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Implementation of the SAW Method for Mobile Phone Selection Recommendations at Holida Seluler Store

Achmad Faiq Mu'afi[1], M. Ghofar Rohman[2], Moh. Rosidi Zamroni[3]
[123] Computer Science, Faculty of Science and Technology, Lamongan Islamic University
*corresponding author : achmdfaiqm@gmail.com

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Abstract

Public demand for mobile phones continues to increase as mobile phones evolve as tools for communication, work, entertainment, and access to digital information. With so many products with varying specifications to choose from, consumers often find it difficult to determine which mobile phone suits their needs. Holida Seluler, a store that sells various types of mobile phones, still uses a manual approach in providing recommendations to customers, which can potentially result in inaccurate decisions. This study aims to develop a website using the Simple Additive Weighting (SAW) method to assist customers in determining the best mobile phone, as well as to design a system capable of presenting objective calculation results based on predetermined criteria weights that can be directly applied in the recommendation process. The data used consists of 50 mobile phone products available in stores, with seven main criteria, namely: price, RAM, internal memory, camera, battery capacity, screen, and refresh rate. This system was built using the PHP programming language and MySQL database. The implementation results show that the system can objectively rank mobile phones based on user preferences, with the A45 alternative as the best choice, obtaining the highest score of 0.9100. This system is capable of providing fast, accurate, and data-driven recommendations, thereby increasing service effectiveness and enhancing the customer experience in choosing the right product.

INTRODUCTION

Advances in information and communication technology have created major changes in modern society, including in the use of mobile phones. Nowadays, mobile phones are not just communication tools, but have become a primary necessity in supporting daily activities such as working, studying, worshipping online, and seeking entertainment [1]. This phenomenon has made people increasingly dependent on mobile devices with specifications and features that suit their needs. Unfortunately, the abundance of mobile phones with various brands, types, and features has caused confusion for some consumers, especially those who do not understand technical specifications. On the other hand, businesses in the mobile phone sales sector, such as Toko Holida Seluler in Lamongan, also face challenges in providing the right product recommendations to consumers. Until now, the mobile phone selection process has been manual and relies on verbal explanations from store employees, which risks causing a mismatch between user needs and the products purchased. This condition highlights the need for a system that can assist in the mobile phone selection process objectively and systematically so that consumers can obtain products that suit their needs.

One solution that can be implemented to address the above problem is to develop a web-based Decision Support System (DSS). DSS is an interactive system designed to assist decision makers in

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selecting the best alternative from a set of options, based on specific criteria [2]. In the context of mobile phone selection, DSS can be used to process product specification data and user preferences, thereby generating appropriate recommendations. To support this system, an accurate and easy-to-apply decision-making method is required [3]. The Simple Additive Weighting (SAW) method is one of the most popular methods in DSS due to its ability to solve multi-criteria problems efficiently. SAW works by adding up the normalised and weighted values of the criteria, resulting in a total score that represents the preference level of each alternative. The advantages of the SAW method lie in its ease of calculation and its ability to produce final results in the form of rankings that are easy to understand. Therefore, the application of this method is very relevant to the needs of stores such as Holida Seluler, which want to provide fast, accurate, and data-driven product recommendation services [4].

Many previous studies have also proven that the SAW method is effective and feasible for use in various decision-making cases. For example, using the SAW method to help consumers choose a used smartphone based on several criteria such as price, RAM, camera, and battery. As a result, the system can provide recommendations with high accuracy values that match manual calculations [5]. Another study by Kusnadi (2024) also proves that SAW is effective in helping consumers choose new smartphones based on technical and financial criteria [4]. In addition, Gunawan (2023) applied SAW in selecting the type of plano paper in a printing shop and found that this method provides fast and accurate calculations and reduces the risk of manual calculation errors [6]. Several other studies even applied SAW in different contexts, such as selecting the best laptop, choosing a wedding package, and others, and the results still showed that the SAW method was able to provide the best recommendations objectively. Based on these findings, it can be concluded that the SAW method is suitable as the main approach in developing a quality decision support system.

