APPLICATION OF ANALYTICAL HIERARCHY PROCESS (AHP) METHOD TO DETERMINE THE SELECTION OF QUALITY WORK PACKAGES: A STUDY ON THE BUDGET PLAN OF PERUM PERURI KARAWANG

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ABSTRACT---_Implementation of the method of Analytical Hierarchy Process (AHP) can be used to classify some fields such as that involving multiple choice , the research is involved to determine the RAB in an election the quality of the material the material and the work of development . Thus obtained points packaged material what only the use and budget how alone are shown in a study of this could be a reference to election package workmanship in a project workmanship of building both the office and home, in terms of this home office. The results of testing the functions and needs of stakeholders using the User Acceptance Testing (UAT) method indicate the level of satisfaction and suitability of the stakeholders. Samples were taken throughout the part of the department that handles the work is that a number of 7 to 6 parameters of assessment._

Keywords---_Analytical Hierarchy Process (AHP), SPK, Plan Budget Cost (RAB) , User Acceptance Testing (UAT)_

I. INTRODUCTION

The need to be building office when it has experienced accelerated very rapid. Construction of houses and buildings either were not graded or stratified , has been implemented in various offices . The number of requests will be building where the building office that brings the wind fresh to the world of construction in particular. However , the era of globalization is strict , demanding all parties to increase their ability to continue to exist and be able to win the competition in their field . Rms companies in the field of services of construction , for example , should be able to improve the ability of the source of the power that it has to be able to beat competitors other in the auction project .

Plan Budget Cost (RAB) projects' costs are necessary in which consists of the cost of materials , wages of workers , as well as the cost of the other associated with project based on the calculation of the volume of occupations has been done previously . (Nugroho, 2009). Company General Printing Money of the Republic of Indonesia (Perum Peruri) owned a housing agency that is located in Karawang and Jakarta. These Housing Department are occupied by employees of Perum Peruri.

Department Maintenance Facility Works and Environment (Fasumling) is a department that is dealing with all the facilities public and the environment which includes office Peruri Jakarta and Karawang , Housing Department Jakarta

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and Karawang and Greening in offices or the Housing Department of Jakarta and Karawang . The Fasumling Department has a Section on Development Maintenance and Environmental Arrangement (Harbanguntaling) which deals with all maintenance of development and afforestation at Perum Peruri, Karawang and Jakarta. In the section of this , there is a Plan Budget Cost (RAB), which was made by the staff to get a nominal price of fitting in accordance with the needs of the provisions that apply .

The result of the calculation of the RAB in Section Harbanguntaling it wants to be grouped into 3 groups of the type of work in accordance with the nominal price of the work that , and based on the needs of the job are Besides that , often occurs difference in understanding about the item Jobs that should be prioritized and the price of materials that must be selected , as should items of work and the price of goods that must be selected it based on the needs that will be used (Sulianta, 2019)

II. LITERATURE REVIEW

A. *Analytical Hierarchy Process* (*AHP*)

According to research (Triantaphyllou & Mann, 1995) Analytic Hierarchy Process (AHP) is a multi- criteria decision making approach and was introduced by Saaty (1977 and 1994). AHP has attractive interest many researchers , especially because of the nature of mathematics which was nice of the methods of this and the fact that the input data required rather easily obtained . AHP is a tool supporting decision that can be used to solve the problem decisions are complex. It uses a multi-level hierarchical structure of objectives , criteria , sub-criteria , and alternatives . Data associated lowered by using a set of comparison in pairs . This comparison is used to get the weight of the importance of the decision criteria, and the relative performance measures of the alternatives in terms of each individual decision criteria , can be seen in Figure 1. If the comparison is not perfectly consistent , then it provides a mechanism to improve consistency .
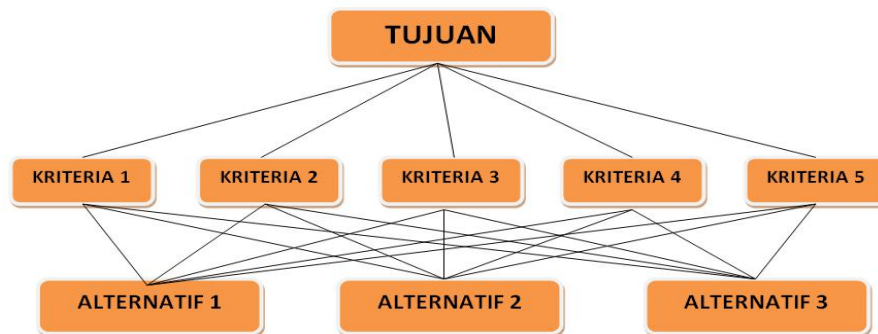

