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Selection of Outstanding Lecturers Using the AHP and Promethee Methods

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ABSTRACT

National University is the oldest private university in Jakarta and second in Indonesia, the University was founded on October 15, 1949. At this University there are several bureaus to take care of various university needs, one of which is the human resources bureau. Human resources bureau is a bureau that regulates various human resources available at the National University, including lecturers and other employees. In this study, every lecturer who teaches at the National University is carried out assessment and to see which lecturer has the most achievement compared to the others, making it easier for the campus, especially the human resource bureau to conduct evaluations that are useful for improving the quality of teaching provided by lecturers who teaches on this campus. Then it can also help the campus to give rewards to outstanding lecturers so that they can further improve their abilities. In determining this outstanding lecturer, several objective criteria are needed. Research in this application uses the AHP method and the PROMETHEE method. Meanwhile, to operate this application, this application will be based on the website..

1. Introduction

National University is the oldest tertiary institution in Jakarta. National University was established on October 15, 1949. After all this time the university was established there have been many developments that have occurred, ranging from facilities to tablespoons contained therein. Now at this university there are already many bureaus that handle problems in accordance with the duties of each of the bureaus, one of which is the HR bureau that has the task of managing human resources (HR) ranging from lecturers to employees working at national universities.

The Human Resources Bureau at the National University has also been neatly arranged according to the chart on the National University website. The human resources bureau is led by a bureau chief, then accompanied by a bureau deputy head, and subsequently there are also two heads, namely the HR administrative division and the HR development division, which has several staff that help to complete certain tasks in accordance with the stated jobdesk. The lecturer is one of the people contained in

human resources administration bureau. The lecturer is assigned to deliver learning material to students, so that students can understand the lessons being delivered by lecturers who are in charge of these subjects. The selection of the best lecturers is a good thing for universities and human resources bureaus. Because the selection of the best lecturers can help the work of the human resources bureau to place lecturers according to their expertise and abilities and can help to provide results to leaders at the National University regarding the human resources they have especially lecturers. Because of these problems the authors designed research with the theme of decision support systems in selecting the best lecturers at the National University.

In SPK objective criteria are needed. In seeing which lecturer is best based on the National University's Human Resources Bureau, the writer uses the AHP and Promethee methods for this. This assessment is based on criteria, these criteria include Job Attendance, Employment Contracts, Academic

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Position and Lecturer Certification. Which of these evaluation criteria is found at the National University HR Department. It is expected that this research can be used as an indicator of the best lecturer ratings in a certain period and also build the enthusiasm of other lecturers to make the quality of learning and teaching delivered to students improve and even better in the future. So that it can make students better understand more about learning in the courses that are in charge of the lecturer concerned.

2. Study of Literature

2.1. Decision Support System

Decision support systems are used to facilitate decision making in uncertain situations, where it is difficult to determine exactly what kind of decision should be made.

Decision support systems are usually used to facilitate the solution of a problem and evaluate an opportunity. In matters of helping management in carrying out work that is not too structured with unclear criteria SPK is the right system. Whereas in the optimization of decision making, but providing an interactive information that makes it easy in making decisions and using models that are already available is not appropriate to use this decision support system.

2.2. Analytical Hierarchy Process (AHP)

AHP is a methodology that basically can solve problems that are complex and less structured into its components, AHP has the ability to use quantitative and qualitative factors in making decisions for individuals and groups.

Steps in using this method:

a. Define the problem
b. Make element priority
c. Sitesis
d. Measure consistency
e. Calculate Consistency Index (CI)

use the formula:

$CI = (\lambda \max - n) / n - 1$

where n = the number of elements

λmaks = maximum eigenvalue of pairwise comparisons matrix

f. Calculate the Value of Consistency Ratio (CR)

use the formula:

$CR = CI / RI$

where CR = Consistency Ratio,
CI = Consistensy Index,
RI = Random Index.

g. Re-Check Consistency Hierarchy Value

Where the value exceeds 10%, then the data assessment must be improved again. But if the consistency ratio (CI / IR) is less or equal to 0.1, (CR <0.1) the result of the calculation is declared correct.