Through this study, the main issue to be addressed is how to build a decision support system for selecting the best mobile phone at Holida Seluler Store using the SAW method. Another issue that we also want to address is how the application of the SAW method can help produce objective recommendations based on user preference weights for certain criteria [7]. By developing a web-based system that can be accessed by customers and the store, it is hoped that the mobile phone selection process will become easier, faster, and more transparent. This system is also expected to simplify the process of analysing available product specification data and assist customers in comparing several mobile phone alternatives according to their needs and budget. With this system, consumers no longer have to rely on verbal information from sellers but can make decisions based on objective data and systematic analysis [8].

This study aims to develop a web-based decision support system that can help consumers choose the best mobile phone at Holida Seluler Store using the Simple Additive Weighting (SAW) method. This system is designed to process mobile phone specification data available in stores and calculate user preference weights for seven main criteria, namely price, RAM, internal memory, camera, battery, screen, and refresh rate. The final result of the system is a list of recommended mobile phones that have been ranked based on the highest preference values. In addition to helping customers determine the most suitable choice, this system is also useful for the store to improve service efficiency and provide added value in customer service. It is hoped that the existence of this system can increase customer satisfaction and strengthen the competitiveness of Holida Seluler Store amid fierce competition in the mobile device market [9].

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RESEARCH METHOD

The Simple Additive Weighting (SAW) method is a method in Decision Support Systems (DSS) used to solve multi-criteria problems by adding up the values of each alternative that has been normalised and weighted according to its level of importance [10]. In the context of mobile phone selection, this method allows users to determine the best alternative based on a combination of several criteria such as price, RAM, internal memory, camera, battery, screen, and refresh rate [11]. The SAW process begins with normalising the value of each alternative against the criteria, then multiplying it by the respective weight, and finally adding it up to obtain the total preference value. The alternative with the highest score is considered the best choice. The simplicity of the concept and clarity of the calculation steps make this method one of the most widely used in various decision-making studies. This method is particularly suitable for quantitative data with predetermined criterion weights [12].

The SAW method has several advantages that make it superior to other methods. These include a simple implementation process, efficient calculations, and final results that provide a clear ranking of each alternative [13]. SAW also allows for the addition or removal of criteria without changing the basic structure of the calculation, making it flexible for use in various decision-making needs [14]. However, this method also has weaknesses, one of which is its sensitivity to the weight values assigned. If the weights are not determined accurately, the final results may be less representative. In addition, this method assumes that all criteria are independent and comparable, whereas in practice this is not always the case [15]. Nevertheless, these advantages are still far more dominant for studies that require rankings based on numerical values. In this study, these advantages were a strong reason for choosing SAW, because Toko Holida Seluler needed a system that was quick and easy to use by both ordinary users and shop administrators.

To obtain the data needed to apply the SAW method, several data collection techniques were used, such as direct observation at Holida Seluler, interviews with the shop owner and employees, and documentation of the specifications of the mobile phones available. The data collected included the price, RAM capacity, camera, battery, and screen features of each mobile phone [5]. In addition, a literature study was also conducted to determine the weight and criteria based on general consumer preferences in choosing mobile phones. The data obtained was then used as input in the decision support system that was built. The main reason for choosing the SAW method was because this method is capable of providing quick and transparent decision results, which is very important in the context of retail stores that require time efficiency and accuracy in recommending products to consumers [16]. With SAW, the selection process is not only based on the subjectivity of employees, but is also supported by a system capable of performing objective calculations based on real data, making decisions more fair and professional [17]. To obtain preference values for each alternative based on predetermined criteria, the Simple Additive Weighting (SAW) method uses a normalisation and weighting process. The first step in this method is to normalise the decision matrix so that each value is on a comparable scale. Next, the normalisation results are multiplied by the weight of each criterion to obtain the final value [18]. The calculation formula for the SAW method can be explained as follows:

$$R_{ij} \begin{cases} \dfrac{X_{ij}}{Max_i(X_{ij})} & If\ j\ is\ the\ benefit\ attribute \\ \dfrac{Min_i(X_{ij})}{X_{ij}} & If\ j\ is\ the\ cost\ attribute \end{cases} \quad \text{.......................................(1)}$$

