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TOPSIS Method Implementation for Employee Performance Information System

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Abstract : Employee performance appraisal is among the responsibilities of human resources, to maintain the quality and performance of its employees. Satya Wacana Christian University (SWCU) has also implemented the system, especially for its non-academic employees. The Employee Assessment Process in SWCU was conducted by filling out an evaluation form manually, based on the evaluation from the supervisor. The manual assessment process takes a lot of time, due to the large number of employees need to be evaluated and the lack of objectivity in the assessment process. Hence, this research is conducted with a purpose to map out and implement a web-based performance assessment information system for the employees, which then can be used to assess those employees' performance using a computerized system. This research is conducted to design an information system of performance assessment by applying Technique for Others Reference by Similarity to Ideal Solution (TOPSIS) method so that the assessment process can be done more objectively, quickly, and more importantly, easily, especially for the multi-criteria assessment process.

Keywords: Employees performance assessment, non-academic employees, TOPSIS.

1. Introduction

Human resource management is an important factor for activity continuity in a company or organization. Employee performance appraisal is a part of human resource management, to maintain the quality and performance of its employees [1, 2]. The employee appraisal process is a company activity, in an attempt to obtain accurate information about the performance of its employees. Performance assessment is a method to measure employees' contributions to their company or organization. This is important since it determines the level of individual performance that is manifested in the completion of the tasks for which they are responsible [3].

Satya Wacana Christian University (SWCU) is a private university in the city of Salatiga, which always strives to improve the quality of its employees, both academic and non-academic. Based on a preliminary interview with the Department of Human Resources (HRD), it was discovered that SWCU had made efforts to improve the quality of the employees by conducting routine performance assessments. The assessment is done three times in a year. The first assessment is carried out in May, for the period from January to April. The second period of the assessment is from May to August, and the third is from September to December.

The Employee Assessment Process in Satya Wacana Christian University (SWCU) has been done by using Employee Performance Assessment List (Employee Implementation Evaluation List / DP3). Some assessment criteria have been used. The assessment is done by employees' direct supervisors, where they currently serve. The manual assessment process takes a lot of time. Moreover, the number of non-academic employees of SWCU is quite many, which is 434 people. This assessment is a very crucial process for the purpose of monthly evaluation of the employees' performances and determining their allowances.

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Answering the above question, this research is done to design an information system of performance assessment by applying Technique for Others Reference by Similarity to Ideal Solution (TOPSIS) method so that the assessment process can be done more objectively, quickly, and more importantly easily especially for the multi-criteria assessment process. The purpose of this study is to design and implement an information system that can assess the performance of employees at SWCU. While the limitations of the problem in this study include: (1) information systems built based on the web using Laravel framework, (2) the criteria used in accordance with DP3 forms, and (3) the design and application development in accordance with needs analysis, do not discuss the efficiency and effectiveness of implementing the system.

2. Literature Review

2.1. Related Work

Ritonga [4] designed and built a desktop based information system by using visual basic programming language, which is used to assess the performance of the employees in PT. Indofood Medan branch. It was done to help the management to take a decision in terms of employee assessment, which is then used as one of the considerations for the company to add or dismiss employees. The assessment process offered by the researcher was done by inspecting the administrative completeness, conducting written tests and interviews, as well as developing 6 assessment criteria so that every alternative was close to the most ideal solution. The research shows that TOPSIS method is appropriate to be used as employees' performances assessment in the company.

Setyadi [5] performed a research to create a decision making supporting system by using TOPSIS method to calculate the evaluation scores of the lecturers in the university level, which was made by using Visual Basic programming language. The system created in the research was started from lecturers' data processing and continued with the assessment process for each assessed criteria and then AHP process for those sub-criteria, which consisted of interest ratio, normalization matrix, to producing Eigen value from the assessed sub-criteria.

Those researchers motivated the author to conduct this research since TOPSIS method is proven to be applicable to be used to assess the employees' performances [4, 5]. In this research, TOPSIS is used to assess the employees' performances and to see the best performing employees in the Institution. The tool used in this research is Framework Laravel based web programing language.

