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Laptop selection decision support system according to buyer criteria with the simple additive weighting method

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ABSTRACT

Along with the development of increasingly modern times, so that all activities require computing technology, such as laptops. However, it is often found among prospective laptop buyers who still have difficulty in determining the laptop that suits their needs. The purpose of this study is to help people who want to buy a laptop when choosing or who are looking for a laptop. to get the right one for their needs. To achieve this goal, a decision support system is needed. The Decision Support method that will be used is SAW (Simple Additive Weighting) because this method can filter several existing alternatives and based on predetermined criteria so that later the best alternative will be obtained. By using the SAW method, a matrix normalization process is needed, the weight value of each attribute, and finally a ranking process is carried out which will determine the optimal alternative. The results obtained in this study are to be able to provide laptop recommendations to prospective buyers based on the specifications of prospective consumen needs.

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1. INTRODUCTION

Along with the times, which are increasingly modern, almost all human activities need to be supported by gadgets, one of which is a laptop. Currently, laptops are also one of the human needs in daily activities. Starting from the needs of communication tasks, office work, and as a communication device, especially in this new normal era [1].

Many brands and types of laptops are sold on the market, and of course at various prices, so it makes it difficult for prospective laptop buyers to ensure options that match their needs. And many users are also found buying laptops with specifications that do not match their needs. For example, a laptop user buys a laptop with low specifications, but its use requires high laptop specifications, so the work is difficult for the laptop to support [2], [3].

Laptop is a desktop personal computer (PC) with small dimensions to increase flexibility in its use. Where, the difference with a desktop personal computer is that it is designed to be lighter, less hot, and more energy efficient, for the hardware contained in it is exactly the same as the components on the desktop [4], [5].

With the presence of a laptop selection case by the prospective buyer, the decision support method was chosen to provide laptop recommendations according to the criteria for needs.

The decision support system is a series of model-based paths in the data processing process as supporting material for data analysis and observation modeling, which is related to future observations [6], [7].

In general, a decision support system is a series of systems that can provide the ability to support the problem-solving process and communicate related semi-structured problems. Specifically, Decision support system is defined as a system that supports the work of managers in solving semi-structured problems by providing information or supporting certain decisions [8], [9]. The decision support system component can be shown in Figure 1.

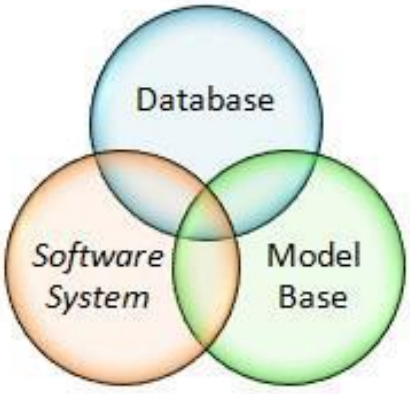

Figure 1. Decision support system component

Next is the basis of the decision support system [10], [11] specially the intelligence stage or the stage of defining the problem and identifying the required information related to the problems at hand and decisions to be made, then the design stage which is a process to represent the model system to be built based on the assumptions that have been set. In this stage, a model of the problem is created, tested, and validated. Next, the choice stage is the selection of the best decisions based on the criteria, and the last is the implementation stage, namely the implementation of the decisions that have been taken, and if there is a development, the decision will be corrected.

In this research, the method used is the Simple Additive Weighting (SAW) method, the SAW method is a method of solving the Multi Attribute Decission Making (MADM) problem which is very simple and very widely used. Not only that, this method is also very easy to apply, because it has an uncomplicated algorithm. Simple Additive Weighting (SAW) is often also known as a weighted addition model. The basic concept of the SAW model is to find the sum of the weights of the performance ratings on each alternative of all attributes. The SAW method can provide problem solving by recommending information or suggestions with the aim of supporting certain decisions [12], [13]. The SAW method is a support system for the decision-making process related to the problem according to the work aspect. The SAW method requires the process of normalizing the decision matrix (X) to a scale proportional to all rows of the normalized matrix (R) with the appropriate preference weights (W) of the matrix columns (W) [14].

Based on this case, it is necessary to establish a decision support system to support the process of selecting a laptop that suits the needs of the prospective laptop buyer.

2. METHOD

The research method used is the Simple Additive Weighting (SAW) method. This method is better known as the weighted addition method, this method is able to select the best alternative based on predetermined criteria. By using this method, it requires a decision matrix normalization process (X) to a scale that can be compared with all available alternatives. The basic concept of this method is to find the weighted sum of the performance ratings for each alternative across all attributes [15].

