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Analysis Of Promethee Methods On Assistance Recipients Family Of Hope Program In Poor People

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ABSTRACT

The Family of Hope Program (PKH) managed by the Ternate City Social Service is a critical social assistance initiative aimed at reducing poverty and improving the welfare of underprivileged families. However, the program's implementation is not optimal due to the lack of a systematic approach in the selection of beneficiaries. Currently, the process relies on manual home visits and subjective visual assessments, which are time-consuming and prone to inaccuracies. This research aims to develop a decision support system (DSS) that utilizes the Promethee method to enhance the objectivity and efficiency of the beneficiary selection process. The Promethee method was chosen for its ability to rank alternatives based on multiple criteria, making it suitable for handling complex decision-making scenarios. Four criteria—age, marital status, education, and disability—were used to evaluate and prioritize potential beneficiaries. This research involved data collection from the Ternate City Social Service, followed by system design and analysis using the Promethee approach. The findings indicate that the Promethee-based DSS provides a structured and transparent mechanism for evaluating candidates, enabling the Social Service to make more accurate and equitable decisions. This system significantly reduces the time required for the selection process while improving its reliability. The study concludes that integrating the Promethee method into the Family of Hope Program can address existing inefficiencies and support the Social Service in achieving its goal of targeted poverty alleviation.

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1. INTRODUCTION

The Family of Hope initiative Beneficiary families who have been identified as recipients of the Family of Hope program are given conditional social assistance. The Republic of Indonesia's Ministry of Social Affairs is in charge of the family of hope program, which is an initiative of the government to help impoverished families by lowering their living expenses. The criteria used are income, savings amount, building area, floor type, wall type, medical expenses, number of meals per day, basic needs, sources of lighting, clean water sources, cooking utensils, number of elderly, number of school children. persons with disabilities, pregnant/breastfeeding women[1]. Ternate City is the capital of the Regional Government in North Maluku Province, Ternate first became an autonomous city since October 4, 1999, specifically until August 4, 2010, when the capital of North Maluku Province was relocated to Sofifi City, which is situated on the island of Maluku, following

11 years of transition and infrastructure preparation. Maluku. Halmahera which is the largest island. The city of Ternate is located on the island of Ternate with an area of 111.39 km2 and a population of 207,789 inhabitants.

It was noted that the quantity of impoverished individuals in North Maluku Province in 2015 increased by 2.2 thousand people from 84.64 thousand people last year, this increase occurred due to the influence of economic needs in North Maluku which continues to increase. The percentage of poor people in North Maluku in March 2017 reached 6.35 percent (76.47 thousand people) compared to the poor in September 2016 of 6.41 percent (76.40 thousand people). The increase in the poverty rate in North Maluku could be a new problem in the development process. It is anticipated that this decision support system will reduce the poverty rate that continues to increase in the city of Ternate, because the social service of the city of Ternate does not yet have a system that assists in providing social assistance, the Family of Hope program is among them. In general, The issues with the Ternate City Social Service's Family of Hope program are still not ideal since there is no support system in place when recipients are chosen, meaning that only limited assessment is done during the selection process. is used and no calculations are made at the time of selecting the recipient. assistant. So that few or many residents often protest because people who should receive assistance do not receive assistance, and vice versa.

One technique that is frequently used to make decisions is Promethee, Promethee is a type of Multi-criteria Decision Making (MCDM) technique, which over the past 20 years has grown to be one of operational research's fastest-growing fields[2], [3], [4].

Previous research on this topic was conducted at the Ternate City Social Service with the title *Sistem Pendukung Keputusan Pemberian Bantuan Program Keluarga Harapan (PKH) Pada Orang Miskin Di Kota Ternate Menggunakan Metode AHP*. In this study, we introduce an update by experimenting with an alternative approach using the Promethee method to compare its effectiveness in beneficiary selection[1].

The theory of MCDM can be categorized into Multi Objective Decision Making (MODM) and Multi Attribute Decision Making (MADM). The objective of Promethee is to streamline the decision-making process by categorizing decisions into six evaluative criteria[5], [6], [7].

2. RESEARCH METHOD

The Ternate City Social Service was selected as the research location. The stages of this research are as follows:

1. Literature Review
   A literature review was conducted to gather relevant information on decision-making methods, particularly the Promethee method, in the selection process for Family of Hope Program (PKH) beneficiaries. The researcher examined previous studies and other relevant references related to the selected methodology.
2. Data Collection
   The researcher collected data based on its type and source, including both primary and secondary data. Data collection techniques included interviews with the Ternate City Social Service, observations of the beneficiary selection process, and document analysis of existing PKH recipient data[8].
3. Data Analysis
   The collected data was analyzed to ensure its relevance and validity for the research process. This data includes criteria such as age, marital status, education level, and disability status, which are used to determine eligibility for assistance[9].
4. Method Implementation
   At this stage, the Promethee method was applied to rank potential beneficiaries based on the predefined criteria. The calculation process included determining preference values, computing Leaving Flow, Entering Flow, and Net Flow values, and establishing the final ranking of beneficiaries.