2.3. Preference Ranking Organization Method for Enrichment Evaluation (Promethee)

PROMETHEE is one of the priority determining methods in multi-criteria analysis. The criteria used are values in outranking relationships. This method works using realtime data in the form of multi-criteria tables. The Promethe method has the ability to handle more than one comparison, and the decision maker only defines the size, indicates the priorities and preferences for each criterion with a focus on values, and ignores the calculation method. The criteria and weights used from each criterion are processed to determine the selection of alternatives whose results are sequentially based on priority. The function of this method can be used as a method in making decisions for the selection of locations, human resources, marketing and other fields that use alternative elections. This method has two phases namely building relationships from a set of alternatives and exploitation that provides optimal criteria answers in multi-criteria problems. In the first phase, the value

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of the out-ranking relationship is based on the consideration of the dominance of each criterion. For the preference index the outranking value is determined based on the preferences of the system.

2.4. Human Resources

Human resource management aims to provide work units that are effective in achieving goals. And in achieving that goal, a study of human resource management will show what it should be like the organization obtains, uses, develops, evaluates, or maintains a large number of quality employees.Human resources must be able to handle the problems of employees, need, employees, managers and other workers in order to help the activities of the company in order to achieve certain objectives. The human resources department unit (HRD) handles the human resource. Management in human resources is a procedure whose purpose is to supply the right people and be placed in positions and positions that are appropriate to the organization when the organization needs it.

3. Research methodology

3.1. Data collection

At this stage the researcher will collect data related to the research being carried out. Among them in the form of criteria and alternative criteria which will later become the final result of this application. All data at this stage is obtained from the results of questionnaires that have been filled out and also uses data from the Bureau of Human Resources at the National University.

3.2. System Requirements Analysis

a. Hardware

The hardware used in this application consists of input, data processing and output units. In the application for selecting the best lecturers based on this website, it uses portable computer components with the following specifications:

a. Axioo Neon RNE laptop
b. Ram 4 Gigabytes
c. Processor: Intel Core i3-2350M

b. Software

The software used in the process of making this web-based lecturer selection application includes:

a. Windows 8.1 Pro N 32-Bit as an operating system.
b. XAMPP Control Panel as a development application based on PHP and MySQL database.
c. Sublime Text as a text editor.
d. Google Chrome as a web browser application.

3.3. System Design

The system that is made is based on the website platform and uses the PHP and Html programming languages while the database uses MySql, for website design that will be calculated later on this website. In this study will practice the results of the analysis directly which aims to test the accuracy of the manual calculation process and by using the program. The steps taken to design this system can be illustrated by flowcharts or diagrams of research stages, methodsAHP and Promethee methods.

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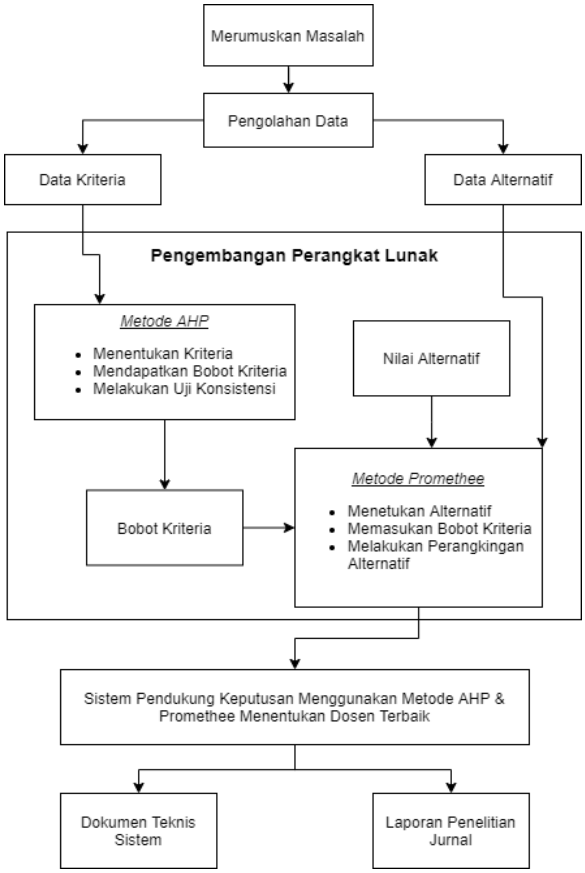

