Recommendations For Repairing Uninhabitable Homes Using the Multi-Attribute Utility Theory (MAUT) Method

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Article Info	ABSTRACT
	A house that is habitable, clean and has a good infrastructure is the hope of every human being. Conversely, an uninhabitable house can cause inconvenience to the occupants of the house and can also be a source of diseases that should be avoided by the occupants of the house. The problems faced by the Riau Provincial PUPR Office remain in the use of manual methods, especially in determining recommendations for potential recipients of uninhabitable houses. The method MAUT is solved by the principle of providing utility values for each criterion with a range of values from 0 to 1, where the worst choice is given for a value of 0 (zero) and the best choice is given for a value of 1 (one), where a comparison of the weights of the values of each criterion results in a relevant comparison between the criteria. The results of the ranking based on the processed data with five alternatives resulted in a score of 18.0 with a status of "worthy of support for home improvements by the Riau provincial government". Research provides the information and knowledge needed to solve problems and make decisions. The usefulness of research findings can be used for programme development and scientific interests. *This is an open access article under the CC BY-SA license.*

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1. Introduction

Based on the 1945 Constitution, Article H of the 1945 Constitution Amendment, housing is one of the fundamental rights of every Indonesian, so every citizen has the right to live in a good and healthy environment. This is confirmed by Law No. 1 of 2011 on Housing and Settlements, which states that a house is a building that serves as a residence or abode and a means for family development. A house is the basic need of every human being to improve dignity, quality of life and livelihood, as well as a reflection of the personal self in an effort to improve the standard of living.

A house that is habitable, clean and has good infrastructure is the hope of every human being. Conversely, an uninhabitable house can cause inconvenience to the occupants of the house and can also be a source of diseases that should be avoided by the occupants of the house. The problem is that there are still families who do not have the financial means to repair their houses. The Public Works and Public Housing (PUPR) Office of Riau Province is planning to build 1,621 habitable houses (RLH) in Riau. The construction of the houses will be carried out in 12 districts. House type 36 was built with a budget of Rp80 million per

unit. It is financed through a special grant (Bankeu) from the Riau regional budget. To address this problem, the regional governments have devised various programmes to help underprivileged communities. Unfortunately, these funds cannot be made available to all applicants because there is an imbalance between the number of applicants for uninhabitable houses and the funds of the Riau Provincial PUPR Office. Therefore, the Riau Provincial PUPR Office needs a system that can be used to make recommendations for houses that should be given priority for repair.

The problems faced by the Riau Provincial PUPR Office are still manual methods, especially in identifying recommendations for potential beneficiaries of uninhabitable houses. The head of the family submits a written application for assistance from the Uninhabitable House Fund to the relevant office, whereupon the application documents are selected for review by an officer. After the data has been verified, the competent authorities submit the data on the applications for assistance from the Uninhabitable Houses Fund to the PUPR Office of Riau Province. Due to budget constraints and the number of applications received, the Riau Provincial PUPR Office team has difficulty identifying the potential recipients of the assistance.

The method MAUT is solved by the principle of providing utility values for each criterion with a range of values from 0 to 1, where the worst choice is given for a value of 0 (zero) and the best choice is given for a value of 1 (one), comparing the weights of the values of each criterion leads to a relevant comparison between the criteria [14]. The application of the method MAUT in the research of Hadinata [13] that a decision support system was created to determine the eligibility of borrowers. In addition, the research of Ramadiani [10] compared the TOPSIS and MAUT methods used to determine the recipients of the Bidikmisi scholarship. In addition, there are several other studies that look at the use of the MAUT method in implementing decision support systems, including: (Aldo, 2019; Alfiarini & Primadasa, 2020; Apriani, 2019; Jannah and Lusiana, 2015; Limbong and Simarmata, 2020; Ramadiani & Rahmah, 2019; Satria, 2018; Situmorang, 2018; Widodo and Nastoto, 2019).

This study aims to use the MAUT method to develop a decision support system that can be used in determining potential recipients of uninhabitable housing based on the calculation of the utility value of each participant that takes into account multiple criteria.

