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COMPARATIVE ANALYSIS OF DECISION SUPPORT SYSTEMS USING THE FUZZY TAHANI AND WASPAS METHODS IN SELECTING TOURISM PLACES TO VISIT IN MAKASSAR

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Abstract
The selection of tourist attractions to be visited, especially the Makassar area requires severalreasons, to make a decision which area to visit, several things need to be considered, besides that a Decision Support System is needed to give the best results. The system used is not just one in order to provide more accurate results. Analysis of the Decision Support System to choose the best tourist attractions in Makassar uses two methods, namely: the FUZZY TahaniMethod and the WASPAS Method. The results of the analysis provide the best method using the same criteria, then the selection of tourist attractions to be visited in Makassar City. Based on the analysis between the The FUZZY Tahani Method and the WASPAS Method in selecting tourist attractions to be visited in Makassar City, in this case the use of the FUZZY Tahani Method is more appropriate. The object of his research is the decision support systemfor selection of tourist attractions to be visited. The results of his research showed that in Theselection of tourist attractions to be visited using the FUZZY Tahani and WASPAS methods the same results were obtained for the best ranking, A7, but there were differences in the results for the next ranking.
Keywords: *Comparative, Analysys, Decision Support System, FUZZY Tahani, WASPAS*

INTRODUCTION

Our activities that take up a lot of time, energy and thoughts in 1 (one) time 24 hours, without realizing it a week has passed, 1 (one) month is not felt and even a year is so short due to busy activities. The daily routine that is carried out means that we do not have much time to get out of the routine for a moment, because time is limited, even if it is just visiting tourist attractions, good time management is needed, so that costs can be saved and distances are not too far away.

Visiting tourist attractions is one way to relieve fatigue after a busy day. There are so many tourist attractions in Makassar City, it is hoped that after visiting these tourist attractions, positive energy will be obtained. What if we don't get it? The reason could be because the tourist attractions are far from us, the cost of going to tourist attractions and visiting time. That is the underlying reason why we need a system and existing systems compared to find out which system can provide an accurate decision.

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

The Decision Support System (DSS) being compared is the DSS using the FUZZY Tahani Method with the SPK using the WASPAS Method for the problem of selecting tourist attractions to visit in Makassar City with the same attributes.

MATERIALS AND METHODS

This research involves prospective tourists who want to choose tourist attractions in Makassar City. Data were taken based on interviews and questionnaires, then criteria were made by giving weights based on the Fuzzy Tahani Method with the WASPAS Method which is a combination of two methods, namely the WSM (Weighted Sum Model) Method and the Weighted Product Model (WPM) Method.

According to Risaldi et al in his research a method capable of analyzing used car specification data based on consumer desires. One such method is the Resistant Fuzzy Model Database. This method was chosen because it has the ability to provide firmness (crisp) on faint (gray) data, namely 1-0 (fuzzy logic). That is, 1 is a true value and can be used as a basis for consideration in making decisions, while 0 is not true and absolutely not worthy of consideration in making decisions. Furthermore, the end of the process of this method is a ranking (fire strength) which shows that the highest value is the most recommended product. This study aims to help the showroom owner Yus Motor and sales decide the choice of used cars quickly and precisely based on consumer desires using the fuzzy database method Tahani model.[1].

Search application services that was designed, could be the based on the difficulty to find out, and to select expedition services which have provided. In these case, when someone who wants to send the packages to a particular destination. Each shipper will see the name of courier services, the god arrive of speed at the destination, prices, and customer services. This application is designed with fuzzy logic method that can be based on the selection of criteria, and specific category. The use of fuzzy logic method can to help and ensure the selection of expedition service that based in variable or criteria are price, speed, location, and services. The result of this research will to display of application that was supported with database systems such as expedition services information and location, and then table of price is available.[2].

The best graduates are pride or people who are considered capable of selling their soft skills or hard skills after completing their Diploma III (D-III) or Starata 1 (S-1) education. The best graduate degrees selected are obtained from several criteria, such as the Grade Point Average (GPA), Organization, Achievement, Intermediate Semester / Corrective Examination, and attitude during their education at a university. In determining the best graduate students, sometimes obstacles arise, causing difficulty in determining the best graduates. Therefore, to determine the best graduate, each alternative must have criteria. Which one, Each criterion has a weight that has been determined individually and is carried out by the completion process using the Weighted Aggregated Sum Product Assessment (WASPAS) method for the ranking process. The highest score or ranking will be used as an alternative recommendation that will get the title of the best graduate Qi[3].

