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Decision Support System for Employee Performance Evaluation with Promethe Method.
Case Study: Faculty of Engineering, Pancasila University

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Abstract

High competent human resources can support the level of employee performance. By conducting performance evaluation assessments it will be known the achievements of each employee. Assessment of employee performance evaluation carried out by the Faculty of Engineering, University of Pancasila uses criteria of diligence, teamwork, sincerity to work, skills, initiative, independence and attendance. The weights of criteria still determined by the Faculty authority. In this study, the authors used the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) to assist in making employee performance evaluation decisions, so that it can be seen which employees get the reward with good performance. There are six stages of the ranking including determine criteria and its weights, calculating the values of the requirements for each employee, preference value calculation between alternatives, calculating the value for the index, calculating entering flow, leaving flod and net flow. The data used is in the form of employee performance evaluation data that have range of 5 years consist of 16 samples taken from employee data from Faculty of Engineering, University of Pancasila. The calculation have been made using this six stages of the PROMETHEE method and after evaluation using precision approach have performance result of 96,364% accuracy compared with the conventional method.

I. INTRODUCTION

The position of the use of information technology is very important, in line with the advancement of science and technology today. When it is used for the smooth operation of the enterprise or as a reference to assist in decision-making in acquiring or obtaining specific data and its realization. It is split into two sections of education management, namely the academic and the general section, where human resources are handled by the general section. The efficiency of human capital is one of the supporting factors for increasing the productivity of the performance of one of the management of education. Human beings are now beginning to build a mechanism that can help find the best solution to a dilemma, namely a decision support system (DSS) [5]. There are options, parameters, and weights in the decision support framework that are used to assess the best solution. Therefore, highly qualified human resources will help the standard of success, the accomplishments of each employee can be known by performing performance assessment reviews. This performance assessment of employees includes requirements for diligence, teamwork, job integrity, skills, initiative, independently and attendance. An alternative is used to facilitate decision making in an educational institution by using the Choice Rating Organization Approach for Enrichment Assessment (PROMETHEE) method [3]. In order to obtain solutions or outcomes in the form of Leaving Flow, Entering Flow and Net Flow rating, this approach is used to evaluate and produce decisions from many alternatives.

II. RELATED WORKS/LITERATURE REVIEW (OPTIONAL)

There are many methods for employee evaluation. There are fuzzy approaches combining with more conventional methods used to get more good result. Ahmed et al [7] usig fuzzy logic for determining the weight of criteria used for

evaluation which is determining the performance indices of employees considering their respective fulfillment in various qualitative and quantitative evaluation criteria and then selecting the best employee who has highest performance index comparing all the indices. Rahmati et al apply a fuzzy approach [6] to both the AHP and TOPSIS methods which have often been used.

PROMETHEE it self have been used for varios problems. In manufacturing, it used to help decision making - and four real-life situations of the manufacturing situation have been tested[8], sustainability assessment of large-scale composting technologies which are six composting systems, including open, enclosed and reactor technology, were evaluated in terms of environmental, financial/economic, social and technical criteria [10], failure mode and effect analysis [11] and Preference modeling experiment [12]. It also has been used for comparison and ranking in industrial enterprises [9]. The procedure is based on enterprise's competences.

In this research, PROMETHEE method will be used to calculate employee ranking which the criteria based on Assesment Form issued by Faculty of Engineering Pancasila University.

III. METHODS

A method of deciding the order (priority) in multicriteria analysis is the Preference Rating Organization Method For Enrichment Assessment (PROMETHEE). Simplicity, clarity and stability are the principal issue. The assumption that the standards used in PROMETHEE are dominant is the use of ideals in relationships that are outranked. The key advantage of the PROMETHEE approach is that it is very simple and easy for decision makers to grasp any possible extension. In the form of a basic multi-criteria table, PROMETHE gives users the ability to use data directly. Furthermore, PROMETHEE has the potential to manage several comparisons, without constraint, the decision-maker only determines its own scale, indicating its priority and preference for each criterion by concentrating on importance, without considering the measurement method [1][2][3]. The PROMETHEE methodology is part of the Multi Criteria Decision Making (MCDM) problem solving category or multiple decision-making criteria, which is a very important discipline in making decisions on a problem with more than one criterion (multicriteria).