2.2. TOPSIS Method

Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) is one of the multi-criteria decision-making methods first introduced by Yoon and Hwang in Marsono [6, 7]. TOPSIS is used to find the best alternative, which has the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution. Searching the closest distance using Euclidean distance to determine the relative proximity of an alternative with the optimal solution.

Positive ideal solutions are defined as the sum of all the best values that can be achieved for each attribute, while the ideal negative solution consists of all the worst values achieved for each attribute. TOPSIS considers both distances to positive ideal solutions and distance to negative ideal solutions by taking proximity relative to positive ideal solutions.

In general, as seen in Figure 1, the TOPSIS procedure is carried out as follows [7, 8]: a) create a decision matrix, b) construct a normalized decision matrix, c) calculate the weighted normalized decision matrix, d) determining the positive ideal solution matrix and the negative ideal solution matrix, e) determining the distance between the values of each alternative with positive ideal solution matrix and negative ideal solution matrix, and f) determine preference values for each alternative.

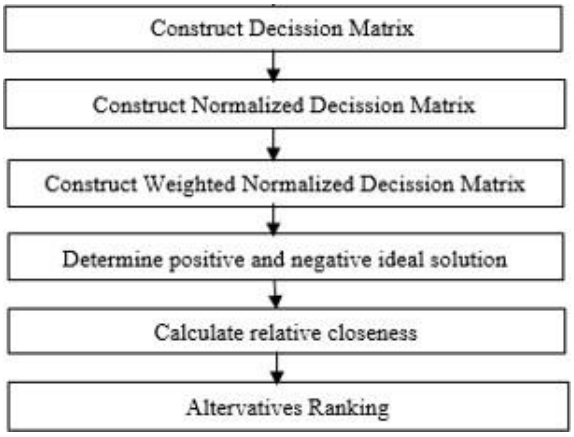


Fig. 1. TOPSIS Methodology [5]

The following below is an explanation of the steps using the TOPSIS method [7, 8].

Step 1. Create a Decision Matrix consisting of m alternatives and n criteria.

$$A_{mn}=\{a_{ij}/i\epsilon(1,2,\ldots,m)and\ j\epsilon(1,2,\ldots,n)\ \} \quad (1)$$

Step 2: Construct normalized decision matrix.

$$r_{ij}=x_{ij}/\sqrt{\sum_{j=1}^{J} x_{ij}^2} \quad (2)$$

where

j	: 1,2,3… J
i	: 1,2,3… n
r_{ij}	: normalized matrix
x_{ij}	: decision matrix

Step 3: Construct the weighted normalized decision matrix.

$$v_{ij} = w_i * r_{ij} \quad (3)$$

where

j : 1,2,3… J
i : 1,2,3… n

Step 4: Determine the positive ideal (PIS) and negative ideal solution (NIS)

$$A^* = \{v_1^*, v_2^*, \dots, v_n^*\} \text{ maximum values} \quad (4)$$

$$A^- = \{v_1^-, v_2^-, \dots, v_n^-\} \text{ minimum values} \quad (5)$$

where

$$v_i^* = \{\max(v_{ij}) \; if \; j \epsilon J; \min(v_{ij}) \; if j \; \epsilon J^-\}$$

$$v^- = \{\min(v_{ij}) \; if \; j \epsilon J; \max(v_{ij}) \; if j \; \epsilon J^-\}$$

Step 5: Calculate the separation measures of each alternative from PIS and NIS.

$$d_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2}, \quad (6)$$

$$d_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \quad (7)$$

where

j : 1,2,3… J

Sep 6: Calculate the relative closeness coefficient to the ideal solution:

$$CC_i = \frac{d_i^-}{d_i^* + d_i^-} \quad (8)$$

where

j : 1,2,3… J

Larger values (CC_i) indicate that the alternative is preferred.

2.3. Employee Performance Appraisal System

Performance appraisal is a process conducted by an organization to obtain accurate information about the performance of its employees. A good assessment produces measurable values in quantity, quality, number of attendance and so on [7, 9]. Other supporting factors include the opinions of colleagues or superiors such as cooperation, attitude, personality, self-adjustment and so on. With these assessment factors, the employee performance appraisal carried out can be truly objective.