Lecturers are valuable assets in a university, both public and private. A good university must have lecturers who are experts in their fields. Therefore lecturers' evaluation performance needs to be done routinely to make sure lecturers have carried

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

out their duties and responsibilities well. The results of the lecturer performance appraisal are used to consider the leadership to develop the lecturer career. This research aims to compare evaluation performance with the Weight Aggregated Sum Product Assessment (WASPAS) and Vise Kriterijumska Optimizajica I Kompromisno Resenje (VIKOR) method. The object of his research is the decision support system for the lecturers' performance evaluation. The results of his research showed that in evaluating the performance of lecturers using the WASPAS and VIKOR methods the same results were obtained for the best ranking, A10, but there were differences in the results for the next ranking.[4].

The Decision Support System is part of a computer-based information system including the Decision Support system or knowledge management that is used to support decision making, it can also be said to be a system that manages data into information for making decisions. Decision Support System (DSS) or Decision Support System (DSS) is a computer-based system and is intended to assist decision makers by utilizing certain data and models to solve various unstructured problems. SPK was built not to make decisions directly, but as a system that assists in decision making. In building an information system, an effective data management system is also needed, so that the data collected can be processed, explored precisely so that the system can work maximally. In order for the information system to operate optimally, information techniques that have been proven to have superior performance are needed. Information engineering is used as the basis for system development which will guarantee the smooth flow of data. Decision Support System applications use data, provide an easy user interface, and can incorporate decision makers' thoughts. There are several models that describe the decision-making process.

The research design in the making is made using software design tools such as:
1. Windows xp sp3 operating system
2. Adobe Dreamweaver CS3 / Notepad++
3. XAMPP control panel

While the hardware uses specifications such as:
1. Intel core2duo inside
2. Ram 1 Gigabyte
3. Hard disk 60 Giga bytes

Fuzzy model is also used to select a project for research and development (R & D) with multi-criteria decision making. The project selection used several qualitative and quantitative criteria. The criteria include cost and some of the obtained advantages if the project was implemented. However, models produced by Ramadan still can not be used in group.In order to anticipate a group assessment, Zhou et al[5]. Indonesian Blind Union said that the number of blind people in Indonesia reached 3.75 million and 40% in school-age children, and this number will continue to increase each year. Blind people will need the tool to help their day to day activities. The research that has been developed still have flaws, whereas they do not provide the sound of information to the people with visual impairment about the obstacle, included no scientific method used in the research, especially about how the appliance works. This research does not only provide ‘beep’ sound when obstacles are detected, but also provides audio information through a headset to the blind people. There are three obstacles detected, they are holes,

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

bumps, and walls, and it can help the blind people to decide whether to dodge or to step high. To support the audio output and the design processing speed of the appliance, this research uses Raspberry Pi 3 mini PC, three ultrasonic sensors that are used to detect obstruction objects upright, hole and bump, and to initialize the initial values before it detects the obstruction. Tahani fuzzy logic method used to different obstacles such as the bumps, flat surfaces, or holes so the blind people feel much safer while walking. implemented fuzzy logic in decision support system to assess project produced by students. The project is rated by more than one person with several fuzzy criteria. The best project is a project with the highest membership value. Another method for the decision support system is analytical hierarchy process (AHP) fuzzy. AHP fuzzy can help users to make decisions on both structured and semi structured problems. In addition, fuzzy analytical hierarchy process is also used to help make decisions on the process of multicriteria robot selection[5].

Decision Making System for the Purchase of Motorized Vehicles Using the Fuzzy Tahani Method. In this thesis, the application is designed with the PHP programming language. The method used is the Fuzzy Query Method of Tahani model, to process car data which will produce output in the form of car data which is recommended for users. Submission of information is presented using web facilities to make it easier to enter the desired criteria and research conducted, regarding Intelligent Internet Marketing to Assist Consumers in Choosing Mobile Phones Using Fuzzy Database Models, Darati[6]. In order to solve this problem, a fuzzy database system is applied, the Darati model is used to help provide cellphone recommendations to consumers, with information system features that can handle imprecise or uncertain, relative, and qualitative human natural language. As well as research conducted, regarding Decision Support Systems for Employee Recruitment Selection Using the Tahani Method (Cv Central Ac and Car Variations). To assist users in making decisions to select whether these prospective employees can be accepted to become permanent employees at Cv Central Ac And Car Variations or not[6].

