Alumni Absorption Assessment for Tracking Alumni Interest Using Analytical Hierarchy Process and Technique for Order Preference by Similarity to Ideal Solution

M Matahari1* and A Hadiana2

1 Magister Sistem Informasi, Universitas Komputer Indonesia, DipatiUkur Jl, 112-116, Bandung, Jawa Barat, Indonesia
2 Lembaga Ilmu Pengetahuan Indonesia, Jl Sangkuriang Gd 20 Cisitu, Bandung, Jawa Barat, Indonesia

*mataharimanaf@yahoo.co.id

Abstract. The aim of this research is for tracking alumni interest at Sekolah Usaha Perikanan Menengah (SUPM) Negeri Sorong. For now the absorption data of alumni has not been used optimally, with an objective assessment. Therefore, further research is needed in assessing the absorption of alumni after graduation by tracing the interest of alumni in looking for work. By using data of alumni absorption and interview of SUPM Negeri Sorong stakeholder, it was found that Analytical Hierarchy Process (AHP) method can be used in weighting criteria as well as alternative and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method as comparison and consideration of the selection of the best alternative. This research had result that combination of AHP and TOPSIS can give the best alternative recommendation. The results that obtained by using AHP and TOPSIS is found that the alternative of Marine Fisheries Private Company is the best choice that alumni is interest in it, and get highest rank with 29% percentage on AHP calculation and 37% in TOPSIS calculation. With this result, we can track alumni interest. The absorption of alumni in the industry can affect the determination of curriculum and education program, the evaluation done by looking up alumni annually determines the next step that SUPM Negeri Sorong will be taken in preparing curriculum and education program.

1. Introduction
The evaluation of alumni absorption that performance every year determines the next step that will be taken by SUPM Negeri Sorong in preparing curriculum and educational program.

The methods that used in assessing and analyzing the absorption capacity is Analytical Hierarchy Process (AHP) for weighting criteria and alternative [1-3], and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method for comparison and consideration selecting the best alternative [4,5]. AHP and TOPSIS is a decision-making method based on Multiple Criteria Decision Making (MCMD) which is a decision-making method to define a number of alternatives based on certain criteria [5,6].

Based on previous studies on the combining AHP and TOPSIS approach [7-10], the purpose of this research was to assessing the absorption of alumni for tracking alumni interest in looking for work. The result gained from mathematical approach was compared with previous study to confirm that the
AHP and TOPSIS approach is effective. Further research using this combined approach can be useful for further study.

2. Methods
The AHP method was developed by Saaty [1-3], The process of AHP is decomposition of a complex problem into a hierarchy with a goal on the top of hierarchy, criterions, and the decision alternative at the bottom. The decision judgments are organized into pairwise comparison matrix at each hierarchy [8]. The TOPSIS method is based on an intuitive and simple idea [4-6], which is that the optimal ideal solution must have the maximum benefit that obtained by select the best alternative which is far from the most unsuitable benefit [7].

The AHP method approach is used in knowing the final weight of the criterion and its alternatives and the TOPSIS method is used to determine the best choice of each available alternative.

3. Result and Discussion
3.1. Objective Weight Using AHP
In the first step of tracking alumni interest is list and determine all criteria and alternatives that construct of hierarchy decision making [1]. The main objective is alumni absorption assessment for tracking alumni interest. These criteria were chosen by following an alumni data, result of interview, an literature survey and include criterion Salary, Expertise, Location, Workload and for alternative; Marine Fisheries Entrepreneurship, Marine Fisheries Private Company, Marine Fisheries Government-owned Enterprises, Non Marine Fisheries Private Company, Government Agency, Continue Study.

