

The Application of Decision Support System for Job Vacancy Recommendation Using Analytical Hierarchy Process at Widya Kartika's Student Career Center

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Abstract. Every year, Widya Kartika University (UWIKU) graduates hundreds of students from various majors. Currently, the speed of graduates in obtaining employment is also one of the main performance indicators of higher education institutions. In addition, the involvement of industry partners through collaboration with universities is also the main thing. Observing this, UWIKU is committed to helping its graduates to get jobs faster by becoming a liaison between graduates and partners. A Decision Support System for recommended job vacancies was set up to solve this. The variables used as decision makers include the Grade Point Average (GPA), study program, study period, and student activities during study. The Analytical Hierarchy Process (AHP) method is considered to be able to overcome this. Through the results of analysis and calculations, the order of the weighting of the criteria was obtained as follows: with the largest eigenvalue 2.276923 for GPA and the smallest value 0.388278 for the study period. Based on the results of calculations and trials, the application can help graduates in finding jobs, as well as partners in finding prospective employees.

INTRODUCTION

Widya Kartika University (UWIKU) was one of the universities located in Surabaya. UWIKU has 3 faculties, namely Literature and Language Education, Economics, and Engineering. Each faculty has a number of study programs, including: Mandarin Language Education, English Literature, Accounting, Management, Informatics Engineering, Architecture, Civil Engineering, and Electrical Engineering.

Every year, UWIKU graduates hundreds of students from various majors. The problem that was often faced was the difficulty of finding work. Meanwhile, currently, the waiting time for graduates to get a job and the suitability of the field of work are also one of the main performance indicators of higher education institutions. In addition, the involvement of the company as an industrial partner through collaboration with universities is also the main thing.

Graduates with different academic backgrounds were often confused in determining the appropriate job. On the other hand, companies also need criteria and selection in obtaining the required employees. Factors that are usually taken into consideration are the Grade Point Average (GPA), period of study, activeness in organizations, and other abilities such as mastery of programming tools or foreign languages.

Observing this, UWIKU was committed to helping its graduates find jobs faster by becoming a liaison between graduates and companies through the Career Center. The importance of developing this career center was once written by [1]. His journal discusses the usefulness of career center systems in universities and institutions. By being aware of the previous research, a continuation of research on the Career Center was carried out at Widya Kartika University.

A Decision Support System for the search for recommended job vacancies has been established to address this issue. Variables used as decision makers include the Grade Point Average (GPA), study program, study period, and student activities during study. This student activity itself was divided into 3, among others: Reasoning Activities, Talent Interest Activities, and Service Activities.

The Analytical Hierarchy Process (AHP) method was considered capable of overcoming this. Research on the use of AHP in job determination has also been conducted before [2], but its application is only for a relatively small number of people. In addition, the criteria used in determining the work are also different from this study.

Through this research, graduates can be helped in finding jobs, according to their specifications. The system built through this research is also beneficial for companies that are industrial partners in finding employees more selectively.

LITERATURE REVIEW

Previous Research

Previous research was conducted by [2]. The journal discusses the application of AHP Topsis on employee recruitment at CV Techindo Global Solution. The systematic calculation of the research will be continued in this study but the criteria in calculating the AHP will certainly be different from this study.

Subsequent research has also been carried out by [3]. The journal discusses the stages of AHP that are implemented to determine new employees with the best criteria. The stages and planning in this research will be continued in this study, but the criteria in calculating AHP will certainly be different from this study.

The other research has also been conducted by [4]. The journal discusses the recommendation of job vacancies for job seekers using the AHP method. The systematic calculation and stages will be implemented in this study, but the criteria for calculating AHP will certainly be different from this study.

Other similar studies have also been conducted by [5]. The journal discusses the selection of workplaces that are in accordance with the AHP method. The stages of research and calculations will also be implemented in this study, but the criteria for calculating AHP will certainly be different from this study.

