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Fuzzy Multi Attribute Decision Making Determining House DSS

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The property industry in Indonesia is experiencing rapid development along with improving economic conditions, causing consumers to face difficulties in choosing a house that suits their preferences. Various factors such as price, location, facilities, and payment methods often make decisions complex.The Fuzzy Multi Attribute Decision Making (FMADM) method is used to determine and evaluate the best options based on the degree of suitability of all criteria, with ranking carried out using the defuzzy method. The results of this study are expected to provide practical solutions for consumers in choosing a house that suits their needs and improve the quality of property developer services in Indonesia. The author's test results show that 72% of users feel helped by this solution method.

Keywords— FMADM,expert system,defuzzy,property solution (*key words)***

I. INTRODUCTION

Currently economic conditions are improving, the property industry in Indonesia is experiencing rapid development. Consumer interest in property developments is also increasing, many property developers offer various choices, such as price, location, facilities and payment methods, which makes it difficult for consumers to choose a house that suits their preferences. Sometimes consumers only consider one aspect such as design or price when choosing a house. However, there are actually several other important aspects that need to be considered when choosing a house. So, with so many housing choices, consumers sometimes feel confused. Therefore, consumers need to be wise in selecting housing and it must be adjusted to their needs. In this context, a method is needed that can help consumers choose housing without having to visit the location, so that consumer satisfaction can be maintained and help developers improve service quality. From this background, there are several problem formulations that can be identified, like how to develop a solution that can help consumers find a house in a housing complex that suits their preferences. How to apply the Fuzzy Decision-Making method to facilitate the decision-making process in choosing a house. How to design a system interface and output that can be easily understood by users.

In creating this system, the author sets boundaries according to the scope discussed previously to maintain the focus of the discussion. The limitations of the problem are like factors considered include type (building area and land area), price, and facilities available in the housing. This system only provides several choices of house types, where the user will determine the best house based on his own choices.

II. METHODS

The following figure shows the three main components of a Decision Support System (DSS): dialogue management, model management, and data management.

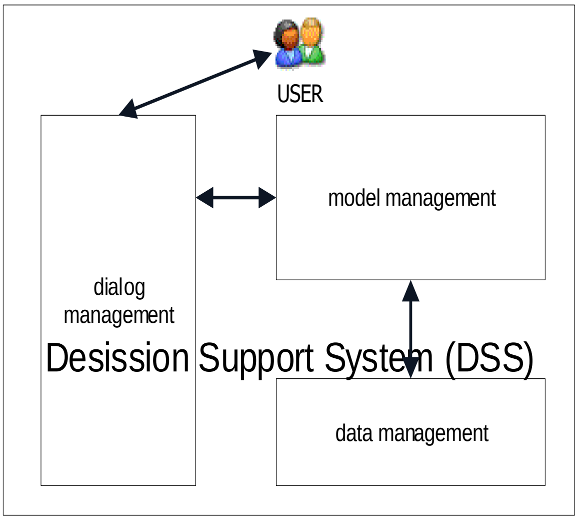

Fig. 1. DSS figure

a. Database Management Subsystem: This subsystem is part of the DSS that provides data for the system. Data is stored in the DBMS database. SPK obtains databases from internal and external sources.

b. Model Base Management Subsystem: This model is a replica of the real world, and is managed by the base model.

c. Base Dialog Management Subsystem:This dialogue system is used to implement and articulate the system so that users can communicate with the designed system.

Man, and Watson theorize that Decision Support Systems (DSS) are interactive systems that assist managers in the decision-making process by utilizing data and decision models to resolve semi-structured and unstructured cases. An unstructured case means that the solution is completely determined by the manager without

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the help of a computer solution (structured), while a semi-structured problem is a combination of the computer solution and the manager's decision (decision support system). In the semi-structured case, the computer solution generates decision options, while the manager decides based on the options generated by the computer.

In general, Fuzzy Multi Attribute Decision Making (FMADM) has one goal, which can be divided into two categories: selecting alternatives with features (criteria) that have the best characteristics and categorizing alternatives based on certain roles.

