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Comparison of SAW and Topsis Methods in The Selection of The Best Online Bike Shops

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ABSTRACT

The need for information technology in this pandemic era is greatly increasing. Many people meet their needs by doing buying and selling transactions as if they were online. Through a decision support system using the SAW (Simple Additive Weighting) and TOPSIS (Technique for Others Reference by Similarity to Ideal Solution), methods can provide the best decision in choosing the best online bicycle store site. On the result of the calculation, it is obtained that the results of the two are appropriate. The SAW and TOPSIS methods produced the same ranking, namely the Rodalink site got the highest ranking with a value of 1.019 on the SAW method of 0.833 on the TOPSIS method followed by serbasepeda, united, and cycles. The results of comparing calculations using these 2 methods are considered the SAW method is the most relevant method.

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INTRODUCTION

The need for information technology in this pandemic era is greatly increasing and cannot be separated from daily life. With the pandemic, limited community activities have hampered the country's economy and changed people's living behavior. Because of this problem, many people use information technology in their daily lives, utilizing technology such as as a means of communication, education, and business activities such as buying and selling products online

During this pandemic, many people are pursuing their hobbies or have new hobbies, hobbies that can be done by themselves to avoid crowds. Such as planting, cooking, to cycling sports. Cycling is a sport that can be done alone, therefore in times like this, people are interested in this sport during pandemic. With the high interest of the public, it provokes bicycle sellers to market their products, but with social restrictions, sellers have switched to selling their products through online shops.

There are many factors that cause a person to shop online on Internet sites. Starting from low costs, quality of types of goods, trust, and ease of transaction facilities to several other factors (Nawangsari & Kamayanti, 2018). Online shops also provide many conveniences in transactions, without the need to come directly to the store consumers can directly buy products online and products can be delivered directly to their homes. These factors are causing the increasing interest of people shopping online. Currently, many online shops have sprung up, causing market competition to be avoided. With the tight competition, online shop owners must improve their services in order to survive this competition. The increasing number of online shops today sometimes confuses buyers to determine which online shop is safe and reliable for their shopping place. To find out, a decision support system was designed.

The decision support system (SPK) is used as a tool for decision makers to expand decision capabilities, but does not replace the judgment of decision makers. With the existence of SPK, it is hoped that it can help the community in determining the best online shop that suits their needs. In making the SPK system using certain methods, such as SAW (Simple Additive Weighting) and TOPSIS

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(Technique for Others Reference by Similatiry to Ideal Solution). In carrying out these methods requires criteria and weights in order to find the best alternative

The Simple Additive Weighting (SAW) method or often referred to as the weighted addition method. The basic concept of the SAW method is to look for the weighted summation of the performance rating on each alternative on all attributes(Malau, 2017). The Simple Additive Weighting (SAW) method is the most widely used and simple method in solving Multi Attribute Decision Making (MADM) problems. MADM is a method used to find optimal alternatives to a number of alternatives with certain criteria and requires to determine the weight of each attribute(Simarmata et al., 2018). The results obtained are based on the number of multiplications of weight values and performance rating values normalized by the matrix to a scale compared to all alternatives (George Sumampouw, 2017). The Simple Additive Weighting (SAW) method is often used because it provides accurate results so that it can be useful in decision making. And the SAW method was chosen because it can determine the weight for each attribute, which will be used in the ranking process to select the best alternative (Narti & Fatmawati, 2021).

TOPSIS is part of Multi-attribute Decision Making (MADM). TOPSIS was introduced by Yoon,K.P., & Hwang in 1981. Topsis concept that the best alternative (negat ideal solution) but also has the farthest distance from the worst solution (negative ideal solution)(Sari, 2018).

Based on the description of the problem above, it is necessary to provide a decision in the selection of the best online bicycle store and compare the performance results of the Simple Additive Weughting and Topsis method methods in determining the best online bicycle store to find out the relevant methods in solving the problem.

