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DECISION SUPPORT SYSTEM FOR SELECTING HOUSING AREAS USING ELECTRE METHOD

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Keywords:Electre, Decision Support Systems, Housing.

ABSTRACT

CV. PondokMulyaMelati Wangi is a company that works on construction projects from planning to implementation. The planning includes making work drawings, 3-dimensional drawings, site plans, RAB (Budget Design), structural design, and IMB management. Meanwhile, the implementation of the company includes new building works, renovations, making floors, fences, terraces, stairs, replacing tiles, ceilings, repainting, manufacturing and installing door frames, aluminum, etc. The decision support system for selecting the location of a residential area aims to make it easier for owners or companies to choose the newest location options in creating a residential area. The decision support system for selecting the location of a residential area uses the method ELECTRE (Elimination Et Choix Traduisant la Realite. The benefit of doing this research is to get the opportunity to further explore and expand knowledge about the use of the method ELECTRE (Elimination Et Choix Traduisant la Realite) and on decision support systems. Researchers draw conclusions to answer the research objectives. One of them is to know the working steps of the methodELECTRE in designing a decision support system that must be done. By using the ELECTRE method, the researcher makes it easier to determine alternatives based on the weight of the assessment and predetermined criteria, thus facilitating the process of making valid decisions and being able to determine the location of residential areas more quickly and accurately. In this study, tests will also be carried out to prove that the ELECTRE method can be used to determine the location of the best residential area from several alternatives and predetermined criteria.

Keywords: Electre, Decision Support Systems, Housing.

INTRODUCTION

The house as one of the basic human needs is a need that must be considered because it involves the welfare of the community. The need for livable houses is increasing, but not in line with the increase in the standard of living of those with a weak economy who require living in unfit for habitation. According to Law no. 4 of 1992 concerning Housing and Settlements, a house is a building that functions as a place to live or shelter and a means of fostering a family. According to John FC Turner, 1972, in his book Freedom to Build said, "The house is an integral part of the settlement, and is not just a one-time physical result, but is a process that continues to develop andrelated to the socio-economic mobility of its inhabitants over a period of time. According to SiswonoYudohusodo (House for All People, 1991: 432), a house is a building that functions as a place to live or shelter and a means of family development. Apart from functioning as a place to live or shelter used to protect from climatic disturbances and other living things, the house is the starting place for the development of life.

RESEARCH METHODS

Below is a picture of the research method flowchart:

