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SMARTPHONE SELECTION DECISION SUPPORT SYSTEM BY USING THE WEIGHTED PRODUCT METHOD

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ABSTRACT

Smartphone has become a must-have device that is essential and integral part of life. It is no longer a luxury commodity but a basic life necessity for millions of people. Various brand and models of smartphones provide customers several options yet create dilemma when deciding the one to purchase. The research objective is to provide decision support system in order to assist customer in decision making process for purchasing smartphones. This research applied a quantitative approach with Weighted Product Method analysis. Purposive sampling technique was chosen as the method of determining respondents. The data obtained through questionnaire from 45 students of Kalla Institute Technology and Business. Based on the research analysis using Weighted Product method, the most recommended smartphone to buy is Iphone from Apple.

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1. INTRODUCTION

Smartphones have become a must-have device and are an important and inseparable part of human life today. Smartphones are no longer a luxury item but a basic life necessity for millions of people. The importance of smartphones has grown over the years and changed the way people do things. With advanced technology, smartphones have evolved far beyond their function as a communication tool to become built-in personal assistants that make life easier to live.

Indonesia is one of the largest mobile phone market shares in Asia which is estimated to reach 238.8 million smartphone users by 2026 (Nurhayati-Wolff, 2021). Smartphone manufacturers certainly benefit from this large market size by providing various smartphone models with competitive prices and attractive features. Various brands, models, and features of smartphones available in this market have given customers many choices.

However, the large number of choices has created a dilemma for customers when deciding which smartphone is the best to buy. This feeling of being overwhelmed because of the many choices available can be related to the paralysis or paralysis experienced by consumers when making decisions where customers experience overthinking, anticipation of regret and indolence (Manolică, A., Gută, A.-S., Roman, T., & Dragn, 2021). Worse, the pressure to make the right decision can cause consumers to choose not to make a choice at all because there are too many alternatives (Huber, F., Köcher, S., Vogel, J., & Meyer, 2012). This certainly has an impact on the level of sales of smartphones if consumers choose not to buy because they cannot determine the best smartphone choice.

Therefore, a decision support system is needed by consumers to assist them in determining the best smartphone to buy that fits their criteria and needs among the various available alternatives. Furthermore, knowing the smartphone features that are the reasons consumers buy smartphones will certainly help smartphone manufacturers to produce products according to the features consumers need. The decision support system that researchers use in this study is the Weighted Product Method.

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Weighted Product is a multi-criteria decision-making method and is included in the category of Fuzzy Multiple Attribute Decision Making (FMADM). Like other FMADM methods, WP is a set of decision alternatives described in terms of several criteria. In the Weighted Product method, decision making is done by connecting the attribute or criteria values that have been raised to the first rank with the weights of the attributes or criteria in question through multiplication operations (Limbong, T., Muttaqin, M., Iskandar, A., Windarto, A. P., Simarmata, J., Mesran, M., ... & Wanto, 2020). This method is suitable for use because the consumer will determine the weight of each criterion which is the consumer's parameter in determining the decision.

Several studies have used this method, for example, Syafitri, N. A., et al. (2016) examined the decision support system for selecting a web-based laptop using price, ram capacity, battery capacity and VGA as criteria. Research with a similar analytical method was also conducted by Silalahi, R. J. G., et al (2021) to find out how consumers of health masks determine the choice of masks to be purchased if the criteria include price, mask layers, repetition, filtration effectiveness, quality, appearance, suitability of face shields, and convenience. Basically, consumers instinctively simply often apply this method when making decisions in purchasing a product, namely by comparing several criteria they need on the product to be purchased.

2. METHOD

Types and Sources of Data

This study uses an explanatory type of quantitative approach, by explaining the influence between variables through hypothesis testing with survey data collection methods. The purpose of the survey is to obtain data that can be compared into a subset of the sample so that similarities and differences can be found. This type of data is cross-sectional. Cross-sectional data is the type of data used to photograph a phenomenon at a certain time.

The object of research in this study were students at the Kalla Institute of Technology and Business, Makassar. The sampling technique in this study is purposive sampling, where this sampling technique is carried out when the researcher determines the sample with certain criteria that are in accordance with the research objectives. The respondents were 45 people with the criteria used by Kalla Institute of Technology and Business students who have smartphones.