These research stages were conducted systematically to ensure an objective and accurate evaluation in the selection of PKH beneficiaries. The investigation into the application of the Promethee method was conducted in multiple phases, specifically literature review, data collection techniques, needs assessment, system design, system execution, and testing. Promethee is a technique for establishing the hierarchy (priority) in multi-criteria analysis. Stability, simplicity, and clarity are the main issues. Promethee's criteria are assumed to be based primarily on the use of values in outranking relationships[10], [11]. The Enrichment Evaluation Preference Ranking Organization Method is an outranking technique that provides a flexible and straightforward approach for decision makers to assess multi-criteria issues. The principle used is the determination of alternative priorities that have been determined based on considerations with basic principles: Max {f1(x), f2(x), f3(x),...,fi(x),...,fk(x)Ix}

Where k is the number of alternative sets and f1(i=1,2,..., k) represents the value or relative magnitude of the criteria for each alternative. The purpose of Promethee is to evaluate and generate recommendations from multiple alternatives. The Promethee method in providing recommendations for prospective recipients in the system has the basics for evaluating data which can be seen in Table 1.

Table 1 Promethee Basics

	$f_1(.)$	$f_2(.)$	…. ..	$f_j(.)$	…. ..	$f_k(.)$
a_1	$f_1(a_1)$	$f_2(a_1)$	…. ..	$f_j(a_1)$	…. ..	$f_k(a_1)$
a_2	$f_1(a_2)$	$f_2(a_2)$	…. ..	$f_j(a_2)$	…. ..	$f_k(a_2)$
a_i	$f_1(a_i)$	$f_2(a_i)$	…. ..	$f_j(a_i)$	…. ..	$f_k(a_i)$
a_n	$f_1(a_n)$	$f_2(a_n)$	…. ..	$f_j(a_n)$	…. ..	$f_k(a_n)$

Description:
$a_1, a_2, \ldots a_n$: n potential participants
$f_1, f_2, \ldots . f_j, f_k$: k evaluation criteria

The Promethee method comprises sequential steps in the calculation process[12]. The following are the steps involved in the Promethee method:

1. Ascertain the number of participants.
2. Determine the number of criteria.
3. Based on the information and the decision maker's considerations, determine the preference type for each of the most relevant criteria.
4. There are six preference types (Usual Type, Quasi Type, Linear Type, Level Type, Quasi Linear Type and Gaussian Type).
5. The preference type used is the Usual Type.
6. Calculation of Inflow, Outflow, and Net Flow.
7. The results of sorting the results of the ranking.

Promethee can be presented in six forms of criterion preference functions that are often used in the calculation process, namely Usual Type, Quasi Type, Linear Type, Level Type, Quasi Linear Type and Gaussian Type[13]. This is not definitive; however, this form is adequate in certain instances. To provide a clearer representation of the disparities, the function of the variance in the valuation of the criteria between participants (d) can be used.

This study employs the Usual Type preference, because this type is more suitable to be applied to many criteria. To see the case of preference for the Usual Type, it can be described in the selection of candidates for family of hope program assistance recipients[14]. One participant with another participant will have a different rank even though there is only a small difference, and will have the same rank if the number or difference in the scores obtained is the same. The Usual Type Equation can be seen in Equation 1.

$$H(d) = \{0, \quad If\ d \leq 0\ 1, \quad If\ d > 0 \qquad (1)$$

Description:
H(d) : difference function of participant criteria
D : difference in criterion scores {d=f(a)-f(b)}

Equation 1 explains that the values of a and b will be worth 0, if and only if f(a) has the same value as f(b), To improve the value, the value must be made absolute if the value of d in each criterion is negative. Figure 1 displays the H(d) function for this preference.

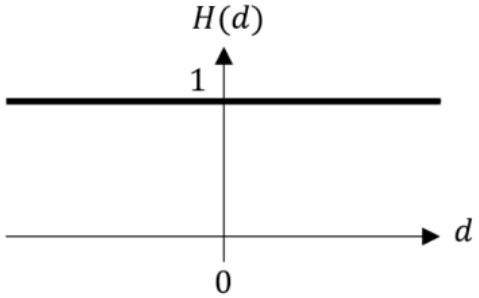

Figure 1. Usual Type

Directions in Outranking Value Charts
The ranking used in the Promethee method includes four forms, including:
Preference Index

The quantity of preference values is known as the preference index from the comparison of criteria between one participant and another[15]. The preference index value that is close to one is the largest preference value. The multi-criteria preference index can be seen from Equation 2 as follows:

$\delta(a,b) = \sum_{i=1}^{n} \pi_i P_i(a,b): \forall a,b \in A$

Description:

$\delta(a,b)$: participant preference index a is better from participant b

$P_i(a,b)$: participant a preference to participant b

π_i : a relative measure of the importance of the criteria f_i

Leaving Flow

The total of those with a direction away from the node is known as the "Leaving Flow," which is an outranking metric. The Leaving Flow is used to determine the outranking value for each node value in the graph. Equation 3 contains the equation.