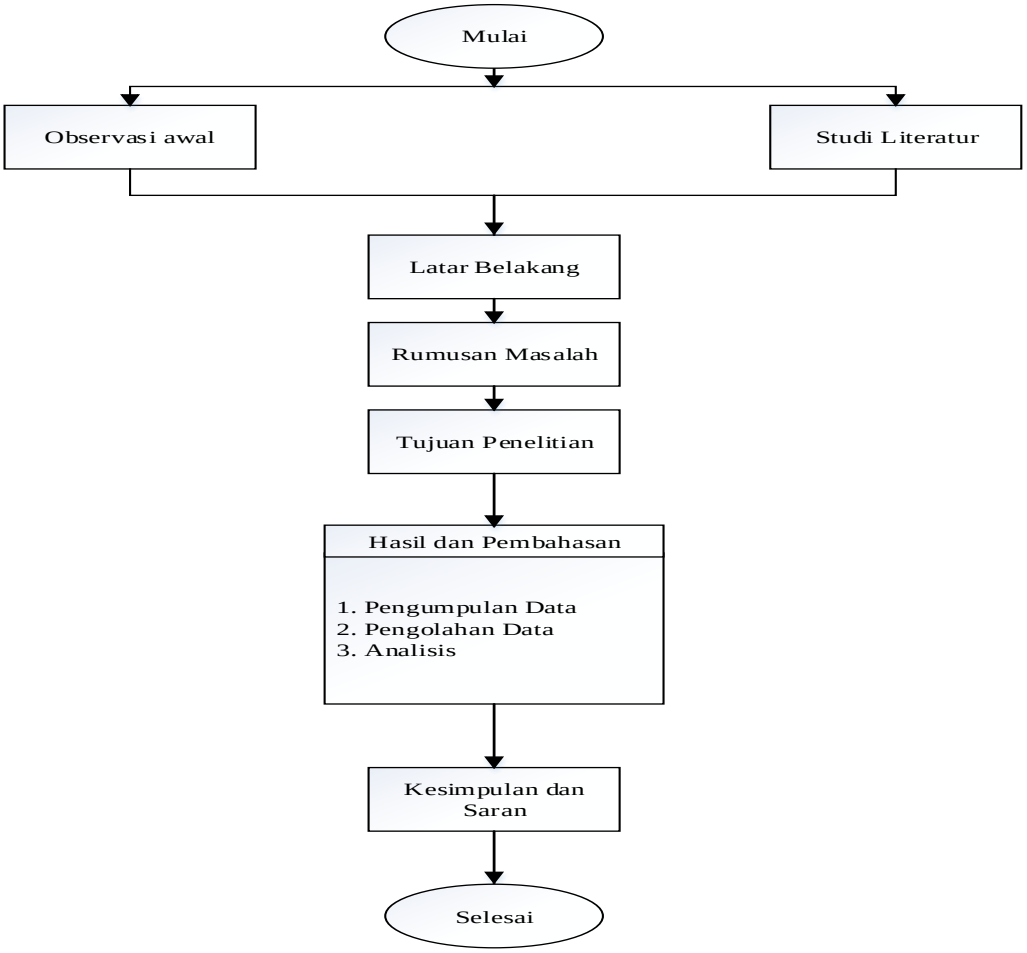

Figure 1. Research Methods Flowchart

Initial Observations

The data needed to determine the location selection of residential areas is data collected through interviews, observations, and documentation of data sources. Based on the data sources needed in this study, the researcher will participate in a group of objects that are used as data sources in the research which can be in the form of humans, or other documents.

Study of literature

Literature study to find the company profile, the problems experienced by the company to the method approach to be used in research. The literature study conducted in this research is conducting direct surveys to the company and conducting interviews with related parties, looking for references from books, related journals, as well as reliable sources on the internet that are closely related to the object of the problem. The method chosen in this study is Electree.

Background

The background of the problem is to determine one of the many problems that occur in the object of research. A problem is the essence of a study where the problem will be found a solution or also called Problem Solving.

Problem Identification and Formulation

The identification and formulation of the problem is a stage to identify some of the problems found by researchers when making observations. Based on several identified problems, this research is based on a decision support system for selecting a residential area location.

Data collection

This data collection stage is divided into two, namely:

1. Primary data

The data obtained by observing and collecting data directly by the researcher, the primary data obtained include:

a. Conducting direct interviews with CV. PondokMulyaMelati Wangi.

b. Participated in conducting a location survey and analyzing the results of the questionnaire that had been carried out by the CV. PondokMulyaMelati Wangi.

2. Secondary Data

Data obtained from the results of literature studies based on previous research and data obtained from the company directly and not the results of observations by researchers, secondary data obtained include:

a. Questionnaire on recommendations for submitting location area selection that has been made by CV. PondokMulyaMelati Wangi by distributing sample questionnaire files and directly surveying the location of the residential area selection.

b. CV. PondokMulyaMelati Wangi surveyed the proposed locations and criteria by recording the weights and criteria that had been listed.

Data processing

Based on the data that has been collected, the data will then be processed using the method used in this study, namely the Electre Method (Elimination Et Choix Traduisant La Realite). Data processing carried out in this study are as follows:

1. Perform the calculation process to get the normalized value.
2. Perform the calculation process to get the weighted normalized value.
3. Perform a calculation process to get a value concordance and discordance matrices.
4. Perform the calculation process to get the weighted normalized value
5. Perform the calculation process to get the dominant aggregate value.

