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SELECTION SYSTEM OF THE BOARDING HOUSE BASED ON FUZZY MULTI ATTRIBUTE DECISION MAKING METHOD

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ABSTRACT

Boarding house is a residence that is temporary and in the form of blocks of rooms in various sizes which are inhabited by students and employees from outside the area. There is a way of selecting the best boarding house which is influenced by several criteria, such as the rental price, amenities, number of rooms and other criteria such as distance to the destination, the location and the time limit on a visit. The number of criteria can easily select the best boarding based on criteria. However, little information on the boarding house has the shortest distance to the destination, this causes problems in choosing a boarding location so that it takes a decision support system for selecting a boarding locations based on considerations. Some of the solutions to solve the problem of selecting a boarding house have not been done. Hopefully it can provide a satisfactory success which has not been achieved. Therefore, this research makes a decision support system to solve the problem of selecting boarding house based on the criteria that have been determined using the method of Fuzzy Multi Attribute Decision Making (FMADM) to generate the best alternative boarding house and know the criteria which became the characteristics and behavior of those searchers boarding houses which have most domination and influence the decision of the boarding searcher to select a boarding house. The selection process for some alternatives on FMADM needs to determine the criteria early in the process as a reference for decision making, while the method of Weighted Product (WP) is used to normalize weight value that indicates the level of importance of each criteria. This research has five levels such as very low, low, moderate, high, very high. Various experiments were conducted to determine the criteria of FMADM method (such as location, district, village, gender of boarding house**,** minimum price and maximum price) as well as to obtain the best alternative from the boarding house. Experimental results showed that FMADM methods that have been developed in this study were able to solve the problem selecting the best boarding house from the highest alternative to alternate the lowest characteristics behavioral of home seekers the most superior in the selection of boarding houses, such as the criteria of the water conditions, the price of boarding houses, facilities, and the distance from the boarding house to the destination. Success rate of 100 respondents from 18 types of criteria were tested using the data in Sukolilo area, Surabaya City.

Keywords: *Descision Support System, Boarding House, Method, Fuzzy Multi Attribute Decision Making, Weighted Product.*

1. INTRODUCTION

Boarding house is a temporary home in the form of block - a block of rooms with different sizes [1]. Boarding houses selected students, workers as a temporary home because a place of study or work far from their homes. Each boarding house has different criteria so it affects the price and its convenience. Moreover, selecting a boarding house requires some consideration in determining the ideal boarding house which is comfortable and in accordance with the criteria expected. Little information about boarding houses may cause problems in choosing the location of the boarding house near the destination, therefore it takes a decision support system to give information about the boarding house that matches the desirable consideration. The selection of a boarding-based geographic information system (GIS) requires the services of Google Maps into a website using the Google Maps API to provide information about the boarding house related to its form of instructions which has efficient way to include information about the price, type of building, area and facilities of the boarding house itself [1].

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With the development of information technology, it increases the ability of computers to solve problems in various fields, such as computer-based decision support system. Decision support system is needed to provide the best solution [2]. There are several solutions to solving problems in choosing a boarding house which have not been done. Choosing the right boarding house in Indonesia is complex because there are several criteria which influence the problems solving in finding a best boarding house, such as the distance rental of boarding houses which have at least six months and a maximum of twenty-four months. The building type of boarding house has similarities with building houses, the building usually has maximum three floors which each floor has six rooms and the room size is about 3x5 meters. The boarding house rental prices every 6 months is approximately 1.5 million rupiah. In addition, boarding houses have also been affected by the criteria of comfort in the terms of facilities such as water, electricity, parking, room size, room capacities, etc. The criteria of the rental price is influenced by the proximity of the boarding house distance to destination, where the distance is too close to the place of destination that rental prices become too expensive. Therefore, this research is needed a method to choose a boarding house based on some certain criteria. In the previous research, it was solving complex problems using traditional methods such as Analytic Hierarchy Process (AHP) but insufficient to solve complex problems [3][4]. FMADM method is a method to result optimal alternative of a number of alternatives to certain criteria. The importance of FMADM method is to determine the weight values for each attribute, then it is continued by the ranking process for selecting alternatives that have been given [5]. There are three approaches to find the weight values of attributes, such as subjective approach, objective approach and an integrated approach between both of subjective and objective. The weight values are determined by the subjectivity of the decision makers in the subjective approach so it is multiple factors on the process of ranking alternatives which can be determined freely. In this research, ranking process uses the method of Weighted Product (WP). WP method is one method of solving Multi-Attribute Decision Making (MADM) to evaluate several alternatives to a set of attributes or criteria, where each attribute join no dependent with each other [6]. WP method uses the normalization process, where a rating of each attribute should be raised to the relevant attribute weights [7].

