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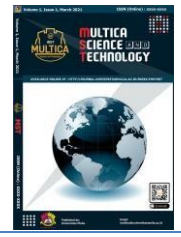

MODEL DECISION ANALYSIS IN DETERMINING BUILDING QUALITY BASED ON THE ANALYTICAL HIERARCHY PROCESS

Burhanuddin [1,a)], Emi Maulani [2)], Veri Ilhadi [3)]

Author Affiliations
[1,2,3] Universitas Malikussaleh

Author Email :
[a)] *burhanuddin@unimal.ac.id*

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ABSTRACT
Building infrastructure consisting of several types of alternatives that provide the need for selection of various kinds of assessments for ranking in carrying out repairs. The purpose of this study is to determine the priority order and condition of building quality, which is useful as a reference in improvement activities related to seeing the satisfaction of policy makers. Problems with building quality can result from various factors, one of which is related to facilities, building repairs and their handling which are feared to affect productivity in assessments and influence policy making. Primary data can be used as research data to be included in the decision model and direct observations can be made at the research location for each building in Dilhokseumawe. This study uses the Analytical Hierarchy Process (AHP) model, to determine the weight of the components obtained from the results of the interest assessment of building components which include the level of building damage, building age, ease of access, building structure, roof structure, building safety level. The results of the analysis show that factors the main consideration is improving the level of building security with a value of 0.297858847, the second ranking is the Building Structure factor with a priority value of 0.257685234%, the third ranking is the Ease of Access factor with a priority value of 0.128154963 and the Fourth is Building Age with a value of 0.076683671%. Finally the Roof Structure with a priority value of 0.072065172%. The results of this study can be used as recommendations for decision making in view of the quality of buildings and buildings.

1. Introduction

With the development of technology in life, the use of this technology becomes necessary and important, one of which is the decision model in decision making. The capacity of a building in a building material is an important element in seeing the quality of a building [1], while multipurpose buildings are multifunctional for large meetings, seminars, weddings, inauguration events and party events and can be used in the revitalization of buildings and cultural heritage areas. (2013) [2].

The number of multipurpose buildings in Lhokseumawe City is spread unevenly, they are located far from the existing multipurpose buildings and conversely one does not know the quality of a multipurpose building because of the quality and the unavailability of adequate information facilities about the building. The choice of building materials greatly affects the quality and availability of these goods and buildings for quality and there is a decision-making model for selecting variants of building improvements to see the quality of the building [3], [4].

The quality of a building can be seen from all points of view contained in the quality of the building. This is an obstacle that will be faced in making decisions to see the quality of the building [5].

During the assessment period, considering the building materials and the many variables assessed, it is necessary to carry out repair work and there is a need for an important decision model for improvement and obtaining solutions from the repair of the model. Many problems can be seen from a complex repair building, and the assessment must look at and consider the building materials so as not to suffer losses in repairing the building. Selection of repair solutions must use a decision model. [6].

It must be viewed from various perspectives through a comprehensive approach and by assessing the condition of the building and determining the scope of repairs needed. The research conducted aims to develop a decision-making model and its implementation by using a decision model and by considering the variables in decision-making [7].

The main objective of the process of selecting building materials in repair is to determine the quality of buildings that have efficiency in meeting the needs of every entrepreneur and can be seen in seeing consistent quality and minimizing losses related to the procurement of raw materials and components. in the selection of building materials [8].

It is difficult to look at build quality from all sides, and this can hinder the building quality assessment process, and processes. The delay in the construction process is different from the specified schedule because the delay in the assessment is seen from all students in fulfilling the quality of the building in the assessment [9].

This is due to the many obstacles that occur due to the absence of clear criteria, the many components to be studied. Therefore it is necessary to have a decision model to assist the process of selecting the quality of the building. There is a decision model in the research that will be made. It consists of five stages of assessment which cover the condition of the building, evaluation of the use value of the building, classification of repairs and can be seen several variants of repairs and selection of repair solutions. Furthermore, this research can be seen from the selection of solutions to improve building quality.

2. Literature Review

2.1 Decision Support System Model

In decision making it can be used as a support for several people or groups in an organization or company, where the goal is to make decisions in a regulated situation, and the situation is not clear in decision making and namely data management, model management, dialogue management, and knowledge management base [10] [11].

The absence of a comprehensive system for determining priority scales for handling building maintenance and the absence of an accurate database of building conditions has resulted in an inaccuracy of data and information as a basis for making various decisions related to building management [12].