To support this research, the author uses some of the most research that has been carried out by several previous studies, both in the form of the Simple Additive Weighting and Topsis methods in the selection of e-commerce. In the research conducted by Sidik in "Implementation of the Simple Additive Weighting Method in Choosing the Best Online Computer Store", in his research found the criteria for an online store that customers will choose, namely having a responsive and compatible visual appearance, emphasis on website loading time, news updates or information updates, good customer service, payment security(Chaeruddin et al., 2021)

According to Zahra Wafda Syamila, Fauziah, Novi Dian Natashia in the title "Analysis of the Best Marketplace Selection during the COVID-19 Pandemic Using the Simple Additive Weighting (SAW), TOPSIS and Weighted product Methods", this research resulted in a website-based best marketplace selection decision support system and calculations using the SAW, TOPSIS, and WP methods have similarities where the value of the highest falls on the same alternative and the accuracy rate of the three methods reaches 100%(Syamila et al., 2021).

According to Mustika Mentari, Defandy Fanny Abdillah, and Olivia Narulita entitled "Determining the Best Online Shop Using the TOPSIS Method". The results obtained in this study were the selection of online shop providers based on 4 criteria using the TOPSIS method in 2 ways, namely calculating the average and calculating the alternative weight value of each respondent getting the same result(Mentari et al., n.d.).

RESEARCH METHOD

Data Collection

This study used three data collection methods, namely, as follows:

A. Observation

Observation or observation is one of the data collection techniques that are quite effective for studying a problem. At the time of making observations, the authors conducted research methods and data collection by providing questionnaires to users of online bicycle stores.

B. Questionnaire

At this stage, the author distributed the questionnaire using a google form containing several questions related to the research and then filled out by the respondents as a reference for data processing.

C. Literature Studies

At this stage, the author conducts a literature study for the collection of data and information obtained from libraries, journals, articles and the internet related to this research

Data Processing

The questionnaire has been distributed to 150 respondents of online shopping service users in the family environment and in the cycling club environment. The distribution of the questionnaire began on May 30, 2022. The number of questionnaires distributed contained 60 questions that were distributed to 150 responders, to facilitate filling and processing of data, criteria and alternatives were made to the selection of online bicycle stores.

In this study, the author used the Simple Additive Weighting (SAW) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method as calculations to find out which online bicycle store is the best of the two methods.

RESULTS AND DISCUSSION

The analysis carried out in this study was to determine the criteria used in the selection of the

best *online* bicycle shop. After determining the assessment criteria, then weight each criterion.

The weighting criteria used in this study are as follows:

Table 1. Weighting Criteria

Code	Criterion Name	Ket	Weight
C1	Website Display	*Benefits*	30%
C2	Product Quality	*Benefits*	25%
C3	Service	*Benefits*	20%
C4	Transaction Security	*Benefits*	15%
C5	Delivery	*Cost*	10%

Table 2. Alternatives

Code	Alternative Names
A1	Rodalink
A2	United
A3	Serbasepeda
A4	Cyclus

Table 3. Altenative Attribute Values

Alternative	C1	C2	C3	C4	C5
A1	679	652	637	639	667
A2	588	537	503	547	557
A3	530	665	511	517	537
A4	520	578	496	496	551

1. *SAW Method Calculation*

The following are the steps for calculating data using the SAW *(Simple Additive Weighting)* method:

1). Determining the Decision Matrix

Based on the weight of the criteria of each alternative, a decision matrix is obtained as follows:

$$\begin{pmatrix} 679 & 652 & 637 & 639 & 667 \\ 588 & 537 & 503 & 547 & 557 \\ 530 & 665 & 511 & 517 & 537 \\ 520 & 578 & 496 & 496 & 551 \end{pmatrix}$$