Figure 1 . AHP Hierarchy Structure

Making a decision based on the criteria that have been taken can also be made by way of pairing criteria are Just like that can be seen in Table 1. Matrix of comparison in pairs .

Table 1. Matrix comparison pairs (Triantaphyllou & Mann, 1995)

C	A_1	A_2	...	A_n
A_1	a_{11}	a_{12}	...	a_{1n}
A_2	a_{21}	a_{22}	...	a_{2n}
...	...	...	...	:

A_m	a_{m1}	a_{m2}	...	a_{mn}

Value numerical are charged for the whole comparison is obtained from the scale ratio of 1 to 9 which has been defined by Saaty , as in the table following this :

Table 2. Pasanga comparative assessment scale n

Intensity of Interest	Information	Explanation
1	Both elements are equally important	Two elements have the same effect on purpose
3	One element is slightly more important than the other elements	Experience and judgment slightly support one element compared to the other elements
5	One element is more important than the other elements	Very strong experience and judgment support one element over another
7	One element is clearly more important than the other elements	One strong and supported element is seen in practice
9	One element is absolutely more important than the other elements	Evidence supporting one element against another has the highest level of affirmation that might be corroborating
2.4.6.8	The values between the two considerations are close together	This value is given if there are two compromises between two choices
the opposite	If for activity i get one number compared to activity j. Then j has the inverse value compared to I	

B. Decision Support System

Decision Support System (SPK) in foreign terms is called the *Decision Support System* (DSS). According to Little, J.DC (in "Models and Managers: The Concept of a Decision Calculus", 1970): DSS as *" a set of model -based procedures for data processing and assessment to help managers make decisions " .*

C. SPK component

According to his research Decision support system has 4 components, among others (Surbakti , 2002) can be seen in Figure 2:

1) *Data Management* . Including *database* , which contains data that is relevant to a variety of situations and regulated by *software* that is called *Database Management Systems* (DBMS).

2) *Management* Model . Involves a model of financial , statistical , *management science* , or a variety of models of

quantitative more , so it can provide to the system an ability of analytical and management *software* are required .

3) *Communication (subsystem dialogue)* . *Users* can communicate and give orders to the SPK through this subsystem . This means providing an interface .

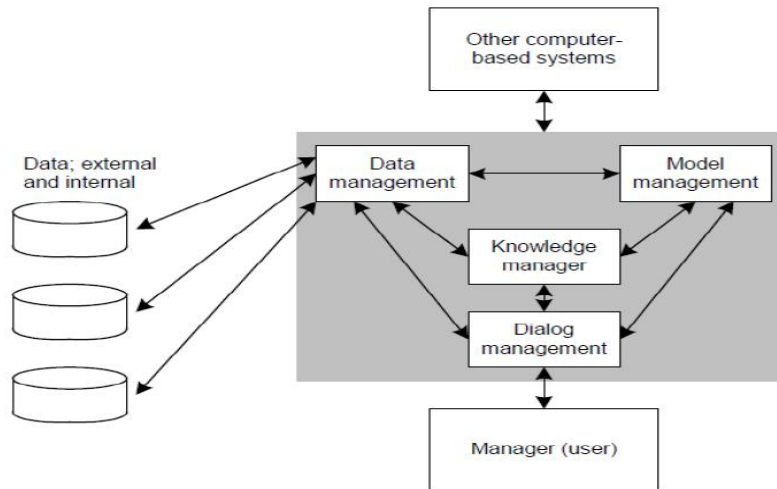4) *Knowledge Management* . This optional subsystem can support other subsystems or act as a stand- alone component .

