$$\mathrm{R31} = \frac{3}{\max\{3,4,3,4\}} = 0,75$$
$$\mathrm{R32} = \frac{3}{\max\{3,4,3,4\}} = 1$$

$$R33 = \frac{3}{\max\{3,4,3,4\}} = 0{,}75$$
$$R34 = \frac{3}{\max\{3,4,3,4\}} = 1$$
$$R41 = \frac{1}{\max\{1,1,1,1\}} = 1$$
$$R42 = \frac{1}{\max\{1,1,1,1\}} = 1$$
$$R43 = \frac{1}{\max\{1,1,1,1\}} = 1$$
$$R44 = \frac{1}{\max\{1,1,1,1\}} = 1$$
$$R51 = \frac{1}{\max\{1,2,2,1\}} = 0{,}5$$
$$R51 = \frac{2}{\max\{1,2,2,1\}} = 1$$
$$R51 = \frac{2}{\max\{1,2,2,1\}} = 1$$
$$R51 = \frac{1}{\max\{1,2,2,1\}} = 0{,}5$$
$$R61 = \frac{3}{\min\{3,3,2,2\}} = 0{,}67$$
$$R61 = \frac{3}{\min\{3,3,2,2\}} = 0{,}67$$
$$R61 = \frac{2}{\min\{3,3,2,2\}} = 1$$
$$R61 = \frac{2}{\min\{3,3,2,2\}} = 1$$

3. So from the calculation of normalization X obtained normalized matrix R as follows:

Table 17. Normalization matrix

Normalization	1	0.8	0.75	1	0.5	0.666666667
	0.8	1	1	1	1	0.666666667
	0.4	0.6	0.75	1	1	1
	0.4	1	1	1	0.5	1

4. Next, perform the ranking process by multiplying the normalized matrix (R) with the preference weight value (W). The value of W = (0.16 0.2 0.16 0.2 0.12 0.16)

Location_1=((1*0.16) + (0.8*0.2) + (0.75*0.16) + (1*0.2) + (0.5*012) + (0.666666667*0.16)) = 0.81
Location_2=((0.8*0.16) + (1*0.2) + (1*0.16) + (1*0.2) + (1*012) + (1*0.16)) = 0.91
Location_3=((0.4*0.16) + (0.6*0.2) + (0.75*0.16) + (1*0.2) + (1*012) + (1* 0.16)) = 0.78
Location_4=((0.4*0.16) + (1*0.2) + (1*0.16) + (1*0.2) + (0.5*012) + (1*0, 16)) = 0.84

From the calculation results above, the value of V2 shows the largest value so that in other words V2 is the best alternative choice that deserves to be determined as the best house according to the weight given by the decision maker.

From the results of calculations using the TOPSIS and SAW methods, it can be seen and seen in the table below.

Table 18. Topsis Calculation Results

Alternative	Wood Name	Score
V1	Location 1	0.6127
V2	Location 2	0.7873
V3	Location 3	0.2937
V4	Location 4	0.3786

SAW calculation results.

Table 19. Saw . calculation results

Alternative	Wood Name	Score
V1	Location 1	0.81
V2	Location 2	0.91
V3	Location 3	0.78
V4	Location 4	0.84

Based on the results of the table above, the comparison between the topsis and saw methods did not find much different results. In both methods, the results of the ranking calculations remain the same as the others, only the difference in the results of the value is quite far

CONCLUSION

The decision-making system for determining the best business location is more detailed so that customers can get a business location that really suits the needs of the family properly and well. The Simple Additive Weighting & Topsis method is able to solve the problem of selecting the best business location properly. The decision support system for determining the best business location produced after the process is only in the form of ranking the highest value to the lowest value. In the future, it may be developed even better. Determining the best business location must consider other influencing factors. For the use of the method, it is hoped that there will be comparisons with other methods. For development, this decision support system program can be developed into an application to hosting.

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