The steps in solving a problem using the SAW method are:

1. Determine alternative (A_i)
2. Determining Criteria (C_j) as a reference in making decisions.
3. Determine the Weight of Importance of each Criterion.
4. Determines the value of the match rating for each criterion.
5. Determine the value of preference weight or level of importance (W) each criterion.
6. Create a decision matrix (X) obtained from the suitability rating for each alternative (A_i) with each criterion C_J)

7. Normalization of the decision matrix (X) by calculating the normalized performance rating value (r_{ij}) by calculating the normalized performance rating value (C_j) with the equation (1), below:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max_i x_{ij}} if\ j\ is\ the\ profit\ attribute\ (benefit) \\ \frac{Min_i x_{ij}}{x_{ij}} if\ j\ is\ the\ cost\ attribute\ (cost) \end{cases} \quad (1)$$

Description of each criterion:

r_{ij} : the normalized performance rating value of the alternative A_i on attributes C_j; i=1,2,…m and j=1,2,…,n.
X_{ij} : criterion attribute value
Max X_{ij} : the greatest value of criteria
Min X_{ij} : the smallest value of the criterion
Benefit : if the greatest value is best
Cost : if the smallest value is best

8. The result of normalization (r_{ij}) forms a normalized matrix (R), shown in equation (2).

$$\mathbf{R} = \begin{vmatrix} R11 & R12 & Ri_j \\ R21 & R22 & Ri_j \\ R31 & R32 & Ri_j \end{vmatrix} \quad (2)$$

9. Result of preference value (V_i) obtained from the ranking process, namely the addition and multiplication of normalized matrices with preference weights (W) so that the value is obtained V_i largest as the best alternative (A_i) and as a solution (0). The preference value ranking process, shown in Equation (3).

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (3)$$

Information:

V_i : ranking for each alternative.
W_j : the weighted value of each criterion.
R_{ij} : normalized performance rating value

3. RESULTS AND DISCUSSIONS

The steps to determine the selection of a laptop according to the needs of prospective buyers with the SAW Method, namely:

a. Specifying Alternative Data (A_i)

Here what is meant by Alternatives, namely several names of laptop brands that have been recorded.

b. Determine the type of laptop criteria

The criteria for laptop requirements are price, RAM (Random Access Memory), hard drive (HDD), processor and GPU.

3.1 Weight of Importance Criteria

The third step is to determine the importance weighted value of each criterion by the decision maker, that is, the value of each alternative on each predetermined criterion. This value can be obtained based on value *crisp*: i = 1,2,3,….,n and j = 1,2,3,…, m

The weighting criteria that are determined in the selection of laptops according to the needs of prospective buyers, shown in Table 1.

Table 1. Weighted Criteria

Criteria	Scale	Bobot (fuzzy number)
Price	2,5 ≤ H < 5 (Million)	5
	5 ≤ H < 7,5 (Million)	4
	7,5 ≤ H < 10 (Million)	3
	10 ≤ H < 12,5 (Million)	2
	H ≥ 12,5 Million	1
RAM	2 GB	1
	4 GB	2
	8 GB	3
	16 GB	4
	32 GB	5
Harddisk	250 GB HDD	1
	320 GB HDD	2
	500 GB HDD	3
	1 TB HDD	4
	128 SSD + 1 TB HDD	5
Processor	Very low	1
	Low	2
	Medium	3
	High	4
	Very High	5
GPU	Very low	1
	Low	2
	Medium	3
	High	4
	Very High	5

In this case, using 5 samples of laptop data. And in Table 2 shows the laptop data

Table 2. Laptop Data

No	Laptop Brand	Specification					Alternative
		Price	RAM	HDD	Processor	GPU	
1	Acer Aspire 5 A514-53	6.999.000	4 GB	1 TB	Intel Core i3-10110U	Intel UHD Graphics	A1
2	Asus VivoBook Ultra K403	8.500.000	8 GB	1 TB	Intel Core i3-8145U	Intel UHD Graphics 620	A2
3	Apple MacBook Air 13	18.500.000	8GB	1 TB + 128 SSD	Apple M1 chip	16 Core Neural Engine	A3
4	Lenovo Ideapad 320 14	4.500.000	4 GB	1 TB	Intel Core i3-6006U	AMD Radeon 530	A4
5	HP Pavilion Gaming 15-ec0001ax	5.125.000	4 GB	1 TB	AMD Ryzen 5 3550H	AMD Radeon Vega 8 Graphics	A5

3.2 Determine the Rating Value

The fourth step (4) is to determine the suitability rating value of each alternative on each criterion, then the number is modeled into the fuzzy number is converted to Crips number. shown in Table 3. The values that have been determined are as follows Table 3, below.

Table 3. Alternative Value in each criterion

Alternative	Criteria				
	C1	C2	C3	C4	C5
A	4	2	4	4	3
B	3	3	4	4	3
C	1	3	5	5	3
D	5	2	4	4	2
E	4	2	4	5	2

1. Give a Weight Value

The fifth step (5) is to assign a weight value (W) to each criterion. Here, the one who gives the weight value for each criterion is the prospective laptop buyer.