Figure 2 . Conceptual Design of Decision Support (Surbakti, 2002)

D. *User Acceptance Testing (UAT)*

Acceptance into a maker of software needs to be held testing so as to show the achievements of conformity with what that is desired by the *stakeholders* (Baihaqi, Dwiasnati, & Hikmayanti, 2019) . The parameters for the assessment is divided into SS (highly agree), Agree , Less Agree , Not Agree and Do not know . Table 3 explains the assessment parameters of software acceptance that will later be distributed to all *stakeholders* .

Table 3 . User Acceptance Testing Parameter (Baihaqi et al., 2019) modification

No	Question	SS	S	KS	TS	TT
1.	The application is easy to use					
2.	The user interface is good					
3.	Application specifications are correct					
4.	Load data fast					
5.	The decision that came out was good					
6.	Appearance criteria questions are appropriate					

III. RESEARCH METHOD

Modeling methods in research is using modeling prototypes that provide a sample of the application that created

that can be fixed together with the *stakeholders* if there is non -compliance follows this reason choose the method prototype :

1. *listen to customer* : collect customer needs for the software to be made ;
2. *mock- up* : build applications quickly , focus more on input output applications in accordance with general needs known in the first stage ;
3. *customer test-drives mock- up* : given to the user for in the evaluation by the user and to discuss solutions to the constraints were experienced at the time of making *a prototype.*

The prototype is suitable used to dig the specification needs of customers in more detail but risky high against the ballooning cost and time project .

IV. RESULTS

A. Decision Proscess Analysis

At the stage of the analysis of the process of decision of this , researchers create a hierarchy simple which consists of three levels, namely the objectives , criteria and alternatives in accordance with the structure of the hierarchies that exist in the method of AHP.

1) Fist level

The first level is the goal , in this process which is Choosing the Quality of Work Packages where the jobs will be grouped according to their respective qualities .

2) Second level

Level two is the criteria which are the kinds of jobs that support to a package of work on the RAB, the criteria are among others Employment Dismantled , Jobs Couple , Works Painting and Works Misc. The author uses these criteria because repairs in official homes are limited to the work of painting and site cleaning only , with the intention that they are not too widespread in his case study .

3) Third level

While the level of the last that alternative , an alternative is used to choose the quality of the package of work that has been used in the repair of the . There are three quality ingredients are quality X, Y, and Z. The calculation AHP will do , we will know the quality which indeed has the weight the highest and which has a weight tertinggilah is a quality that is matched with a packet of work that .
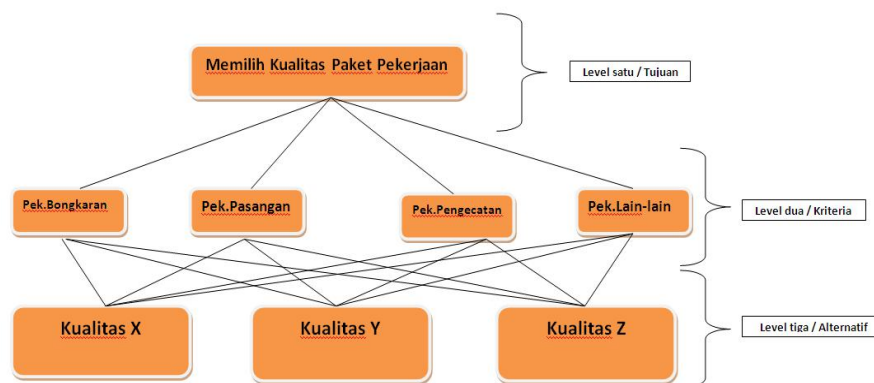

Figure 3 . Quality Selection Chart for RAB on the AHP method

After the compilation of the hierarchy is completed , the next step is to do a comparison between the elements by

taking into account the influence of the elements at the level above it . The first division is done for elements at the criterion level by taking into account the level above it , namely its purpose . Comparisons are made on a scale of one to nine and satisfy AHP axioms . The comparison matrix of level two with regard to its relation to level one is as follows .