In this research, FMADM method determines the criteria referenced in the decision, while WP method is for normalization of weight value which indicates the level of importance of each criteria into five levels (such as very low, low, moderate, high, very high). The purpose of this research is to develop a decision support system FMADM method to generate the best alternative boarding house and know what criteria that characterize the most dominant behavior of home seekers that may influence the decision of the seeker boarding to selecting house boarding.

2. SYSTEM DESIGN

This research has a resolution to find the best boarding house in Indonesia because most of boarding houses Indonesia is also lived by the landlord. In this situation, people get difficulties in determining what type of boarding house which is best for them because they need to adapt with their landlord too. This problem can be solved the application in this research. It can help students or workers in finding that best boarding house with several criteria, such as the distance of at least 6 months lease, unlike the hotels that can be rented at any time with a lot of class. Meanwhile, the boarding houses are houses that are rented based on the room sizes and generally each floor has only one bathroom, one kitchen, so the occupant can share and take turns. Besides, the rental price per room valid for at least six months and the price is affected by distance proximity of boarding houses to the destination, which is getting close to the point of interest, the more expensive the rental price. Data input from this research is the criterion data from his rented house in the area Sukolilo, Surabaya, East Java, Indonesia, (such as 50 houses of regions Gebang, 50 houses of the area Keputih, and 50 houses of home area of lecturers in ITS Campus) based on 18 data criteria which are shown in Table 1. Each criterion has a weight value of each alternative and it has been divided into 5 levels, as shown in Figure 1. Based on observations and interviews, every inhabitants of the boarding house of 100 respondents indicates that they dislike boarding house on weighs 0.2 (very less) while the most preferred has a weight of 1 (very good).

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Table 1. Data Criteria for Boarding House

No	Type of Criteria	Sub Criteria
1.	Price	1. Rental Price
		2. Rental prices of electronic equipment
2.	Facilities	3. Water
		4. Electricity
		5. Place for drying
		6. Places to Wash
		7. Number of Bathroom
		8. The size of the Bathroom
		9. Kitchen room
		10. TV
		11. Parking Place
3.	Rooms	12. Number of rooms
		13. Room size
		14. Room capacity
		15. Room Facility
4.	Other Criteria	16. The distance from the destination
		17. Visiting hours for night
		18. Locations

