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Analysis of the Application the Promethee Method in Determining Work Partners at the Central Statistics Agency of Central Aceh Regency

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ABSTRACT

The selection of partners at the Central Statistics Agency of Central Aceh Regency faces challenges because manual selection methods are considered inefficient and inaccurate. Therefore, this study aims to improve the accuracy and efficiency of the selection process by applying the Promethee (Preference Ranking Organization Method for Enrichment Evaluations) method. This method is used as a multi-criteria decision-making technique and is implemented using the Python programming language for automatic and real-time data processing. The data used comes from the 2024 partner recruitment process at the Central Statistics Agency of Central Aceh Regency, consisting of candidates who have met the administrative requirements. The validity of the promethee method is tested through the calculation of an error percentage that reaches 10%, demonstrating the method's ability to filter partners according to the established criteria. In conclusion, the application of the promethee method has been proven to improve the efficiency and accuracy of the partner selection process, where the Python-based system developed can reduce the time and effort required in decision-making while producing more valid and reliable partner recommendations.

I. Introduction

Human resources are crucial to any company, as their performance directly impacts the achievement of organizational goals. Despite variations in a company's structure and objectives, the foundation is often human-centric, with mission execution heavily reliant on human contributions. Therefore, improving human resource management is vital to enhance workforce quality and performance. Work partners, or collaborators, are essential in partnerships across sectors, communities, and government or non-government entities, working towards common goals based on agreed principles and roles [1].

The Central Statistics, a non-ministerial government agency reporting directly to the President of Indonesia, was originally established as the Central Statistics under 1960 laws and rebranded under Law No. 16 of 1997. Central Statistics, has an important role in collecting, processing, and presenting statistical data foundational for Indonesia's development policies across economic, social, and public sectors. However, partner selection at BPS Central Aceh Regency currently lacks definite criteria, hindering efficient partnerships. A decision analysis using defined criteria is needed to select suitable partners. This study identifies key criteria for selecting work partners: education (C1), Android proficiency (C2), competency tests (C3), experience as a statistical partner (C4), age (C5), and residence (C6). The promethee method is employed in this process, focusing on simplicity, clarity, and stability through outranking relationships based on economic influence parameters.

II. Literature Review

A. Decision Support System

A decision support system is a computer-based system that provides various decision alternatives to help management address structured and unstructured problems using data and models. The decision-making steps include: first, identifying the problem by understanding and recognizing the issue at hand. Second, selecting a suitable model or method for problem-solving based on mathematical analysis and model sensitivity. Third, collecting relevant data and information to support problem identification and method selection. Fourth, applying the chosen model or method, considering the details and complexity of the calculations as well as the characteristics of the data and decision criteria. Fifth, evaluating the available alternatives with the help of a model to assess them against multiple criteria. Finally, determining the best solution by considering the main criteria and applying it, supported by a computerized system appropriate to the problem's characteristics.

B. Work Patrner

Work partners are a crucial human resource essential for a company's success. Collaborations with partners should not be underestimated, as they are key factors that can influence various aspects of the company, including productivity, innovation, and overall sustainability. In an era of globalization and intensifying competition, the importance of having reliable and efficient partners becomes increasingly evident.

C. Promethee Method

Promethee (Preference Ranking Organization for Enrichment Evaluation) is a ranking method used in multi-criteria analysis. Developed by JP. Brans and first published in 1982 at a conference organized by R. Nadeau and M. Landry at Laval University, Quebec, Canada, promethee is a technique for prioritizing or ranking alternatives in multi-criteria decision-making (MCDM). It is designed to process both quantitative and qualitative data simultaneously.

In the promethee method there are six form of criteria preference type, where it is used to provide an illustration which is better for dissimilar areas. These six types of preferences include:

1. Usual Criterion

$$H(d) = \begin{cases} 0 \; if \; d = 0 \\ 1 \; if \; d \neq 0 \end{cases} \quad \text{.....(1)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$

2. Quasi Criterion

$$H(d) = \begin{cases} 0 \; if \; d \leq q \\ 1 \; if \; d > q \end{cases} \quad \text{.....(2)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$
q : Parameter q (must be a fixed value)

3. Linear Criterion

$$H(d) \begin{cases} 0 \; if \; d \leq 0 \\ \frac{d}{p} \; if \; 0 < d \leq p \\ 1 \; if \; d > p \end{cases} \quad \text{.....(3)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$
q : Parameter q (must be a fixed value)

4. Level Criterion

$$H(d)\begin{cases} 0\ if\ d \le q \\ \frac{1}{2}\ if\ q < d \le p \\ 1\ if\ d > p \end{cases} \quad \text{.....(4)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$
q : Parameter q (must be a fixed value)

5. Linear Criterion with Indifference

$$H(d)\begin{cases} 0\ if\ d \le p \\ \frac{d-p}{q-p}\ if\ q < d \le p \\ 1\ if\ d > p \end{cases} \quad \text{.....(5)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$
q : Parameter q (must be a fixed value)

6. Gaussian Criterion

$$H(d) = \begin{cases} 1 - e^{\left(-\frac{d^2}{2\sigma^2}\right)} \end{cases} \quad \text{.....(6)}$$

Description:
H(d) : Criterion difference function between alternatives
d : Difference in criterion values$\{d = f(a) - f(b)\}$
σ : Gaussian Threshold
e : exp value

D. Python

Python is a programming language used for implementing the promethee method in this research, providing capabilities for automatic and real-time data processing which enhances decision-making accuracy and consistency.

