



# Implementation of AHP and TOPSIS Method to Determine the Priority of Improving the Management of Government's Assets

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**Abstract**— Many problems of asset management based on audit results is an indicator of weakness implementation of asset management which adversely affects of the Audit Board of the Republic of Indonesia. All evaluation of the implementation of asset management is the first step in improving the quality of asset management. This study aims to build decision support system to help problems solving prioritization improved management of government assets with AHP and TOPSIS methods. Integration of AHP and TOPSIS methods are used to perform weighting and ranking alternatives. Weights are obtained by comparison of the level of interest criteria carried out by experts ranked. While alternative methods produced are based on the calculation method in which the best alternative has the shortest distance from the positive ideal solution and the farthest from the negative ideal solution. Alternative asset management is a low priority in the increasing in asset management. The results of this analysis, a system is used for prioritization based on defined criteria. The test results shows that the system can provide an alternative sequence that has an accuracy rate of 83% and has an average value of 4.91 of an evaluation system 5-point scale with the aspect of effectiveness, efficiency and user satisfaction.

**Keywords**— AHP; TOPSIS; Priority; Evaluation; Asset Managements

## I. INTRODUCTION

Making a decision can be carried out through Analytical Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods to rank alternative weighting and determination in helping decision-makers (Pires et al, 2011). AHP method is widely used in the evaluation themes (Dweiri et al, 2016). This method is excellent for modeling experts in decision supporting systems (Deng et al, 2014). This method was developed by Saaty in 1980, divides the complex system in meticulous system element hierarchy by making paired comparisons, making a comparison matrixes, then eigenvector of the matrixes is formed, resulting is weight. Finally, *eigenvalues* is used for assessing the strength ratio of the consistency of comparison (Bozbura et al., 2007). Starting to set goals, identifying key criteria, rank the main criteria based on experts. The second stage is to identify sub-criteria and sub-criteria sort ranked by major criteria (Dweiri et al, 2016).

TOPSIS method is often used for selection (Kelemenis and Askounis, 2010). TOPSIS method was developed by Hwang and Yoon in 1981. This method is excellent for assessing the number of alternatives for efficient computation (Kusumadewi et al, 2006). According to this technique, the best alternative has the shortest distance from the positive ideal solution and the farthest from the negative ideal solution (Dagdeviren et al, 2009).

Inspection report of the State Audit Board (SAB) shows the number of asset management issues. Starting from the asset management issues, the need is for a thorough evaluation of asset management. Evaluation of assets management is a stage in the developing of assets management. The results of evaluation stage, then the determination of priorities. Determination of priority is done due to many units of work and shortage of human resources is in an effort to develop the quality of assets management. Determination of priority is done by implementing the method of AHP and TOPSIS. The results of the calculation method will be obtained rank order of business unit performance in managing assets. The priority of developing the assets management is focused on the unit that has a low value.

## II. THEORETICAL FRAMEWORK

### A. FORMER STUDY

Fuzzy AHP and Fuzzy TOPSIS approach can be used in determining the priority level of effectiveness 7M (Management, Manpower, Marketing, Method, Machine, Material, and Money) for enhanced system performance untuk peningkatan kinerja sistem produksi. By consideration of criteria weights generated by the AHP, Fuzzy TOPSIS method approach is applied to produce the performance score of each alternative (Rostamzadeh dan Sofian, 2011). Performance measurement of service quality that combines in performance measurement is done by proposing a combining method is the FAHP, TOPSIS, DEA, that are applied on the basis of the distribution of electricity to show the efficiency of electricity distribution (Celen dan Yalcin, 2012). SCOR method (Supply Chain Operations Reference) is used to do supplier performance evaluation. Supporting Fuzzy TOPSIS allows the use of linguistic assessment to evaluate supplier performance, the best rank and categorize supplier (Junior and Carpinetti, 2016).

Integration of AHP and TOPSIS methods are used to derive the weights of criteria and ranking alternatives have been done by some previous researchers (Secme et al, 2009; Pires et al, 2011; Buyukozkan dan Cifci, 2012; Taylan et al, 2014).

