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A Web-Based Decision Support System Implementation for Evaluating Premier Smartphone Brands Using Weighted Product Method

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Abstract

In the current modern era, smartphones have become an indispensable part of daily life, extensively utilized across a multitude of activities, particularly through online platforms. This underscores the imperative of aiding individuals in making precise decisions regarding the smartphone that aligns most with their needs. To address this exigency, the development of a Decision Support System (DSS) employing the Weighted Product method assumes paramount significance in this research. This DSS empowers users to select the most fitting smartphone by assigning weight values to various performance metrics. The criteria used in this research are price, RAM, ROM, battery capacity, and Android version. The successful implementation of this system streamlines the smartphone selection process, enabling users to make judicious choices that perfectly cater to their requirements while optimizing performance metrics.. In this research, Poco X3 Pro has the highest Vector V value of 0.255441, making it the best-recommended smartphone.

Keywords: Web; DSS; Information; Smartphone; Weight Product

1. Introduction

In our continuously evolving digital era, smartphones have seamlessly integrated into the daily lives of millions worldwide [1]. These devices are no longer mere communication tools; they have evolved into multifunctional hubs encompassing work, entertainment, shopping, and the execution of everyday tasks. The market offers a plethora of diverse smartphone brands and models, each boasting a unique array of features, specifications, and prices [2].

While technological advancements have ushered in considerable benefits, they have also presented new challenges for consumers tasked with selecting the smartphone that best aligns with their needs and preferences [3]. Within this context, a Decision Support System (DSS) has assumed growing significance. This DSS aids individuals in tackling the intricate and complex task of choosing the optimal smartphone that fulfills their personal criteria [4].

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The rapid pace of technological innovation has led to an overwhelming array of choices, making the selection process both exciting and daunting. Factors such as processor speed, camera capabilities, battery life, and operating system functionality all come into play when determining the ideal smartphone. Additionally, considerations about budget constraints, brand loyalty, and specific use cases further complicate the decision-making process [5] [6].

This research embarks on an exploration of the development and implementation of a web-based Decision Support System (DSS) utilizing the Weighted Product method. This method has demonstrated its effectiveness in evaluating various factors influencing smartphone selection, including performance, pricing, features, among others [7] [8]. We will scrutinize how this DSS streamlines and simplifies the decision-making process, empowering users to choose the smartphone that best suits their requirements[9] [10].

Several previous researchers have conducted studies on weight product with different case scenarios. Muazir et al. have conducted research on the weight product in the employee selection recommendation system, which is highly needed for selecting the best candidates [11]. Andriani et al. have conducted research on implementing a Web-Based Decision Support System for Insurance Type Selection for Prospective Customers using the Weighted Product Method [12]. Linda, in her research, has applied the decision support system method known as the Weighted Product (WP) with the aim of helping parents easily and quickly select baby porridge, thereby avoiding errors in meeting their child's nutritional needs [13]. In their research, Pratama et al. aimed to establish a system for assessing the soft skills of teachers in the school to evaluate the performance of each teacher. They identified a challenge in assessing teacher performance at MTs Nurul Iman Simpang Empat, which was the subjectivity in the assessment process due to the lack of a structured assessment system for evaluating teacher soft skills [14].

As such, this study seeks to provide a comprehensive insight into how the Weighted Product method can be employed in the development of a web-based DSS to facilitate more efficient and informed decision-making in the ever-evolving landscape of smartphone selection. Through this exploration, we aim to equip consumers with the tools they need to navigate the dynamic world of smartphones, ensuring that their choices align with both their immediate needs and long-term preferences.

2. Reseach Methods

Research Data

The source of research data for this study is from MK Cell Aceh Utara, which provides specifications and, at the same time, values for each alternative that will be used for the purposes of this research. The data obtained is divided into 5 important features that should be considered, as shown in Table 1.

Table 1. *Main Criteria Table*

No	Feature	Description
1	Price	The amount of money required to purchase the smartphone.
2	RAM	The capacity of RAM provided.
3	ROM	The storage capacity for files provided.
4	Battery Capacity	The supported battery capacity.
5	Android Version	The Android version level that will be used.

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This table outlines the key criteria that will be used to evaluate and compare different smartphone alternatives in the research.