2). Matrix Normalization

Normalizing the matrix by means that if the criterion attribute is a benefit then dividing each element of the matrix by the maximum value of each criterion value. If the cost divides the minimal value of the matrix column by each element of the matrix. Here is the solution of matrix normalization :

a. Normalization of the Website Appearance criteria

$R_{1.1} = \frac{679}{Max\ 679;588;530;520} = = 1\frac{679}{679}$

$R_{2.1} = \frac{588}{Max\ 679;588;530;520} = = 0.87\frac{588}{679}$

$R_{3.1} = \frac{530}{Max\ 679;588;530;520} = = 0.78\frac{530}{679}$

$R_{4.1} = \frac{520}{Max\ 679;588;530;520} = = 0.77\frac{520}{679}$

b. Normalization of Product Quality criteria

$R_{1.2} = \frac{652}{Max\ 652;537;665;578} = = 0.98\frac{652}{665}$

$R_{2.2} = \frac{537}{Max\ 652;537;665;578} = = 0.81\frac{537}{665}$

$R_{3.2} = \frac{665}{Max\ 652;537;665;578} = = 1\frac{665}{665}$

$R_{4.2} = \frac{578}{Max\ 652;537;665;578} = = 0.87\frac{578}{665}$

c. Normalization of Service criteria

$R_{1.3} = \frac{637}{Max\ 637;503;511;496} = = 1\frac{637}{637}$

$R_{2.3} = \frac{503}{Max\ 637;503;511;496} = = 0.79\frac{503}{637}$

$R_{3.3} = \frac{511}{Max\ 637;503;511;496} = = 0.80\frac{511}{637}$

$R_{4.3} = \frac{496}{Max\ 637;503;511;496} = = 0.78\frac{496}{637}$

d. Normalization on Transaction Security criteria

$R_{1.4} = \frac{639}{Max\ 639;547;517;496} = = 1\frac{639}{639}$

$R_{2.4} = \frac{547}{Max\ 639;547;517;496} = = 0.86\frac{547}{639}$

$R_{3.4} = \frac{517}{Max\ 639;547;517;496} = = 0.81\frac{517}{639}$

$R_{4.4} = \frac{496}{Max\ 639;547;517;496} = = 0.78\frac{496}{639}$

e. Normalization on Delivery criteria

$R_{1.5} = \frac{667}{Max\ 667;557;537;551} = = 1.24\frac{667}{537}$

$R_{2.5} = \frac{557}{Max\ 667;557;537;551} = = 1.04\frac{557}{537}$

$R_{3.5} = \frac{537}{Max\ 667;557;537;551} = = 1\frac{537}{537}$

$R_{4.5} = \frac{551}{Max\ 667;557;537;551} = = 1.03\frac{551}{537}$

The result of the normalized value of the performance rating (rij) forms a normalized matrix (R)

$$R = \begin{pmatrix} 1{,}00 & 0{,}98 & 1{,}00 & 1{,}00 & 1{,}24 \\ 0{,}87 & 0{,}81 & 0{,}79 & 0{,}86 & 1{,}04 \\ 0{,}78 & 1{,}00 & 0{,}80 & 0{,}81 & 1{,}00 \\ 0{,}77 & 0{,}87 & 0{,}78 & 0{,}78 & 1{,}03 \end{pmatrix}$$

3). Stages of Ranking (V)

After getting the R matrix, it is continued by using the ranking process (rank). By multiplying the weight of the criteria by each row in the normalization matrix (R).

V_1 = {(0.3*1.00)+(0.25*0.98)+(0.2*1.00)+(0.15*1.00)+(0.1*1.24) = 1.019

V_2 = {(0.3*0.87)+(0.25*0.81)+(0.2*0.79)+(0.15*0.86)+(0.1*1.04) = 0.852

V_3 = {(0.3*0.78)+(0.25*1.00)+(0.2*0.80)+(0.15*0.81)+(0.1*1.00) = 0.866

V_4 = {(0.3*0.77)+(0.25*0.87)+(0.2*0.78)+(0.15*0.78)+(0.1*1.03) = 0.822

From the calculation results of the ranking above, the results of the ranking from the online bicycle shop are obtained as follows:

Table 4. Saw Method Ranking

Code	Alternative	Value	Ranking
A1	Rodalink	1,019	1
A2	United	0,852	3
A3	Serbasepeda	0,866	2