### B. MANAGEMENT OF GOVERNMENT'S ASSETS

Assets management is a management process from the planning stage until the elimination of the need, where the process is done in the monitoring of the asset over the life its use by an agency. Assets management policy of government is stipulated in Government Regulation No. 27, 2014 concerning Assets Management of State or Regional. Management of government assets include demand planning and budgeting, procurement, use, utilization, safety and maintenance, assessment, transfer, destruction, removal, administration, and guidance, supervision and control (Ministry of Justice and Human Rights, 2014)

### C. AHP METHOD

AHP method allows users to provide value relative weights of a compound or alternative criteria compound against a criterion intuitively by performing pairwise comparisons. Then Saaty determines a consistent way to change the paired comparisons into a set of number that represents the relative priority of each criteria and alternative (Turban et al, 2007). There are several principals that must be understood in resolving problems using AHP (Saaty, 1990), is the preparation of hierarchical structure, assessment criteria through a paired comparison with Saaty's comparative scale (Table 1), prioritization and consistency test.

TABLE I - SCALE OF PAIRWISE COMPARISONS

INTEREST RATE	EVIDENCE
1	ELEMENT 1 AND 2 ARE EQUALLY IMPORTANT
3	ELEMENT 1 IS MORE IMPORTANT ENOUGH THAN ELEMENT 2
5	ELEMENT 1 IS MORE IMPORTANT THAN ELEMENT 2
7	ELEMENT 1 IS VERY IMPORTANT THAN ELEMENT 2
9	ELEMENT 1 IS ABSOLUTELY MORE IMPORTANT THAN THE ELEMENT 2
2,4,6,8	THIS VALUE IS GIVEN WHEN THERE ARE TWO COMPONENT BETWEEN TWO OPTIONS

#### Prioritization through the following stages:

- Summing the values of each column in the matrix of pair wise comparisons.
- Dividing the value of  $A_{ij}$  in each column with the number in the column in question in order to get the matrix normalized.
- Summing the value in each row from matrix that normalized and dividing by summing element in each row. The result of dividing it shows the overall priority value to each element.

#### Consistency test carried out through the following steps:

- Multiplying each value in the first column with the relative priority of the first element, the value in the second column with the relative priority of the second element and so on.
- Summing each row.
- The result of the line summing id divided by the relative priority element in question.
- Summing the result, then divided by number of existing elements, the results is called  $\lambda_{max}$
- Calculate Consistency Index (CI)

$$CI = \frac{\lambda_{maks} - n}{n - 1} \tag{1}$$

f. Determining a value Index Random Consistency (IR) corresponding to the size of each matrix shown in Table 2.

TABLE II- INDEX RANDOM CONSISTENCY

N	1	2	3	4	5	6	7	8	9	10
IR	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

g. Calculate Consistency Ratio (CR)

$$CR = \frac{CI}{IR} \tag{2}$$

h. Checking consistency, if the value  $CR \leq 0,1$  so, it is consistent however if  $CR > 0,1$  it is not consistent.

#### D. TOPSIS METHOD

TOPSIS method is an approach to solve the problems of multicriteria. TOPSIS method is based on the concept that the best alternative is selected not only the shortest distance from the positive ideal solution but it also has the longest distance from the negative ideal solution (Kusumadewi, 2006).

TOPSIS method has the following steps:

- Determining the decision of matrix
- Determining the normalized decision matrix ( $r$ )

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \tag{3}$$

c. Calculate a weighted normalized decision matrix ( $y$ )

$$y_{ij} = W_i r_{ij} \tag{4}$$

d. Calculating ideal solution matrix of positive and negative ideal solution matrix ( $A$ )

$$A^\pm = (y_1^\pm, y_2^\pm, \dots, y_n^\pm); \tag{5}$$

e. Calculating the distance ( $D_i^+$ ) between the weighted value of each alternative to the positive ideal solution and the distance ( $D_i^-$ ) between the weighted value of each alternative against the negative ideal solution.

$$D_i^+ = \sqrt{\sum_{j=1}^m (y_j^+ - y_{ij}^+)^2} \tag{6}$$

$$D_i^- = \sqrt{\sum_{j=1}^m ((y_j^- - y_{ij}^-))^2} \tag{7}$$

f. Calculating the value of preferences ( $V$ ) for each alternative

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{8}$$

### III. METHODOLOGY

In to obtain optimal results, the implementation of research studies by following the procedure as shown in Figure 1.