A study using a similar method was also conducted by [6]. The journal discusses determining the best employees using the AHP method. The systematic calculation of the research will be implemented in this study. This study will adjust to the criteria used and certainly different from previous research.

Analytical Hierarchy Process

AHP is a decision support system which was developed by [6] that AHP is a model that can describe the existing weighting criteria into a hierarchy. In the Analytical Hierarchy Process method, the following steps are carried out

1. Define the problem and determine the desired solution.

In this stage the writer tries to determine the problem that the writer will solve in a clear, detailed and easy to understand manner. From the existing problems the author tries to determine a solution that might be suitable for the problem. The solution to the problem may open more than one. This solution will be developed further in the next stage.

2. Create a hierarchical structure that begins with the main goal.

After compiling the main goal as the top level, a hierarchy level will be compiled below it, namely suitable criteria for considering or assessing the alternatives given by the author and determining these alternatives. Each criterion has a different intensity. The hierarchy continues with sub-criteria (if possible).

3. Create a pairwise comparison matrix that describes the influence of each element on the criteria at the level above it.

The matrix used is simple, has a strong position for the consistency framework, obtains other information that may be needed with all possible comparisons and is able to analyze the sensitivity of overall priorities for changes in considerations. The matrix approach reflects the dual aspects of priorities, namely dominating and being dominated. Comparisons are made based on the judgment of the decision maker by assessing the level of importance of an element compared to other elements. To start the pairwise comparison process, a criterion is chosen from the topmost level of the hierarchy, for example K and then from the lower level the elements to be compared, for example E1,E2,E3,E4,E5.

4. Define pairwise comparisons so that the total number of assessments is $n \times [(n-1)/2]$ pieces

The result of the comparison of each element will be a number from 1 to 9 which shows the comparison of the level of importance of an element. The results of the comparison are filled in the cells corresponding to the elements being compared. The pairwise comparison scale and its meaning introduced by Saaty can be seen below

5. Calculate the eigenvalues and test their consistency. If it is not consistent then the data collection is repeated.

6. Repeat steps 3,4, and 5 for all levels of the hierarchy

7. Calculate the eigenvectors of each pairwise comparison matrix which is the weight of each element for determination.

The calculation is done by adding up the values of each column of the matrix, dividing each value from the column by the total column in question to obtain a normalized matrix, and adding up the values from each row and dividing by the number of elements to get the average.

8. Check the consistency of the hierarchy.

As for what is measured in the Analytical Hierarchy Process is the consistency ratio by looking at the consistency index. The expected consistency is near perfect in order to produce a decision that is close to valid. Although it is difficult to achieve perfection, the expected consistency ratio is less than or equal to 10%

RESEARCH METHOD

The research process includes several stages, consists of:

1. Data Collection

The data was obtained through interviews with the Widya Kartika Career Center. Student data was obtained from Widya Kartika's ICT. Supporting theory is obtained through literature study.

2. Requirements Analysis

Based on the data obtained, the decision support system method that is most appropriate to the user's needs is determined.

3. System Design and Implementation

Based on the results of the analysis, a system design was made. The system design is the implementation of the design into a system built using a particular application. In addition, the decision support system method is also applied to the application.

4. System Testing and Evaluation

After the system is created, the next is system testing. System testing is carried out in order to obtain an evaluation for future system development

RESULT AND DISCUSSION

Calculation Main Criteria

As much as 9 points of value get from Widya Kartika's Student Career Center through discussion. This value can be changed at any time depending on the circumstances. That value was written at **Table 1**

TABLE 1. Main Criteria Value

| Main Criteria | Value |
|------------------|-------|
| GPA | 9 |
| Study Programs | 7 |
| Study Activities | 5 |
| Study Periods | 5 |

Step of calculation :