A4	Cyclus	0,822	4

Based on the calculation results using the SAW method, it was obtained that Rodalink had the highest value of 1.019 then followed by Serbasebeda with a value of 0.866, United with a value of 0.852 and finally Cyclus with a value of 0.822

2. *Topsis Method Calculation*

Here are the steps for calculating data using the TOPSIS() method:

1) Matrix Normalization
Normalizes the matrix by squaring each element in the decision matrix and then dividing it by the root of the corresponding total rows. Here's how it is calculated (R) :

a. Normalization of the matrix C1

$R1.1 = \frac{679}{\sqrt{679^2 + 588^2 + 530^2 + 520^2}} = = 0.583 \frac{679}{1165,4}$

$R1.2 = \frac{588}{\sqrt{679^2 + 588^2 + 530^2 + 520^2}} = = 0.505 \frac{588}{1165,4}$

$R1.3 = \frac{530}{\sqrt{679^2 + 588^2 + 530^2 + 520^2}} = = 0.455 \frac{530}{1165,4}$

$R1.4 = \frac{520}{\sqrt{679^2 + 588^2 + 530^2 + 520^2}} = = 0.446 \frac{520}{1165,4}$

b. Normalization of the matrix C2

$R2.1 = \frac{652}{\sqrt{652^2 + 537^2 + 665^2 + 578^2}} = = 0.534 \frac{652}{1220,6}$

$R2.2 = \frac{537}{\sqrt{652^2 + 537^2 + 665^2 + 578^2}} = = 0.440 \frac{537}{1220,6}$

$R2.3 = \frac{665}{\sqrt{652^2 + 537^2 + 665^2 + 578^2}} = = 0.545 \frac{665}{1220,6}$

$R2.4 = \frac{578}{\sqrt{652^2 + 537^2 + 665^2 + 578^2}} = = 0.474 \frac{578}{1220,6}$

c. Normalization of the C3 matrix

$R3.1 = \frac{637}{\sqrt{637^2 + 503^2 + 511^2 + 496^2}} = = 0.590 \frac{637}{1079,8}$

$R3.2 = \frac{503}{\sqrt{637^2 + 503^2 + 511^2 + 496^2}} = = 0.466 \frac{503}{1079,8}$

$R3.3 = \frac{511}{\sqrt{637^2 + 503^2 + 511^2 + 496^2}} = = 0.473 \frac{511}{1079,8}$

$R3.4 = \frac{496}{\sqrt{637^2 + 503^2 + 511^2 + 496^2}} = = 0.459 \frac{496}{1079,8}$

d. Normalization of the C4 matrix

$R4.1 = \frac{639}{\sqrt{639^2 + 547^2 + 517^2 + 496}} = = 0.578 \frac{639}{1104,9}$

$R4.2 = \frac{547}{\sqrt{639^2 + 547^2 + 517^2 + 496}} = = 0.495 \frac{547}{1104,9}$

$R4.3 = \frac{517}{\sqrt{639^2 + 547^2 + 517^2\ 496}} = = 0.468 \frac{517}{1104,9}$

$R4.4 = \frac{496}{\sqrt{639^2 + 547^2 + 517^2 + 496}} = = 0.449 \frac{496}{1104,9}$

e. Normalization of the C5 matrix

$R5.1 = \frac{667}{\sqrt{667^2 + 557^2 + 537^2 + 551^2}} = = 0.575 \frac{667}{1160,6}$

$R5.2 = \frac{557}{\sqrt{667^2 + 557^2 + 537^2 + 551^2}} = = 0.480 \frac{557}{1160,6}$

$R5.3 = \frac{537}{\sqrt{667^2 + 557^2 + 537^2 + 551^2}} = = 0.463 \frac{537}{1160,6}$

$R5.4 = \frac{551}{\sqrt{667^2 + 557^2 + 537^2 + 551^2}} = = 0.475 \frac{551}{1160,6}$

Table 5. Normalized Matrix Result (R)

Code	C1	C2	C3	C4	C5
A1	0,583	0,534	0,590	0,578	0,575
A2	0,505	0,440	0,466	0,495	0,480
A3	0,455	0,545	0,473	0,468	0,463
A4	0,446	0,474	0,459	0,449	0,475