Fig 1. Flowchart Research Stages

In the initial stage, the process of gathering from the Human Resources Bureau regarding the points contained in which human resource bureau can be used as criteria data. Then the questionnaire was distributed to determine the importance of each criterion. In addition, the process of collecting references starting from papers, articles, journals, papers, or pages on the internet regarding the selection of the best lecturers, SPK, AHP method, PROMETHEE method and other references that aim to support the achievement of research objectives. After the data is collected, an analysis is carried out to determine the input, output, user needs and functional needs of the best lecturer selection support system. Furthermore, making data modeling and process modeling, and the algorithm making process is also carried out for each type of preference criteria. The system that has been made a model will then be implemented into the application using PHP programming and MySQL databases. Then as the final stage, testing the system has been made to look for errors so they can be corrected. This test is carried out so that the system matches what is desired at the time of making this application.

4. Results and Discussion

4.1. AHP and Promethee Analysis into the System

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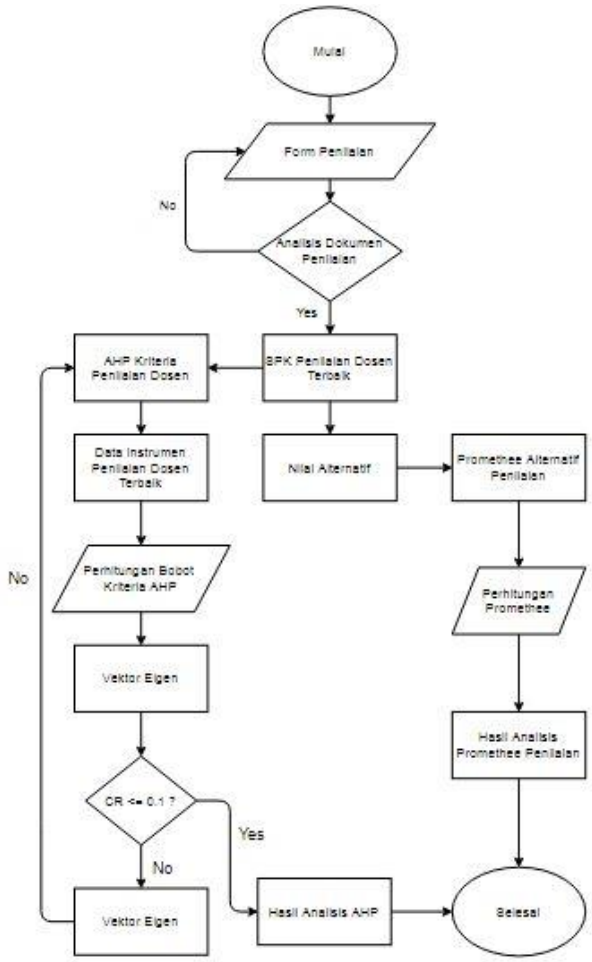

Fig 2 AHP and PROMETHEE Flowcharts Selection of the Best Lecturers

Based on the flowchart above that the AHP method is used in calculating the criteria weights. The steps are first, the user inputs the value of the criteria comparison based on the results of the questionnaire, then a preference comparison between the criteria will result in a pairwise comparison matrix. Then do the eigenvector search and check the consistency of the eigenvector. Consistency checking will produce a consistency ratio (CR). If (CR) $\leq$ 0.1 then the eigenvector is consistent and the criterion weight value is the eigenvector. If (CR)> 0.1 then the eigenvector is inconsistent then the input process of the criterion comparison value needs to be repeated. While the Promethee method will be used to rank the best alternative lecturers. The step is the user will enter an alternative value for each criterion. Then each value will be multiplied by the criteria weight. Then the preference value, preference index and ranking process will be determined by calculating the preference direction. Calculation of the preference direction is done by calculating the value of leavingflow and enteringflow for partial ranking, and calculating netflow for full ranking. Ranking of alternative final results is done by sorting netflow from the largest to the smallest.