Weight Product Method

The Weighted Product Method is one of the techniques employed to address problems in the realm of Multiple Attribute Decision Making (MADM) systems. MADM is an approach where multiple criteria serve as the basis for decision-making, typically in scenarios where mathematical analysis is not overly complex and involves selecting alternatives in limited numbers. This method is well-suited for situations in which there are several distinct criteria, and it is necessary to assign varying levels of importance to each of these criteria. In this manner, the Weighted Product Method aids in making decisions based on predetermined preferences and priorities. Here are the steps in the Weighted Product Method:

Criteria Determination

The criteria to be used as the basis for decision-making are identified, denoted as "Vi," along with the attributes for each criterion. A decision matrix is created.

Weight Normalization

The weights are normalized by dividing the weight of each criterion by the sum of all criterion weights. It is ensured that the total weight values sum up to one.

Vector Si Calculation

The vector Si is calculated by raising each alternative's attribute values for each criterion to the corresponding positive or negative weight exponent based on whether it represents a benefit or cost criterion.

Vector Vi Determination

Vector Vi represents the values that will be used for ranking the alternatives.

Vector V Ranking

The alternatives are ranked using the Weighted Product formula:

The formula for normalizing weights is applied in (1)

$$\sum_{j=1}^{n} w_j = 1. \quad (1)$$

The formula for calculating vector S is utilized in (2)

$$S_i = \prod_{j=1}^{n} x_{ij}^{w_j}, \ i=1,2,...,m \quad (2)$$

The formula for determining vector V is employed

$$V_i = \frac{\prod_{j=1}^{n} x_{ij}^{w_j}}{\prod_{j=1}^{n} (X_j)^{w_j}}; \ i=1,2,...,m \quad (3)$$

The final step involves ranking the alternatives based on the values obtained from the Weighted Product Method. In this manner, informed decisions are made by considering the specified criteria and their respective weights in the decision-making process.

Research Flowchart

The initial stage in this process involves determining the values for all criteria and all the alternatives to be evaluated. From the available dataset, we can ascertain the values of the membership function for each alternative. This process entails applying the membership function for each existing criterion. Subsequently, the calculation proceeds by utilizing the predefined weights for each criterion. The results of these calculations are used to determine preference values for each alternative, represented in the form of vector S. Furthermore, the

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calculation continues to determine preference values for the alternatives in the form of vector V. Lastly, the system provides smartphone recommendations based on these calculations, facilitating users in selecting the smartphone that best suits their needs. The flowchart of the Weighted Product Method in this study is displayed in Figure 1.

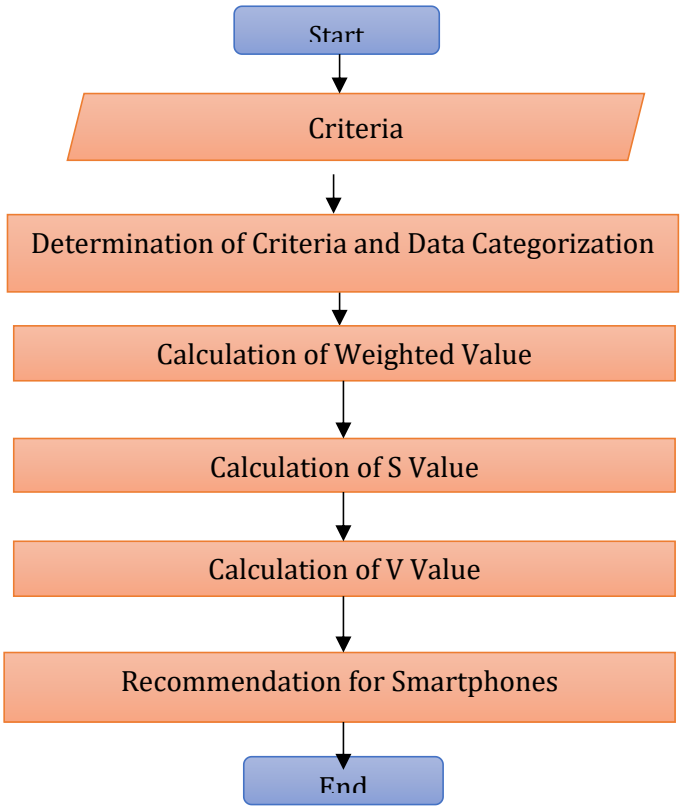

Figure 1. *Research Flowchart*

The research involves several crucial stages in determining criteria and categorizing relevant data. The first stage is the determination of criteria, where the parameters used are price, RAM, ROM, battery capacity, and Android version. After the criteria are established, the next step is to calculate the weighted values of each parameter. This process involves assigning weights or importance to each criterion in the evaluation. Subsequently, the calculation of the S value is conducted, which represents the final result of the assessment of each smartphone based on the established criteria. This S value serves as the basis for calculating the V value, which will be used to recommend the most suitable smartphone choices based on the predetermined criteria. Therefore, this research aims to provide recommendations regarding the optimal smartphone choices based on the identified criteria.