Analysis

The analysis carried out was obtained from the results of previous data processing. The results of the processing will be analyzed which aims to identify the possibilities and problems that may occur when selecting a residential location area in order to obtain the best results.

CONCLUSIONS AND RECOMMENDATIONS

Researchers draw conclusions to answer the research objectives. One of them is to know the working steps of the methodELECTRE (Elimination Et Choix Traduisant la Realite) in designing a decision support system that must be done. Suggestions given by researchers are in the form of input for the company and suggestions related to further research development.

RESULTS AND DISCUSSION

Data collection

Here are some data obtained from direct observation and interviews with employees of CV. PondokMulyaMelati Wangi is as follows:

A general description of the company

The following is a general description of the object of research, namely as follows:

1. Company Profile

CV. PondokMulyaMelati Wangi is a company that works on construction projects from planning to implementation. The planning includes making work drawings, 3-dimensional drawings, site plans, RAB (Budget Design), structural design, and IMB management. Meanwhile, the implementation of the company includes new building works, renovations, making floors / floors, fences, terraces, stairs, replacing ceramics, ceilings, repainting, manufacturing and installing door frames, aluminum, etc. In 2012 CV. PondokMulyaMelati Wangi has started to develop its own housing project located in the Bandung area. There are several that up to now this company has developed, namely: 1. PondokMulyaMelati Wangi Housing 2. PesonaMulya Residence. Research conducted at CV.

Rating The suitability of each alternative on each criterion

Table 1. Reference weights

Bobot	Keterangan
1	Baik
2	Tidak Baik
3	Cocok
4	Tidak Cocok
5	Cukup

Table 1 is a reference weight table that indicates the data normalization process that has been carried out so that the duplication of data on a criterion information can be removed and can lead to similarity in the criteria provided by CV. PondokMulyaMelati Wangi for the conditions of establishing a new land selection.

Table 2. Alternatives to determining the location

Alternatif	Variabel
Garut	a1
Nagreg	a2
Tasik	a3
Cianjur	a4

Table 2 is an alternative and variable table.

Data processing

Based on the data collection that has been obtained, the following data processing steps are carried out, namely as follows:

In this procedure, each attribute must be converted into a matching value which needs to be determined in advance the suitability rating of each available alternative.

Table of Suitability Rating of Each Alternative on Each Criterion

Table 3. Rating of decision matrix normalization

Alternatif	Kriteria				
	k1	k2	k3	k4	k5
a1	4	3	2	3	4
a2	4	4	3	3	2
a3	4	3	4	4	2
a4	4	4	3	2	5
Bobot Normalisasi	4	3.5	3	3	3.3