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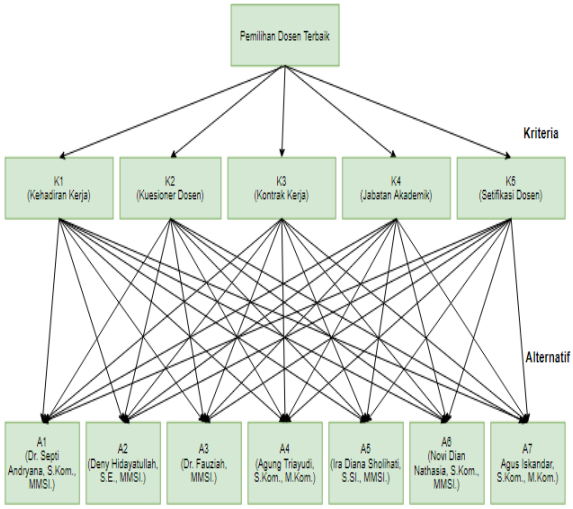

Fig 3. Hierarchical Structure of AHP Method and Promethee Selection of Best Lecturers

Based on the picture above there are 5 criteria and 7 alternatives that are used as consideration in determining the best lecturer.

Criteria in this assessment include:

a. Work attendance
   Lecturers who have the most work attendance will be prioritized.
b. Lecturer Questionnaire
   Lecturers with questionnaire results filled out by students and get high grades will be prioritized.
c. Employment contract
   Lecturers with long work contracts at the university will be prioritized.
d. Academic Position
   Lecturers with strategic and important academic positions for universities will be prioritized.
e. Lecturer Certification
   Lecturers with many certifications and are well accredited will be prioritized.

Explanation of the criteria in this application are:

Table 1 Keriteria Table

Code	Explanation	Criteria Name
K1	Keriteria 1	Work attendance
K2	Keriteria 2	Lecturer Questionnaire
K3	Keriteria 3	Employment contract
K4	Keriteria 4	Academic Position
K5	Keriteria 5	Lecturer Certification

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While the alternatives in this study were initialized as follows:

1. A1 = Alternative 1
2. A2 = Alternative 2
3. A3 = Alternative 3
4. A4 = Alternative 4
5. A5 = Alternative 5
6. A6 = Alternative 6
7. A7 = Alternative 7

4.2. Calculation of AHP Method

Calculation of criteria weights using the AHP method based on the completed assessments is as follows:

Table 2
Assessment Criteria

Code	Criteria Name	Min Max	Preference Type	Q	P.
K1	Work attendance	Maximization	2	1	5
K2	Lecturer Questionnaire	Maximization	2	1	5
K3	Employment contract	Maximization	3	5	5
K4	Academic Position	Maximization	3	5	5
K5	Lecturer Certification	Maximization	2	1	5

The steps in calculating the weighting of criteria values using AHP are:

a. Enter a comparison assessment of each criterion according to the questionnaire that refers to the matrix comparison scale, as follows in table 3.

Table 3
Comparison of Criteria

Code	K1	K2	K3	K4	K5
K1	1	1	1	4	1
K2	1	1	1/2	4	1
K3	1	2	1	1	1/2
K4	1/4	1/4	1	1	1/2
K5	1	1	2	2	1

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b. Minimize the value of each column of the comparison matrix and add up each column of the matrix, following in table 4.

Table 4
Comparison Decimal Matrix Criteria

Code	K1	K2	K3	K4	K5
K1	1	1	1	4	1
K2	1	1	0.5	4	1
K3	1	2	1	1	0.5
K4	0.25	0.25	1	1	0.5
K5	1	1	2	2	1
∑	4.25	5.25	5.5	12	4

c. Normalize the values of each paired comparison matrix column by dividing the values in the matrix column with the results of the column addition, as shown in table 5.