The purpose of employee performance appraisals shown in Figure 2. Performance appraisals can be used to plan employee capacity building programs such as training provisions to increase their productivity. Performance appraisal can also be used as a basis for calculating rewards for improving employee welfare. Other purposes are for the promotion, transfer, dismissal of employee and improvement of relationship between staff and managers.

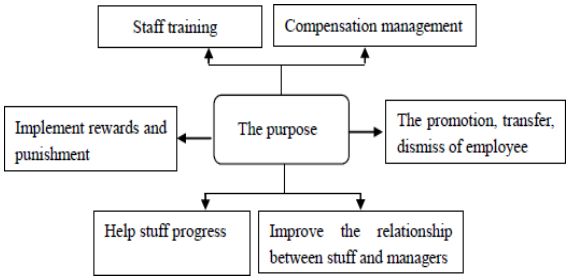


Fig. 2. The Goal of Employee Performance Appraisal [10]

Employee performance can be seen from the variables that affect their productivity. These include: output quantity, output quality, output period, attendance at work and cooperative attitude. These variables are the most commonly used, but they can be adjusted because each job has certain characteristics.

3. Research Methodology

There were five phases in the research, including: 1) Requirement analysis and data gathering, 2) System design, 3) Application or program design, 4) Implementation and testing as well as testing result analysis, and 5) research writing.

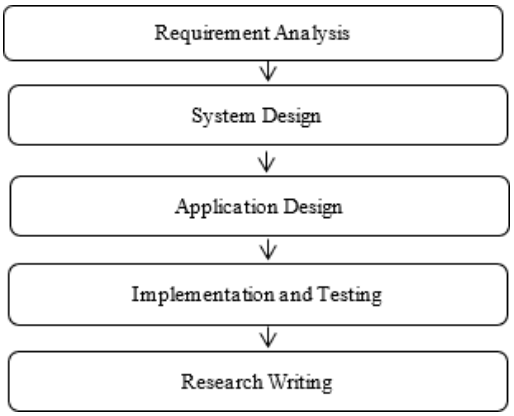


Fig. 3. Research Methodology

The data gathering method was done by performing direct interviews to the SWCU's HRD. Based on the interview results, the writer found that there was not any system used by SWCU to assess the performances of its non-academic employees. SWCU had already applied bio-matric attendance, but it was apart from the context of this research. The limitation of this research was the assessment of the employees' performances from their direct supervisors.

The employee performance assessment software was designed using prototyping method [11]. In prototyping method, software development is done in stages, by making a simple prototype first, and then developing it according to the needs of the

user (figure 4). The measurement of the software complexity is also conducted to produce the estimation of the resource requirements such as project work effort, project duration and speed of delivery [12].

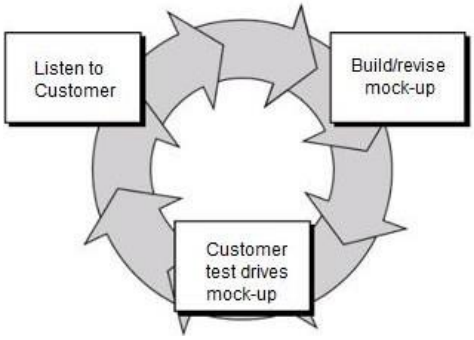


Fig. 4. Software Development Method [11]

4. Result and Discussion

4.1. System Design

The employee performance assessment information system in this research was designed by using Unified Modelling Language (UML) Diagram. UML diagram consisted of use case diagram, activity diagram and class diagram. The explanation of each of the diagram is portrayed in the following graphs.