The FMADM (Fuzzy Multi Attribute Decision Making) stage consists of 2 parts:

a. *Determines a value for each option based on the degree of match based on the criteria.*

b. *Evaluate all options to come up with the best option. Ranking can be done in two ways: defuzzy, which first makes cuts based on fuzzy numbers and then ranking based on those fuzzy numbers.*

Following are the steps to complete Fuzzy Decision Making:

a. *Problem Representation In this section there are 3 activities that must be carried out:*
   - Defining goals and a set of options for decisions According to the characteristics of the problem, goals can be represented in language that humans can understand and can also be in the form of numerical values. If there are n decision options for a problem as"A=" {"A" _"i" ∣"i=1, 2…, n"}
   - Identify various criteria

     If k = criterion then"C=" {"C" _"t" ∣"t=1,2,…,k"}.
   - Creating a hierarchical structure of cases with certain considerations, the following hierarchical description can be presented:

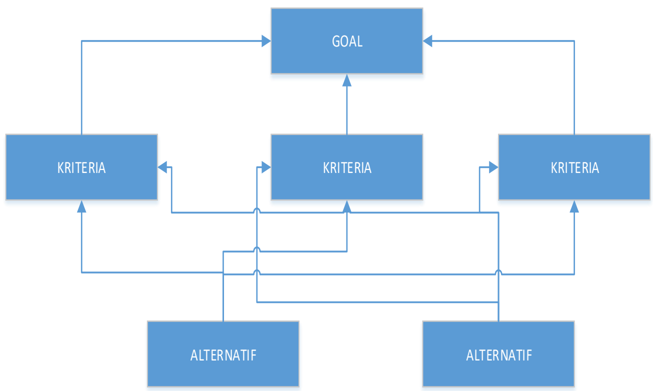

Fig. 2. DSS figure

b. *Evaluation of Fuzzy Sets:*
   - Select a set of assessments to determine how heavy the criteria are, as well as the level of conformity of each alternative to the criteria. In general, an assessment set consists of several elements, namely: variables that can be understood by humans (x) which represent the weight of the criteria and the degree of suitability of several alternatives to the criteria. The membership function for each rating must be determined after defining this set of ratings. Usually, the triangle function is used as follows:

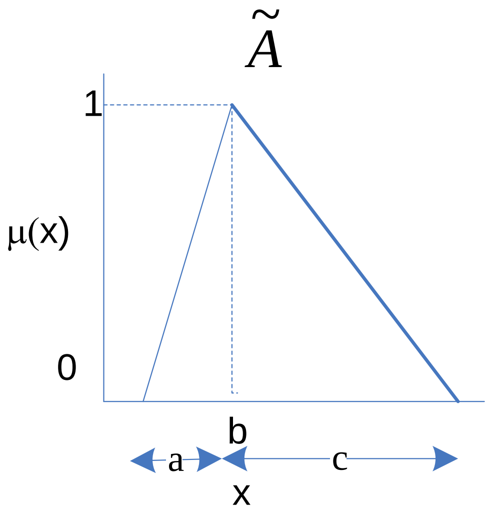

Fig. 3. DSS figure

$$\mu(x) = \begin{cases} \dfrac{(x-a)}{(b-a)}, & a \le x \le b \\ \dfrac{(x-c)}{(b-c)}, & b \le x \le c \\ 0, & x \le \text{b atau } x \ge c \end{cases}$$

- Evaluate how important the criteria are, as well as how similar each alternative is to the criteria.
- By using the mean operator, collect the weights of the criteria and the level of match to the criteria.