3. Result and Discussions

Data Preparation

Here is the list of smartphones directly obtained from MKcell store in Table 2.

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Tabel 2. *Data Preparation*

No	Smartphone	Price	Ram	Rom	Battery Capacity	Andorid Version
1	Oppo A12	1.800.000	3	32	4230	9
2	Redmi 9c	1.300.000	3	32	5000	10
3	Oppo A55	2.600.000	4	128	5000	11
4	Vivo Y33s	3.000.000	6	128	5000	11
5	Redmi 9	1.500.000	3	32	5020	10
6	Redmi N 12	2.475.000	6	128	5000	12
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
13	Realme Narzo	1.500.000	4	64	5000	11
14	Vivo V27 5G	5.550.000	8	256	4600	13
15	Vivo V27e	3.789.000	8	256	4000	13

Model Representation

The data that has undergone the preprocessing stage will be utilized as training data to facilitate classification for test data using the Weighted Product method. Presented below is the dataset used as training data in Table 3.

Table 3. *Training Data*

No	Smartphone	Harga	Ram	Rom	Battery Capacity	Andorid Version
1	poco X3 pro	3.800.000	6	128	5160	11
2	Redmi A1	1.300.000	3	32	5000	12
3	Samsung G A34 5G	4.400.000	8	125	5000	11
4	Redmi Note 12 Pro 5G	4.300.000	8	256	5000	13
5	Oppo A55	2.600.000	4	128	5000	11

In this phase, we will compute the weight of one criterion relative to another. The criteria weighting is depicted in Table 3. The calculation of criteria weighting employs numerical values to represent the importance weight of one element relative to another.

Determining Criteria and Their Weights

In this stage, we proceed with determining the criteria and assigning weights to each criterion, as outlined in Tables 4 and Tables 5.

Table 4. *Criteria Weights*

Weight	Code	Description
1	(STP)	Very Not Important
2	(TP)	Not Important
3	(CP)	Fairly Important
4	(P)	Important
5	(SP)	Very Important

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In this step, we specify the criteria and their respective weights, as indicated in Table 3.4. These weights range from "Very Not Important" (1) to "Very Important" (5), allowing us to quantify the significance of each criterion in our decision-making process.

Criterion Evaluation Table

The description of each criteria in Table 5 through Table 9.

Table 5. *Price*

No	Price Range		Description	Value
1	1,000,000 2,000,000	>	Very Cheap	1
2	2,000,000 2,500,000	>	Cheap	2
3	3,000,000 3,700,000	>	Reasonably Priced	3
4	3,800,000 4,000,000	>	Expensive	4
5	4,500,000 5,600,000	>	Very Expensive	5

Table 6. *Ram*

No	RAM Range	Description	Value
1	1 > 2	Very Poor	1
2	2 > 3	Poor	2
3	3 > 4	Fair	3
4	5 > 6	Good	4
5	6 > 8	Very Good	5

Table 7*. Rom*

No	ROM Range	Description	Value
1	1 > 30	Very Poor	1
2	30 > 40	Poor	2
3	40 .> 65	Fair	3
4	65 > 130	Good	4
5	130 > 256	Very Good	5

Table 8. *Battery Capacity*

No	Battery Capacity Range	Description	Value
1	1,000 mAh > 2,000 mAh	Very Poor	1
2	2,000 mAh > 3,000 mAh	Poor	2
3	3,000 mAh > 4,000 mAh	Fair	3
4	4,000 mAh > 4,500 mAh	Good	4
5	4,500 mAh > 5,500 mAh	Very Good	5

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Table 9. *Android Version*

No	Android Version	Description	Value
1	Android 1 > 5	Very Poor	1
2	Android 5 > 6	Poor	2
3	Android 6 > 8	Fair	3
4	Android 8 > 10	Good	4
5	Android 10 > 13	Very Good	5

Calculate initial weight

To obtain the importance weight values from the table above, we performed the following steps:

1. Sum all the benefit columns in the Importance row to get the total weight.
2. Divide each benefit by the total weight after calculating the weight.

$$w1 = \frac{3}{3+5+5+4+4} = \frac{3}{21} = 0{,}1$$

$$W2 = \frac{5}{3+5+5+4+4} = \frac{3}{21} = 0{,}2$$

$$w3 = \frac{5}{3+5+5+4+4} = \frac{3}{21} = 0{,}2$$

$$w4 = \frac{4}{3+5+5+4+4} = \frac{3}{21} = 0{,}1$$

$$w5 = \frac{4}{3+5+5+4+4} = \frac{3}{21} = 0{,}1$$

Tabel 10. *Initial weight calculation*

Criteria	Price	Ram	Rom	Battery Capacity	android version	Total weight
Cost/banefit	Cost	Benefit	Benefit	benefit	benefit	
Importance	3	5	5	4	4	21
Weight	0,1	0,2	0,2	0,1	0,1	1

Calculating Vector S

After obtaining the values in the Vector S, the next steps include:

1. Exponentiate each criterion by the weight.
2. Multiply all the exponentiated criteria, resulting in Vector V values.

S1 = (1-0,142857) x (40,38095) x (40,238095) x (50,190476) x (50,19048) = 3,572478

S2 = (1-0,142857) x (20,38095) x (20,238095) x (50,190476) x (50,19048) = 2,568159

S3 = (3-0,142857) x (30,38095) x (50,238095) x (50,190476) x (50,19048) = 3,007017

S4 = (5-0,142857) x (50,38095) x (50,238095) x (50,190476) x (50,19048) = 3,156925

S5 = (5-0,142857) x (50,38095) x (40,238095) x(40,190476) x (50,19048) =2,86901

After completing the calculations for Vector S, the next step is to calculate Vector V, which is the final step in determining the best smartphone.

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Table 11. *Calculating Vector S*

No	Criteria	Price	Ram	Rom	Battery Capacity	Android version	S
1	poco X3 pro	1	4	4	5	5	3,5724
2	Redmi A1	1	2	2	5	5	2,5681
3	Oppo A55	3	3	5	5	5	3,0070
4	Redmi N 12 Pro	5	5	5	5	5	3,1569
5	Samsung G 5G	5	5	4	4	5	2,8690

Calculating Vector V

To calculate Vector V, the final step involves dividing each value in Vector S by the total of all Vector S values, resulting in Vector V. The smartphone with the highest Vector V value is the recommended best smartphone. In this research, poco X3 pro has the highest Vector V value of 0.255441, making it the best-recommended smartphone.

$$V1 = \frac{3{,}572478}{3{,}572478+2{,}568159+3{,}007017+\ 3{,}156925+2{,}86901}$$

$$V2 = \frac{2{,}568159}{3{,}572478+2{,}568159+3{,}007017+\ 3{,}156925+2{,}86901}$$

$$V3 = \frac{3{,}007017}{3{,}572478+2{,}568159+3{,}007017+\ 3{,}156925+2{,}86901}$$

$$V4 = \frac{3{,}156925}{3{,}572478+2{,}568159+3{,}007017+\ 3{,}156925+2{,}86901}$$

$$V5 = \frac{2{,}86901}{3{,}572478+2{,}568159+3{,}007017+\ 3{,}156925+2{,}86901}$$

Table 12. *Calculating Vector V*

No	Criteria	Price	Ram	Rom	Battery Capacity	Android version	V
1	Poco X3 pro	1	1	4	4	5	0,255441
2	Redmi A1	1	2	2	5	5	0,169252
3	Oppo A55	3	3	5	5	5	0,198174
4	Redmi N 12 Pro	5	5	5	5	5	0,208054
5	Samsung 5G	5	5	4	4	5	0,189079

Implementation

Data Analysis Display

In this data analysis view, you will find the results of the ranking of all alternatives. The analysis display includes bar graphs and is accompanied by an explanation of the highest-rated smartphone below the graph. It resembles the image shown in Figure 2.