III. Research Methodology

Data collection in this study utilized several techniques to ensure a comprehensive analysis. A literature review was conducted using various sources such as journals, books, and papers related to the research topic, which were then evaluated and analyzed to serve as references for the study. Observations involved collecting data on work partners from the Central Statistics Agency of Aceh Tengah Regency, focusing on variables such as education, Android proficiency, competency tests, experience as a statistical partner, age, and domicile. Additionally, interviews were conducted with key informants, namely the person in charge of partners at the Central Statistics Agency of Central Aceh Regency, to gain insights and validate observational data.

IV. Results and Discussion

The development process for the work partner selection system at the Central Statistic Agency of Aceh Regency involved systematic analysis and design, leading to several important findings. Identifying the main problem of partner selection without definite variables prompted a thorough user needs analysis and process mapping. Data from 659 potential partners were collected and processed using a Python-based system to ensure automatic and real-time processing. The promethee method was applied to objectively select partners, with the system design illustrated through Data Flow

Diagrams (DFD) to visualize data flow and main processes within the system. The database was stored in Excel files and accessed and processed using the Pandas library in Python, ensuring high data quality.

A. Systems Analysis

System analysis is a crucial stage in developing software or information systems, serving as the foundation for understanding system needs, processes, and interactions. This stage involves problem identification, user needs analysis, and process mapping. The necessity for system analysis arises from system failures, ensuring the developed system aligns with needs and goals, thereby enhancing overall quality and success. The current issue at the Central Statistics Agency of Central Aceh Regency is the partner selection process based on estimation without definite variables, leading to inefficiency and subjectivity. This unstructured approach causes significant issues such as lack of objectivity, inefficiency, and inappropriate partner selection affecting task execution and data quality. Data from 659 potential partners was collected and processed using a Python-based system for automated, real-time processing. The promethee method was applied to objectively select partners, with all data processed and stored in the database.

B. System Planning

In designing the system developed using Python, the Data Flow Diagram (DFD) approach was utilized to illustrate the data flow and main processes within the system. DFD helps visualize how applicant data is processed, from input and processing stages to the final output of rankings and decisions. The level 0 diagram (Context Diagram) shows the relationship between external entities, such as applicants, and the main system. The level 1 diagram details internal processes, including applicant data input, criteria definition, preference calculations, flow calculations, ranking determination, and result output. Using DFD, the data flow and transformations within the system can be clearly and easily understood by various stakeholders, ensuring an effective and efficient system design.

C. Database Planning

In this research, the database design uses Excel files as the storage medium, which will be applied within the Python program. Applicant data stored in Excel files will be accessed and processed using the Pandas library.

D. Promethee Manual Calculations

Based on existing data, there are 6 criteria and assessment weights that are used as a reference in determining work partners. These criteria can be seen in the following table:

Table 1. Criteria

Criteria	Weight
Education	0.20
Skills in Operating Android	0.15
Competency Test	0.25
Experience as a Statistics Partner	0.15
Age	0.10
Domicile	0.15

In calculating the promethee method, the author uses several types of preferences, which can be seen in the table below:

Table 2. Definition of Criteria

Criteria	Preference Type	Parameter	
		q	p
Education	Quasi	1	2

Criteria	Preference Type	Parameter	
		q	p
Skills in Operating Android	Usual	0	0
Competency Test	Linear	0	70
Experience as a Statistics Partner	Quasi	0	1
Age	Level	0	18
Domicile	Usual	0	0

E. Results from the promethee method

At this stage, out of 659 partners who registered, only 344 partners met the administrative requirements and were subjected to a promethee calculation. Subsequently, a ranking was conducted based on the net flow values.

Table 3. Ranking

Ranking	Partner
1	80
2	412
3	81
4	532
5	111
6	493
7	91
8	548
9	379
10	96
11	357
12	430
13	362
14	541
15	582
16	479
17	504
18	432
19	165
20	119
...	....
340	511
341	407
342	448
343	84
344	393

In table 3 the number of partners who passed shows a discrepancy with the number of partners who passed without promethee calculations. Therefore, to determine how valid the method is, the author uses the following formula:

$$Persentage\ error = \frac{Method\ results - Actual\ results}{Actual\ result} \times 100\%$$

$$= \frac{344 - 310}{310} \times 100\%$$

$$= \frac{34}{310} \times 100\% = 0.10 \times 100\% = 10\%$$

To determine how valid the method is for determining work partners, it is important to measure how accurate the method is with results that are considered correct or standard.

The comparison of results when using the method versus not using the method can be illustrated in the pie chart below:

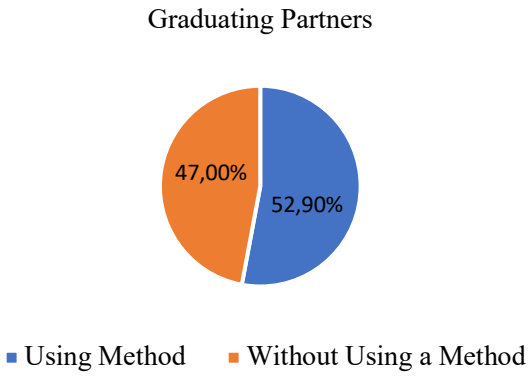

Fig 1. Comparison Pie Chart Method

V. Conclusion

Based on the previous explanation, it can be concluded as follows: The application of the promethee method in selecting partners for the Central Statistics in Central Aceh Regency has shown an improvement in accuracy and efficiency compared to conventional methods. Out of 659 registered partners, only 344 met the administrative requirements and were evaluated using the promethee method. This outcome indicates that the use of promethee effectively filters partners who better meet the set criteria. The method has proven to be valid, with an error percentage of 10%, demonstrating its reliability in selecting suitable partners. This validity was established by comparing the promethee results with the conventional method, which only passed 310 partners. Additionally, the use of a Python-based system for implementing the promethee method has enhanced efficiency in data processing and decision-making. This system enables automatic and real-time data processing, thereby reducing the time and effort required for the partner selection process.

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