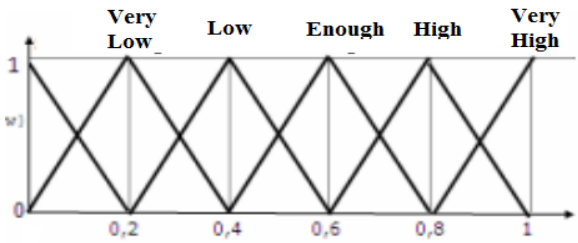

Figure 1. Graph of Alternative Weight for Each Criterion

Searching the best boarding house based on the desired criteria will require a decision support system. The decision is selecting an activity or action strategy with qualified, variable; and the model is determined to solve the problem. According to Mat and Watson, DSS is an interactive system that can help in decision-making through the use of data and decision models to solve the problem that are semi-structured and unstructured [8]. There are several models which are used in developing decision support systems, one uses a model FMADM. FMADM is a method for finding the optimal alternative to determine the weight values for each criterion and continued ranking process for selecting alternatives that have been given [9]. There are three approaches to find the weight values of attributes, such as subjective approach, objective approach and an integrated approach between both of subjective and objective. Each approach has its advantages and disadvantages. The weight values are determined by the subjectivity of the decision makers in the subjective approach so it is multiple factors on the process of ranking alternatives which can be determined freely. While the weight value is calculated mathematically on an objective approach, it ignores the subjectivity of decision-makers [10]. The concept of the problem is evaluating alternative m A_i (i = 1,2, ..., m) to a set of attributes or criteria C_j (j = 1,2, ..., n), where each attribute is not interdependent with each other. This method requires that the decision maker determines the weights for each attribute. Based on the data types which are used in each performance of alternatives, FMADM can be divided into three groups: all data used are data fuzzy, all the data used are data crisp, or the data used are a mixture of data which are fuzzy and crisp. If the data given in the form of linguistic fuzzy, then the data must be first converted to the form of fuzzy numbers, then it is converted again into crisp numbers. Here are several methods that can be used to solve the problem FMADM, such as Simple Additive weighting method (SAW), Weighted Product (WP), ELECTRE, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Analytical Hierarchy Process (AHP) [11]. In this research, using WP method is one method of settlement on the issue of Multi-Attribute Decision Making (MADM) to evaluate several alternatives to a set of attributes or criteria, where each attribute is mutually dependent with each other [6]. WP methods is used for the process of normalization, which should be raised to a power rating of each attribute in advance with the relevant attribute weights [7].

The steps of method of FMADM and WP method for decision support system for the selection of Boarding House are (1) Determine the criteria referenced in the decision (C_i), (2) Determining the weight value that indicates the level of importance of each criteria (W) into 5 set, (3) any decision of selecting a number of alternatives based on predetermined criteria, (4) Determining the weight value of each alternative for each criterion as in Figure 1, (5) Prepare a matrix decision (X) based

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on the weight of importance and weighting alternative, (6) doing that will select the process of ranking the alternatives that have been selected by the decision makers, (7) the process of preference for each alternative (V) as defined in Equation 1. The process of ranking is done by using WP. There are two stages in the process of normalization to methods of WP, they are process improvement criteria weights (W) with Equation 2, then do the normalization process (S) matrix decision by multiplying the rating attribute, where the rating attribute must first be raised to the weight of attributes, such as the equation 3.

$$V_i = \frac{\prod_{j=1}^{n} x_{ij}^{w_j}}{\prod_{j=1}^{n} x_j^{w_j}}, \quad (1)$$

$$W_j = \frac{W_j}{\sum W_j}, \quad (2)$$

$$S_i = \prod_{j=1}^{n} x_{ij}^{w_j}, \quad (3)$$

where is preference value for each alternative which having larger indicate the alternatives chosen. is the attribute weights, alternatives are rating each attribute and is the result of on decision matrix normalization alternative to i. This research can be a reference for the methods to solve the problems of election boarding house with the fulfillment of the criteria optimal as an important element to produce the best boarding house. Then, a list of the best boarding is used as input by WP method to select the best boarding houses in the yield level of importance of each criterion that is optimal with limited 18 criteria for boarding houses in the area of Sukolilo, Institute of Technology Surabaya as many as 150 homes.

3. EXPERIMENTS AND RESULTS

Based on the steps to resolve the problem of selecting the best boarding method FMADM, the first step is to determine the criteria to be used as reference in decision making as in Table 1. The implemetation of 18 criteria is shown in Figure 2. The second step is to determine the level of importance of each criterion into 5 sets (very high, high, Pretty, Low, very Low). Based on the results of the tests on 100 respondents and 18 criteria of the level of interest, the highest weight value of 1 is the criteria of all three, the high level of importance is worth 0.8 on the criteria of the 1st, 2nd, 4th, 10th, to14th and 16th. While the interest rate is quite worth 0.6 criteria which can be found in the 5th, 6th, 7th, 9th, 11th, 13th, 15th and 18th criteria. The lower interest rate which is worth 0.4 criteria can be found in the 8th, 12th, and 17th criteria. Meanwhile, the very low level of interest worth 0.2 does not have the weight values (at 0), shown in Figure 3.