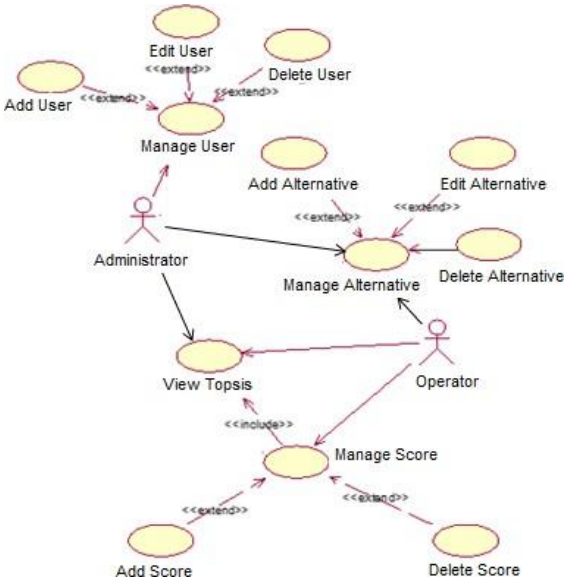


Fig. 5. Use Case Diagram

Use Case Diagram used in the system design can be seen in Figure 5. In the Use Case above, there are two actors, called operator and administrator. The operator actor had the access right to manage the alternative, in this case the alternative was the employees who were going to be assessed. Apart from that, the operator actor also had the access right to manage their marks, which were then used in TOPSIS calculation. The second actor was administrator, who also had the similar access rights with the operator. However, this second actor also had additional access right, which was adding users who would then have the right access as operators or administrators.

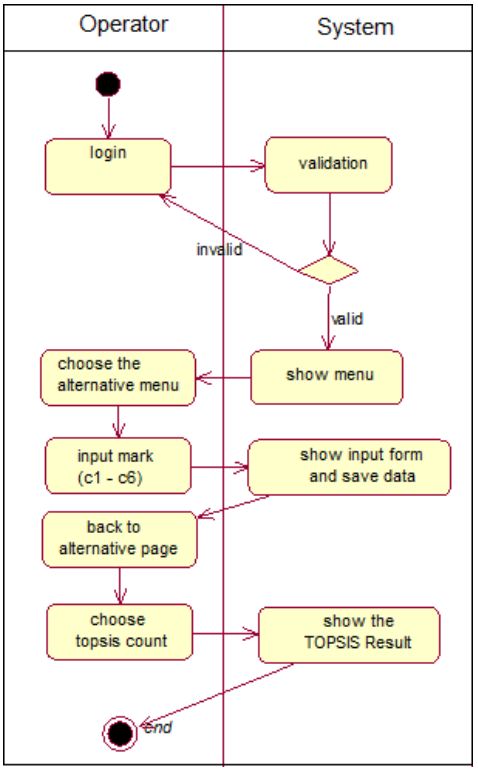


Fig. 6. Activity Diagram to Calculate TOPSIS

Figure 6 is the activity diagram to calculate TOPSIS. TOPSIS calculation was started with the login process and then, there were several alternative menus, in which in every alternative there were button c1 to c6, representing the five criteria that were used to calculate TOPSIS. When pushing those buttons, the user would be directed to the assessment forms and after all forms were filled in, the user could select the count button so that the user would go to the TOPSIS calculation page that consisted of several tabs of TOPSIS calculation steps.

Figure 7 is a class diagram used in this scoring system. Class diagrams describe the structure of information systems, with model classes, databases and controller classes that are used to process model and view classes, which are the appearance of this system. From the class diagram, there is a model_ criteria class which functions to process the assessment criteria, model_evaluation class to process stored values, and model_ternative classes to process alternative data. Furthermore, the system has three controller classes namely the criteria controller, controller evaluation and AlterController.