2) Weighted Normalization
Weighted normalization is carried out by multiplying the normalization matrix by the weight of predetermined criteria. The following is the result of the calculation of weighted normalization (Y) :

a. C1 weighted normalization
Y1.1 = (0.583)*(0.300) = 0.175
Y1.2 = (0.505)*(0.300) = 0.151
Y1.3 = (0.455)*(0.300) = 0.136
Y1.4 = (0.446)*(0.300) = 0.134

b. C2 weighted normalization
Y2.1 = (0.534)*(0.250) = 0.134
Y2.2 = (0.440)*(0.250) = 0.110
Y2.3 = (0.545)*(0.250) = 0.136
Y2.4 = (0.474)*(0.250) = 0.118

c. C3 weighted normalization
Y3.1 = (0.590)*(0.200) = 0.118
Y3.2 = (0.466)*(0.200) = 0.093
Y3.3 = (0.473)*(0.200) = 0.095
Y3.4 = (0.459)*(0.200) = 0.092

d. C4 weighted normalization
Y4.1 = (0.578)*(0.150) = 0.087
Y4.2 = (0.495)*(0.150) = 0.074
Y4.3 = (0.468)*(0.150) = 0.070
Y4.4 = (0.449)*(0.150) = 0.067

e. C4 weighted normalization
Y5.1 = (0.575)*(0.100) = 0.057
Y5.2 = (0.480)*(0.100) = 0.048
Y5.3 = (0.463)*(0.100) = 0.046
Y5.4 = (0.475)*(0.100) = 0.047

Table 6. Weight Normalization Results (Y)

Code	C1	C2	C3	C4	C5
A1	0,175	0,134	0,118	0,087	0,057
A2	0,151	0,110	0,093	0,074	0,048
A3	0,136	0,136	0,095	0,070	0,046
A4	0,134	0,118	0,092	0,067	0,047

3) Determining the Ideal Positive and Negative Solution
Determining positive and negative ideal solutions based on criteria attributes. In the ideal solution, if the benefit is taken, the maximum value of the weighted normalization is taken, but if the *cost* is taken, the minimum value is taken. On the contrary, the ideal solution is negative if the benefit then the value taken is the minimum value of the weighted normalization, and if it is cost then the value taken is the maximum value of the weighted normalization. Here are the results of the positive and negative ideal solutions :

Table 7. Positive Ideal Solution (A+)

C1	C2	C3	C4	C5
0,175	0,136	0,118	0,087	0,046

Table 8. Negative Ideal Solution (A-)

C1	C2	C3	C4	C5
0,134	0,110	0,092	0,067	0,057

4) Determining the Ideal Distance of Positive and Negative

Determining the ideal distance of positive and negative by squaring the difference of each result of the weighted normalization matrix with the ideal solution, then summing it with each alternative and then rooting it. Here are the results of the positive and negative ideal distances:

a. Positive ideal distance

D1+ = $\sqrt{\{((0{,}175-0{,}175)^2)+((0{,}136-0{,}134)^2)+((0{,}118-0{,}118)^2)+((0{,}087-0{,}087)^2)+=0.012((0{,}046-0{,}057)^2)\}}$

D2+ = $\sqrt{\{((0{,}175-0{,}151)^2)+((0{,}136-0{,}110)^2)+((0{,}118-0{,}093)^2)+((0{,}087-0{,}074)^2)+=0.045((0{,}046-0{,}048)^2)\}}$

D3+ = $\sqrt{\{((0{,}175-0{,}136)^2)+((0{,}136-0{,}136)^2)+((0{,}118-0{,}095)^2)+((0{,}087-0{,}070)^2)+=0.048((0{,}046-0{,}046)^2)\}}$