Analysis Method

This study uses the Weighted Product method to analyze the data that has been collected. This method is most appropriate to be applied because consumers themselves are active in determining the weight for each criterion based on considerations of criteria that are very important, important, quite important, not important, or very unimportant (Kurniawan & Amanda, 2017). According to Basyaib (2006), the first step in using the weighted product method is to determine: 1) the criteria that will be used as a reference in decision making, 2) the suitability rating of each alternative for each criterion and 3) the preference weight of each criterion.

Determination of the value of the weight W

W is the weight of each criterion that will be calculated. The formula to find the value of W:

$$W_j = \frac{W_j}{\sum Wj}$$

The variable W is a positive power for the profit attribute and negative for the cost attribute. The preference for alternatives is given by the equation:

$$S_i = \prod_{j=1}^{n} X_{ij}^{W_j}$$

Information:
Π: product
Si : score / value of each alternative
Xij: alternative value of i to attribute 1
jwj: weight of each attribute or criterion

$$W_j = \frac{W_j}{\sum Wj}$$

n : Number of criteria

$$V_i = \frac{\prod_{j=1}^{n} X_{ij}^{W_j}}{\prod_{j=1}^{n} X_{ij} * W_j} \quad atau \quad V_i = \frac{S_i}{\sum S_i}$$

Where :
V : Alternative preferences are analogous to vectors V X : Criteria Value
w : Weight of Criteria/subcriteria i : Alternative
j : Criteria
n : Number of Criteria
* : The number of criteria that have been assessed on the vector S

3. RESULTS AND DISCUSSION

Alternative Smartphone Options

Based on the data obtained, it is known that almost most of the students of the Kalla Institute of Technology and Business use smartphones in the form of Iphones and Samsungs, so this study uses two samples of smartphone data. The table below is the alternative smartphone data that will be ranked.

Table 1. Smartphone Alternatives

Alternatif	Code
Iphone	A1
Samsung	A2

From the data obtained, it is known that the iPhone price range is twice as high as Samsung's. The camera needs of iPhone users are also higher at 25 MP than Samsung users who only need 12 MP. Here are the results of alternative smartphone data.

Table 2. Sample of Student's Smartphone Data

Criteria	Iphone	Samsung
Price	Rp. 8.000.000	Rp. 4.000.000
Battery	4000 mAh	4000 mAh
Camera	25 mp	12 Mp
Screen	5 Inch	5 Inch

Each type of smartphone that becomes an alternative has the same opportunity to be chosen by the decision maker.

Alternative Criteria in Smartphone Selection

In this study the criteria used are related to price, battery, camera and screen as shown in table 1 below:

Table 3. Criteria and Code

Criteria	Code
Price	C1
Battery	C2

Camera	C3
Screen	C4

Table 3 is a table of criteria that may be selected according to the wishes and needs of decision makers/consumers. Consumers make decisions based on the criteria parameters in table 3 in choosing a smartphone. After knowing the smartphone data, then the data is given the weight of each criterion in the form of a value from one to five. Weights 1 – 5 indicate the level of importance from very unimportant, not important, moderately important, important to very important. The following table shows the weights for each criterion.

Table 4. Weights per Criterion

Criteria	Scale	Weight
C1	< 4 million	1
	4 million – 8 million	2
	8 million - 12 million	3
	14 million - 18 million	4
	> 18 million	5
C2	<1000 mAh	1
	1000 – 2000mAh	2
	2000 – 3000mAh	3
	3000 – 4000mAh	4
	> 5000mAh	5
C3	< 5 MP	1
	5 MP – 8 MP	2
	8 MP – 12 MP	3
	12 MP – 25 MP	4
	> 25 MP	5
C4	< 2 Inch	1
	2 - 3 Inch	2
	3 - 4 Inch	3
	4 - 5 Inch	4
	> 5 Inch	5

Table 4 is a table of weights for each criterion which shows the level of importance of each criterion. Meanwhile, table 5 shows the data on the priority weight values for each criterion for the two alternative smartphone choices.