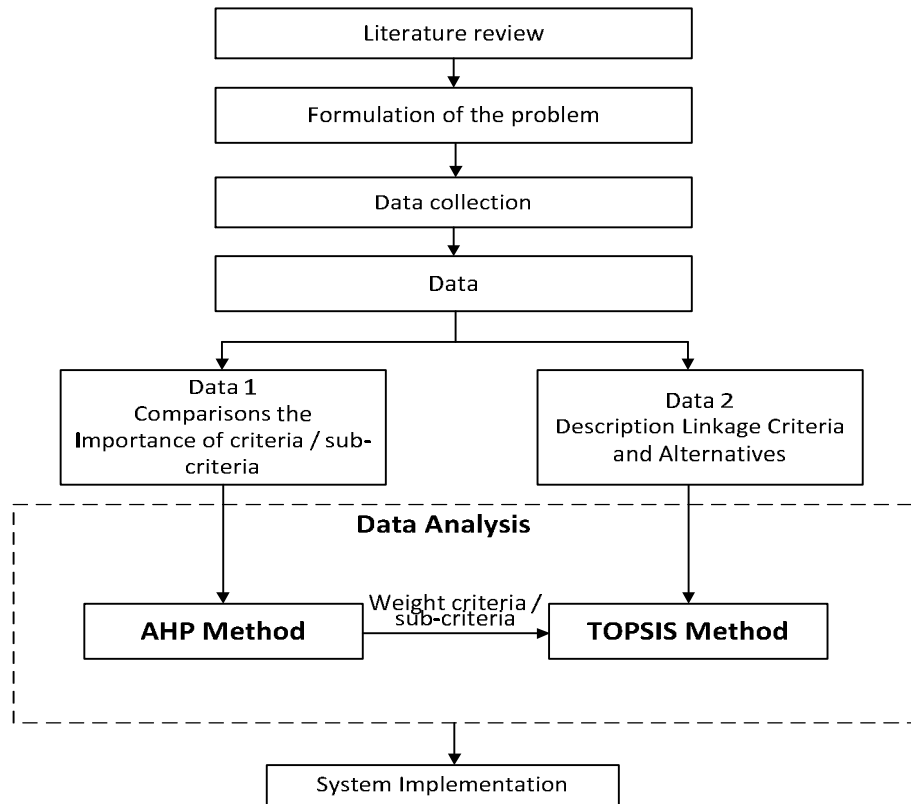


Fig. 1 Observation procedure

The study begins with a literature study to get a comprehensive understanding of the implementation of AHP and TOPSIS by studying literature as international journals, national journals, books and scientific papers have been verified. In building a decision support system, the necessary variables for the system requirements such criteria, sub-criteria and alternatives. The criteria is used by the Government Regulation No. 27, 2014 is shown in Table 3. As an alternative in this research is the implementation of asset management in six work units within the Ministry as samples, aimed in Table 4.

TABLE III  
 CRITERIA AND SUB CRITERIA

Code	Criteria	Code	Sub Criteria
C1	Utilization	SC11	Determination of the Status Usage (PSP) to the manager of the goods
		SC12	PSP proposal to the goods
		SC13	PSP report
C2	Securing and Maintenance	SC21	Administration Security
		SC22	Physical security
		SC23	Legal safeguards
		SC24	Maintenance
C3	Eradication	SC31	Goods damaged / missing
		SC32	The proposed eradication
		SC33	Eradication report
C4	Administration	SC41	Book keeping
		SC42	Inventory
		SC43	Reporting
C5	Supervision and Control	SC51	Supervising
		SC52	Publishing
		SC53	Supervision and control report