Explanation:

R_{ij} : Performance scores that have undergone the normalisation process

X_{ij} : Available attribute values

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$Max_i\ X_{ij}$: Maximum values for each criterion
$Min_i\ X_{ij}$: Minimum value for each criterion
Cost : If the lowest value is the optimal one
Benefit : If the highest value is the most beneficial

Using this formula, the value of each alternative will be normalised within the range of 0-1, where the closer to 1 means the better. For the cost criterion, the lower the initial value, the better (because it is more economical), while for benefits, the higher the value, the better. After the normalisation process, the system will proceed to the stage of multiplication by weight and calculation of the final preference value.

$$Vi = \sum_{j=1}^{n} W_i . R_{ij} \quad \text{...}(2)$$

Explanation:
V_i : Final value obtained for each alternative
W_i : Weighting values for each criterion
Rij : Matrix normalisation

This formula sums the results of multiplying the weight of each criterion by the normalised value of each alternative. The alternative with the highest$VVii$ value is considered the best alternative because it indicates that the product has the most optimal performance against the specified criteria. This method provides logical and measurable final results because it considers all aspects of assessment based on weighting. This process also ensures that the decisions made are objective, transparent, and consistent with the data input into the system.

The data used in this study was obtained from Holida Seluler, a store that provides various brands and types of mobile phones with different specifications. Data was collected through direct observation, interviews with store owners, and documentation of available product specifications. A total of 50 mobile phone alternatives were analysed based on seven main criteria, namely price, RAM, internal memory, camera, battery capacity, screen type, and refresh rate. Each piece of data was arranged in a table format and processed using the SAW method to obtain preference values for each alternative. The criteria weights were determined based on the level of importance from the consumer's point of view, so that the system could provide objective product recommendations. This data was then used as input in a web-based decision support system developed during the research.

Table 1. Alternative Options

No	Alternative	Price (IDR)	RAM (GB)	Internal Storage (GB)	Camera (MP)	Battery (mAH)	Screen	Refresh Rate (Hz)
1	Infinix Smart 8 Pro	1.200.000	8	128	13	5000	IPS LCD	90
2	Oppo A38	1.600.000	4	128	50	5000	IPS LCD	90
3	Samsung A24	2.100.000	8	128	50	5000	SUPER AMOLED	90
4	Vivo Y20s	1.050.000	8	128	13	5000	IPS LCD	60
5	Redmi 13	1.400.000	8	128	50	5000	IPS LCD	90
…	…………….	…….	…	……	……..	………	……….	…
…	…………….	…….	…	……	……..	………	……….	…
…	…………….	…….	…	……	……..	………	……….	…
45	Samsung S10 Plus	2.500.000	8	128	16	4100	DYNAMIC AMOLED	120
46	Oppo A98	2.250.000	8	256	64	5000	IPS LCD	120
47	Vivo Y33s	950.000	8	128	50	5000	IPS LCD	60
48	Oppo A58	1.700.000	8	128	50	5000	IPS LCD	60
49	Realme C11	400.000	3	32	13	5000	IPS LCD	60
50	Redmi 9c	700.000	4	64	13	5000	IPS LCD	60

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RESULTS AND DISCUSSION

A Decision Support System (DSS) for selecting the best mobile phone has been successfully developed using the Simple Additive Weighting (SAW) method, implemented in the form of a web-based application using PHP and MySQL. The initial step in the system testing process involves inputting mobile phone data into the system, including specifications such as price, RAM, internal memory, camera, battery, screen, and refresh rate. The mobile phone data used was obtained directly from Holida Seluler Store and has been compiled in an alternative table format. To ensure the accuracy of the system, 50 alternative mobile phones were tested using actual data available in the store.