3.1.1. Construct a Pair-wise Comparison Matrix. The strengths of AHP is the use of pair-wise comparison to obtain accuracy of ratio scale priority [2-3]. The pair-wise comparison matrix is constructed from i × j elements, where i and j were the number of criteria and this case is 4 criteria (n = 4). So, in the matrix A mark aij is represent relative measure of criteria i with respect to criteria j. The equation showed in Equation 1. The pair-wise comparison generate a matrix of relative ranking for each level hierarchy.

$$ A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1j} \\ a_{21} & 1 & \cdots & a_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ a_{i1} & a_{i2} & \cdots & a_{ij} \end{bmatrix} $$

(1)

The comparison between each element were made by using Saaty measurement scale, that showed in Table 1. The numerical value between 1 to 9 depending on the importance of element [3]. (See Table 1)

| Relative Intensity | Definition                                           |
|-------------------|------------------------------------------------------|
| 1                 | Criteria/Alternative A is equally important from B   |
| 3                 | A moderately more important from B                   |
| 5                 | A strongly more important from B                     |
| 7                 | A very strongly more important from B                |
| 9                 | A Extremely more important from B                    |
| 2, 4, 6, 8        | Intermediate Value, when compromise is needed        |

And the determination of the criteria measurement can be seen in Table 2. And then, searching for criteria weight (priority vector) by normalizing each value by dividing each value with the sum of the column. And the rest of pair-wise comparison judgment of alternative using same step of calculating criteria preference. (See Table 2).
Table 2. Pair-wise comparison matrix of criteria.

| Criteria Preference | Salary | Expertise | Location | Workload | Priority Vector |
|---------------------|--------|-----------|----------|----------|-----------------|
| Salary              | 1      | 2         | 5        | 4        | 0.4918          |
| Expertise           | 1/2    | 1         | 4        | 3        | 0.3056          |
| Location            | 1/5    | 1/4       | 1        | 1/2      | 0.0778          |
| Workload            | 1/4    | 1/4       | 2        | 1        | 0.1248          |
| ∑                   | 1,95   | 3,58      | 12       | 8.5      | 1               |

3.1.2. Synthesis Judgement of Pair-wise Comparison. After all pair-wise comparison has formed and getting the result of eigen vector, the next step is calculating the value of eigen vector (λ) by using Equation 2, that the result can be used for calculating consistency index (CI).

$$\lambda = \left( \sum a_{11} \times \bar{x}_1 \right) + \cdots + \left( \sum a_{1n} \times \bar{x}_n \right)$$  \hspace{1cm} (2)

And the result of $\lambda = 4.0485$

Then calculate the consistency index (CI) using Equation 3, where n is the matrix size.

$$\lambda = \left( \sum a_{11} \times \bar{x}_1 \right) + \cdots + \left( \sum a_{1n} \times \bar{x}_n \right)$$ \hspace{1cm} (3)

And the result is CI = 0.0162. When CI value is $\neq 0$, then it must be find the tolerance limit of inconsistency by using Equation 4.

$$CR = \frac{CI}{RI}$$ \hspace{1cm} (4)

And because CI value is $\neq 0$ we have to find the Consistency Ratio (CR) using Equation 4, where value of Random Index (RI) is taken from Saaty Random Index in Table 4.

Table 4. Saaty Random Index.

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

The final result of weighting using AHP can be seen in Figure 1 and the percentage chart in Figure 2, where the first position is occupied by Marine Fisheries Private Company alternative with the final score of 0.2942 and most influenced by Salary criteria as the main factor with score 0.1948. The second position is occupied by Continue Study alternative with the final score of 0.2256 and most influenced by Expertise criteria with the highest score 0.1183. Then followed by third position by Government Agency alternative with final weight 0.1408 and same as first position, most influenced by Salary criteria as main factor with score 0.0709. In the fourth position is filled by Non Marine Fisheries Private Company with final score of 0.1342 and influenced by Salary criteria as the main factor with score 0.1028. While the fifth position is occupied by Marine Fisheries Government-owned Enterprises with a final score of 0.1071 and most influenced also by the salary with score 0.0629. And the last position is occupied by Marine Fisheries Entrepreneurship with the final score of 0.0980 and influenced by Expertise criteria with a score 0.0383 (See Figure 1&2).
3.2. Ranking the Alternatives Using TOPSIS

Technique for Order Presence by Similarity to Ideal Solution (TOPSIS) is based on the concept that the best alternative not only has the shortest distance from the positive ideal solution, but also the longest distance from the negative ideal solution. In general, the TOPSIS procedure follows these steps:

- Establish the decision matrix by normalization the matrix.
- Determine the weighted decision matrix which has been normalized.
- Identify the positive and negative ideal solution.
- Calculate the separation distance of each competitive alternative the positive an negative ideal solution.
- Rank the preference value for each alternatives.