$R_1 = \frac{4}{\sqrt{4^2+4^2+4^2+4^2}} = 0{,}5000$

$R_2 = \frac{3}{\sqrt{3^2+4^2+3^2+4^2}} = 0{,}4243$

$R_3 = \frac{2}{\sqrt{2^2+3+4^2+3^2}} = 0{,}3244$

$R_4 = \frac{3}{\sqrt{3+3^2+4^2+2^2}} = 0{,}4867$

$R_5 = \frac{4}{\sqrt{4^2+2^2+2^2+5^2}} = 0{,}5714$

$R_6 = \frac{4}{\sqrt{4^2+4^2+4^2+4^2}} = 0{,}5000$

$R_{11} = \frac{4}{\sqrt{4^2+4^2+4^2+4^2}} = 0{,}5000$

$R_{12} = \frac{3}{\sqrt{3^2+4^2+3^2+4^2}} = 0{,}4243$

$R_{13} = \frac{4}{\sqrt{2^2+3+4^2+3^2}} = 0{,}6489$

$R_{14} = \frac{4}{\sqrt{3+3^2+4^2+2^2}} = 0{,}6489$

$R_{15} = \frac{2}{\sqrt{4^2+2^2+2^2+5^2}} = 0{,}2857$

$R_{16} = \frac{4}{\sqrt{4^2+4^2+4^2+4^2}} = 0{,}5000$

$R_7 = \frac{4}{\sqrt{3^2+4^2+3^2+4^2}} = 0{,}5657$

$R_8 = \frac{3}{\sqrt{2^2+3+4^2+3^2}} = 0{,}4867$

$R_9 = \frac{3}{\sqrt{3+3^2+4^2+2^2}} = 0{,}4867$

$R_{10} = \frac{2}{\sqrt{4^2+2^2+2^2+5^2}} = 0{,}2857$

$R_{17} = \frac{4}{\sqrt{3^2+4^2+3^2+4^2}} = 0{,}5657$

$R_{18} = \frac{3}{\sqrt{2^2+3+4^2+3^2}} = 0{,}4867$

$R_{19} = \frac{2}{\sqrt{3+3^2+4^2+2^2}} = 0{,}3244$

$R_{20} = \frac{5}{\sqrt{4^2+2^2+2^2+5^2}} = 0{,}7143$

From the results of these calculations, the r matrix is obtained and is written as follows:

$$\times = \begin{bmatrix} 0.5000 & 0.4243 & 0.3244 & 0.4867 & 0.5714 \\ 0.5000 & 0.5657 & 0.4867 & 0.4867 & 0.2857 \\ 0.5000 & 0.4243 & 0.6489 & 0.6489 & 0.2857 \\ 0.5000 & 0.5657 & 0.4867 & 0.3244 & 0.7143 \end{bmatrix}$$

The weighting of the matrix before being normalized and after being normalized, each column of the matrix R is multiplied by the weights. In this section, the weighting of the matrix of normalization results from the previous process is weighted using decision-making weights. This weighting is done using the following equation:

$$\times = \begin{bmatrix} 0.5000 & 0.4243 & 0.3244 & 0.4867 & 0.5714 \\ 0.5000 & 0.5657 & 0.4867 & 0.4867 & 0.2857 \\ 0.5000 & 0.4243 & 0.6489 & 0.6489 & 0.2857 \\ 0.5000 & 0.5657 & 0.4867 & 0.3244 & 0.7143 \end{bmatrix}$$

The weighting of the matrix before being normalized and after being normalized, each column of the matrix R is multiplied by the weights. In this section, the weighting of the matrix of normalization results from the previous process is weighted using decision-making weights. This weighting is done using the following equation:

$$V = RW$$

From the formula above, the weighting result matrix is obtained as below:

$$\times = \begin{bmatrix} 0.5000 & 0.4243 & 0.3244 & 0.4867 & 0.5714 \\ 0.5000 & 0.5657 & 0.4867 & 0.4867 & 0.2857 \\ 0.5000 & 0.4243 & 0.6489 & 0.6489 & 0.2857 \\ 0.5000 & 0.5657 & 0.4867 & 0.3244 & 0.7143 \end{bmatrix}$$

The result of the normalized weights is the result of the calculation of all the weights that have been averaged. After obtaining the matrix from the weighting results, then multiplied by the normalized weight as below:

$$\times = \begin{bmatrix} 4 & 3 & 2 & 3 & 4 \\ 4 & 4 & 3 & 3 & 2 \\ 4 & 3 & 4 & 4 & 2 \\ 4 & 4 & 3 & 2 & 5 \end{bmatrix}$$

To find out the results of the matrix R, you must first calculate the formula:

$$x = \begin{bmatrix} 0.5000 & 0.4243 & 0.3244 & 0.4867 & 0.5714 \\ 0.5000 & 0.5657 & 0.4867 & 0.4867 & 0.2857 \\ 0.5000 & 0.4243 & 0.6489 & 0.6489 & 0.2857 \\ 0.5000 & 0.5657 & 0.4867 & 0.3244 & 0.7143 \end{bmatrix}$$

After obtaining the weighted matrix from the results, then multiplied by the normalized weight as below:

Normalization weight	4	3.5	3	3	3,3

After multiplying it by the normalized weight in the table above, you can get the results in the matrix V.