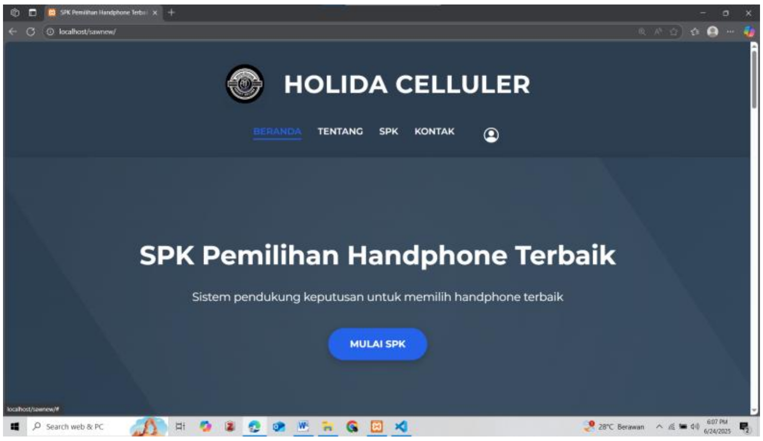

Figure 1. Home Page

Figure 1 shows the home page, which is the initial display that appears when users access the mobile phone selection decision support system. The System Home Display shows the main interface, which is designed with a focus on simplicity and ease of navigation. At the top of the page, there is a main menu consisting of "Home", "Mobile Phone Data", "Criteria", "Calculation", and "About the System", which makes it easy for users to explore all the features of the application. The home page also provides a brief welcome in the form of a description of the system, its purpose, and the benefits it offers to store users and general customers. This information aims to provide an initial understanding of the system's functions before users engage in further interaction. Next, users can access a special page that displays the complete SAW calculation results.

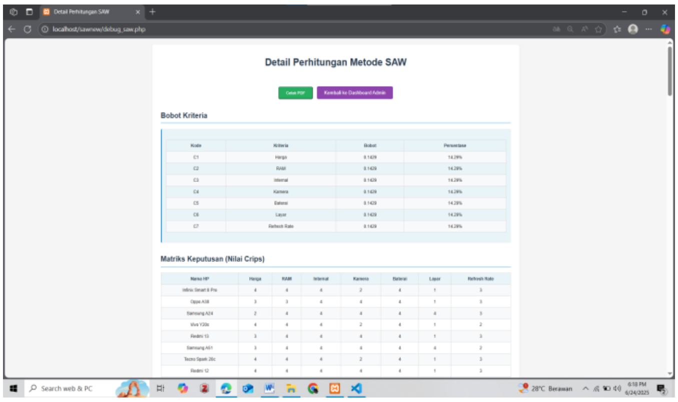

Figure 2. Calculation and Ranking Results Page

Figure 2 displays the SAW calculation results within the system, where the normalised value of each criterion is multiplied by the assigned weight. The final result is a preference value used to determine the ranking

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of the best mobile phones. On this page, the system automatically displays a table of normalised values for each criterion used, such as price, RAM, camera, battery, and others. Each alternative value has been adjusted according to the type of criterion, whether it is a benefit or a cost. This process allows all values from different scales to be comparable to one another. It shows the order of the best mobile phones based on the highest preference value. The results of these calculations are displayed in a table containing columns for alternative codes, product names, and calculated total scores. The alternative with the highest score is displayed at the top and recommended as the best mobile phone based on the criteria entered. This display is designed to make it easier for users to make decisions without having to calculate manually. The process is fast, transparent, and directly accessible to both general users and shop administrators. Through this feature, the system not only functions as a calculation tool, but also as an analysis support tool that provides results that are logically and mathematically accountable. The first step in the system testing process is to input mobile phone data into the system, which includes specification information such as price, RAM, internal memory, camera, battery, screen, and refresh rate.