Table 5. Priority Weight Values Per Criterion for Each Smartphone Alternative

Criteria Code	Iphone	Samsung
C1	5	5
C2	4	4
C3	4	4

C4	3	1

User Input Weight

At this stage, users or potential consumers enter the weight of importance for each criterion according to their needs. Furthermore, the weight correction will be carried out first. The results we found on the initial weight W= (0.25 0.25 0.25 0.25) will be improved so that the total weight is Wj= 1, where W is the weight of each criterion that consumers enter. The calculation of improvement criteria using the equation:

Table 6. Attribute Types Per Criteria

Criteria	**Weight**	**Cost/benefit**	**code**
Price	5	Cost	C1
Battery	5	Benefit	C2
Camera	5	Benefit	C3
Screen	5	Benefit	C4
Amount	20		

Table 6 provides an overview of the attribute types for each criterion where the C1 (Price) criterion is a cost attribute so that it is negative while the C2 (Battery), C3 (Camera), and C4 (Screen) criteria are positive attributes.

Table 7. Alternative values and criteria

Alternative/ Criteria	C1	C2	C3	C4
A1	8000	4000	25	5
A2	4000	4000	12	5

After obtaining the alternative values and criteria, then the weighted product method is calculated using the weighted product method to determine the ranking as a recommendation in choosing a smartphone. To determine the weight of each criterion, it is done by dividing 100% by the number of criteria used so that each criterion has a weight of 25%. Furthermore, the weight of importance will be multiplied by -1 (if cost) and multiplied by 1 (if benefit) which results in the rank of each of the criteria.

Table 8. Criteria Weighting

Weight/criteria	C1	C2	C3	C4	∑ Wj
Weight of interest	0,25	0,25	0,25	0,25	1
Rank	-0,25	0,25	0,25	0,25	

Vector S

The next step is to calculate the alternative Si vector for each value. This is done by multiplying all the criteria (attributes) in each alternative by W (weight) for a positive rank and for the profit attribute. Negative power of weight for the cost attribute. In the case of this cellphone selection. W

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(weight) is a positive power because there is no cost attribute (attribute whose value is greater the more detrimental). Here is how to calculate the Si vector using the equation.

$S1 = (8000^{-0,25})(4000^{0,25})(25^{0,25})(5^{0,25}) = 2,811706626$

$S2 = (4000^{-0,25})(4000^{0,25})(12^{0,25})(5^{0,25}) = 2,783157684$

Table 9. Vector Value of Si

Vektor Si	Si Vector Value
S1	2,811706626
S2	2,783157684
Jumlah n	5,59486431

Vector V

After getting the Vector S value, then determining the highest rank of smartphone alternatives based on the magnitude of the value V (vector value used for ranking) for each alternative from the total value in all alternative values (vector S). Calculation of ranking using equations.

$V1 = \frac{2,811706626}{5,59486431} = 0,5025513525$

$V2 = \frac{2,783157684}{5,59486431} = 0,4974486475$

Table 10. Vector Value Vi

Vektor Vi	Nilai Vektor Vi
V1	0,5025513525
V2	0,4974486475
	1

Decision Ranking as Smartphone Recommendation

After calculating the value of the vector V , then the largest value is obtained which is the best alternative. Table 7 shows the results of smartphone alternative rankings. Here are the results of Smartphone Alternative Ranking

Table 11. Ranking of Decisions

Alternative	V	Rank
Iphone	0,5025513525	1
Samsung	0,4974486475	2
	1	

Based on calculations from simulations of two types of smartphones available on the market with criteria selected by the user according to their needs using the Weighted Product model, the results obtained show that the largest value (max) is at the Alternative value A1 = 0.5025513525 so that the iPhone is the alternative chosen as an option. the best recommendation or the best decision that can be chosen by consumers or in this case Kalla Institute of Technology and Business students.

4. CONCLUSION

Based on the research that has been done, it can be concluded that the weighted product method can be applied to the case of choosing a smartphone by ranking the highest vector (V) value which is an alternative to choosing a smartphone as recommended based on the criteria that have been set previously. The results of data analysis show that the recommended alternative for smartphones is the Iphone (A1). Judging from the many students at the Kalla Institute of Technology and Business who use Iphones, it seems that it can be concluded that the weighting of the criteria and assessments applied to the research is in line with the real conditions. For further research, it is recommended to add alternative smartphone choices and criteria. The combination of using the Weighted Product and Simple Additive Weighting methods can also be an analytical method that shows a comparison of the accuracy of the two methods in making decisions.

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