2. Research Methodology

In conducting an objective data and information research, which is used as a reference point for the research, it is hoped that quality research will be conducted using this data. The process of conducting this research is shown in a diagram in Figure 1.
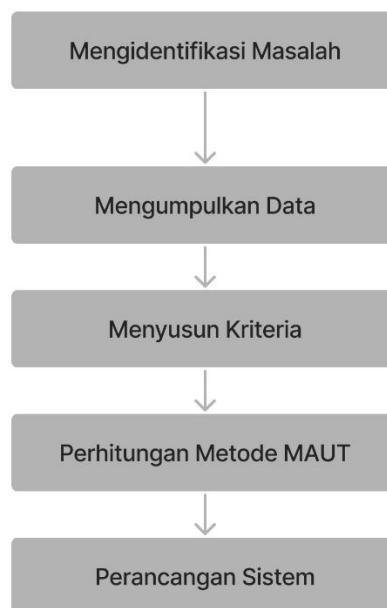

Figure 1. Research Methodology

The explanation of each stage in the research methodology in figure 1 above is as follows:

2.1 Problem Identification

Research is usually done to answer questions that a researcher has not been able to answer. In order to clearly identify the objectives of the study, problem identification is carried out. In general, problem identification is part of a research process that can be understood as an attempt to define an existing problem and to make the problem measurable and verifiable. Simply put, problem identification is the process of determining what is at the heart of a study. In this study, the source of the problem comes from experience. This is because it is involved in the process of determining the feasibility of repairing habitable houses in the PUPR office in Riau province. The research methods used are qualitative and quantitative. In analysing the problem, this stage is about identifying the problems that exist in the subject of study, starting from the problems that occur in the field and the impacts that occur in order to determine the solution to the problems encountered.

2.3 Data Collection

Data collection in this study is done through literature studies and interviews. In the literature studies, data is obtained after reviewing journals, books and manuscripts of dissertation publications and other reference sources. Data collection through interviews was done by meeting and interviewing the heads of PUPR office in Riau province.

2.4 Compiling Criteria

The step of compiling criteria is done to ensure that the data processed in the system after data collection meets the criteria used in determining the feasibility of repairing habitable houses within the PUPR office in Riau province.

2.5 Calculation of the MAUT Method

According to Schaefer (2015), Multi-Attribute Utility Theory (MAUT) is used to convert a certain importance into a numerical value with a scale of 0-1, where 0 is the worst choice and 1 is the best choice. This allows for an accurate direct comparison of different values. The end result is a ranking of alternative scores that describes the choices made by the decision-makers. Some of the steps involved in the calculation using the Multi-Attribute Utility Theory (MAUT) method are:
1. Divide a decision into different dimensions.
2. Determine the relative weighting of each dimension.
3. List all the alternatives.
4. State the utility for each alternative according to its attributes.
5. Multiply the utility by the weighting to determine the value of each alternative.

2.6 System Design

In this step, the system design is carried out, generally with the intention of giving an overview of the new system or the system to be proposed. In this design, the components of the information system to be developed are identified. To describe what the system does in preparing the requirements for a system and designing the functions contained in the system, it can be described using the Unified Modelling Language (UML).

2.7 Result Testing

Black Box Testing is a test that focuses on the functional specifications of the software. The tester can define a set of input conditions and perform tests on the functional specifications of the programme. With this black box testing, it is hoped that any errors or inadequacies in the application can be detected by researchers as early as possible.

3. Result and Duscussion

The decision support system for determining the recommendations of potential recipients of assistance for uninhabitable housing using the method (MAUT). The method is used to find the optimal alternative value of multiple alternatives and given criteria by summing the weights of each alternative's performance score on the attribute. Thus, it can make a comparison that can be used as a recommendation for potential recipients of uninhabitable housing.

3.1. Alternative Data

Alternative data is data that is used for processing in a decision support system. Below is a list of recommendations for potential recipients of uninhabitable housing that you can select and use as an alternative for calculation.

Table 1. Alternative Data

Code	Alternative	Gender	Age
A01	Budi	Male	46
A02	Enna Roslina	Female	47
A03	Sofia Ningsih	Female	45
A04	Agus Prasetyo	Male	48
A05	Johan Pratama	Male	50

3.2. Determining Criteria and Weights

In determining the recommendations for potential recipients of aid for uninhabitable housing, several criteria must be taken into account and are used as a basis for calculating the choice, as shown in the following table.

Table 2. Criteria Data

Criteria	Information
K01	Home Status
K02	Types of House Walls
K03	Types of House Roof
K04	Types of House Floor
K05	Family Income
K06	House Area
K07	Number of Children

(MAUT) is a comparison of quantitative methods used to combine measurements of different risk and profit costs. Each criterion has several alternative values that are able to solve a solution, In looking for an alternative that a user wants, to identify it is to multiply against a predetermined priority scale. So that using the MAUT method will produce a solution to the alternatives that can be a solution. Its overall evaluation value is defined by the equation. Where Vi(x) is the evaluation value of an object to i and wi is the weight that determines the value of how important the element is to i to other elements. And the value of n is the number of elements. The yield of weights is 1.

Table 3. Alternatives To Criteria

Alternative	Criteria						
	Home Status	Types of House Walls	Types of House Roof	Types of House Floor	Family Income	House Area	Number of Children
Anton							
Hendriko							
Siswanto							
Faisal Putra							
Yulishmet							

The following is a table of match ratings from each alternative on predetermined criteria.