TABLE IV  
 ALTERNATIVE SAMPLE

No	Alternative
1	BP
2	BHM
3	BU
4	BOK
5	PK
6	BK

The questionnaire is required as a reference for assessing the performance of asset management. In measuring the implementation of asset management designed two kinds of questionnaires. The first questionnaire contains a list of questions to perform pair wise comparisons among criteria / sub-criteria, using a scale of Saaty pair wise comparisons. Whereas the second questionnaire lists the execution votes on an alternative asset management, consisting of five criteria are divided into sixteen assessment questions, each question is based on the four elements of evaluation ratings. Answer a second questionnaire on sixteen assessment questions using a five-point Likert scale as shown in Table 5 (Widoyoko, 2015). While the element of judgment record answers using a model essay.

TABLE V - LIKERT CONVERSION SCALE

Linguistic Value	Abbreviation	Score
Very Good	VG	5
Good	G	4
Good Enough	GE	3
Bad	B	2
Absolutely Bad	AB	1

In this stage of data collection is done by netting a questionnaire distributed to respondents and respondents' expert evaluators performance. Respondents experts judge the importance of criteria / sub-criteria to perform pairwise comparisons among criteria / sub-criteria. Respondents performance evaluator assesses the performance of the asset management work unit. In assessing the performance of asset management, assessment data collection is done in three ways: interviews, observation and document collection (Patton, 2009). Data analysis are performed using the integration of AHP and TOPSIS. The shape of the system implementation is the creation of applications with the integration of AHP and TOPSIS. These applications will be built using the PHP programming language and MySQL database.

#### IV. RESULT AND DISCUSSION

##### A. Result

In the resulting system is starting by entering user data, the data work units, the data criteria and sub-criteria, the data elements of assessment, determine the level of importance of criteria and sub-criteria based on expert opinion. Based on the data, and then do the calculation method of AHP to obtain the weight of each criteria and sub-criteria that have been through the test of consistency with the acquisition of the consistency ratio is less than equal to 0.1. From the weight obtained by the multiplication operation performed between the weights of criteria and sub-criteria weights resulting global weight. The value of the interest rate criteria and sub-criteria is obtained based on expert opinion and arranged in a matrix of pairwise comparison criteria (Table 6) and sub-criteria (Table 7).

TABLE VI - PAIRWISE COMPARISON MATRIX CRITERIA

Criteria	C1	C2	C3	C4	C5
C1	1	3	2	0,5	6
C2	0,333	1	0,5	0,333	3
C3	0,5	2	1	0,333	4
C4	2	3	3	1	7
C5	0,167	0,333	0,25	0,143	1

TABLE VII - PAIRWISE COMPARISON MATRIX SUB CRITERIA

Sub Criteria	SC11	SC12	SC13	SC21	SC22	SC23	SC24	SC31	SC32	SC33	SC41	SC42	SC43	SC51	SC52	SC53
SC11	1	3	2													
SC12	0,333	1	0,333													
SC13	0,5	3	1													
SC21				1	0,5	0,333	2									
SC22				2	1	0,5	4									
SC23				3	2	1	4									
SC24				0,5	0,25	0,25	1									
SC31								1	6	2						
SC32								0,167	1	0,25						
SC33								0,5	4	1						
SC41											1	3	0,5			
SC42											0,333	1	0,25			
SC43											2	4	1			
SC51														1	2	0,5
SC52														0,5	1	0,333
SC53														2	3	1

From the pairwise comparison, and then determine the weight criteria (Figure 2), sub-criteria (Figure 3) and weighting of global significance (Figure 4) as well as to test the consistency.