1. Converting the main criteria data (9 points Likert scale) to Saaty pairwise comparison

Changing the main criteria data was done by taking the value of the first criteria (eg L_i), the second criteria (eg L_j) and then reducing L_i by L_j . If the result of subtracting L_i with L_j was positive, then the formula for calculating the value of pairwise comparisons of i to j (S_{ij}) was at equation(1)

$$S_{ij} = (L_i - L_j) + 1 \tag{1}$$

Meanwhile, if the result of subtracting L_i with L_j was negative, the formula for calculating the value of pairwise comparison of i to j (S_{ij}) was at follows

$$S_{ij} = \frac{1}{|L_i - L_j| + 1} \tag{2}$$

By using the formulas before it can be seen that the pairwise comparisons for the main criteria were as follows at Table 2

TABLE 2 Pairwise Comparison Main Criteria

| | GPA | Study Programs | Study Activities | Study Periods |
|-----|-----|----------------|------------------|---------------|
| GPA | 1 | 3 | 5 | 5 |

| | | | | |
|-------------------------|------|------|----|----|
| Study Programs | 0.33 | 1 | 3 | 3 |
| Study Activities | 0.2 | 0.33 | 1 | 1 |
| Study Periods | 0.2 | 0.33 | 1 | 1 |
| Total | 1.73 | 4.67 | 10 | 10 |

2. Normalizing data and averaging data normalization to determine Priority Vector

Normalizing the data was by dividing each ij data by the number. It can be written as the following formula as follows:

$$Norm = \sum_j^n \left(\frac{S_{ij}}{J_j} \right) \quad (3)$$

Next for the priority vector was to evenly - average each - each line (average). It can be written as:

$$P_i = \frac{Norm}{n} \quad (4)$$

The following was a Priority Vector calculation for each row in the pairwise comparison in Table 3

TABLE 3 Main Criteria Normalization And Priority Vector

| | GPA | Study Programs | Study Activities | Study Periods | Priority Vector |
|-------------------------|------------|-----------------------|-------------------------|----------------------|------------------------|
| GPA | 0.58 | 0.64 | 0.5 | 0.5 | 0.55 |
| Study Programs | 0.19 | 0.21 | 0.3 | 0.3 | 0.25 |
| Study Activities | 0.12 | 0.07 | 0.1 | 0.1 | 0.09 |
| Study Periods | 0.12 | 0.07 | 0.1 | 0.1 | 0.09 |
| Total | 1 | 1 | 1 | 1 | 1 |

3. Calculation of Eigenvalues

The calculation of the eigenvalues can be done by multiplying the row matrix in the table that hasn't been normalized and the Priority Vector column. The calculation of the eigenvalues was in Table 4.

TABLE 4 Main Criteria Eigen Value

| Main Criteria | Eigen Value |
|----------------------|--------------------|
| GPA | 2.276923 |
| Study Programs | 1.01685 |
| Study Activities | 0.388278 |
| Study Periods | 0.388278 |

4. Determination of Consistency Ratio to determine whether the weight of the criteria was feasible to use

Determination of the consistency ratio can be determined by determining the Principal Eigen Value (Lamda max / Lmax) and Consistency Index. It can be written as

$$Lmax = \sum_{i=1, j=1}^{n,m} (P_i \times J_j), \quad \text{dimana } n = m \quad (5)$$

Meanwhile, if the CR value is > 10%, it means that the value is inconsistent and must be re-taken. Those can be written as

$$CR = \frac{CI}{RI} \quad (6)$$

The value of the Random Consistency Index (RI) is a constant value that refers to the number of criteria that are owned. RI table can be written at Table 5

TABLE 5 Random Consistency Index (RI)

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------|---|---|------|------|------|------|------|-----|------|------|
| R.I. | 0 | 0 | 0.52 | 0.89 | 1.11 | 1.25 | 1.35 | 1.4 | 1.45 | 1.49 |

Source from Thomas L. Saaty, 1994 (Saaty 1994)

The following is the calculation process along with the results of Lmax, CI and CR for capital criteria.

$$\begin{aligned} L_{max} &= 1.733333 \times 0.554945 + 4.666667 \times 0.251648 + 10 \times 0.096703 + 10 \times 0.096703 \\ &= 4.07033 \\ CI &= \text{constant}((4.07033-4)/(4-1)) \\ &= 0.023443 \\ CR &= 0.023443/0.89 \\ &= 2.63407\% \end{aligned}$$

Because the CR value <10% means that the pairwise comparison is consistent and the weights can be used.