Table 4. Match branch of each alternative on each criterion

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A01	2,5	5,5	7	6	5	7,5	5
A02	10	5,5	5	6	5	7,5	7,5
A05	2,5	5,5	10	10	10	10	10
A04	10	2,5	5	6	8	2,5	5
A05	10	2,5	2,5	2,5	8	2,5	2,5

In the implementation of the MAUT method, there are several steps, namely:
1. The first step of creating a decision matrix

$$X = \begin{matrix} 2,5 & 5,5 & 7 & 6 & 5 & 7,5 & 5 \\ 10 & 5,5 & 5 & 6 & 5 & 7,5 & 7,5 \\ 2,5 & 5,5 & 10 & 10 & 10 & 10 & 10 \\ 10 & 2,5 & 5 & 6 & 8 & 2,5 & 5 \\ 10 & 2,5 & 2,5 & 2,5 & 8 & 2,5 & 2,5 \\ 2,5 & 5,5 & 7 & 6 & 5 & 7,5 & 5 \end{matrix}$$

The normalization of the destination matrix of the prospective head of the puskesmas is determined in the formula:

$$U_x = \frac{x - xi^-}{xi^+ - xi^-} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Information:
U(x)   = Normalization of alternative weights x
X   = Alternative weights
xi-   = Worst weight (minumum) from criteria to x
xi+   = Best weight (maximum) from criteria to x

The following is the result of the calculation of the normalization matrix of recommendations for prospective recipients of uninhabitable housing assistance.

Table 5. Matrix Normalization Results

Code	Alternative	C1	C2	C3	C4	C5	C6	C7

A01	Anton	1	1	1	1	2,5	1	2
A02	Hendriko	-0	1	1,67	1	2,5	1	1
A05	Siswanto	1	1	0	0	0	-0	-0
A04	Faisal Putra	-0	0	1,67	1	1	3	2
A05	Yulishmet	-0	0	2,5	1,87	1	3	3

The next step will be carried out the multiplication of the normalization matrix by the weight of the reference using the formula:

$$V(x) = \sum_{i=1}^{n} Wj.Xij \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

The result of the calculation process using the above formula is as follows:

Table 6. Normalized Matrix Multiplication Result From Preference Weight Result

Code	Name	Total of Preference Value
A01	Anton	57,5
A02	Hendriko	48,8
A05	Siswanto	18
A04	Faisal Putra	42,3
A05	Yulishmet	55,1

Based on the calculation results above, the highest score was obtained, namely 1802 with the alternative of Siswanto. For the results of the ranking can be seen in the following table.

Table 7. Ranking Results

Code	Name	Total of Preference Value	Status
A01	Anton	57,5	Uninhabitable
A02	Yulishmet	55,1	Uninhabitable
A05	Hendriko	48,8	Uninhabitable
A04	Faisal Putra	42,3	Uninhabitable
A05	Siswanto	18,0	Inhabitable

From Table 7 above, the highest score of 18.0 is obtained, which falls on the 5th alternative, so the recommendation of prospective recipients to help uninhabitable houses is prioritized to Siswanto.

3.3. Implementation

The implementation carried out is to create a system using the web-based PHP programming language. Figure 2 below is the result of the implementation of the MAUT method in determining potential recipients of uninhabitable houses.

📊 Data Hasil Akhir   🖨 Cetak Data

⊞ Hasil Akhir Perankingan

ID Rumah	Alternatif / Nama Rumah	Kepala Keluarga	Nilai Preferensi	Status
RMH001	RUMAH 01	Anton	57.5000	Tidak Layak
RMH005	RUMAH 05	Yulishmet	55.1250	Tidak Layak
RMH002	RUMAH 02	Hendriko	48.8336	Tidak Layak
RMH004	RUMAH 04	Faisal Putra	42.3336	Tidak Layak
RMH003	RUMAH 03	Siswanto	18.0000	Layak

Figure 2. Final Result of The Ranking

4. Conclusion

The results of the investigation carried out lead to the conclusion that:

1. The process of selecting recommendations for potential recipients of uninhabitable housing using the method of muti-attribute utility theory (MAUT) can be one of the solutions to problems in selecting recommendations for potential recipients of uninhabitable housing.

2. The design of application software for decision support system recommendations for potential recipients of uninhabitable housing assistance with multi-attribute utility theory (MAUT) method can be well applied into a web-based system.

3. The results of ranking based on the processed data with five alternatives a score of 18.0 on behalf of Siswanto with the status of worthy of receiving home improvement assistance from the provincial government of Riau.

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