D4+ = $\sqrt{\{((0{,}175-0{,}134)^2)+((0{,}136-0{,}118)^2)+((0{,}118-0{,}092)^2)+((0{,}087-0{,}067)^2)+=0.055((0{,}046-0{,}047)^2)\}}$

b. Negative ideal distance

D1- = $\sqrt{\{((0{,}175-0{,}134)^2)+((0{,}134-0{,}110)^2)+((0{,}118-0{,}092)^2)+((0{,}087-0{,}067)^2)+=0.057((0{,}057-0{,}057)^2)\}}$

D2- = $\sqrt{\{((0{,}151-0{,}134)^2)+((0{,}110-0{,}110)^2)+((0{,}093-0{,}092)^2)+((0{,}074-0{,}067)^2)+=0.057((0{,}048-0{,}057)^2)\}}$

D3- = $\sqrt{\{((0{,}136-0{,}134)^2)+((0{,}136-0{,}110)^2)+((0{,}095-0{,}092)^2)+((0{,}070-0{,}067)^2)+=0.029((0{,}046-0{,}057)^2)\}}$

D4- = $\sqrt{\{((0{,}134-0{,}134)^2)+((0{,}118-0{,}110)^2)+((0{,}092-0{,}092)^2)+((0{,}067-0{,}067)^2)+=0.013((0{,}047-0{,}057)^2)\}}$

Table 9. Positive and Negative Ideal Distance

Code	Positivef	Code	Negative
D1+	0,012	D1-	0,057
D2+	0,045	D2-	0,021
D3+	0,048	D3-	0,029
D4+	0,055	D4-	0,013

5) Rankings

The preference/stinging value is obtained from the division of the negative ideal distance by the sum of positive and negative. Here's the calculation:

V1 = $\frac{0{,}057}{0{,}057+0{,}012}$ = 0.833

V2 = $\frac{0{,}021}{0{,}021+0{,}045}$ = 0.320

V3 = $\frac{0{,}029}{0{,}029+0{,}048}$ = 0.377

V4 = $\frac{0{,}013}{0{,}013+0{,}055}$ = 0.191

Table 10. Topsis Method Ranking

Code	Alternative	Value	Ranking
A1	Rodalink	0,833	1
A2	United	0,320	3
A3	Serbasepeda	0,377	2
A4	Cyclus	0,191	4

Based on the calculation results using the TOPSIS method, the results were obtained that Rodalink had the highest value of 0.833 then followed by Serbasebeda with a value of 0.377, United with a value of 0.320 and finally Cyclus with a value of 0.191

3. Comparison of Algorithmic Processes on the SAW and TOPSIS Methods

Based on the results of the comparative analysis of the SAW and TOPSIS methods, the results as below are obtained:

Table 11. Comparison of Weight Values of Each Alternative

Code	Total Value	Rank	Code	Total Value	Rank	Range of Values
A1	1,019	1	A1	0,833	1	0,186
A2	0,852	3	A2	,320	3	0,532
A3	0,866	2	A3	0,377	2	0,489
A4	0,822	4	A4	0,191	4	0,631

From the sensitivity test process in the table above, it produces a comparison value between the SAW Method and the TOPSIS Method, namely the total changes in the SAW method are more than the total changes in the TOPSIS method.

Meanwhile, the result of the preference value (ranking) of each method has the same largest value result, namely A1 (Rodalink). With the largest weight range in the SAW method, which is 0.186 so it can be concluded that the SAW method is the most relevant method to solve this case

CONCLUSION

Based on the results of the research and discussion carried out, it can be concluded that the calculation results using the Simple Additive Weighting (SAW) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) have similarities where the highest preference value falls on alternative 1, namely Rodalink with a value of 1.019 then followed by Serbasebeda with a value of 0.866, United with a

value of 0.852 and finally Cyclus with a value of 1.019 then followed by Serbasebeda with a value of 0.866, United with a value of 0.852 and finally Cyclus with the value of 0.822 was obtained in the calculation of SAW. While in the calculation of TOPSIS, the result was obtained that Rodalink had the highest preference value of 0.833 then followed by Serbasebeda with a value of 0.377, United with a value of 0.320 and finally Cyclus with a value of 0.191. Based on the results of the study, it was concluded that the SAW method is more relevant for solving the case.

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