Table 5
Normalized Criteria Comparison Matrix

Code	K1	K2	K3	K4	K5
K1	0.235	0.190	0.182	0.333	0.250
K2	0.235	0.190	0.091	0.333	0.250
K3	0.235	0.381	0.182	0.083	0.125
K4	0.059	0.048	0.182	0.083	0.125
K5	0.235	0.190	0.364	0.167	0.250

d. Find the priority value weights based on a pairwise comparison matrix by calculating the average value of the sum of each row of matrices with the formula for the number of rows of normalized values divided by the number of criteria, as shown in table 6.

Table 6
Normalized Criteria Comparison Matrix

Code	K1	K2	K3	K4	K5	Priority Weight
K1	0.235	0.190	0.182	0.333	0.250	0.238
K2	0.235	0.190	0.091	0.333	0.250	0.220

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K3	0.235	0.381	0.182	0.083	0.125	0.201
K4	0.059	0.048	0.182	0.083	0.125	0.099
K5	0.235	0.190	0.364	0.167	0.250	0.241

e. To calculate the Consistency Measure (λmax), the method is to add the multiplication results for each column from each criterion to the priority of each criterion. The calculation formula is as below.

CM = (Jkpl x CM_1) + (Jkpl x CM_2) + .. + (Jkpn x CMn)
Information :
CM = Consistency Measure
Jkp = Number of columns per criterion
CM = (4.25 * 0.238) + (5.25 * 0.2200) + (5.5 * 0.2012) + (12 * 0.099) + (4 * 0.241) = 5,425

Consistency Index
CI = (λ max -n) / (n - 1)
Explanation:
n = Number of Criteria
(5,425−5) / (5−1) = 0.10625

Consistency Ratio
CR = CI / IR
Explanation:
CI = Consistence Index
RI = Index Ratio
CR = Consistency Ratio
CR = 0.107 / 1.12 = 0.096 with the results of the Consistent calculations.

If the value of the Consistency Ratio <= 0.1 means the process of weighting the criteria is valid and the weight of the criteria is considered consistent, then the weight of the criteria is saved into the database. But if the Cinsistency Ratio value> 0.1 then the process of weighting the criteria is considered less valid and the process must be repeated again.

The results of checking the consistency of the vector weight above, as shown in Figure 4.

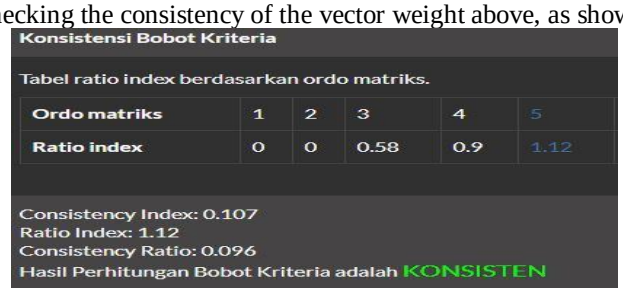

Figure 4 Consistency Results Weight Criteria Value

4.3. Calculation of the Promethee Method

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After getting weighted the value of the criteria using the AHP method the next step determines the ranking of priorities with the PROMETHEE method.

a. The first stage is to enter the alternative weight values in accordance with the questionnaire that has been filled, the following table 7 alternative weight values.

Table 7
Alternative Value Weight

Code	A1	A2	A3	A4	A5	A6	A7
K1	3	4	3	3	4	3	3
K2	3	4	3	3	3	4	3
K3	4	3	5	4	4	4	3
K4	4	3	4	3	3	3	2
K5	3	3	4	5	4	4	3

b. Determining the type of minimum or maximum dominance of each criterion, can be seen in table 8.

Table 8
Type of Criteria Domination

Code	Name	Weight	Min Max
K1	Work attendance	0.238	Maximization
K2	Lecturer Questionnaire	0.22	Maximization
K3	Employment contract	0.201	Maximization
K4	Academic Position	0.099	Maximization
K5	Lecturer Certification	0.241	Maximization

c. Then look for preference types and parameters for each criterion that is very suitable based on the data, as shown in table 9.