At the TOPSIS stage, will using the results data from the AHP overall composite weight that have been obtained previously. Using the weighted results as inputs are contained, TOPSIS stages begin by constructing a decision matrix and followed by making an normalized decision matrix. The calculations performed to obtain the results is use Equation 5. This step is for establish the decision matrix by normalize the matrix.
\[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \]  

(5)

Furthermore, after obtaining the result of the normalized decision matrix, the next stages is making a weighted decision matrix by multiplying each matrix, the calculation is done by using Equation 6.

\[ y_{ij} = w_{ir} r_{ij} \]  

(6)

Then calculate the positive ideal solution \( A^+ \) and the negative ideal solution \( A^- \) that define according to the weighted decision matrix and using Equations 7 and Equation 8.

\[ A^+ = (y^+_1, y^+_2, ..., y^+_n) \]  

(7)

\[ A^- = (y^-_1, y^-_2, ..., y^-_n) \]  

(8)

Explanation:

\[ y^+_j = \begin{cases} \max_i y_{ij} & \text{if } j \text{ is an attribute of benefit} \\ \min_i y_{ij} & \text{if } j \text{ is an attribute of cost} \end{cases} \]

\[ y^-_j = \begin{cases} \min_i y_{ij} & \text{if } j \text{ is an attribute of benefit} \\ \max_i y_{ij} & \text{if } j \text{ is an attribute of cost} \end{cases} \]

\( j = 1, 2, ..., n \).

Where \( A^+ \) is looks for the highest alternative value against each criterion, and \( A^- \) looks for the lowest alternative value against each criterion that associated with the benefit and cost attribute. After obtaining the result of positive and negative ideal solutions, we can find the proximity value of each alternative to the ideal solution by using Equations 9 and Equation 10.

\[ D^+_i = \sqrt{\sum_{j=1}^{n} (y^+_i - y^-_{ij})^2} ; i = 1, 2, ..., m \]  

(9)

\[ D^-_i = \sqrt{\sum_{j=1}^{n} (y^-_{ij} - y^-_{ij})^2} ; i = 1, 2, ..., m \]  

(10)

Next step after obtaining \( D^+ \) dan \( D^- \) values, then we can find the rank of preference value for each alternative (V) using Equation 11.

\[ V_i = \frac{D^-_i}{D^-_i + D^+_i} ; i = 1, 2, ..., m \]  

(11)

From the result of positive and negative ideal solution is determined the distance between positive ideal solution with negative ideal solution, to get the rank value based on distance value, where the biggest distance get highest rank. Based on the result, that obtained the highest ranking by Marine Fisheries Private Company alternative with a score of 0.817619. The percentage of each alternative can be seen in Figure 3.
4. Conclusions
Based on the analysis that has been done, there are several conclusions and recommendation as follows:

- The search for assessment of alumni absorption for tracking alumni interest of SUPM Negeri Sorong can be assessed using a combination of AHP methods to determine the final weight of each criterion and alternative, and TOPSIS method to find out the best results of the best alternative. In addition can be seen the factors that affect the interest of alumni in the world of work, ie in terms of salary, interests, location, and workload.
- This research has resulted in trace interest of alumni with highest weight fall on Sawata KP alternative and get highest rank in alumni choice with 29% percentage on AHP calculation and 37% in TOPSIS calculation.

The results of the test using AHP and TOPSIS which is although not 100% accurate, but still can be acceptable in generating judgments that lead to better alternatives with factors that influence it, which can be used as a consideration of curriculum preparation and learning programs by the SUPM.

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