Handling of buildings, especially buildings designated as private or government offices, public service centers, and education institution buildings, should be an important priority in maintaining performance and service. Handling of buildings damaged by natural disasters, excessive and fatal function loads considering the big risks involving the safety of many people, rehabilitation is a top priority that must be carried out immediately according to the level of damage to each building [13].

2.2 Determination of Building Quality

The strategy for determining building quality using a decision support system for its implementation can only work if there is an accurate and accountable database. The database and SPK are two things that are very closely related and inseparable because if there is no building database then the SPK cannot be made, the database is the initial, main and basic reference data [14].

The decision-making analysis process requires several consideration criteria from several existing alternatives. One of the characteristics of well-formulated criteria is their relevance to the key issues at hand. Each criterion must answer one important question about how well an alternative will be able to solve a problem at hand [12].

The factor of the physical condition of the building that meets the standards and is strongly supported by the availability of infrastructure from adequate supporting equipment is a benchmark for the quality of the building. This study aims to build a decision-making system model that can determine the quality of buildings. The use of a decision support system is expected to make it easier for interested parties to monitor the condition and quality of buildings and store them in a database for long-term interests.

It takes several interrelated variables in the assessment of infrastructure and quality of buildings. This is indicated by the analytical evaluation of the quality of a building. The main problems include aspects of building facilities and infrastructure (C1), building facilities and quality (C2), building structures (C3), roof structures (C4), building safety levels (C5) on the quality of a building [15].

2.3 Model AHP

The analysis model using the Analytical Hierarchy Process (AHP) is a method for solving a problem as a whole and has a derivative from a hierarchical arrangement by giving a subjective value to the existence of variable values and determining which variables have high priority and affect the results of an assessment [16]. There is a hierarchy in complex decision making, a problem can be explained in stages into a grouping which is then arranged into a hierarchical form so that the problem will be tidier and look more focused [17] [18]. The housing selection decision support system using the AHP and GIS methods is expected to be able to solve existing problems. The process of determining the quality of buildings based on the SPK using the AHP method with the determination based on the desired cri teria will reduce errors in determining the value and condition of a building.

AHP has the ability to solve multi-objective and multi-criteria problems based on a comparison of the preferences of each element in the hierarchy. So, this model is a comprehensive decision-making model [19]. The steps in calculating the AHP Analytical Hierarchy Process (AHP):

1) Perform pairwise comparisons for each sub-element using a 1-9 Saaty scale as shown in

Table 1. Paired Comparison Rating Scale

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	notion between two proximate values	This value is specified when options are adjacent. For instance, 4 is given in-between 3 and 5
Reciprocals of above	If activity *i* has one of the above nonzero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

2) Synthesis of Priority
3) Logical Consistency, used to measure the level of consistency of the results of pairwise comparisons. Inconsistency can be caused by a lack of information when assessing the priority of criteria or the presence of elements
subjectivity of decision makers. analysis of the results of pairwise comparisons is considered consistent if the Consistency Ratio (CR) value is not more than 10% [13].
d) Calculating the value of the Consistency Ratio (CR)

Table 2. Random Consistency Index (R.I)

N	1	2	3	4	5	6	7	8	9	10
Random consistency index (R.I.)	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

3. Research Methods

1. Data Collection Techniques

The technique in decision making can be used as a support for several people or groups in an organization or company, where the goal is to make decisions in situations as the value has been determined. Then and semi-structured situation in decision making. The technique and data collection is to look for literature study materials, namely by conducting a literature review by reviewing the Evaluation of Building Quality Measurements, evaluation models for evaluating building quality facilities and infrastructure.

The decision to use the AHP method in this study was determined based on previous studies which showed that this method could be used to find solutions in making a decision. In decision making it can be used as a support for several people or groups in an organization or company, where the goal is to make decisions in situations that have been arranged, and situations are not clear in decision making.

Furthermore, the presentation of data is to make it easier for researchers to see an overview of variables and attributes as a whole or certain parts of the research focus on determining the level of quality analysis of buildings, facilities and infrastructure. Furthermore, documentation in data collection techniques by recording existing data in the field in utilizing existing secondary data.

