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AN APPLICATIONS IN DETERMINING THE BEST REFRIGERATOR BY USING THE TOPSIS METHOD

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ABSTRACT

Electronics is one of the household needs where these tools are very helpful in maintaining the freshness of food or drinks, namely the refrigerator or refrigerator. At this time, many other products have electronic product brands with all their advantages. The current research chooses the best quality used refrigerators because many refrigerators can still be used. To overcome this, a decision support system is needed in determining the best refrigerator using the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) method.Because this method uses the principle that the chosen alternative (used refrigerator) must have the closest distance from the positive ideal solution and the farthest from the negative ideal solution from a geometric point of view by using Euclidean distance to determine the relative proximity of an alternative (used refrigerator) to the optimal solution so that have good calculations and make good decisions. The criteria used in the assessment are the brand of the refrigerator, the engine, the body of the refrigerator, the freezer (coolant) space, the thermostat, and the refrigerator door.

Keywords: Electronics, TOPSIS, Used Refrigerators

1. INTRODUCTION

The refrigerator is an electrical device that functions as a cooler for food and drinks and helps the process of freezing food so that it is durable and does not rot quickly. Therefore, the refrigerator is very important today. New refrigerators are quite expensive among low-income people, to get a cheap and affordable price among the general economy, a used or used refrigerator is very useful among the community.

Computer technology is increasing, one of which is the ability to determine and accommodate data to be processed as a source of information. Decision Support System (Decission Support System) is a computer-assisted decision-making process to help make decisions using certain data and models to solve some unstructured problems (Wibowo, 2011). To help a layman to buy a used refrigerator that is suitable for use, a computer technology is used, namely a Decision Support System using the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) method.

This study uses data from CV. Anugrah Wijaya Mandiri is headquartered in Klambir 5 Tj. Gusta, Sunggal District with a decision support system method, namely Topsis (Technique For Others Reference by Similarity to Ideal Solution). Because this method uses the principle that the chosen alternative (used refrigerator) must have the closest distance from the positive ideal solution and the farthest from the negative ideal solution from a geometric point of view by using Euclidean distance to determine the relative proximity of an alternative (used refrigerator) to the optimal solution so that have good calculations and make good decisions. The criteria used in the assessment are the brand of the refrigerator, engine, refrigerator body, freezer (coolant) space, thermostat, and refrigerator door.

2. METHODS

At this research stage, it will be explained one by one how the system of the whole research is made:

2.1 Analysis

The analysis stage is carried out after collecting data obtained from literature studies and interviews regarding determining the best employees using the Topsis method. The data obtained will be analyzed using the Technique For Others Reference by Similarity to Ideal Solution (Topsis) method.

2.2 Design

The design process is the process of the system workflow, the stages of working on the system and the stages of the system running well. At the design stage, the researcher describes the system framework through a flowchart.

2.3 Testing

The testing phase is needed to be a measure that the decision support system can run according to its objectives, this test consists of black box testing and user acceptance testing. This test is performed in the following way:

a. Black Box Test
   Black box testing is a test that aims to show software functions about how to operate, whether the input data and output data have been running as expected or not.
b. User Acceptance Test
   User acceptance test is the final test carried out by prospective users of the system that will be implemented or will be implemented later. This test is tested on users. If an error occurs or is not in accordance with the objectives to be achieved, then a system analysis is carried out again until no errors are found, and in accordance with the objectives to be achieved.

2.4 Implementation

The implementation phase is the implementation phase by using a program on a system. The system display or interface is made to make it easier for users to understand and operate the functions that exist in the system. This implementation stage is an amalgamation of each of the previous stages, so that the system built is ready for use, and has gone through the testing phase to avoid errors in the system. The testing process is carried out by conducting experiments and proving whether the features of the system that have been built are in accordance with the needs or there are still shortcomings. So, this decision support system is ready to be used.

3. RESULTS AND DISCUSSION

3.1 Data Needs Analysis

In assigning a good quality used refrigerator based on the highest value. the first step that must be done is to determine the criteria used, the criteria used are the weighting of the assessment of the criteria.

1. Alternative Data Needs Analysis
   There are four alternatives used in determining good quality used refrigerators, namely:
   a. Used Refrigerator A.
   b. Used Refrigerator B.
   c. Used Refrigerator C.
   d. Used Refrigerator D.

The used refrigerator data above is data from Cv. Jaya Service which has been repaired by the company and will be sold.