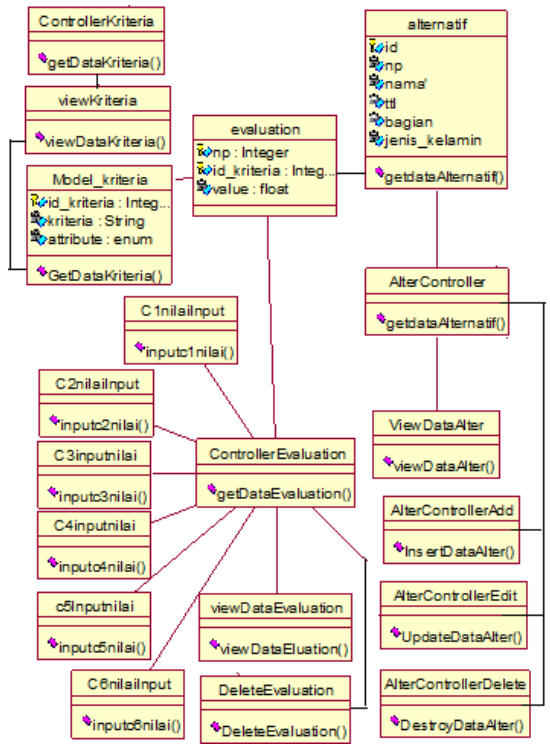


Fig. 7. Class Diagram

4.2. Developing the Application

The result of this research was an information system that could assess the performances of the non-academic employees in SWCU by using TOPSIS method. In the employee list page, the user could manage the data by using edit, update, and delete functions. Most importantly, the user could enter the marks of the employees' performances. The input form can be seen in Figure 8.

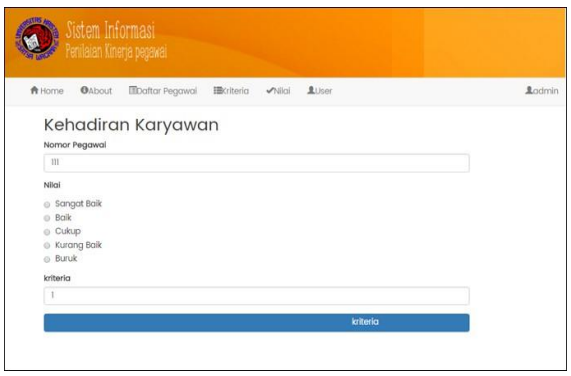
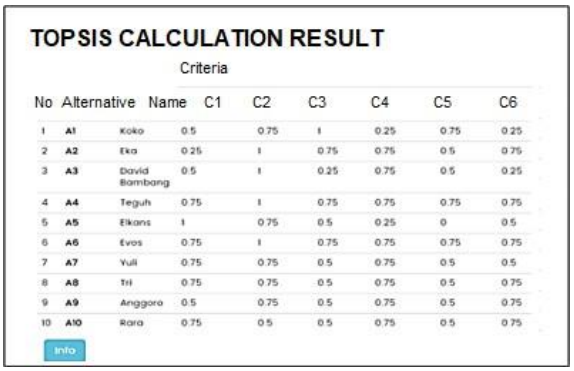


Fig. 8. Mark Input Form

All criteria in the dropdown input of the mark had to be filled so that the TOPSIS calculation could be accurate. Those criteria were the ones used in the employees' performance assessment in SWCU and were included in DP3 form. The results of the mark inputs could be seen in the mark page, which could also be used to check the result of the inputs if there were some errors.

The list of the inputted mark would be used to calculate TOPSIS. When pushing count/calculate the TOPSIS button, the user would be directed to a new page, as shown in Figure 9.



TOPSIS CALCULATION RESULT

Criteria

No	Alternative	Name	C1	C2	C3	C4	C5	C6
1	A1	Koko	0.5	0.75	1	0.25	0.75	0.25
2	A2	Eka	0.25	1	0.75	0.75	0.5	0.75
3	A3	David Bambang	0.5	1	0.25	0.75	0.5	0.25
4	A4	Teguh	0.75	1	0.75	0.75	0.75	0.75
5	A5	Elkans	1	0.75	0.5	0.25	0	0.5
6	A6	Evos	0.75	1	0.75	0.75	0.75	0.75
7	A7	Yuli	0.75	0.75	0.5	0.75	0.5	0.5
8	A8	Tri	0.75	0.75	0.5	0.75	0.5	0.75
9	A9	Anggoro	0.5	0.75	0.5	0.75	0.5	0.75
10	A10	Rara	0.75	0.5	0.5	0.75	0.5	0.75