Table 2. Criteria

Description	Criterion Code	Attribute
Price	C1	*Cost*
RAM	C2	*Benefit*
Internal Storage	C3	*Benefit*
Camera	C4	*Benefit*
Battery	C5	*Benefit*
Screen	C6	*Benefit*
Refresh Rate	C7	*Benefit*

Table 2 presents a list of criteria used in the decision-making process to determine the best mobile phone using the Simple Additive Weighting (SAW) method. These criteria were determined based on field observations and interviews with Holida Seluler Store regarding the factors most considered by consumers when choosing a mobile phone. In this table, there are seven main criteria, namely price, RAM, internal memory, camera, battery capacity, screen type, and refresh rate. Each criterion is designed to represent an important aspect of the device's performance and functionality. The price criterion is set as cost, while the other criteria are classified as benefits. This grouping is important because it will affect the normalisation process in the SAW method.

Table 2 These criteria form the basis for the system to compare products and ensure that the recommendations provided reflect the actual needs of consumers. With clear criteria, the analysis process can be carried out systematically and measurably. The criteria weighting table contains the weighting values assigned to each criterion in the assessment process ( ). These weights indicate the level of importance of each criterion in the final decision. The weights are determined based on general consumer preferences and interviews with retailers, with a rating scale of 0 to 1. The total weight is 1, in accordance with the basic principles of the SAW method. Criteria considered most important, such as the camera and battery, are given higher weights than other criteria such as *refresh rate* or screen type, as shown in Table 3. These weights are flexible and can be changed according to the needs of the system user.

Table 3. Criterion Weight Values

Criterion Code	Weight	Simplification
C1	25%	0.25
C2	15%	0.15
C3	10%	0.10
C4	15%	0.15
C5	15%	0.15
C6	10%	0.10
C7	10%	0.10

The weight values shown in Table 3 are one of the main components in the preference value calculation process. Accuracy in determining weights is very important, as it will affect the final ranking results. Therefore,

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the system is also designed so that administrators can dynamically rearrange weights if necessary, making the system more adaptive and relevant to user needs. Details of the sub-criteria for each of the main criteria that have been determined previously. Sub-criteria serve to group alternative values into structured categories that will be used in the assessment process. For example, for the price criterion, the sub-criteria are divided into several specific price ranges with predetermined assessment scores. Similarly, RAM, cameras, and others are divided based on their capacity or technical capabilities. These sub-criteria, as shown in Table 4, play an important role in transforming the original values into consistent and easily processed scale values in the SAW calculation.

Table 4. Sub-criteria

Code	Criterion Name	Crips	Value	Description
	Price	< 800	5	Very Good
	Price	800 - < 1.300	4	Good
C1	Price	1.300 - < 1.800	3	Fair
	Price	1.800 - < 2.300	2	Very low
	Price	> 2.300	1	Very Poor
	RAM	< 2GB	1	Very Poor
	RAM	2 - < 4GB	2	Very low
C2	RAM	4 - < 6GB	3	Fair
	RAM	6 - ≤ 8GB	4	Good
	RAM	> 8GB	5	Very Good
C3	Internal Storage	8 - < 32GB	1	Very Poor
	Internal Storage	32 - < 64GB	2	Very low
	Internal Storage	64 - < 128GB	3	Fair
	Internal Storage	128 - ≤ 256GB	4	Good
	Internal Storage	> 256GB	5	Very Good
C4	Camera	< 8 MP	1	Very Poor
	Camera	8 - < 16 MP	2	Very low
	Camera	16 - < 32 MP	3	Fair
	Camera	32 - ≤ 64 MP	4	Good
	Camera	> 64 MP	5	Very Good
C5	Battery	< 2000 mAH	1	Very Poor
	Battery	2000 - < 3000 mAH	2	Very low
	Battery	3000 - < 4000 mAH	3	Fair
	Battery	4000 - ≤ 5000 mAH	4	Good
	Battery	> 5000 mAH	5	Very Good
C6	Screen	IPS LCD	1	Very Poor
	Screen	OLED	2	Very low
	Screen	AMOLED	3	Fair
	Screen	SUPER AMOLED	4	Good
	Screen	DYNAMIC AMOLED	5	Very Good
C7	Refresh Rate	< 60Hz	1	Very Poor
	Refresh Rate	60 - < 90Hz	2	Very low
	Refresh Rate	90 - < 120Hz	3	Fair
	Refresh Rate	120 - ≤ 144Hz	4	Good
	Refresh Rate	> 144Hz	5	Very Good