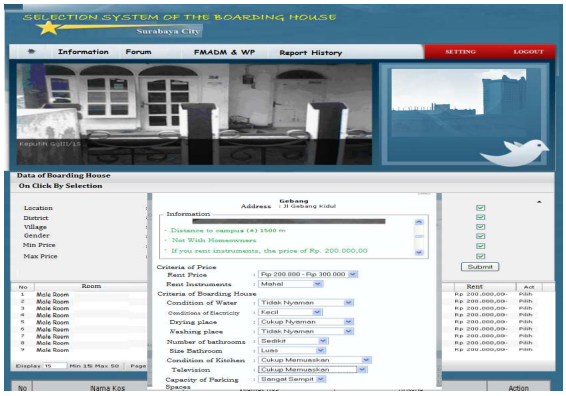

Figure 2. Implementasi of Criteria

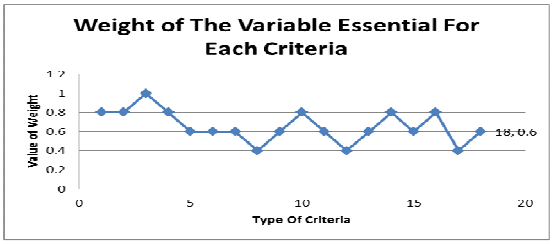

Figure 3. The weight of the interest Levels for each criterion

The third step is to make decisions selecting a number of alternatives based on criteria, such as A_1 is an alternative to the first boarding house on street of Gebang Kidul 11, on street of Gebang Wetan 42 as A_2, and A_3 on the street of Gebang Lor 88A. The fourth step determines the weight value of each alternative which is based on predetermined criteria. It is shown in Table 2.

Table 2. Weights of Each Alternative

Nomor of Criteria Type	A_1	A_2	A_3
1	0.8	0.8	0.8
2	0.6	0.2	1
3	0.8	0.6	0.4
4	0.8	1	1
5	0.8	0.8	0.6
6	0.8	0.8	0.4
7	0.4	0.4	0.4
8	0.4	0.4	0.4
9	0.6	0.4	0.6

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10	0.8	0.6	0.6
11	0.8	1	0.6
12	1	1	0.6
13	0.4	0.6	0.6
14	0.8	1	0.6
15	0.6	0.8	0.6
16	0.2	0.6	0.4
17	0.2	0.2	0.2
18	0.6	0.4	1

The fifth step is arranging the weights into the decision matrix (X), as follows:

$$X = \begin{bmatrix} 0.8 & 0.6 & 0.8 & 0.8 & 0.8 & 0.8 & 0.4 & 0.4 & 0.6 & 0.8 & 0.8 & 1 & 0.4 & 0.8 & 0.6 & 0.2 & 0.2 & 0.6 \\ 0.8 & 0.2 & 0.6 & 1 & 0.8 & 0.8 & 0.4 & 0.4 & 0.4 & 0.6 & 1 & 1 & 0.6 & 1 & 0.8 & 0.6 & 0.2 & 0.4 \\ 0.8 & 1 & 0.4 & 1 & 0.6 & 0.4 & 0.4 & 0.4 & 0.6 & 0.6 & 0.6 & 0.6 & 0.6 & 0.6 & 0.6 & 0.4 & 0.2 & 1 \end{bmatrix}$$

$$W = [0.8 \ 0.8 \ 1 \ 0.8 \ 0.6 \ 0.6 \ 0.6 \ 0.4 \ 0.6 \ 0.8 \ 0.6 \ 0.4 \ 0.6 \ 0.8 \ 0.6 \ 0.8 \ 0.4 \ 0.6]$$

The sixth step is the process of ranking using Weighted Product (WP). The results of the normalization of weight (W) using Equation 2 can be seen in Table 3. In addition, the process of normalization (S) uses a decision matrix equation 3, where the advantage of having the rank attribute is positive while the cost attribute the rank is negative. Attribute advantages such as the type of the third criterion to criteria to 18, while the cost attribute is an attribute that contains elements such as the cost of criteria 1 and 2. The experiment results of the three alternatives for normalization (S) decision matrix can be seen in Table 4. The seventh step is the process of preference for each alternative (V), in which the preference value for each alternative with a larger value indicates that the alternative is chosen, it can be seen in Table 5.