How to fill the matrix elements in the table :

a.   Elements a [I, j] = 1 where I = 1,2, ……., N (n = 5)

b.   Elements of matrix triangle on as input

c.   The bottom triangle matrix element has the formula a [I, j] = 1 / a [I, j] for I ≠j

The results of the evaluation criteria can be seen in the following table :

Table 4 . Hierarchy weighting factor matrix for all criteria

	Pek. Bongkaran	Pek. Pasangan	Pek. Pengecatan	Pek. Lain-lain
Pek. Bongkaran	1	1	5	7
Pek. Pasangan	1	1	7	7
Pek. Pengecatan	1/5	1/7	1	3
Pek. Lain-lain	1/7	1/7	1/3	1

Tabel 2. *Hierarchy weighting factor matrices for all the criteria are minimized*

	Pek. Bongkaran	Pek. Pasangan	Pek. Pengecatan	Pek. Lain-lain
Pek. Bongkaran	1,000	1,000	5,000	7,000
Pek. Pasangan	1,000	1,000	7,000	7,000
Pek. Pengecatan	0,200	0,143	1,000	3,000
Pek. Lain-lain	0,143	0,143	0,333	1,000
Jumlah	2,343	2,286	13,333	18,000

Furthermore, the elements in each column are divided by the number of columns in question , which will get a normalized relative weight . Then look for the value of *Eigen vectors* are generated from ratar -rata value weights relative to each line . The results can be seen in the table as follows :

Tabel 3. The matrix of factors weighting hierarchy for all criteria are normalized

	Pek. Bongkaran	Pek. Pasangan	Pek. Pengecatan	Pek. Lain-lain	Jumlah
Pek. Bongkaran	0,427	0,437	0,375	0,389	1,628
Pek. Pasangan	0,427	0,437	0,525	0,389	1,778

Pek. Pengecatan	0,085	0,063	0,075	0,167	0,390
Pek. Lain-lain	0,061	0,063	0,025	0,056	0,205
Jumlah					4,001

Tabel 4. The matrix of factors weighting hierarchy for all criteria are normalized

	Pek. Bongkaran	Pek. Pasangan	Pek. Pengecatan	Pek. Lain-lain	Eigen Vektor
Pek. Bongkaran	0,427	0,437	0,375	0,389	0,407
Pek. Pasangan	0,427	0,437	0,525	0,389	0,444
Pek. Pengecatan	0,085	0,063	0,075	0,167	0,097
Pek. Lain-lain	0,061	0,063	0,025	0,056	0,051
Jumlah					1

a) Calculate the lambda maximum

Furthermore, the value of lambda maximum (maximum) is obtained by summing the results of multiplication of the number of entries in the column of the matrix of weighting factors simplified with Eigen Vector. Eigenvalues maximum are obtained are as follows :

λmax = (2,343*0,407) + (2,286*0,444) + (13,333*0,097) + (18*0,051)

= 4,177

b) Calculate the consistency index (CI)

CI = (λmax – n) / n-1

Because the matrix berordo 4 (ie, consisting of 4 criteria) then the value of index consistensi were obtained :

CI = (4,177 – 4) / 4 – 1

= 0.059

c) Calculate the consistency index (CR)

CR = CI / RI

For n = 4, RI = 0.90 (Saaty table), then :

CR = 0.059 / 0.90 = 0.066

Because CR <0.100 means that the Preference Assessment is Consistent .