The Weighted Aggregated Sum Product Assessment (WASPAS) method is a unique combination of the known MCDM approach, namely the weighted sum model (WSM) and weighted product model (WPM) initially requiring linear normalization of the elements of the decision matrix using two equations.

The Weight Aggregated Sum Product Assessment (WASPAS) method has 4 (four) completion steps, including:

1. Step 1 - Decision Matrix, the criterion values of each alternative are converted into a matrix form with row elements being criteria and column elements being alternatives.

$$x = \begin{matrix} x11 & x12 & x1n \\ x21 & x22 & x2n \\ \dots & \dots & \dots \\ xm1 & xm2 & xmn \end{matrix} \quad \dots\dots\dots\dots (1)$$

2. Step 2 - Normalization, the criterion value of each alternative is changed into a form that has been normalized. If the criteria are Benefit then normalization is carried out with formula 2 (two). as follows

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

$\overline{x}_{ij} = \frac{x_{ij}}{max(x_{ij})}$……..(2)

Information:

$\overline{x}_{ij}$= is the criterion value that has been normalized

x = is the criterion value before it is normalized

i = is the i-th alternative

j = is the jth criterion

= the largest value of the weight of criteria j

Meanwhile, if the criteria are Cost then normalization will be carried out as in formula 3 (three).

$\overline{x}_{ij} = \frac{min(x_{ij})}{x_{ij}}$.....(3)

Information:

$\overline{x}_{ij}$= is the criterion value that has been normalized

x= is the criterion value before it is normalized

i = is the i-th alternative

j= is the jth criterion

= the smallest value of the criteria weight j

Benefit criteria if the value of these criteria is expected to have a higher value, while it is said to be a Cost Criterion if the value of these criteria is expected to have a lower value.

3. Step 3 - perform calculations using the Weighted Sum Model (WSM) formula as in formula 3 (three) and the Weighted Product Model (WPM) formula as in formula 4 (four).

a. Perform calculations using the Weighted Sum Model (WSM) formula

$WSM_i = \sum_{j=1}^{n} \overline{x}_{ij} w_{ij}$…….. (4)

Information:

$\overline{x}_{ij}$= Calculation results of the Weight Sum Model (WSM)

n= Is the criterion value that has been normalized

x= Number of data

i= is the weight of the criteria

i = is the i-th alternative

j = is the jth criterion

b. Perform calculations using the Weighted Product Model (WPM) formula as in formula 5 (five).

$WPM_i = \Pi_{x_{ij}}^{n} \overline{x}_{ij}^{w_{ij}}$……(5)

Information:

$\overline{x}_{ij}$= is the criterion value that has been normalized

x= is the weight of the criteria

i = is the i-th alternative

j= is the jth criterion

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

4. Step 4-, After calculating with the Weighted Sum Model (WSM) and Weighted Product Model (WPM), the next step is to calculate the value of the Weight Aggregated Sum Product Assessment (WASPAS) as in formula 6 (six).

$Q_i = \lambda . WSM_i + \lambda . WPM_i$.....(6)

Information:

Q_i= is the value of the WASPAS calculation results
WSM_i= is the calculated value with WSM = is the calculated value with WPM.
λ= is a constant real number between 0 to 1.

RESULTS AND DISCUSSIONS

The implementation of the use of the Fuzzy Logic Method as found in the tourism selection application is the core of the tourism selection SPK in Makassar. On the tourist attraction selection page, the user can determine the criteria for the desired tourist object to get results that match the predetermined criteria. The tour selection page consists of 8 criteria which consist of 3 fuzzy criteria, namely funds, distance and visiting time and 5 Non Fuzzy criteria, namely places of worship, lodging, supermarkets, souvenirs, and restaurants. Selection of Tourism Data Criteria that have been determined by the user on the tourism selection page will be sent and processed to find recommended tourist objects. Initially, non-fuzzy data were checked, namely places of worship, lodging, supermarkets, souvenirs, and restaurants. If it does not meet all of them then there are no recommended tourism objects and no recommended tourism objects. However, if all of these non-fuzzy criteria meet the requirements specified by the user, then a check is carried out on fuzzy criteria. If the membership degree value is greater than 0, then the tourism object is a recommended tourism object. After the process of calculating the degree of membership and fire strength is complete, the name of the recommended tourism object is displayed along with the percentage value. The recommended value ranges from 0 to 1. The closer to the value 1, the more recommended the tourism object.

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

The tourism selection page is the core of the tourism selection DSS in Makassar. On the tourist attraction selection page, the user can determine the criteria for the desired tourist object to get results that match the predetermined criteria.