The formula F_i is formulated as:

$$F_i = \left(\frac{1}{k}\right)[(S_{i1} \otimes W_1) \oplus (S_{i2} \otimes W_2) \oplus \ldots \oplus (S_{ik} \otimes W_k)]$$

S_{it} And W_t

substituted with fuzzy numbers that is

$$S_{it} = (o_{it}, p_{it}, q_{it});$$

$$S_{it} = (a_t, b_t, c_t);$$

F_t can be approximated as;

$$F_i = (Y_i, Q_i, Z_i)$$

with:

$$Y_i = \left(\frac{1}{k}\right) \sum_{t=1}^{k} (o_{it} a_i)$$

$$Q_i = \left(\frac{1}{k}\right) \sum_{t=1}^{k} (p_{it} b_i)$$

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$$Z_i = \left(\frac{1}{k}\right) \sum_{t=1}^{k} (q_{it} c_i)$$

$$i = 1, 2,..,n$$

c. *Some corrections an alternative so that the case can be solved, this section consists of 2 steps that must be carried out:*

- Aggregation results provide alternative decision priorities. Because the aggregation results are represented by triangular fuzzy numbers, these aggregation results are very important in the ranking method as a decision alternative. Integral total value is one option.
  - The F formula is fuzzy where F=(a,b,c) then:
  - $I_T^{\alpha}(F) = \left(\frac{1}{2}\right)(\alpha c + b + (1 - \alpha)a)$
  - The value a is an optimism index that shows how optimistic the decision maker is. A higher a value indicates that the degree of optimism is higher. Where there are 2 fuzzy numbers F_i and F_j.
- Choose the highest option from several existing options based on its priority as the best option. The greatest suitability of the options to the decision criteria is indicated by F_j the larger value and this value will be the goal.

III. RESULT AND DISCUSSION

Data Flow Diagram for view how to make solution for this case, This Data Flow Diagram have 3 process and 2 entities for make solution for.t

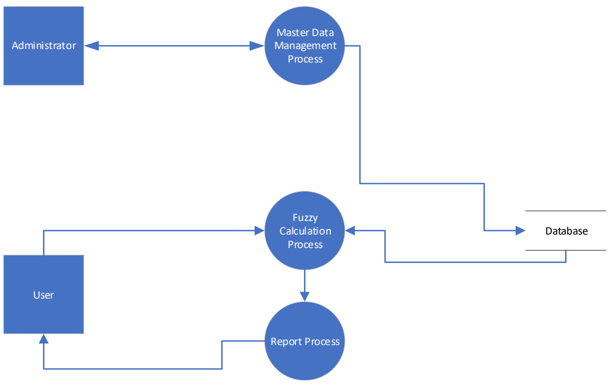

Fig. 4. DFD Level 0

a. DFD Level 0 Master Data Management Process

The data maintenance process has only one process, according to the data flow diagram level 0 overview. The only process that can be included in the process is master data management. The administrator is an external entity that plays a very important role in this process and acts as an actor who enters developer data, housing data and house data into the input of the master data management process. The results of this process are stored in the developer, housing and house data store.

b. DFD Level 0 Fuzzy Calculation Process

The fuzzy calculation process has only one process, according to the data flow diagram level 0 overview. Only users can participate in the process. The user is a very important external entity in this process, and the only such process is Fuzzy Calculation. The user is the actor who enters the house criteria into the fuzzy calculation process input. The user's input will be saved into the House Criteria data store. This fuzzy calculation process will produce house recommendations.

c. DFD Level 0 Report Process

According to the general description of the level 0 data flow diagram, the reporting process only has one process, namely the report. This process really requires House Recommendations from the house selection process, and this report produces house recommendations that will be given to users.

Behind the system it is necessary to determine the values as the initial and final limits, these values are determined based on previous data or recommendations from experts in the field of home selection so that they can be used as training data.