From the calculation results show that Spouse Work is the most important criterion , with a weight value of 0.444 or 44.4%, next is a demolition work with a weight value of 0.407 or 40.7%, then Painting Work with a weight value of 0.097 or 9.7%, and the last Other Work with a weight value of 0.051 or 5.1%.

Table 8 . Earnings rate

Tingkat Perolehan	Kriteria	Eigen Vektor
1	Pek. Pasangan	44,4%

2	Pek. Bongkaran	40,7%
3	Pek. Pengecatan	9,7%
4	Pek. Lain-lain	5,1%
	Jumlah	100%

d) Calculation of Evaluation Factors for Job Criteria

Table 9 . Matrix Weighting Works Dismantled

Pek. Bongkaran	Kualitas X	Kualitas Y	Kualitas Z
Kualitas X	1	5	7
Kualitas Y	1/5	1	3
Kualitas Z	1/7	1/3	1

Table 10 . Matrix Weighting Works Dismantled

Pek. Bongkaran	Kualitas X	Kualitas Y	Kualitas Z
Kualitas X	1,000	5,000	7,000
Kualitas Y	0,200	1,000	3,000
Kualitas Z	0,143	0,333	1,000
Jumlah	1,343	6,333	11,000

Table 11 . Matrix weighting Works Dismantled were normalized

Pek. Bongkaran	Kualitas X	Kualitas Y	Kualitas Z	Jumlah
Kualitas X	0,745	0,789	0,636	2,170
Kualitas Y	0,149	0,158	0,273	0,580
Kualitas Z	0,106	0,053	0,091	0,250
Jumlah				3,000

Table 12 . Matrix weighting Works Dismantled were normalized

Pek. Bongkaran	Kualitas X	Kualitas Y	Kualitas Z	Eigen Vektor	λ maks
Kualitas X	0,745	0,789	0,636	0,723	0,970
Kualitas Y	0,149	0,158	0,273	0,193	1,222
Kualitas Z	0,106	0,053	0,091	0,083	0,913
Jumlah				0,999	3,105

e) Consistency Index (CI)

Because the matrix berordo 3 (ie from 3 criteria), the value of the index consistency were obtained :CI $=$ $(\lambda \max - n) / n - 1$

$$= (3 - 3) / 3 - 1 = 0$$

CR $= CI / RI = 0 / 0,58 = 0$

The trial sample calculation using AHP obtained table

Table 13 . Final Results Selection of Work Package Quality in the RAB

No	Nama Pekerjaan	Harga (Rp.)	Kualitas X	Kualitas Y	Kualitas Z	Hasil
1.	Pekerjaan Perbaikan dan Pengecatan Rumah Dinas Perum Peruri Blok A5 No. 15 Puri Telujambe Karawang	Rp.75.850.000,-	54.839.550	14.639.050	6.295.550	Kualitas X
2.	Pekerjaan Perbaikan dan Pengecatan Rumah Dinas Perum Peruri Blok B6 No. 2 Puri Telujambe Karawang	Rp.34.440.000,-	20.939.520	9.367.680	4.132.800	Kualitas X

Based on the above results , global ranks or priorities are obtained for each quality . The quality of the figures / rank highest is the quality of the package of work that .

B.   *User Interface*

Display the interface of research is using or based website that uses language programming in PHP and based local is not in line right.