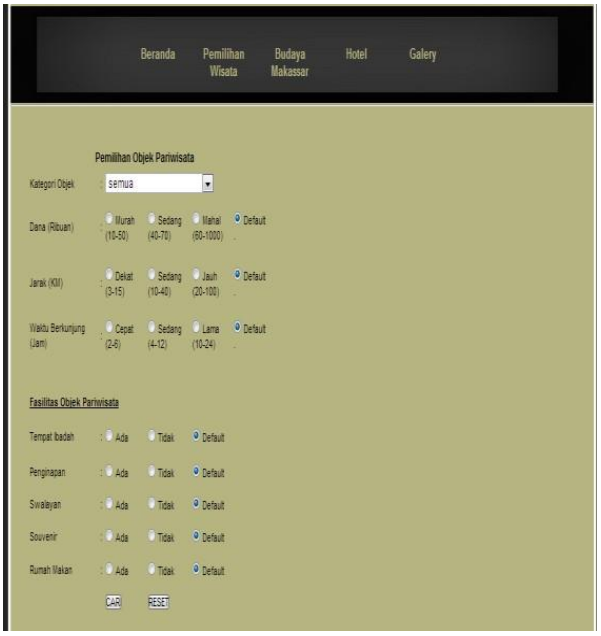

Figure 1 Tour selection form

Your Limit Data Processing Form is used by administrators to store the membership degree values of each tourist attraction. The membership degree data processing form can be seen in Figure 2. Non Fuzzy criteria include places of worship, lodging, supermarkets, souvenirs and restaurants.

Fuzzy Membership Functions include Funds, Distance and Time

Categorized funds into sets:

a. Cheap Fuzzy sets have domains (10-50) units of K=1000 IDR

Using the rising linear curve formula (left shoulder)

b. Fuzzy set currently has domain (40-70)

c. Expensive Fuzzy sets have (60-100) domains

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

For example:

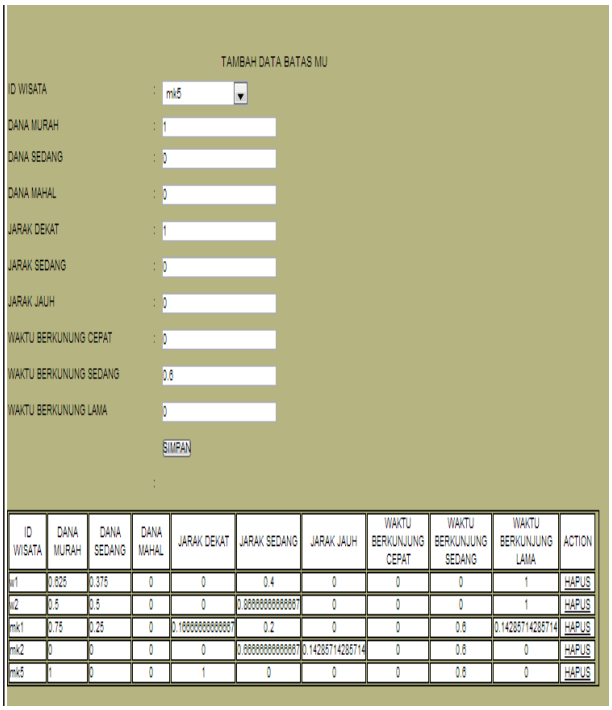

Figure 2 Form of data if the overall degree of membership

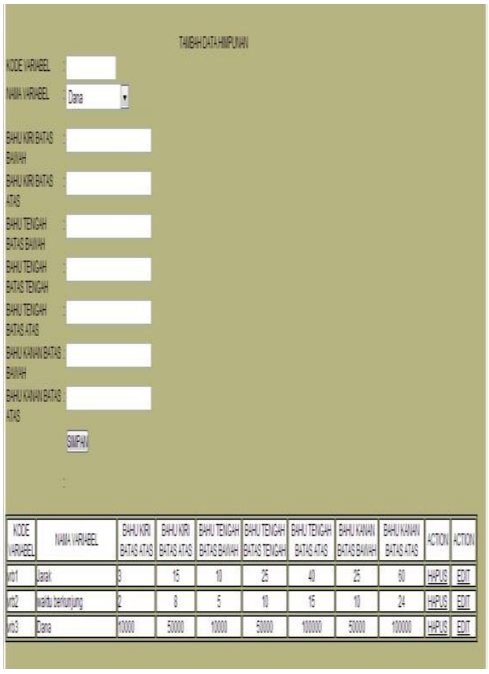

Figure 3 Form Membership Degree Data Processing Form

The Set Data Processing Form is used by administrators to add, delete or change set data which consists of three variables, namely the variables of funds, distance, and visiting time. The data set processing form can be seen in Figure 3.