In addition, the sub-criteria in Table 4 also make it easier for users to understand the performance level of each alternative without having to read the technical data in detail. Scores in the sub-criteria are determined based on the logic that the higher the value in the benefit criteria, the higher the score. This structure makes the system more intuitive, consistent, and free from interpretation bias. This table serves as the starting point in the process of converting raw data into numerically processed data. The results of the normalisation process for all mobile phone alternatives are displayed in this table, after each attribute value has been converted using the cost and benefit approach, resulting in a uniform assessment scale for the subsequent preference calculation process. Normalisation is carried out to equalise the scale of each criterion value so that it can be compared fairly and objectively. In the SAW method, normalisation differs for benefit and cost criteria. For benefit criteria, the alternative value is divided by the maximum value in that column, while for cost criteria, the minimum value is divided by the alternative value. This normalisation results in numbers between 0 and 1, which indicate how well

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the alternatives perform in each criterion. Normalisation is very important because the original values between criteria have different units, such as price in rupiah and RAM in gigabytes. The normalisation results are shown in Table 5, so that each value between criteria can be compared objectively and used as a basis for calculating the next preference value.

Table 5. Data Normalisation Results

Code	Cost	Benefit					
	C1	C2	C3	C4	C5	C6	C7
A1	0,500	1,000	1,000	0,800	0,800	0,800	0,750
A2	0,500	1,000	1,000	0,800	0,800	0,600	1,000
A3	0,300	1,000	1,000	1,000	0,800	0,600	1,000
A4	1,000	1,000	1,000	0,800	0,800	0,600	1,000
A5	0,500	1,000	1,000	0,800	0,800	0,200	0,750
….	….	….	….	….	….	….	….
….	….	….	….	….	….	….	….
….	….	….	….	….	….	….	….
A45	1,000	1,000	1,000	0,600	0,800	1,000	1,000
A46	0,500	1,000	1,000	0,800	0,800	0,200	1,000
A47	0,250	1,000	1,000	0,800	0,800	0,200	0,500
A48	0,333	1,000	1,000	0,800	0,800	0,200	0,500
A49	0,200	0,500	0,500	0,400	0,800	0,200	0,500
A50	0,200	0,750	0,750	0,400	0,800	0,200	0,500

The system can continue the process of weighting these values to produce a final score. Table 5 shows that certain alternatives have advantages in some criteria even though they are not always superior overall, emphasising the importance of a multi-criteria approach in product selection. The final result of the SAW method calculation is the total preference value and ranking order of all mobile phone alternatives. Each value is obtained from the sum of the normalised values multiplied by the weight of each criterion, as shown in Table 6. The alternative with the highest score in the table is declared as the best recommendation in the system.

Table 6. Ranking Results

Alternative	Value	Rank
A45	0,9100	1
A24	0,9000	2
A29	0,8900	3
A35	0,8050	4
A13	0,7750	5
…	…	…
…	…	…
…	…	…
A20	0,5250	45
A15	0,4875	46
A50	0,4875	46
A12	0,4500	48
A43	0,4500	48
A49	0,4250	50

In the results obtained in Table 6, alternative A45 ranks first with a preference value of 0.9100, while alternative A49 ranks last with a value of 0.4250. This difference in scores illustrates the level of suitability of each product to the specified criteria. This table makes it easy for users to immediately see the most suitable product without having to perform manual calculations. In addition, these ranking results provide transparency in the decision-making system, as all values and rankings can be traced back to the previous calculation process. The information displayed in this table serves as the final reference for users in determining product choices and proves that the SAW method can be used effectively to provide objective and accurate recommendations.