PROMETHEE belongs to a family of methods of outranking that involve two phases: [2] [4]
1. Create superior relationships with K, where K is a set of alternatives.
2. The use of this relationship responds to the optimization criteria in the multi-criteria problem paradigm.

The importance of the overriding relationship in the first stage is based on the consideration of the superiority of each criterion. The preference index is calculated and superior values are graphically displayed on the basis of the decision-preferences maker's. The steps for the PROMETHEE method calculation are as follows [1][3]:
1. Determine the conditions or factors used and the weights
2. Calculating the values of the requirements for each employee
3. Preference value calculation between alternatives.
   A contrast between one alternative and another is made at this point. With the provision of.

$$H(d) = \begin{cases} 0 \ if \ d \ \leq 0 \\ 1 \ if \ d \ > 0 \end{cases}$$

The formula for the preference value calculation is

$$d = X_1 - X_2$$

$$H(d) = \begin{cases} 0 \ if \ d \ \leq 0 \\ 1 \ if \ d \ > 0 \end{cases}$$

4. Calculates the value for the index
   Multi Criteria Choice Index calculation. The formula for the multi-criteria preference index value calculation is:

$$Y = \frac{1}{k} \ (d_1 + d_2 + d_3 + \cdots d_n)$$

5. The Entering Flow and Leaving Flow Calculation.

Calculating Flow Leaving. Leaving Flow, in the Promethee method that uses partial sequences, is used to evaluate the priority order.
The Leaving Flow calculating formula is

$$\varphi^+ = \frac{1}{k-1}(y_{11} + y_{12} + y_{13} + \cdots y_n)$$

The Entering Flow Calculation. The Entering Flow calculation is often used in addition to Leaving Flow to evaluate the priority order in the Promethee method that utilizes partial order.
The Entering Flow estimation formula is

$$\varphi^- = \frac{1}{k-1}(y_{11} + y_{21} + y_{31} + \cdots y_n)$$

6. Calculating Net Flow.
   Used to produce the final decision determining the sequence in solving the problem so as to produce a complete sequence.
   The formula for calculating net flow is

$$\varphi = \varphi^+ - \varphi^-$$

7. The results of rankings
   After the PROMETHEE method stages finish, next step is to evaluating the precision and accuration of the result. The evaluation is using Precision approach. The formula for this step is

$$Precision = \frac{TP}{TP + FP} * 100\%$$

IV. RESULTS

The steps in the PROMETHEE method calculation are as follows:

1. Determine the conditions or factors used and the weights
   Based on Assesment Form issued by Faculty of Engineering Pancasila University, the criteria and weights used to determine the assessment of employee performance are as follows:
   - Diligence with a 10% weight .
   - Teamwork for a 15% weight .
   - Job Integrity to work for a 20% weight .
   - Skills with a 15% weight .
   - Initiative with a 15% weight.
   - Independently with a 10% weight .
   - Attendance with a 15% weight

2. Calculating criteria value of each employee times weights. We used 16 samples of employees at Engineering Faculty of Universitas Pancasila. These employees named as X1 .. X16
   In the every year calculation, each weight in each criteria times the scores of each employee. If number of criteria is n, then the formula of score of each employee is:

$$ES = \sum_{i=1}^{n} N_i \times B_i$$

ES = Total Employee Score
N = Employee Score per criteria
B = Weight per criteria
Calculating the values of the requirements for each employee

Table 1.
Employee Identity

Employee Indentity	Employee Score (ES)				
	First Year	**Second Year**	**Third Year**	**Fourth Year**	**Fifth Year**
X1	73,75	80,95	84,85	84,85	85,05
X2	71,4	80,5	92,5	92,5	87,25
...	…	…	…	…	…
X16	77,75	84	88,5	88,5	81,25

3. Preference value calculation between alternatives to get index value. A contrast between one alternative and another is made at this point. The seven criteria write as f1 .. f7

Table 2.
The Criteria Alternative

Criteria		Alternative			
		X1	**X2**	**...**	**X16**
f1( )	**First Year**	9	9	…	8
	...	…	…	…	…
	Fifth Year	9,6	8,8	…	8,5
...	**...**	…	…	…	…
f7( )	**First Year**	5,25	0,9	…	12,75
	...	11,7	9	…	15
	Fifth Year	2,4	11,25	…	11,25