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

Metode WASPAS

The implementation of the WASPAS Method in the Selection of Tourism Objects to be visited is based on 3 (three) Criteria:

C1=Funds
C2=Distance
C3=Time to visit

Completion of this case begins with developing Criteria, determining Benefit Criteria and Cost Criteria, Attributes and determining the weight of each criterion. Determine Benefit Criteria and Cost Criteria, Benefit Criteria if the value of these criteria is expected to be of higher value, while it is said to be Cost Criteria if the value of these criteria is expected to be of lower value.

Table 1. Table Criteria

Kode	Kriteria	Attribut	Bobot
C1	Dana	Cost	25%
C2	Jarak	Benefit	40%
C3	Waktu Berkunjung	Benefit	35%

Then determine the rating scale for each criterion.

Table 2. Table Rating Scale

Keterangan	Bobot
Sangat Baik	5
Cukup	3
Kurang	1

After determining the rating scale, we make Alternative Data for the choice of determining the tourist object you want to visit in Makassar City.

Table 3. Tabel Alternative Data

Kode	Destinasi Wisata
A1	Celebes Canyon
A2	Pantai Akkarena
A3	Leang-leang
A4	Lappa Laona
A5	Bantimurung
A6	Pantai Appalarang
A7	Helena Sky Bridge

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

A8	Buttu Macca

After the Criteria, Rating Scale and Alternative Data have been determined, then follow the WASPAS Method Steps.

WASPAS Method Steps:

1. Create a Decision Matrix

Table 4. Table Decision Matrix

No	Alternatif	C1	C2	C3
1	A1	3	3	5
2	A2	5	3	5
3	A3	3	3	3
4	A4	3	3	1
5	A5	1	1	3
6	A6	1	1	1
7	A7	3	5	5
8	A8	1	3	1
	Max	5	3	5
	Min	1	1	1
	Bobot	25%	40%	35%

2. Table 5.Table Normalization

No	Alternatif	C1	C2	C3
1	A1	0.3	0.6	1.0
2	A2	0.2	0.6	1.0
3	A3	0.3	0.6	0.6
4	A4	0.3	0.6	0.2
5	A5	1.0	0.2	0.6
6	A6	1.0	0.2	0.2
7	A7	0.3	1.0	1.0
8	A8	1.0	0.6	0.2

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

Normalize criterion 1 (C1), type=Cost then xij=min(xij)/ij, where min value (ij)=1, example
A11=1/3=0.3
A12=1/5=0.2
A13=1/3=0.3
… A18(please continue while practicing)
Normalization of criterion 2 (C2), type=Benefit then xij=xij/maxij, where min value (ij)=3, example
A21=3/3=1
A22=3/3=1
A23=3/3=1
…A28(please continue while practicing)
Normalization of criterion 3 (C3), type=Benefit then xij=xij/maxij, where min value (ij)=5, example
A31=5/5=1
A32=5/5=1
A33=3/5=0.6
…A38(please continue while practicing)
3. Perform calculations using the Weighted Sum Model (WSM) formula 3 and using the Weighted Product Model (WPM) formula 4.
examples of WSM calculations
WSM1=(0.3*0.25)+(1*0.4)+(1*0.35)
WSM1=0.075+0.4+0.35
WSM1=0.83
So WSM1 for A1=0.83

WSM2=(0.2*0.25)+(1*0.4)+(1*0.35)
WSM2=(0.05+0.4+0.35)
WSM2=0.80
So WSM2 for A2=0.80
and so on up to the WSM8 value for A8.

The overall WSM calculation results for criteria ranging from C1 to C8 are as shown in Table 6.

Table 6. Tabel WSM table for each alternative

No	Alternatif	C1	C2	C3	WSM
1	A1	0.33	0.60	1.00	0.67
2	A2	0.20	0.60	1.00	0.64
3	A3	0.33	0.60	0.60	0.53

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

4	A4	0.33	0.60	0.20	0.39
5	A5	1.00	0.20	0.60	0.54
6	A6	1.00	0.20	0.20	0.40
7	A7	0.33	1.00	1.00	0.83
8	A8	1.00	0.60	0.20	0.56
	w	0.25	0.4	0.35	

Next, to calculate the WPM for each criterion, we take the following examples of calculations:
WPM calculation example:
WPM1=(0.3^0.25)+(1^0.4)+(1*0.35)
WPM1=(0.76+1+1)
WPM1=2.76
So WPM1 for A1=2.74

WPM2=(0.2^0.25)+(1^0.4)+(1^0.35)
WPM2=(0.67+1+1)
WPM2=2.67
So WPM2 for A2=2.67
and so on up to the WPM8 value for A8.