The criteria used for weighting AHP (analytical hierarchy process) were obtained through a literature review. These criteria are considered by conducting a questionnaire from the results of the respondents' answers. The criteria used include:

1. Building Damage Rate.
2. Building Age
3. Ease of Access
4. Building structure
5. Roof Structure
6. Building safety level

2. Determination of Criteria

For the required value, each alternative will calculate the total value by multiplying all the EVN values of each alternative to the EVN criteria that have been previously obtained. If you have got each of the total values from the existing alternatives, the results are then sorted from the largest to the smallest value. The biggest value is the best choice of all so it gets rank 1, and so on. 8. Comparison Calculations Between Alternative Criteria
At this stage, each of the predetermined alternative criteria is calculated using the same steps, starting from the calculation of the pairwise comparison matrix to calculating the value of the consistency ratio for each alternative.

3. Ranking of the Total Value of Each Alternative

All the required values, each alternative will be calculated for the total value by multiplying all the EVN values of each alternative to the EVN criteria values that have been obtained previously. If you have got each of the total values from the existing alternatives, the results are then sorted from the largest to the smallest value. The biggest value is the best choice of all so it gets rank 1, and so on.

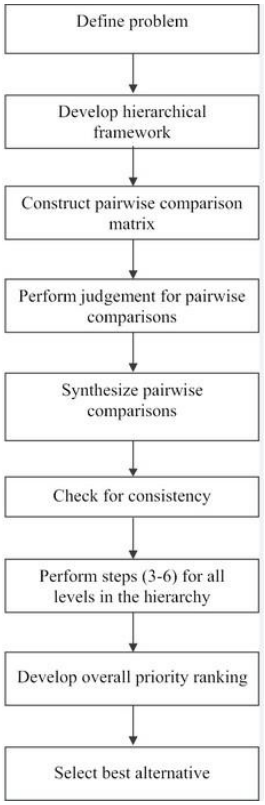

Figure 1. Ranking of the Total Value of Each Alternative

Picture the steps of the AHP method

4. Results and Discussion

4.1 Determine Criteria and Alternatives

The initial steps in determining the Analysis Model Decision in Determining the Quality of Buildings based on the Analytical Hierarchy Process are as follows:

Table 3. Determine Criteria and Alternatives

Criteria:	A1 = Building Damage Level
	A2 = Age
	A3 = Ease of Access
	A4 = Building Structure
	A5 = Roof Structure
Alternatif :	B1 = Using the safety level of Building A1, Age of Building A2, Ease of Access (A3), Building Structure (A4), Roof Structure (A5) B2 = Using Age of Building A2, Building safety level A1, Ease of Access (A3), Building Structure (A4), Roof Structure (A5) B3 = Ease of Access (A3), Using Age of Building A2, Level of security Building A1, K, Building Structure (A4), Roof Structure (A5) B4 = Building Structure (A4), Ease of Access (A3), Using Age of Building A2, Building safety level A1, Roof Structure (A5), Ease of Access (A3), Using Building Age A2, Building safety level A1

4.2 Analysis of the AHP Model

1. Analysis of the matrix comparison value for each alternative

A. Comparison matrix for criteria

With the priority assessment on the criteria comparison matrix, these values are then used for the pairwise comparison matrix values for the criteria as follows:

Table 4. Comparison matrix for criteria

	Building Safety Level	Building Safety Level	Building Safety Level	Building Safety Level	Building Safety Level
Building Safety Level	1	1	3	7	5
Building Age	1	1	3	7	3
Ease of Access	0,333333	0,333333	1	5	1,666667
Building structure	0,1428513	0,147143	0,428429	1	0,715714
Roof Structure	0,2	0,2	0,6	7	1
	2,6761976	2,676176	8,028529	27	11,35238

B. Ranking of the Total Value of Each Criterion

The steps in ranking the values for each criterion in determining the priority of the elements at the lowest hierarchical level to achieve the goal are as follows.

Table 5. Ranking of the Total Value of Each Criterion

Criteria	A1	A2	A3	A4	A5	Total	EVN
A1	5	5	15	71	23	119	0,38566
A2	4,6	5	13,8	57	21	101,4	0,35985
A3	2,047048	2,047618	5	26,33333	9,571471	45	0,14668
A4	0,7145714	0,714214	2,142143	5	3,285786	11,8714	0,03119
A5	1,8	1,8	5,4	19,8	5	33,8	0,10662
			Keseluruhan			311,0571	

λ maks	CI	CR
5,32357858	0,080894645	0,072227362

As for the assessment, it has been consistent because the CR value is <0.1, meaning that the weighting preference is consistent

2. Analysis of the matrix comparison value for each criterion for the level of building safety

A. Ratio Value Consistency

As for each of the consistency ratios, they include: Building Safety Level A is clearly better than Building Safety Level B, Scale: 7, for the ratio value of Building Safety level B is slightly better than Building Safety Level C Scale: 3, for ratio scale Next, Building Safety Level A is absolutely better than Building Safety Level C, which is a scale of: 9.