2. Analysis of Criteria Data Needs
   There are six criteria used in the selection of good quality used refrigerators, which are listed in table 1.

Table 1Criteria and Sub Criteria Data
(Source: Cv. Jaya Service)

Criteria	Sub-criteria

Machine	- the sound of the engine sounds working well - engine sound sometimes stutters - the sound of the engine sounds very bad
Freezer	- Very cold - Cold - Less Cold - Not cold
thermostat	- works fine - not functioning properly
Refrigerator body	- still very smooth without any defects - There are a few scratches and no dents. - lots of scratches but no dents. - slightly dented but not scratched - lots of dents and scratches
Fridge Door	- still works fine - slightly damaged - damaged
Brand	- Hitachi - Electrolux - Sharp - Panasonic - Samsung

3.2 System analysis

The survey process was carried out twice, the first survey was conducted using an interview system to an expert, namely Mr. Muhardi Saputra as Branch Manager to determine the criteria needed in determining good quality used refrigerators. From the beginning good quality will be worth selling.

The second survey process was carried out to determine the priority scale on the assessment criteria. The priority scale shows the weight of these criteria. From the results of the interview, the priority scale of the criteria can be seen in table 2

Table 2.Criteria Priority Scale
(Source: Cv. Jaya Service)

Criteria	Rating Priority
Machine	Main priority
Freezer	Main priority
thermostat	Main priority
Body	Second Priority
Door	Second Priority
Brand	Third Priority

1. Priority Input and Data Filter

In this research method, the weight value is obtained from the multiplication between the criteria and sub-criteria weights. Meanwhile, to get the value of the weight of the criteria, the researchers determined themselves based on the priority scale of the interview results. Criteria that have a very high priority get a very high score, the influence of priority gets a high score, up to the criteria that have no influence get the lowest score. Determination of the priority scale of the influence of the criteria is usually determined by a decision maker and the total weight if added up is 100% (Adriyendi, 2015). Determination of the value of the weight of the criteria is determined by the decision maker with criteria C1 and C5 is a very priority influence because it is given the highest value. Criteria C3, C6, C7 and C8 are priority influences and criteria C2 and C4 have sufficient priority influence. The total weight if the whole of the criteria is added up is 100%. (Memariani,

2009). Based on the two journals from the research of Andriyendi and Azizollah Mariani, the researchers set the weight value of the criteria as shown in table 3.

Table 3Weight (weight) of the Priority Scale

Criteria	Priority	Weight	Percent
Machine	Main priority	0.18	18
Freezer	Main priority	0.18	18
thermostat	Main priority	0.18	18
Body	Second Priority	0.16	16
Door	Second Priority	0.16	16
Brand	Third Priority	0.14	14
AMOUNT		1.00	100

Description Table 4.3 shows a recapitulation of the questionnaire, which is explained as follows:

1. Main Priority is the main assessment seen in determining the quality of used refrigerators so that the highest weight value is given. The criteria that get top priority are the engine, freezer and thermostat.
2. Second Priority is an assessment that is taken after evaluating the three criteria that have the main priority. So get a lower value than the main priority.
3. The Third Priority is the final assessment carried out on used refrigerators to determine their quality. Then given a very low weight value of the two priorities above.

2. Creating a Decision Matrix

The criteria have a range of values that will be grouped into fuzzy numbers. The following is a breakdown of the values in the criteria:

a. Fridge Machine Criteria

Fridge Machine Criteria have sub-criteria assessment. These sub-criteria are grouped in numbers *fuzzy* which can be seen in table 4

Table 4 *Fuzzy* on the Refrigerator Machine sub criteria

Criteria	Sub Criteria	*Fuzzy*
Refrigerator Machine	- the sound of the engine sounds working well	1
	- engine sound sometimes stutters	0.75
	- the sound of the engine sounds very bad	0.5

b.Freezer

Freezer criteria have sub-criteria assessment. These sub-criteria are grouped in fuzzy numbers, which can be seen in table 5

Table 5 *Fuzzy on the Freezer sub criteria*

Criteria	Sub Criteria	*Fuzzy*
Freezer	- Very cold	1
	- Cold	0.75
	- Less Cold	0.5
	- Not cold	0.25

c.Thermostat

Thermostat criteria have sub-criteria assessment. These sub-criteria are grouped in fuzzy numbers, which can be seen in table 6