The overall WPM calculation results for criteria ranging from C1 to C8 are as shown in Table 7.

Table 7. WPM table for each alternative

No	Alternatif	C1	C2	C3	WPM
1	A1	0.33	0.60	1.00	2.58
2	A2	0.20	0.60	1.00	2.48
3	A3	0.33	0.60	0.60	2.41
4	A4	0.33	0.60	0.20	2.14

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

5	A5	1.00	0.20	0.60	2.36
6	A6	1.00	0.20	0.20	2.09
7	A7	0.33	1.00	1.00	2.76
8	A8	1.00	0.60	0.20	2.38
	w	0.25	0.4	0.35	

4. The last step of the Weight Aggregated Sum Product Assessment (WASPAS) method is to calculate the WASPAS value using formula 4(four) against table 6(six) and table 7(seven).

$Qi = \lambda . WSM_i + (1 - \lambda) . WPM_i$.....(5)

Qi = WASPAS value to i
λ= constant real number between 0 and 1
WSMi = value of WSM to i
WPMi=WPM value to i

Example of WASPAS calculation results:
value=$\lambda = 0.5$
Q1=(0.5)*WSM1+(1-0.5)*WPM1
Q1=(0.5*0.83)+(1-0.5*2.76)
Q1=(0.5*0.83)+(0.5*2.76)
Q1=0.42+1.38
Q1=1.80

Q2=(0.5)*WSM2+(1-0.5)*WPM2
Q2=(0.5*0.80)+(1-0.5*2.67)
Q2=(0.5*0.80)+(0.5*2.67)
Q2=0.40+1.33
Q2=1.73

and so on up to the calculation of Q8 for A8.

Table 8. Table of WASPAS calculation results for each alternative

No	Alternatif	WASPAS	Rekomendasi Ke-
1	A1	1.62	2

Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

2	A2	1.56	3
3	A3	1.47	4
4	A4	1.27	7
5	A5	1.45	6
6	A6	1.25	8
7	A7	1.80	1
8	A8	1.47	5

The results of the WASPAS calculation for each alternative are shown in Table 8. It shows that the 1st (first) order as a recommended place is the A7 criterion for the Helena Sky Bridge tourist destination with the 1.80 WASPAS calculation results for each, 2nd place (second) is criterion A1 for the Celebes Canyon tourist destination with the results of each WASPAS calculation of 1.62, 3rd place (third) is criterion A2 for the Akkarena Beach destination with the results of the respective WASPAS calculation of 1.56, 4th place is criterion A3 for the Leang-leang destination with the results of each WASPAS calculation of 1.47, 5th (five) is criterion A8 for Buttu Macca tourist destinations with the results of each WASPAS calculation of 1.47, 6th (sixth) is criterion A5 for Bantimurung tourist destinations with the results of each WASPAS calculation - 1.45 each, 7th (seventh) is criterion A4 for Lappa Laona tourist destinations with the results of each WASPAS calculation of 1.27, 8th (eighth) is criterion A6 for Appalarang Beach tourist destinations with the results of each WASPAS calculation of 1.25.

CONCLUSIONS & RECOMMENDATIONS

The selection of tourist attractions to be visited in Makassar City using the Fuzzy Tahani Method and the WASPAS Method can provide alternative methods because based on the processed data each has a different level of accuracy. by using the same variables, namely Funds, Distance and Time. This study uses the FUZZY Hold method with membership functions linear up (left shoulder), middle linear, linear down (right shoulder). Meanwhile, the WASPAS method is a combination of the Weighted Sum Model (WSM) and using the Weighted Product Model (WPM). The difficulty level of the WASPAS method lies in reading the data for the membership function and then selecting the function that matches the problem to be included in the membership function, while the WASPAS method calculates the weight of the criteria done twice through the WSM and WPM methods.

Future researchers should add more methods with the same problem so that there are many comparisons because the more methods used the more valid the data produced, but it is necessary to pay attention to the suitability of the method with the existing problems.

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Nusantara Hasana Journal
Volume 2 No. 9 (Februari 2023), Page: 269-283
E-ISSN : 2798-1428

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