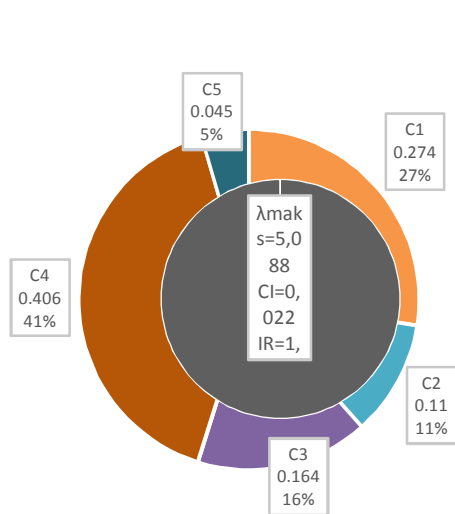


Fig.2 Weight criteria

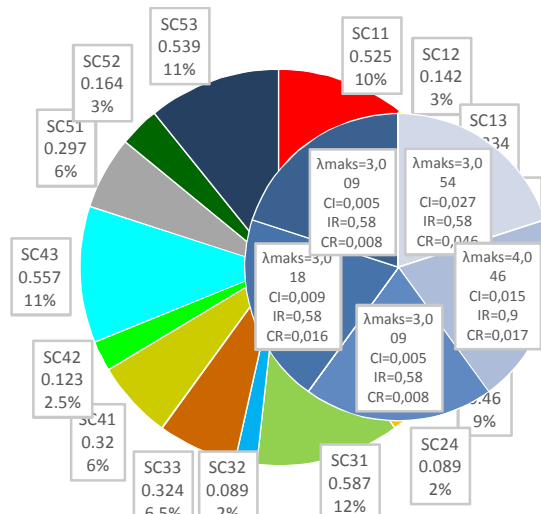


Fig.3 Weight sub criteria

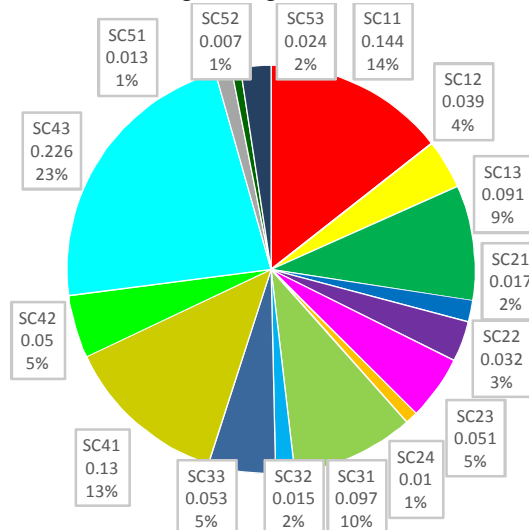


Fig. 4 Weight global significance

Next, rating process is performed with TOPSIS method. The rating process is begun data values based on the alternative performance assessments conducted by evaluators such as Table 8.

TABLE VIII - SCORING ALTERNATIVE PERFORMANCE

Alternative	Sub Criteria															
	SC11	SC12	SC13	SC21	SC22	SC23	SC24	SC31	SC32	SC33	SC41	SC42	SC43	SC51	SC52	SC53
BP	G	G	G	VG	VG	G	VG	CG	VG	VG	G	G	VG	VG	VG	AB
BHM	G	GE	G	VG	VG	G	VG	G	VG	VG	VG	VG	VG	VG	VG	AB
BU	AB	AB	G	VG	GE	B	VG	VG	VG	VG	VG	B	VG	VG	VG	VG
BOK	G	GE	G	GE	VG	G	VG	G	VG	VG	VG	VG	VG	VG	VG	AB
PK	G	GE	VG	G	VG	G	VG	G	VG	VG	G	VG	VG	VG	VG	AB
BK	GE	G	G	G	VG	VG	VG	G	VG	VG	G	VG	VG	VG	VG	VG

From these alternative performance value data and then do the conversion so as to form such a decision matrix Table 9.

TABLE IX - DECISION MATRIX

Alternative	Sub Criteria															
	SC11	SC12	SC13	SC21	SC22	SC23	SC24	SC31	SC32	SC33	SC41	SC42	SC43	SC51	SC52	SC53
BP	4	4	4	5	5	4	5	3	5	5	4	4	5	5	5	1
BHM	4	3	4	5	5	4	5	4	5	5	5	5	5	5	5	1
BU	1	1	4	5	3	2	5	5	5	5	5	2	5	5	5	5



BOK	4	3	4	3	5	4	5	4	5	5	5	5	5	5	5	1
PK	4	3	5	4	5	4	5	4	5	5	4	5	5	5	5	1
BK	3	4	4	4	5	5	5	4	5	5	4	5	5	5	5	5

Then determine the normalized decision matrix. Weighted decision matrix is produced from the matrix multiplication operation between the global weights obtained from AHP with normalized decision matrix. Next, continued with the process of calculating the distance between the weighted values of each alternative against the ideal solution and negative ideal solution. Further calculates the reference value of each alternative such as a Table 10.