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The results of this study indicate that a web-based decision support system built using the Simple Additive Weighting (SAW) method is capable of providing objective, fast, and efficient mobile phone selection recommendations. From the calculation results, alternative A45 obtained the highest preference score of 0.9100, indicating that this alternative best meets the criteria specified by the user. The system is also capable of automatically processing data from various mobile phone alternatives and generating rankings based on the weights and values of the criteria, which helps users make more rational decisions without having to calculate manually. When compared to other studies on laptop selection decision support systems using the SAW method, the results achieved show similarities in terms of the accuracy and speed of the system in ranking alternatives. Similar studies also conclude that the SAW method is suitable for cases with many criteria and alternatives, such as in the selection of electronic products. In addition, studies in the context of selecting a place of residence show that SAW provides stable results and is able to consistently reflect user preferences. This reinforces the findings in this study that the SAW method remains relevant for use in various fields.

Other studies have shown that smartphone selection also supports the effectiveness of the SAW method. In these studies, the system successfully provided recommendations that matched user needs based on technical criteria such as price, memory capacity, and camera. Although the context is similar to this study, the system developed in this study is superior in terms of dynamic weighting flexibility and a user-friendly web-based interface. This shows that system development does not only depend on algorithms, but also on interface integration and ease of accessibility by end users. Overall, when compared to various previous literature studies, the system developed in this study provides a new contribution by presenting a decision-making solution that is not only accurate and logical, but can also be operated directly by shops and consumers. The SAW method has been proven to provide consistent, accountable results that support data-driven decision-making. The successful implementation of this system also emphasises that combining the SAW method with an interactive digital platform can improve service efficiency and provide a more modern experience in the product selection process in the electronic retail sector.

CONCLUSION

This study successfully designed and built a web-based decision support system for selecting the best mobile phone at Holida Seluler Store using the Simple Additive Weighting (SAW) method. This system is capable of processing data from various product alternatives based on seven predetermined main criteria, namely price, RAM, internal memory, camera, battery, screen type, and refresh rate. Through the normalisation process and preference value calculation, the system can provide the best product recommendations objectively and measurably. The implementation results show that the A45 mobile phone alternative is the best choice with the highest preference score of 0.9100. The SAW method was chosen for its ability to handle multi-criteria decision-making cases efficiently and transparently. Compared to the manual approach, this system is proven to be faster, more accurate, and easier to use, both by shop administrators and customers. Additionally, the system can be adjusted to changes in weight or criteria as needed. The application of this method is also in line with previous studies that demonstrate the effectiveness of SAW in producing rational decisions. Thus, the developed system not only improves the efficiency of the product selection process but also supports the improvement of service quality and customer satisfaction in the retail store environment.

SUGGESTIONS

Based on the results of research and implementation of a decision support system for mobile phone selection using the Simple Additive Weighting (SAW) method, there are several things that can

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be recommended for further development. First, the system should be equipped with data visualisation features such as comparison graphs between alternatives to make it easier for users to understand the results intuitively. Second, the addition of search and filter features based on specific brands or specifications will increase user convenience in exploring products. In addition, to improve the accuracy of the recommendation results, the system can be developed using a hybrid approach, for example, combining the SAW method with other methods such as Weighted Product (WP) or Analytic Hierarchy Process (AHP), in order to obtain more dynamic and complex weightings. System testing can also be expanded by involving more users from various backgrounds to measure overall user satisfaction and experience. Finally, this system has great potential to be integrated with real-time product stock data, so that it not only recommends the best products, but also ensures the actual availability of products in stores.

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