Table 6 *Fuzzy* On Sub Criteria Thermostat

Criteria	Sub Criteria	*Fuzzy*
thermostat	- works fine	1

	- not functioning properly	0.75

d. Refrigerator Body

Criteria Refrigerator body has sub-criteria for assessment. These sub-criteria are grouped in fuzzy numbers, which can be seen in table 4.7

Table 7 *Fuzzy* on the sub-criteria of the Refrigerator Body

Criteria	Sub Criteria	*Fuzzy*
Refrigerator Body	- still very smooth without any defects	1
	- There are a few scratches and no dents.	0.75
	- lots of scratches but no dents.	0.5
	- slightly dented but not scratched	0.25
	- lots of dents and scratches	0.1

e. Fridge Door

Fridge Door Criteria have sub-criteria assessment. These sub-criteria are grouped in fuzzy numbers, which can be seen in table 8

Table 8 *Fuzzy* on the Fridge Door sub-criteria

Criteria	Sub Criteria	*Fuzzy*
Fridge Door	- still works fine	1
	- slightly damaged	0.75
	- damaged	0.5

f. Brand

Refrigerator Brand Criteria have sub-criteria assessment. These sub-criteria are grouped in fuzzy numbers, which can be seen in table 9

Table 9*Fuzzy*on the sub-criteria of the Refrigerator Brand

Criteria	Sub Criteria	*Fuzzy*
Gill	- Hitachi	1
	- Electrolux	0.75
	- Sharp	0.5
	- Panasonic	0.25
	- Samsung	0.1

Researchers took samples of four used refrigerators that have been repaired and are about to be sold by the company as case examples for the accuracy of selecting good quality used refrigerators using the TOPSIS method. Of the four fish, they have their own assessment criteria. The used refrigerator is calculated based on the criteria and obtained data from Cv. Jaya Service as table 10.

Table 10 Used Refrigerator Data Table with Value from Criteria
(Source: Cv. Jaya Service)

Refrigerator	CONDITION					
	Machine	*Freezer*	*thermostat*	Body	Door	Brand
A	The sound of the engine sounds very bad	Cold	Works fine	a little dented but not scratched	slightly broken	Electrolux
B	the sound of the engine sounds working well	Not cold enough	Works fine	a little dented but not scratched	Still Working Well	Samsung
C	the sound of the engine sounds working well	Very cold	Works fine	a little dented but not scratched	Slightly Broken	Sharp

D	Engine Sound Sometimes Stuttering	Not cold enough	Works fine	a little dented but not scratched	Damaged	Hitachi

From the assessment data for each fish, it is then transformed into a fuzzy number match rating for each criterion. The results of the match rating can be seen in table 11.

Table. 11 Fuzzy Suitability Rating of Each Alternative on Criteria

Alternative	CRITERIA					
	C1 (0.18)	C2 (0.18)	C3(0.18)	C4 (0.16)	C5(0.16)	C6(0.14)
A1	0.5	0.75	1	0.25	0.75	0.75
A2	1	0.5	1	0.25	1	0.1
A3	1	1	1	0.25	0.75	0.5
A4	0.75	0.5	1	0.25	0.5	1

3. Calculating Normalized Value

Calculate the normalized value in the TOPSIS method using the formula:

$$R_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad \text{.....(4.1)}$$

As an example of calculating column C1:

X1 $= \sqrt{(0.5)^2 + 1^2 + 1^2 + (0.75)^2} = 1.6771$

R11 $= \frac{0.5}{1.6771} = 0.2981$

R12 $= \frac{1}{1.6771} = 0.5963$

R13 $= \frac{1}{1.6771} = 0.5963$

R14 $= \frac{0.75}{1.6771} = 0.4472$

And so on for the values in columns C2, C3, C4, C5 and C6

Table 12 TOPSIS Method Normalized Value

Alternative	CRITERIA					
	C1 (0.18)	C2 (0.18)	C3 (0.18)	C4 (0.16)	C5 (0.16)	C6 (0.14)
A1	0.2981	0.5223	0.5	0.5	0.4867	0.5556
A2	0.5963	0.3482	0.5	0.5	0.6489	0.0741
A3	0.5963	0.6963	0.5	0.5	0.4867	0.3704
A4	0.4472	0.3482	0.5	0.5	0.3244	0.7407

4. Calculating Weighted Normalized Value

Calculating the weighted normalized value is each value in the criteria column multiplied by the weighted value (*weight*) it. For example:

C1 => 0.2981x0.18 = 0.0537; 0.5963x0.18 = 0.1073; 0.5963x0.18 = 0.1073; 0.4472x0.18 = 0.8005

Then on C2, C3, C4, C5, C6

Normalization calculation can be seen in table 13

Table 13 Weighted Normalization Value

Alternative	CRITERIA					
	C1	C2	C3	C4	C5	C6
A1	0.0537	0.094	0.09	0.08	0.0779	0.0778

A2	0.1073	0.0627	0.09	0.08	0.1038	0.0104
A3	0.1073	0.1253	0.09	0.08	0.0779	0.0519
A4	0.8005	0.0627	0.09	0.08	0.0519	0.1037

5. Determining Positive Ideal Solution (A+) and Negative Ideal Solution (A-)

To find the Positive Ideal Solution (A+) and Negative Ideal Solution (A-) withFormula: A+ = max(y1+,y2+,…,yn+) and A- = min(y1-,y2-,…,yn-). Max is the largest value from the column of each criterion. Min is the smallest value from the column of each criterion.

Table 14 Positive Ideal Solution and Negative Ideal Solution

Solution	CRITERIA					
	C1	C2	C3	C4	C5	C6
A+	0.1073	0.1253	0.09	0.08	0.1038	0.1037
A-	0.0537	0.0627	0.09	0.08	0.0519	0.0104

6. Calculating Positive Ideal Solution Distance (D+) and Negative Ideal Solution Distance (D-)

Calculate the positive ideal solution distance (D+) and negative ideal solution distance (D-) using the formula:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(y_i^+ - y_{ij})^2}\,; \quad i = 1,2,\ldots,m. \tag{4.2}$$

Calculating the distance of the positive ideal solution or the distance of the negative ideal solution in terms of the alternative point of view. Calculations for each alternative. Examples of calculations for the first alternative, namely A1 are:

A1: D+ ==

0.0728

$$\sqrt{(0.1073-0.0537) + (0.1037-0.0778)^{2\ 2} + (0.08-0.08)^2\ \ (0.1253-0.094) + \ ^2 + (0.1038-0.0779)^2\ \ (0.09-0.09)^2 +}$$

A1: D-

=

$$\sqrt{(0.0537-0.0537) + (0.0778-0.0104)^{2\ 2} + (0.08-0.08)^2\ \ (0.094-0.0627) + \ ^2 + (0.0779-0.0519)^2\ \ (0.09-0.09)^2 +}$$

= 0.0787

Next for A2, A3 and A4. So that the calculation results can be seen in table 15

Table 15Positive Ideal Solution Distance (D+) and Negative Ideal Solution Distance (D-)

Alternative	Solution Distance	
	D+	D-
A1	0.0728	0.0787
A2	0.1122	0.0748
A3	0.0583	0.0959
A4	0.0854	0.097

7. Preference Value

Calculating preference values in the TOPSIS method using the formula:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{4.3}$$

Preference calculation is done on each alternative. For example in alternative A1:

A1:V1 = $\frac{0.0787}{0.0787 + 0.0728} = \frac{0.0787}{0.1515}$ = 0.5195. Next for A2, A3 and A4.

The results of the calculation of preferences for each alternative can be seen in table 4.16

Table 4.16 Preference Value Results

Alternative	Preference
A1	0.5195
A2	0.4000
A3	0.6219
A4	0.5318

8. Ranking

The final result of the calculation if ranked as follows:

1. A3 = 0.6219
2. A4= 0.5318
3. A1 = 0.5195
4. A2 = 0.4000

4. CONCLUSIONS

From the results of the analysis of the decision support system for the selection of good quality used refrigerators with the topsis method, it can be concluded that. Decision Support Systems made using the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) method can use the principle that the chosen alternative must have the closest distance from the positive ideal solution and the longest (farthest) distance from the negative ideal solution from a geometric point of view. by using the Euclidean distance (distance between two points) to determine the relative proximity of an alternative to the optimal solution. The criteria taken in this decision support system refers to the research data in Cv. Jaya Service is a brand of refrigerator, engine, refrigerator body, freezer room (cooler), thermostat, and refrigerator door so that it can implement a Decision Support System in the selection of good quality used refrigerators. The Application of Decision Support System for Selection of Good Quality Used Refrigerators with the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) method has been able to meet the need to assist in the selection of good quality used refrigerators. So the company can determine which refrigerator is of good quality.

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