$$\times = \begin{bmatrix} 2,1{,}4849 & 0{,}9733 & 1{,}4600 & 1{,}8571 \\ 2,1{,}9799 & 1{,}4600 & 1{,}4600 & 0{,}9286 \\ 2,1{,}4849 & 1{,}9467 & 1{,}9467 & 0{,}9286 \\ 2,1{,}9799 & 1{,}4600 & 0{,}9733 & 2{,}3214 \end{bmatrix}$$

Determine the set of concordance and discordance

For each pair of alternatives k and l (k, l = 1,2,3,…, m and k ≠ l) the set J criteria are divided into two subsets, namely concordance and discordance. In this section, the set of concordances and discordances is determined by comparing the values in the weighted matrix. To determine the results of the calculation of the set, a comparison table is needed as follows:

Table 4. Comparator Matrix Row 1 Column 2

Matrix	1	2	3	4	5
1	2	1.4849	0.9733	1.4600	1,8571
2	2	1.9799	1.4600	1.4600	0.9286

Table 5. Comparator Matrix Row 1 Column 3

Matrix	1	2	3	4	5
1	2	1.4849	0.9733	1.4600	1,8571
3	2	1.4849	1,9467	1,9467	0.9286

Table 6. Comparator Matrix Row 1 Column 4

Matrix	1	2	3	4	5
1	2	1.4849	0.9733	1.4600	1,8571
4	2	1.9799	1.4600	0.9733	2,3214

Table 7. Comparator Matrix Row 2 Column 1

Matrix	1	2	3	4	5
2	2	1.9799	1.4600	1.4600	0.9286
1	2	1.4849	0.9733	1.4600	1,8571

Table 8. Comparator Matrix Row 2 Column 3

Matrix	1	2	3	4	5
2	2	1.9799	1.4600	1.4600	0.9286
3	2	1.4849	1,9467	1,9467	0.9286

Table 9. Comparator Matrix Row 2 Column 4

Matrix	1	2	3	4	5
2	2	1.9799	1.4600	1.4600	0.9286
4	2	1.9799	1.4600	0.9733	2,3214

Table 10. Comparator Matrix Row 3 Column 1

Matrix	1	2	3	4	5
3	2	1.4849	1,9467	1,9467	0.9286
1	2	1.4849	0.9733	1.4600	1,8571

Table 11. Comparator Matrix Row 3 Column 2

Matrix	1	2	3	4	5
3	2	1.4849	1,9467	1,9467	0.9286
2	2	1.9799	1.4600	1.4600	0.9286

Table 12. Comparator Matrix Row 3 Column 4

Matrix	1	2	3	4	5
3	2	1.4849	1,9467	1,9467	0.9286
4	2	1.9799	1.4600	0.9733	2,3214

Table 13. Comparator Matrix Row 4 Column 1

Matrix	1	2	3	4	5
4	2	1.9799	1.4600	0.9733	2,3214
1	2	1.4849	0.9733	1.4600	1,8571

Table 14. Comparator Matrix Row 4 Column 2

Matrix	1	2	3	4	5
4	2	1.9799	1.4600	0.9733	2,3214
2	2	1.9799	1.4600	1.4600	0.9286

Table 15. Comparator Matrix Row 4 Column 3

Matrix	1	2	3	4	5
4	2	1.9799	1.4600	0.9733	2,3214
3	2	1.4849	1,9467	1,9467	0.9286

Specifying the Criteria Index

To determine the set of concordances using the formula in the matrix V: At this stage, the calculation of the concordance matrix is carried out based on the set of concordances obtained from the previous process. This step uses the method of comparing the values in the matrix V. For example, a comparison is made of the matrix V row 1 (V1i) and row 2 (V2i). if the column below is larger than it is not included in the set of concordances and skip to the next criterion if the set above is large then it is included in the set of concordances.