TABLE I. EXAMPLE CASE

Criteria	Variable	Min Value	Max Value
Building area	*LB*	*53*	*70*
Surface area	*LT*	*90*	*200*
The width of the road	*LJ*	*4*	*7*
Price	*H*	*50,000,000*	*250,000,000*

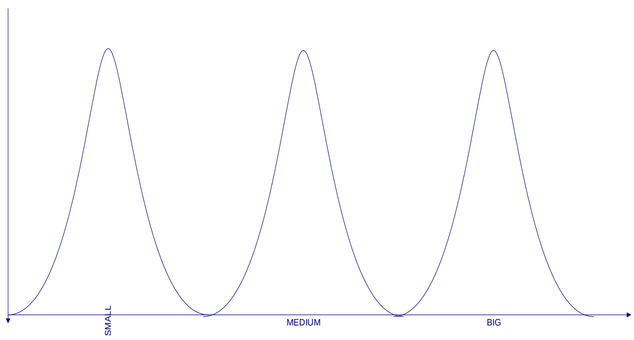

Fig. 5. Fuzzy Graphic

Implementation of criterion 1 (Building Area Criteria):

LB = 60 – min / middle value – min
= 60 – 53 / 64 – 53
= 0.8 (closeness value of membership degree)
Min (user choice is in the large category, with min = 53, max = 70)
Difference = max – min
= 70 – 53 = 17

Middle value = min + difference / 2
= 53 + 17 / 2 = 63.4 = 64

LT = 180 – max / middle value – min
= 180 – 200 / 174 – 200
= 0.76
= 0.7 (closeness value of membership degree)
Min (user choice is in the large category, with min = 148, max = 200)
Difference = max – min
= 200 – 148 = 52
Middle value = min + difference / 2
= 148 + 52 / 2 = 174

LJ = 5 – min / nilai tengah – min
= 5 – 4 / 5 – 4 = 1 / 1
= 1
= 1(closeness value of membership degree)
Min (user choice is in the medium category, with min = 4, max = 7)
Difference = max – min
= 7 – 4 = 3
Middle value = min + difference / 2
= 4 + 3 / 2 = 7 / 2 = 3.5

H = 110.000.000 – min / nilai tengah – min
= 110.000.000 – 100.000.000 / 138.000.000 – 100.000.000
= 0,27 (closeness value of membership degree)
Min (user choice is in the medium category, with min =100.000.000, max =175.000.000)
Difference = max – min
= 250.000.000 – 100.000.000
= 150.000.000
Middle value = min + difference / 2
= 100.000.000 + 150.000.000 / 2
= 175.000.000

	Y	Q	Z
Small(S)	*0,2*	*0,4*	
Medium(M)	*0,4*	*0,5*	*0,6*
Big(B)	*0,6*	*0,8*	*1*

User Input	***LB***	***LT***	***LJ***	***H***
Fuzzy proximity value	*0,6*	*0,8*	*1*	*0,26*

Calculation of fuzzy match values/FITNESS INDEX
Alternative 1 (housing 1):

*Y1 = (user1 choice * membership degree Y)*
*= (0.8*0.6) + (0.76*0.6) + (1*0.4) + (0.26*0.4) / 4*
= 0.36
Q1 = (user choice 1 membership degree Q)*
*= (0.8*0.8) + (0.76*0.8) + (1*0.5) + (0.26*0.8) / 4*
= 0.489
*Z1 = (user choice 1 * membership degree Z)*
*= (0.8*1) + (0.76*1) + (1*0.6) + (0.26*0.6) /4*
= 0.039

£ = 0,5
*Ì1 = (1/2) * ((0,5) * z1 + Q1 + (1-0,5) + (Y1))*
*= ½ * ((0,5) * 0,039 + 0,489 + (0,5) + 0,36)*
*= ½ * (0*0,28 + 0,22 + 1 + 0,16*
*= ½ * 1,38*
= 0,69

After planning the creation and testing of a decision support system to determine the optimal value for housing in the Sidoarjo area using the fuzzy decision making method, several conclusions can be drawn, namely:

The FMADM (Fuzzy Multi Attribute Decision Making) stage consists of 2 parts:

a. Information about the housing being tested along with the housing criteria can be stored in a database, so that the process can be carried out easily if one day it is needed.

b. This system can help the process of selecting housing that suits the user's needs.

c. This system uses a fuzzy decision making method in the housing selection process in the Sidoarjo area.

d. The result of the housing selection process is a ranking of housing names as a recommendation for users to determine housing choices that suit the user's needs

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