TABLE X - PREFERENCE SCORE

Alternative	$D^+$	$D^-$	Preference Score
BP	0,0286	0,0545	0,6559
BHM	0,0200	0,0564	0,7383
BU	0,0573	0,0265	0,3160
BOK	0,0203	0,0563	0,7355
PK	0,0215	0,0559	0,7224
BK	0,0244	0,0456	0,6516

After it is obtained, it is done with a preference value in doing the rating alternatives like Figure 5. The work unit with low ratings are a priority in the effort to improve assets management.

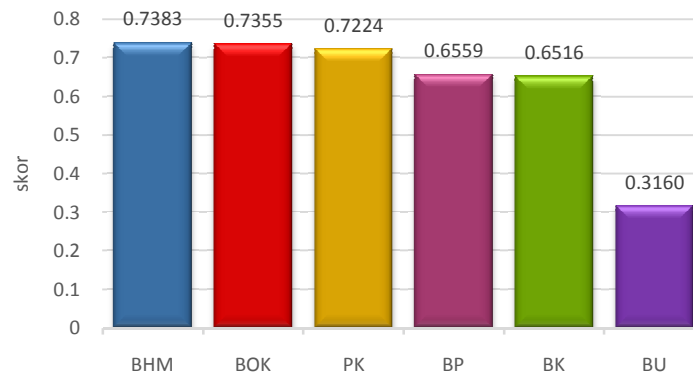


Fig. 5 Alternative ranking

**B. Discussion**

In the process of the AHP, produce weight criteria and sub-criteria weights. Multiplication between both produce global significance, which the administration has the greatest weight criteria, sub-criteria as well as the reporting has a weight of sub-criteria. It was consistent, that the administration of the assets is the criterion that describes all the activities in which the asset management operations of reporting asset is an instrument to find out that the implementation of asset management implemented properly and accountably. TOPSIS for further process in which is a ranking of alternatives. Consecutive work unit with the highest to lowest preference value is BHM with the value 0.7383, BOK with a value of 0.7355, 0.7224 PK values, BP with a value of 0.6559, 0.6516 and BK with BU value with value of 0.3160. Priority is based on the increase in the asset management work unit with a low rating. By the obtaining rank orders of alternatives and determined priority criteria, then the work unit that the first priority in improving the management of their assets, that BU, BK are the second priority, third priority is BP, and so on. Priority setting is meant that efforts to improve asset management has become more focused on solving problems at an asset management work unit.

Based on the comparison of alternative rankings is generated by coordinator asset management with system works, there are different alternatives rank with the accuracy of 83%. It shows that the system has been built in accordance with the stages of the process AHP and TOPSIS. Rating system is generated alternatives can be stated to be better than the results is given by the coordinator of an asset manager, for the application of AHP and TOPSIS into account the weight of each criteria / sub-criteria and able to provide an alternative to the calculation of the distance ranked alternatives with positive and negative ideal solution. While the method of assessment coordinator asset management, all the criteria / sub-criteria are considered to have the same importance weight. Based on the results of the evaluation system, that the system has good ratings from users of the system with an overall average score of 4.91 on a scale of 5 on aspects of effectiveness, efficiency and satisfaction to the users of the system. Decision support system is built a web-based system. By the web-

based system, then the system users such as administrators, evaluators and leaders can use online system to remember the location of the work force are in almost all provinces in Indonesia. Thus, as the leader's decision makers can make decisions quickly and accurately.

## V. CONCLUSIONS

This study successfully is established SPK prioritization increasing in assets management with AHP and TOPSIS, web-based so that decisions can be quickly and accurately and generate alternative rank order, with an accuracy of 83%.

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