4. Calculating the importance of the index. Here we computed the index of differences between two employees every year

Table 3.
The Index Differences Between Two Employes

Year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Index (X1,X2) =	-1,1428571	-0,2772727	-0,3318182	-0,3318182	-
Index (X1,X3) =	0,33571429	0,04090909	-0,6954545	-0,6954545	-0,1692308
Index (X1,X4) =	-0,5714286	-0,2772727	-0,3318182	-0,3318182	0,29230769
...	…	…	…	…	…
Index(X16,X15)=	-0,2571429	0,16363636	-0,05	-0,05	-0,0718846

5. Calculating the Entering flow and leaving flow. We compare each empoyee with another employee to get the values

Table 4.
The Entering Flow and Leaving Flow

	...	**X12**	**X13**	**...**	**X16**	**Leaving Flow**	**Entering Flow**
X1	…	0,427807692	-0,144269231	…	-0,454269231	**0,429269**	**-0,429269231**
X3	…	0,59703842	0,024961538	…	0,285038462	**2,629269**	**-2,629269231**
...	…	…	…	…	…	**...**	**...**
X16	…	0,882076923	0,31	…	0	**6,334769**	**-4,421923077**

Then we calulate the Netflow each employee every year where Netflow = Leaving Flow – Entering Flow.

Table 5.
The Netflow Each Employees

Year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Net Flow X1	-1,5142857	2,12727273	-6,3545455	-6,3545455	0,85853846
Net Flow X2	14,4857143	8,40909091	0,83636364	0,83636364	5,25853846
...	...	...	...	...	...
Net Flow X16	6,48571429	8,40909091	0,83636364	0,83636364	-6,7414615

6. The rangking results. From the result of calculating netflow above, we arrange the ranking of the employees sorted from biggest netflow value which is considered has the biggest ranking

Table 6.
The Rangking Results

Number	Alternative					Net Flow				
	First Year	Second Year	Third Year	Fourth Year	Fifth Year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
1	X2	X2	X3	X3	X16	14,48571429	8,409090909	9,109090909	9,109090909	10,75669231
2	X7	X4	X11	X11	X7	6,728571429	8,409090909	5,645454545	5,645454545	9,442461538
3	X4	X11	X7	X7	X3	6,485714286	4,240909091	1,609090909	1,609090909	5,258538462
4	X6	X7	X2	X2	X13	2,085714286	3,109090909	0,836363636	0,836363636	4,609538462
5	X1	X10	X4	X4	X10	-1,514285714	2,381818182	0,836363636	0,836363636	3,994461538
6	X3	X1	X8	X8	X6	-6,214285714	2,127272727	-0,177272727	-0,177272727	2,727538462
7	X5	X3	X12	X12	X1	-22,05714286	1,409090909	-1,336363636	-1,336363636	0,858538462
8		X8	X9	X9	X15	-0,377272727	-2,259090909	-2,259090909	-2,508461538
9		X9	X10	X10	X14		-0,95	-2,504545455	-2,504545455	-4,424461538
10		X6	X6	X6	X9	-1,468181818	-5,404545455	-5,404545455	-6,716461538
11		X5	X1	X1	X4	-27,29090909	-6,354545455	-6,354545455	-6,741461538
12					X8					-6,992461538
13					X12					-10,26446154

After the PROMETHEE method calculation steps have been completed, an assessment will be carried out to measure the degree of accuracy and precision of the method used. The evaluation of the average degree of precision using the PROMOTHEE method is as follows:

Table 7.
The Evaluation of The Average Degree of Precision

Year	Accuracy [%]
First Year	100
Second Year	81.82
Third Year	100
Fourth Year	100
Fifth Year	100
Average Accuracy	
96.364	

V. Conclusions

After being analyzed using the PROMETHEE method, it can be concluded as follows:
-   PROMERTHEE in the end can provide answers to the evaluation of employee performance evaluation of seven criteria, diligence, teamwork, job integrity, skills, initiative, independently and attendance.
-   The data processing accuracy rate using the PROMETHEE method from year one to year five is 96.36 percent.

In the future works we will use fuzzy method to adjust the weights of the criteria so we can get more objective ranking.

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