Info

Fig. 9. TOPSIS Page

Next, TOPSIS calculation can be seen in the following pseudocode:

Pseudocode TOPSIS

```
1. foreach($kriteria as $record){
2.  $normal=round(($krit[$record]/
      sqrt($kuadrat[$record])),4);
3.        echo "<td>".$normal."</td>";
4.  }
5.  foreach($kriteria as $record){
6.  $y[$record][$i-1]=round(($krit[$record]/
      sqrt($kuadrat
7.        [$record])),4)  *$bobot[$record];
8.  }
9. $yplus=array();
10.  foreach($kriteria as $record){
11.  $yplus[$record]=($atribut[$record]==
      'benefit'?max
12.     ($y[$record]):min($y[$record]));
13. }
14. $ymin=array();
15. foreach($kriteria as $record){
16. $ymin[$record]=
17.  $atribut[$record]=='cost'?max($y[$record])
      :min($y[$record]);
18. }
19. $dplus=array();
20. foreach($kriteria as $record){
21.    if(!isset($dplus[$i-1]))  $dplus[$i-1]=0;
22.   $dplus[$i-1]+=pow($yplus[$record]-
      $y[$record][$i-1],2);
23.   }
24. $jp= round(sqrt($dplus[$i-1]),6);
25. }
26. $dmin=array();
27.   foreach($kriteria as $record){
28. if(!isset($dmin[$i-1]))$dmin[$i-1]=0;
29. $dmin[$i-1]+=pow($ymin[$record]-$y[$record][$i
      -1],2);
30. }
31. $jm=round(sqrt($dmin[$i-1]),6);
32. }
33. foreach($kriteria as $record){
34. $V[$i]=$dmin[$i-1]/($dmin[$i-1]+$dplus[$i-1]);
35. }
```

Based on the above pseudocodes, the steps of calculating TOPSIS are as follow:

1. Creating evaluation matrix by performing join table in the database.
2. Creating normalized decision matrix, which is the result of evaluation value divided by the number of square root of the value in the

respective criteria.

3. Counting the normalized weighted decision matrix gained from the result of the normalized matrix times the weight per criteria.
4. Deciding the positive ideal solution matrix gained from finding the biggest evaluation value in every criterion, and also negative ideal solution matrix gained from the smallest evaluation value in every criterion.
5. Finding the value of the positive and negative distance of each alternative by counting the square root of the value of positive ideal matrix value minus evaluation value per criteria of each alternative.
6. Finding the preference value, in which the bigger preference value shows the better working performance.

The preference value is the final value of the TOPSIS, which can be used to assess the employees' working performances. The result can be used to rank, for example finding the best 10 employees as shown in Figure 10.

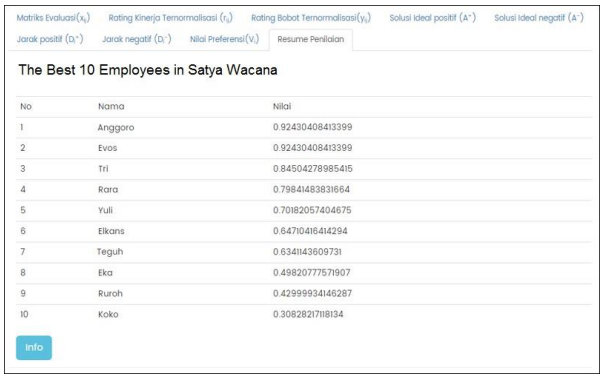


Fig. 10. *Assessment* Resume.

5. Conclusion

Based on the result of the research, it can be concluded that the information system developed in this research can accommodate and manage the data from DP3 well, which incorporates all the existing criteria. The use of the TOPSIS method in calculating the working performance enable the institution to decide the score of every employee easily. This information system also makes the process of creating employee performance evaluation quicker.

The use of information system in the employees' performance assesment is expected to help SWCU to evaluate its staff in the univeristy level in general and in the working unit levels specially. It is suggested for the future researches to integrate this system with the biometrix attendance that has already been applied in SWCU. The assesment resume can also be developed further based on the needs of the university.

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