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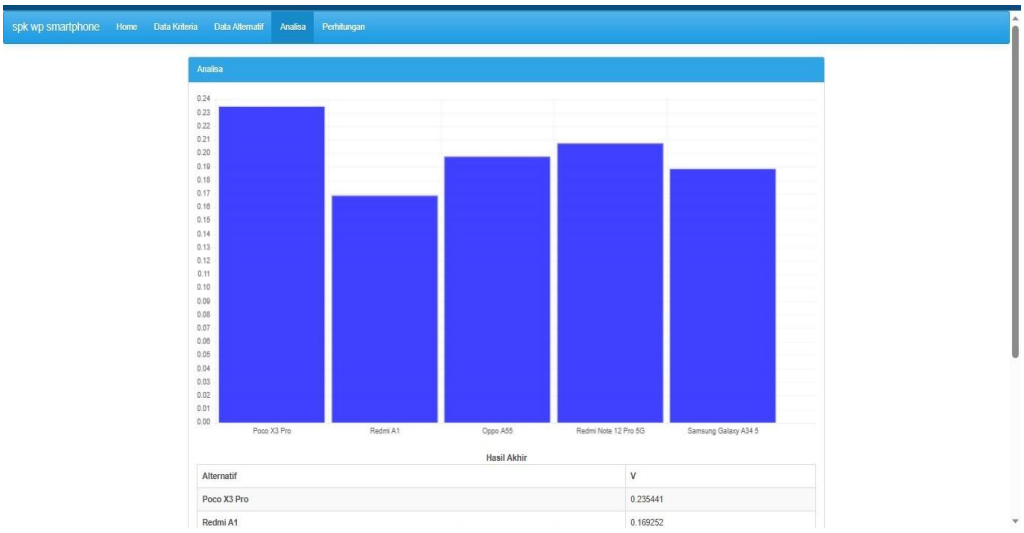

Figure 2. *Data analysis form*

This visualization provides a clear representation of smartphone rankings, making it easier for users to identify the top-rated option. The explanation below the graph offers additional insights into the qualities and advantages of the highest-rated smartphone.

Calculation Results of V

Here is the figure depicting the calculation results of V, displaying the V values for each smartphone alternative.

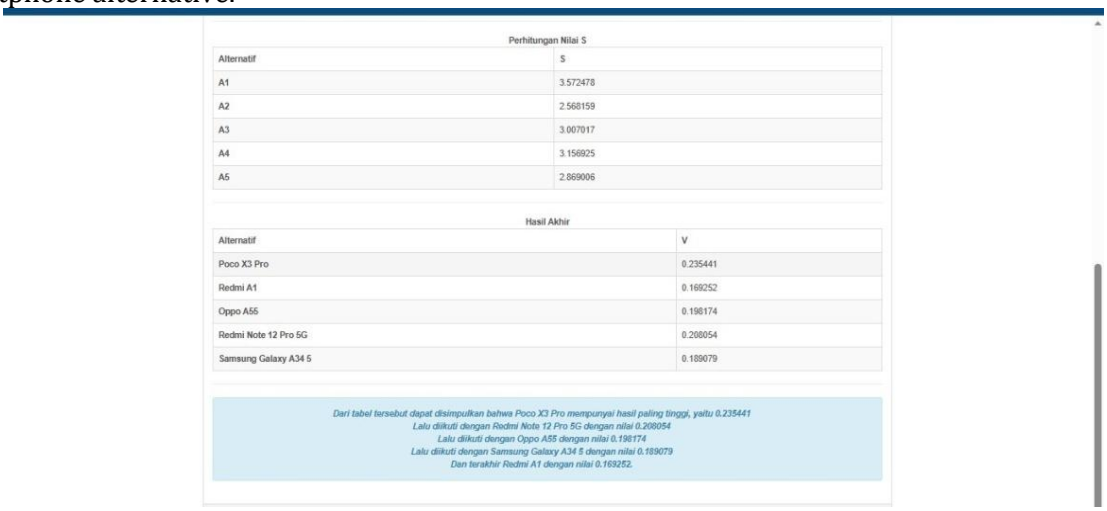

Figure 3. *Data analysis form*

4. Conclusions

This research has successfully developed a decision support application that helps buyers receive personalized smartphone recommendations based on their desired criteria using the weight product method. The application excels in providing guidance on selecting the most suitable smartphone according to individual preferences. The transparency of the calculations and the presentation of results, including detailed breakdowns and graphical representations of the top choices, further enhance the user experience. This system is a valuable tool for individuals looking to simplify the smartphone selection process and make informed decisions based on their needs and preferences. In this research, poco X3 pro has the highest Vector V

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value of 0.255441, making it the best-recommended smartphone. The highest vector value, V, represents the best smartphone recommendation.

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