1)   Home Display

Figure 4 . Home Menu Display

Note : At the start or main menu this is the first display that appears when the login is successful . The initial menu contains information about the Decision Support System for the Selection of Work Package Quality in the RAB.
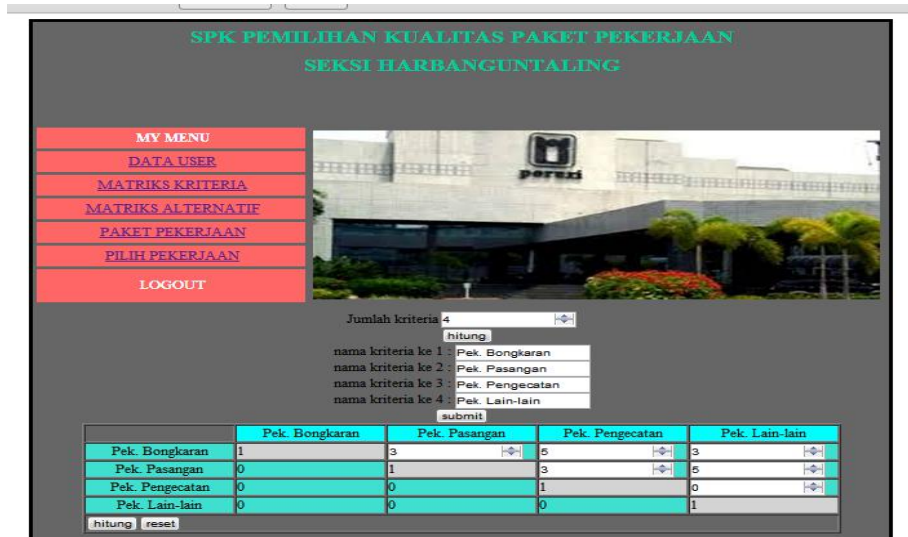
2) Citeria Matrix Display

Figure 5 . Criteria Matrix

Description : In the view matrix of criteria for this , displaying a table that contains weighting of each criterion that is entered by the admin. The system will process the input it , then will appear the result of consistency . If it is consistent , the calculation can proceed to the next calculation , if it is not consistent then the calculation must be repeated .

C. Testing

The process of testing using the parameters that have been determined in advance using the methods of *UAT*, spread and then returned back as a matter of reference of testing. Table 14 is a recapitulation of questionnaires that have been given to stakeholders.

Table 14 . Recap of UAT Results

No	Questions	SS	S	KS	TS	TT
1	Application is easy to be used	6	1	0	0	0
2	User interface is good	5	2	0	0	0
3	Specification of the application	7	0	0	0	0
4	Timing of Loading of data	6	1	0	0	0
5	Result is good	6	1	0	0	0
6	The criteria has been met	7	0	0	0	0

The results of table 14 are then displayed into a graph that will make it easier to read the comparison of the level of satisfaction of stakeholders to what has been made.
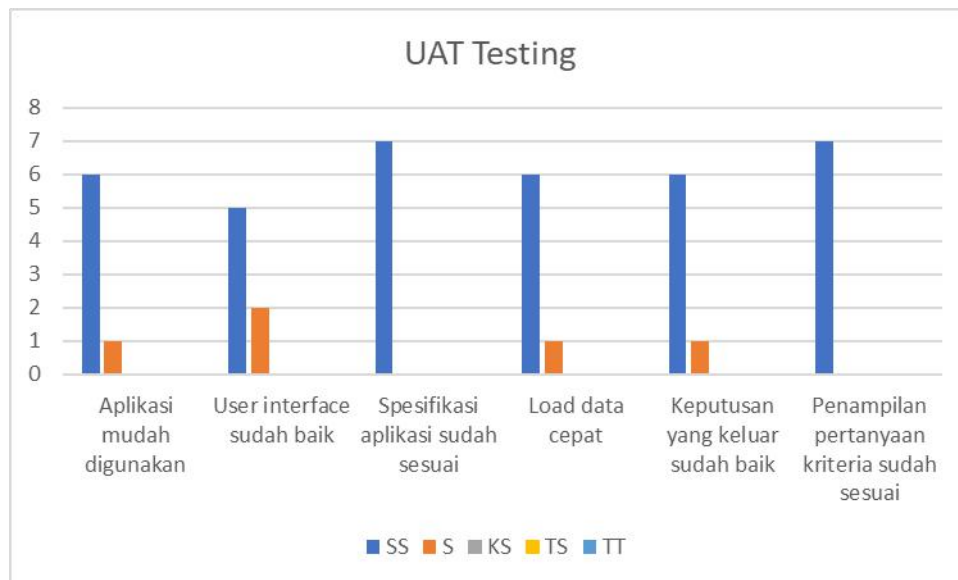
Figure 6 . UAT Results Graph