Table 16. Table Concordance and Discordance

Concordance	
Pasangan	Indeks Kriteria
C12	1,4,5
C13	1,2,5
C14	1,4
C21	1,2,3,4
C23	1,2,5
C24	1,2,3,4
C31	1,2,3,4
C32	1,3,4,5
C34	1,3,4
C41	1,2,3
C42	1,2,3,5
C43	1,2,5

Discordance	
Pasangan	Indeks Kriteria
C12	2,3
C13	3,4
C14	2,3,5
C21	5
C23	3,4
C24	5
C31	5
C32	2
C34	2,5
C41	4,5
C42	4
C43	3,4

From these results it can be determined the Concordance and Discordance matrix as follows:

Table 17. Concordance Matrix and Discordance Matrix

Matriks *Concordance*				
a1	0	10.3	10.8	7
a2	13.5	0	10.8	13.5
a3	13.5	13.3	0	10
a4	10.5	13.8	10.8	0

Matriks *Discordance*				
a1	0	0.53305	1	1
a2	1	0	0.98321	1
a3	0.95402	1	0	1
a4	0.98321	0.3494	0.6988	0

Determining the Dominant Concordance and Discordance Matrix

At this stage, the concordance and discordance matrices must be compared with the threshold value (), in which the threshold value must be calculated first. In the concordance matrix part, the calculation of the dominant concordance matrix value is carried out based on the concordance matrix that has been obtained through the previous process.

Whereas in the discordance matrix part, the calculation of the dominant discordance matrix value is carried out based on the discordance matrix that has been obtained through the previous process.

The threshold value is obtained from the sum of all concordance and discordance values, then divided by the number of matrix rows then multiplied by the number of matrix rows and the final stage is reduced by the value 1. From using the comparison of the formula above, the calculation of the concordance and discordance matrices is obtained as below:

Threshold Concordance

$$\frac{10{,}3 + 10{,}8 + 7 + 13{,}5 + 10{,}8 + 13{,}5 + 13{,}5 + 13{,}3 + 10 + 10{,}5 + 13{,}8 + 10{,}8}{4(4-1)}$$

=11.45833 Threshold Value

After getting the result of the threshold value, then it is compared with the concordance matrix value. If ≥, then the F matrix is given the number 1, instead it is given the number 0. The requirements that must be used when calculating the value of the concordance dominant matrix are as follows:

f = 1, for ckl ≥ c
f = 0, for ckl<c

where c is the threshold value obtained from the following equation:

c = Σ ckl / (m X (m - 1)),

for k = 1, 2, 3, 4; l = 1, 2, 3, 4 and mis the number of places for determining the location of housing. From the use of the comparison formula above, it can be obtained the dominant concordance matrix as follows:

Table 18. Concordance=F

Concordance= F				
a1		0	0	0
a2	1		0	1
a3	1	1		0
a4	0	1	0	

Threshold Discordance

$$\frac{0{,}53305 + 1 + 1 + 1 + 0{,}98321 + 1 + 0{,}95402 + 1 + 1 + 0{,}98321 + 0{,}3490 + 0{,}69880}{4(4-1)}$$

=0.875141 Threshold Value

It is the same as the Concordance matrix after getting the threshold value and then comparing it to the Discordance matrix value. If ≥, then the G matrix is given the number 1, instead it is given the number 0. The requirements that must be used when calculating the dominant discordance matrix value are as follows:

g = 1, for dkl ≥ d
g = 0, for dkl<d

where d is the threshold value obtained from the following equation:
d = Σ dkl / (m X (m - 1)),

for k = 1, 2, 3, 4; l = 1, 2, 3, 4 and mis the number of places for determining the location of housing. From the use of the comparison formula above, the dominant discordance matrix can be obtained as follows:

Table 19 Discordance=G

Discordance = G.				
a1		0	1	1
a2	1		1	1
a3	1	1		1
a4	1	0	0	

Determining the aggregate dominance matrix

The next step is to determine the aggregate dominance matrix value, by multiplying the matrix with the matrix. for each value of the concordance and discordance matrices, in order to obtain the results of the matrix value. Where the dominant concordance matrix is F and for the dominant discordance matrix is $G.F_{kl}G_{kl}E_{kl}$