Table 9
Type Preferences and Parameters

Code	Name	Type Preferences	Q	P.
K1	Work attendance	2	1	5
K2	Lecturer Questionnaire	2	1	5

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K3	Employment contract	3	5	5
K4	Academic Position	3	5	5
K5	Lecturer Certification	2	1	5

d. Calculation of EnteringFlow, LeavingFlow which is the result of ranking ranking with the formula:

Leaving flow:

$$\emptyset^{+}(a) = \frac{1}{n-1}\sum_{x \in A} \varphi(x, a)$$

Entering flow:

$$\emptyset^{-}(a) = \frac{1}{n-1}\sum_{x \in A} \varphi(x, a)$$

The results of enteringflow and leaving flow calculations are shown in Figure 5.

Perbandingan Alternatif

Alternatif	Alternatif 1	Alternatif 2	Alternatif 3	Alternatif 4	Alternatif 5	Alternatif 6	Alternatif 7	Jumlah	Leaving
Alternatif 1	0	0.06	0	0.02	0.02	0.02	0.08	0.2	0.0333
Alternatif 2	0	0	0	0	0	0	0.02	0.02	0.0033
Alternatif 3	0.04	0.1	0	0.06	0.06	0.06	0.12	0.44	0.0733
Alternatif 4	0.24	0.28	0	0	0	0	0.3	0.82	0.1367
Alternatif 5	0	0.04	0	0	0	0	0.06	0.1	0.0167
Alternatif 6	0	0.04	0	0	0	0	0.06	0.1	0.0167
Alternatif 7	0	0	0	0	0	0	0	0	0
Jumlah	0.28	0.52	0	0.08	0.08	0.08	0.64		
Entering	0.0467	0.0867	0	0.0133	0.0133	0.0133	0.1067		

Fig 5. Calculation of Entering Flow and Leaving Flow

e. Calculate & sort the results from NetFlow as an index determining the final priority alternative ranking results, with the formula:

Net flow:

$$\emptyset(a) = \emptyset^{+}(a) - \emptyset^{-}(a)$$

The results of the calculation of enteringflow, leavingflow, netflow, ranking criteria are in Figure 6.

Hasil Akhir

Alternatif	Leaving Flow	Entering Flow	Net Flow	Urutan
Alternatif 1	0.0333	0.0467	-0.0133	5
Alternatif 2	0.0033	0.0867	-0.0833	6
Alternatif 3	0.0733	0	0.0733	2
Alternatif 4	0.1367	0.0133	0.1233	1
Alternatif 5	0.0167	0.0133	0.0033	3
Alternatif 6	0.0167	0.0133	0.0033	4
Alternatif 7	0	0.1067	-0.1067	7

Alternatif prioritas pilihan terbaik adalah **Alternatif 4** dengan total: **0.1233**

Fig 6. Alternative Calculation Results

5. Conclusion

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Based on the results of this research, several conclusions can be drawn regarding the selection of the best lecturers at the National University using the PROMETHE and AHP methods as follows:

1. This system uses the AHP method for the process of calculating criteria that produces criteria weights and uses the Promethe method for alternative ranking processes and then produces alternative sequences from highest to lowest.
2. Criteria and alternative data from this study are based on the Human Resources Bureau, National University.
3. This system aims to assist the university in determining and selecting the best lecturers using the criteria weighting and alternative ranking methods.
4. The weighting of criteria and alternatives in this application is based on the assessment of a pre-filled questionnaire.
5. The final results of processing and testing criteria using the AHP method resulted in a Consistency Index of 0.107, 1.12 Index Ratio, a 0.096 Consistency Ratio with a Consistent predicate. Then for alternative processing it was found that the best choice was alternative 4 with a total of 0.1233. With the following alternative order alternative 4, alternative 3, alternative 5, alternative 6, alternative 1, alternative 2, alternative 7.

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