Calculation Alternative Criteria

Table 6 displays Pairwise Alternative Criteria Table. This data was student data and get from Widya Kartika's ICT Center.

TABLE 6 Pairwise Alternative Criteria

| | 3113002 | 31113004 | 31113005 | 31113010 |
|-----------------|----------------|-----------------|-----------------|-----------------|
| 31113002 | 7 | 7 | 9 | 7 |
| 31113004 | 5 | 5 | 9 | 9 |
| 31113005 | 9 | 1 | 9 | 9 |
| 31113010 | 7 | 1 | 5 | 1 |
| Total | 28 | 14 | 32 | 26 |

Step by step :

1. Calculation of Criteria Weight

Proceed with calculating the Priority Vector Criteria

$$\begin{aligned} P1 &= ((7/28+7/14+9/32+7/26))/4 \\ &= 0.32512 \\ P2 &= ((5/28+5/14+9/32+9/26))/4 \\ &= 0.29078 \\ P3 &= ((9/28+1/14+9/32+9/26))/4 \\ &= 0.255065 \\ P4 &= ((7/28+1/14+5/32+1/26))/4 \\ &= 0.129035 \end{aligned}$$

The following was a Priority Vector calculation for each row in the pairwise comparison in Table 7

TABLE 7 Alternative Pairwise Comparison And Priority Vector

| | 3113002 | 31113004 | 31113005 | 31113010 | Priority Vector |
|-----------------|----------------|-----------------|-----------------|-----------------|------------------------|
| 31113002 | 0.25 | 0.5 | 0.28 | 0.27 | 0.33 |
| 31113004 | 0.18 | 0.36 | 0.28 | 0.35 | 0.29 |
| 31113005 | 0.32 | 0.07 | 0.28 | 0.35 | 0.26 |
| 31113010 | 0.25 | 0.07 | 0.16 | 0.04 | 0.13 |
| Total | 1 | 1 | 1 | 1 | 1 |

2. Determination of Decision Support System Results

Determination of the results of the decision support system is done by multiplying the matrix between the main criteria normalize data and the alternative criteria priority vector weights. That can be written at Table 8.

TABLE 8 Main Criteria Normalize Data With Alternative Criteria Priority Vector

| | 3113002 | 31113004 | 31113005 | 31113010 | Priority Vector |
|--|----------------|-----------------|-----------------|-----------------|------------------------|
|--|----------------|-----------------|-----------------|-----------------|------------------------|

| | | | | | |
|-----------------|------|------|-----|-----|------|
| 31113002 | 0.58 | 0.64 | 0.5 | 0.5 | 0.33 |
| 31113004 | 0.19 | 0.21 | 0.3 | 0.3 | 0.29 |
| 31113005 | 0.12 | 0.07 | 0.1 | 0.1 | 0.26 |
| 31113010 | 0.12 | 0.07 | 0.1 | 0.1 | 0.13 |
| Total | 1 | 1 | 1 | 1 | 1 |

From the results of this multiplication, there were results of this research in Table 9

TABLE 9 AHP results

| Student ID | AHP Value |
|-------------------|------------------|
| 31113002 | 0.57 |
| 31113004 | 0.24 |
| 31113005 | 0.10 |
| 31113010 | 0.10 |

AHP calculation was successful and the top were selected, student ID 31113002 with a result value of 0.57 as the recommended candidate for employees.

CONCLUSION

Based on the test results, several conclusions can be drawn as follows:

1. The Analytical Hierarchy Process (AHP) method can be used in determining prospective employees from graduates.
2. Applications that have been made were able to give student recommendation to company.
3. Alternative criteria for graduates was vary depending on the results they have achieved during their studies

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