Table 3. Normalization of Weights to Each of The Criteria

Type Weight of Criteria	Value	Type Weight of Criteria	Value
W1	0.0678	W10	0.0678
W2	0.0678	W11	0.0508
W3	0.0847	W12	0.0339
W4	0.0678	W13	0.0508
W5	0.0508	W14	0.0678
W6	0.0508	W15	0.0508
W7	0.0508	W16	0.0678
W8	0.0339	W17	0.0339
W9	0.0508	W18	0.0508

Table 4. Normalization value (S) of the Three Alternatives

Attribute weights	A_1	A_2	A_3
-0.0678	0.8	0.8	0.8
-0.0678	0.6	0.2	1
0.0847	0.8	0.6	0.4
0.0678	0.8	1	1
0.0508	0.8	0.8	0.6
0.0508	0.8	0.8	0.4
0.0508	0.4	0.4	0.4
0.0339	0.4	0.4	0.4
0.0508	0.6	0.4	0.6
0.0678	0.8	0.6	0.6
0.0508	0.8	1	0.6
0.0339	1	1	0.6
0.0508	0.4	0.6	0.6
0.0678	0.8	1	0.6
0.0508	0.6	0.8	0.6
0.0678	0.2	0.6	0.4
0.0339	0.2	0.2	0.2
0.0508	0.6	0.4	1
Normalization (S) of The Decision Matrix	0.6602	0.7602	0.5942

Table 5. Preference value of each alternative

Decision Matrix	Total of Decision Matrix (ΣS)	Decision Matrix		
		S_1	S_2	S_3
S_1	2.0146	0.660	0	0
S_2	2.0146	0	0.760	0
S_3	2.0146	0	0	0.594
Preference value		0.327	0.377	0.294

So that in this research, the method of FMADM can be used as a reference method in solving the problems of boarding house election with WP methods to choose a best boarding house to deliver

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the level of importance of each criterion that is optimal in the area of Sukolilo, Institute of Technology Surabaya to help students or workers in finding a boarding house that is best around the area of Sukolilo, Institute of Technology Surabaya in terms of the criteria that is dominant such a cheap price, full facilities, and the shortest distance to the destination. With based on the analysis of experimental data, the three largest preference value is owned by the second alternate with a value of 0.3773. The solutions from a decision support system for the search of the best boarding house is located on the second alternative data (A_2) on Street of Gebang Wetan 42 which can be seen in Figure 4 for the implementation of the electoral system a boarding house.

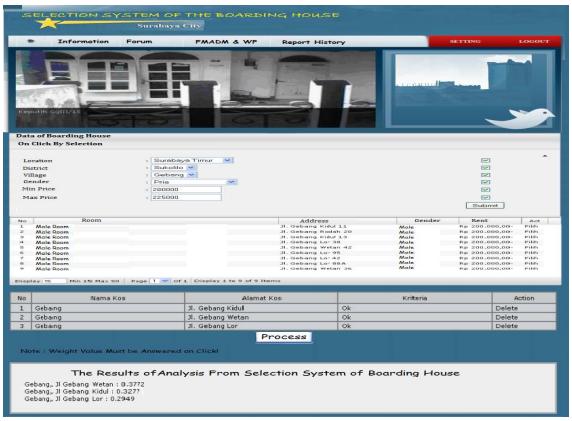

Figure 4. Implementation of The Selection System of Boarding House Using FMADM Method

4. CONCLUSION

This research results a solution to complete the selection process of best boarding house which is useful for students or job seekers to find a boarding house in the area of Sukolilo, Institute of Technology Surabaya with some dominant criteria. Based on trials of the system implementation, the wide selection of boarding house seekers can choose as an alternative boarding house. After that, they do the process with FMADM method which can solve the problems of the boarding home selection criteria to meet the optimal point as an important element to produce the best boarding house. Then, a list of the best boarding is used as an input by WP method to select the best boarding houses in the yield level of importance of each criterion that is optimal with 18 criteria with the limitations indicated the level of importance of each criterion. The success of the quality obtained used 100 respondents out of 18 criteria for testing three of the location of the boarding house for one of the process and the three of different values preferences. The data of the location of the boarding house are used while testing the best location of the boarding house lies in the location of boarding house on the street of Gebang Wetan 42 and a preference value (V) is 0.3773.

5. SUGGESTION

This research will continue to classify a boarding house with a hybrid method that will be applied in building a system that makes it easy to analyze data in a boarding house with several criteria. From here will come the analysis which can be used as a consideration in determining the wisdom of his rented house marketing strategies to improve efficiency and profit from both the search and the owner of a boarding house.

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