E = F × G,then

$$F\begin{bmatrix} -,0,0,0 \\ 1,-,0,1 \\ 1,1,-,1 \\ 0,1,0,- \end{bmatrix} \times G\begin{bmatrix} -,0,1,1 \\ 1,-,1,1 \\ 1,1,-,1 \\ 1,0,0,- \end{bmatrix} = E\begin{bmatrix} -,0,0,0 \\ 1,-,0,1 \\ 1,1,-,0 \\ 0,0,0,- \end{bmatrix}$$

Elimination of a less favorable alternative

The purpose of this elimination is for Matrix E to show the order of choice of each alternative. This is done by providing the order of choice for each alternative. At this stage, an elimination process is carried out on the alternatives that have the least value of 1 in the aggregate dominance matrix. The result of this elimination is an alternative with the highest number of values 1 in the aggregate dominance matrix.

$$E\begin{bmatrix} -,0,0,0 \\ 1,-,0,1 \\ 1,1,-,0 \\ 0,0,0,- \end{bmatrix}$$

Eliminate the matrix result

Table 20. Matrix result

Matriks Eliminasi				
a1		~~0~~	~~0~~	~~0~~
a2	0		0	1
a3	1	1		0
a4	~~0~~	~~0~~	~~0~~	

Alternatives 1 and 4 are eliminated because they have the least yield, namely = 1 in the aggregate dominance matrix. The result of this elimination is an alternative with the highest value of 1 in the aggregate dominance matrix. Judging from the calculation process in the previous aggregate dominance matrix, it can be seen that alternatives 1 and 4 have a value of 1 which is less than alternatives 2 and 3. Thus, alternatives 2 and 3 are the result of decisions from the Electre method, which can be used as a decision to determine. housing location based on criteria and possible alternatives.

ANALYSIS

The results of the calculations in determining the housing location selection concluded that the Electre method applied in selecting housing was appropriate. The criteria used in conducting research consisted of 4 criteria, namely: location (K1), infrastructure (K2), environmental conditions (K3), land contours (K4), and flood portability (K5). Alternative housing locations used are: Garut (A1), Nagreg (A2), Tasik (A3) and Cianjur (A4). The results of the Electre method analysis show that Nagreg and Tasik are suitable for housing locations. The results of the calculation of the elimination matrix carried out show that the results of alternatives 2 and 3 have more numbers 1 than alternatives 1 and 4 which do not have number 1, so alternatives that are feasible to be used as housing locations are alternatives 2 and 3, namely Nagreg and Tasik. After the calculations were made to get 2 alternative results, it was concluded that the company only chose 1 area to be used as a strategic housing location, namely the Nagreg area. The choice of location in the Nagreg area is because the area is close to public facilities such as close to the Cileunyi toll road and close to the company's location in the Ujung Berung area, as well as making it easier to monitor this location.

CONCLUSION

Researchers can find out how to work in determining the location of housing with the Electre method in designing a decision support system with location criteria, infrastructure, environmental conditions, land contours and the potential for flooding. The alternatives taken include Garut, Nagreg, Tasik and Cianjur.

Researchers in conducting this study were able to design a decision support system model in choosing a housing location with a factor between these locations having no potential for flooding, adequate infrastructure and a comfortable environment. The elimination matrix shows that those with the most number of numbers 1 are alternatives 2 and 3, then these alternatives are feasible to be selected in selecting housing locations.

Research using the Electre method can make it easier to conduct research on decision support systems for selecting a residential area of CV. PondokMulyaMelati Wangi. By using this method, the researcher performs calculations easily according to the stages of matrix calculations carried out using the Microsoft Excel application and produces the best decision-making solution with the results of the matrix if the number 1 is less than the alternative is

eliminated and vice versa if the matrix result has 1 more. many then these alternatives are chosen.

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