Table 4. The value of the input weight of prospective buyers

Criteria	Criteria Requirements	Bobot Preferensi (W)
C1	Price	0,20 (20%)
C2	Kapasitas RAM	0,15 (15%)
C3	Kapasitas *Harddisk*	0,25 (25%)
C4	Jenis *Processor*	0,20 (20%)
C5	GPU	0,15 (15%)

2. Creating a Decision Matrix

After getting an alternative rating value for each criterion, the next step is to decide matrix (X) which is obtained from the suitability rating of each alternative (Ai) on each criterion (Ci).

Then the result is as follows: $\begin{bmatrix} 4 & 2 & 4 & 4 & 3 \\ 3 & 3 & 4 & 4 & 3 \\ 1 & 3 & 5 & 5 & 3 \\ 5 & 2 & 4 & 4 & 2 \\ 4 & 2 & 4 & 5 & 2 \end{bmatrix}$

3. Perform Normalization

The seventh step (7) normalizes the decision matrix (X) by calculating the normalized performance rating value (rij) of the alternative (Ai) on the criterion (Cj) with the Normalization formula, in Table 5 is the result of the decision normalization process based on the calculation of criteria.

$$r_{11} = \frac{4}{\max\{4; 3; 1; 5; 4\}} = 0{,}25$$

$$r_{21} = \frac{3}{max\{4; 3; 1; 5; 4\}} = 0{,}33$$

$$r_{31} = \frac{1}{\max\{4;3;1;5;4\}} = 1{,}00$$

$$r_{41} = \frac{5}{max\{4;3;1;5;4\}} = 0{,}20$$

$$r_{51} = \frac{4}{max\{4;3;1;5;4\}} = 0{,}25$$

Table 5. Normalization

Bobot	C1	C2	C3	C4	C5
	20%	15%	25%	20%	15%
A	0.25	1.00	1.00	1.00	0.67
B	0.33	0.67	1.00	1.00	0.67
C	1.00	0.67	0.80	0.80	0.67
D	0.20	1.00	1.00	1.00	1.00
E	0.25	1.00	1.00	0.80	1.00

4. The result of normalization

Below is the result of normalization (rij) in the form of a normalized matrix (R) from the calculation of the suitability value for each of the above alternatives:

$$R = \begin{bmatrix} 0{,}25 & 1{,}00 & 1{,}00 & 1{,}00 & 0{,}67 \\ 0{,}33 & 0{,}67 & 1{,}00 & 1{,}00 & 0{,}67 \\ 1{,}00 & 0{,}67 & 0{,}80 & 0{,}80 & 0{,}67 \\ 0{,}20 & 1{,}00 & 1{,}00 & 1{,}00 & 1{,}00 \\ 0{,}25 & 1{,}00 & 1{,}00 & 0{,}80 & 1{,}00 \end{bmatrix}$$

5. The result of preference value for each (Vi)

After normalizing, the next step is to carry out the process of calculating the preference value for each alternative (Vi), the result obtained is the sum of the normalized matrix row elements (R) with the preference weight (W). below is the calculation of the preference value for each alternative (V_i).

V1 = (0,20*0,25) + (0,15*1,00) + (0,25*1,00) + (0,20*1,0) + (0,15*0,67) = 0,750

V2 = (0,20*0,33) + (0,15*0,67) + (0,25*1,00) + (0,20*1,00) + (0,20*0,67) = 0,717

V3 = (0,20*1,00) + (0,15*0,67) + (0,25*0,80) + (0,20*0,80) + (0,20*0,67) = 0,760

V4 = (0,20*0,20) + (0,15*1,00) + (0,25*1,00) + (0,20*1,00) + (0,20*1,00) = 0,790

V5 = (0,20*0,25) + (0,15*1,00) + (0,25*1,00) + (0,20*0,80) + (0,20*1,00) = 0,760

6. Rank Results

Below in Table 5 are the results of the ranking using the Simple Additive Weighting (SAW) method

Table 6. Rank Result

Alternative	Total	Rank
A	0.750	4
B	0.717	5
C	0.760	3
D	0.790	1
E	0.760	2

The biggest value is in V4 so that Alternative D is chosen as the best alternative.

That way, the Lenovo Ideapad 320-14 brand laptop is a laptop that meets the specifications needed by potential laptop buyers.

4. CONCLUSION

The conclusion of this research is that the calculation results obtained by using the SAW method which refers to the predetermined criteria, the laptop with the Lenovo Ideapad 320-14 brand was chosen as a laptop that suits the needs of the prospective laptop buyer. And the Simple Additive Weighting (SAW) method in deciding support system for choosing a laptop has made it easier for prospective buyers to find a laptop with specifications that match their needs.

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