B. Calculation of comparison between alternatives

With the priority assessment on the paired index matrix for comparison of criteria, those values are then used for the value of the pairwise comparison matrix with the value components as follows

Table 6. Calculation of comparison between alternatives

TKB	B1	B2	B3	B4	B5
B1	1	7	9	1	7
B2	0,142857	1	1,285714	0,142857	1
B3	0,111111	0,777778	1	0,111111	0,7778
B4	1	7	9	1	7
B5	0,142857	1	1,285714	0,142857	1
	2,396825	16,77778	21,57143	2,396825	16,778

C. Calculation of Normalized Vector Eigenvalues (EVN)

As for the analysis of matrix comparison values for each criterion for the level of building safety

Table 7. Calculation of Normalized Vector Eigenvalues

Criteria	A1	A2	A3	A4	A5	TOTAL	EVN
A1	5	35	45	5	35	125	0,434195
A2	0,714286	5	6,428571	1,5714	5	18,71428571	0,065005
A3	0,555556	3,888889	5	0,5556	3,888889	13,88888889	0,048244
A4	5	35	45	5	29	119	0,413354
A5	0,714286	5	0,714286	0,7143	4,142857	11,28571429	0,039202
						287,8888889	

Calculation of Consistency Index (CI)

λmaks	CI	CR
4,820477	-0,04488	-0,04007

Because CR <0.1, it means that the weighting preferences are consistent

C. Calculation of comparison between alternatives

As for the alternative criteria that have been determined, it is calculated using the same stages, starting from the calculation of the pairwise comparison matrix to calculating the value of the consistency ratio for each alternative is as follows:

Table 8. Calculation of comparison between alternatives

Building structure	B1	B2	B3	B4	B5
B1	1	7	5	5	1
B2	0,142857	1	0,714286	0,714286	0,1429
B3	0,2	1,4	1	1	0,2
B4	0,2	1,4	1	1	0,2
B5	1	7	5	5	1
	2,542857	17,8	12,71429	12,71429	2,5429

C. Calculation of Normalized Vector Eigenvalues (EVN)

The total value of each alternative will be calculated by multiplying all the EVN values of each alternative to the EVN criteria previously obtained as follows:

Table 9. Calculation of Normalized Vector Eigenvalues (EVN)

Criteria	A1	A2	A3	A4	A5	TOTAL	EVN
A1	5	35	25	25	5	95	0,329988
A2	0,714286	5	3,571429	3,8571	0,714286	13,85714286	0,048134
A3	1	7	5	5	1	19	0,065998
A4	1	7	5	5	1	19	0,065998
A5	5	35	25	25	5	95	0,329988
						241,8571429	

For the λmax value of 4.213232618, the CI value is -0.196691845 and the CR is -0.175617719

As for the value of each alternative, the total value will be calculated by multiplying all the EVN values of each alternative to the EVN criteria previously obtained. If you have got each of the total values from the existing alternatives, the results are then sorted from the largest to the smallest value. The biggest value is the best choice of all so that it gets a rank of 1. The ranking value is Model Decision Analysis in Determining Building Quality based on the Analytical Hierarchy Process.

Table 10. Ranking Value Table

	Alternative	Alternative
B1	0,297859	1
B2	0,076684	4
B3	0,128155	3
B4	0,257685	2
B5	0,072065	5

5.1 Conclusion

The conclusions that can be drawn from research on decision model analysis in determining building quality are as follows:

1. Based on the hierarchical model that has been compiled using the AHP (analytical hierarchy process) model, a policy making model can be found in determining Priorities for Building Improvement Decision Making, especially buildings in the city of Lhokseumawe, taking into account the factors of Building Safety Level, Building Age, Ease of Access, Building Structures, Roof Structures to obtain building assessment results from the highest to the lowest scores for the quality of each building.
2. From the results of the Research Model Decision Analysis in Determining Building Quality, the value obtained is that the Building Safety Level is assessed. has the highest score value with a value of 0.297858847.

5. Acknowledgement

There is a merging of models for more accurate results. then there is more complete training data in each building and more training data so that there is more for better and more precise results..

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