MOS calculations in the *performance* category :

1. MOS Application is easy to use

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 0) + (4 \times 1) + (5 \times 6)}{7} = 4.8$$

2. MOS User Interface is good

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 0) + (4 \times 2) + (5 \times 5)}{7} = 4.0$$

3. MOS Specifications It is appropriate

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 0) + (4 \times 0) + (5 \times 7)}{7} = 5.0$$

4. MOS Load data fast

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 1) + (4 \times 1) + (5 \times 6)}{7} = 4.8$$

5. MOS The decision that came out was good

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 0) + (4 \times 1) + (5 \times 6)}{7} = 4.8$$

6. MOS Application is very helpful in managing attendance recaps

$$MO = \frac{(1 \times 0) + (2 \times 0) + (3 \times 0) + (4 \times 0) + (5 \times 7)}{7} = 5.0$$

Explanation:

The biggest parameter in the calculation above is the value of five (5) then the results of the above section have a satisfaction level in order of numbers 1-5 will be illustrated in Figure 7 of the MOS Results chart .
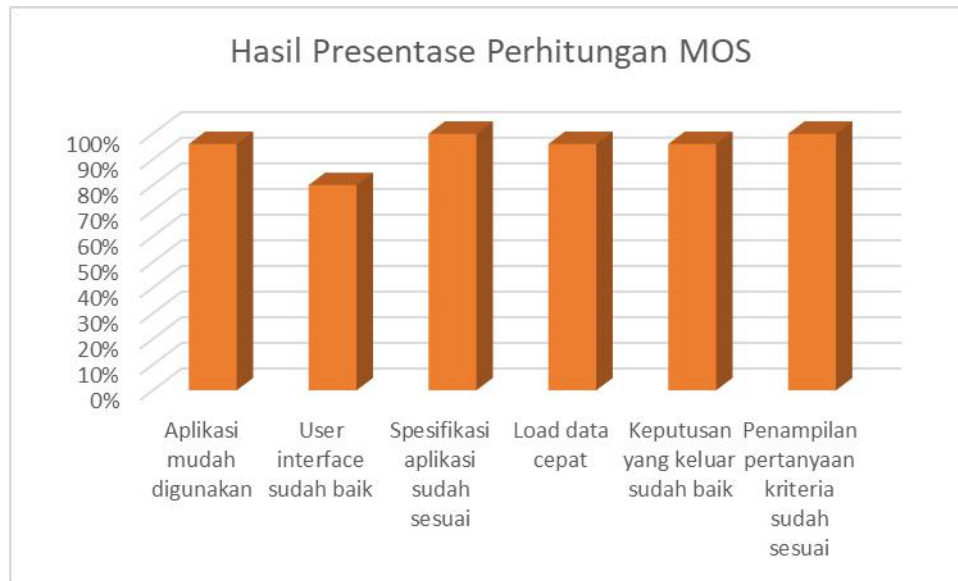
Figure 7 . Results Percentage Calculation of MOS

V. CONCLUSIONS AND SUGGESTIONS

1. Conclusion

Based on the results of the application of the method *of Analytical Hierarchy Process* (AHP) to determine or provide input in the withdrawal of the conclusions in the system supporting the decision are discussed in the study times this . The level of stakeholder satisfaction with the results is in the range of 80% - 100%. Because the choice of results or conclusions are only 3 recommendations not yet complex .

2. Suggestion

Research further may refer to the study of times this if indeed choice of withdrawing the conclusion is simple and not complex , would be but if it already has a lot of criteria and conclusions worth using 2 methods or algorithms are combined in order to mutually complement of any shortcomings . AHP on research time it provides an alternative if the criteria at the state meet branching to function as it could facilitate the withdrawal of conclusion despite the many parameters.

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