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

Description:

$\varphi^+(a)$: Leaving Flow value

$\delta(a,x)$: indicates participant a preference is better than x.

n : total value

Entering Flow

Entering Flow is an outranking measurement character that represents the number of nodes that have an approaching direction. Equation 4's Entering Flow is used to determine the outranking value for each node value in the graph.

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

Description:

$\varphi^-(a)$: Entering Flow value

$\delta(a,x)$: indicates participant a's preference is better than x.

n : total value.

Net Flow

Subtracting the Leaving Flow and Entering Flow numbers that were decided by equations 3 and 4 yields the Net Flow. so that Equation 5 yields the factors taken into account when calculating Net Flow.

$\varphi(a) = \varphi^+(a) - \varphi^-(a)$

Description:

$\varphi(a)$: Net Flow value

$\varphi^+(a)$: Leaving Flow value

$\varphi^-(a)$: Entering Flow value

A participant has a higher chance of being chosen if their Leaving Flow value is higher and their Entering Flow value is lower. Promethee I uses a partial ranking system that is based on Entering Flow and Leaving Flow data. However, because Promethee II is dependent on each participant's Net Flow value, it has a complicated ranking system, meaning that the participant with a higher Net Flow score occupies a better ranking[3].

3. RESULTS AND DISCUSSION

Researchers have interviewed the informants directly in order to identify criteria and alternatives. Six options and four criteria are available for use in this study, namely:

Table 1. Criteria and Types of Criteria

Criteria	Type
Disability (K1)	Benefit
Age (K2)	Benefit
Marital Status(K3)	Benefit
Education (K4)	Benefit

Table 2. Determining the Suitability Rating of Each Alternative

Alternative	Criteria			
	K1	K2	K3	K4
A01	5	5	3	3
A02	5	5	5	5
A03	5	5	3	3
A04	5	5	5	3
A05	3	5	3	3

Each alternative's appropriateness rating on each factor is displayed in the table above. Each alternative's value in each criterion is a match value since the greatest value is the largest. Determine the type of preference utilized for each criterion before moving on to the computation stage. Equation 1 was applied in the promethee approach for every criterion utilized in this investigation. Following the selection of the type, compare each of the available options to determine the preference value.

(A01,A02) = 0+0+0+1

(A02,A01) = 0+0+1+0

And so on until (family 6, family 5). Once each alternative's preference value has been determined, the preference index is calculated by dividing The number of criteria according to the preference value.

(A01,A02) = 1/4 (0+0+0+1)=1/4=0,25

(A02,A01) = 1/4 (0+0+1+0)=1/4=0,25

The outcomes of the preference index computation are as follows.

Table 3. Multicriteria Preference Index

	A01	A02	A03	A04	A05
A01		0,25	0,25	0,25	0
A02	0,25		0,5	0,25	0,75
A03	0,5	0		0	0,25
A04	0,5	0	0,25		0,5
A05	0,5	0	0	0	
∑	1,75	0,25	1	0,5	1,5

Once the preference index value has been determined, use equations 7-9 to move on to the hierarchical phases of leaving flow, entering flow, and net flow. These are the results of the Leaving Flow, Entering Flow, and Net Flow computations.

Table 4. Nilai Leaving, Entering, dan Net Flow

Alt	Leaving Flow	Entering Flow	Net Flow
A01	0,2	0,45	-0,25
A02	0,45	0,05	0,4
A03	0,25	0,25	0
A04	0,35	0,15	0,2
A05	0,15	0,35	-0,2

As indicated in table 5, the hierarchical phases of leaving, entering, and net flow is reached after the values of departing, entering, and net flow have been calculated.

Table 5 shows that, with a net flow value of 0.4, the second family is placed first, whereas the fourth family, with a net flow value of 0.2, comes in second. Therefore, it may be said that the promethee approach provides support to the second and fourth families who are eligible for recommendations.

Table 5. Ranking

Alt	Leaving Flow	Entering Flow	Net Flow	Rank
A01	0,2	0,45	-0,25	4
A02	0,45	0,05	0,4	1
A03	0,25	0,25	0	3
A04	0,35	0,15	0,2	2
A05	0,15	0,35	-0,2	5

4. CONCLUSION

The findings of this study demonstrate that the application of the Promethee method provides a structured and systematic approach to the selection of Family of Hope Program (PKH) beneficiaries at the Ternate City Social Service. By utilizing a multi-criteria decision-making approach, the method enhances the accuracy and fairness of the selection process, addressing previous inefficiencies associated with manual assessments. The analysis was conducted using four key criteria: disability status, age, marital status, and education level. Each criterion was assigned a preference value, and the ranking process was carried out based on the computed values of Leaving Flow, Entering Flow, and Net Flow. The results revealed that Family 2 obtained the highest Net Flow value of 0.4, followed by Family 4 with a Net Flow value of 0.2. These families were identified as the most eligible recipients of PKH assistance, as they demonstrated the greatest need based on the established criteria. The Promethee method effectively ranked potential beneficiaries, ensuring a systematic and objective selection process that minimizes subjective assessments and biases.

Based on the findings, this study concludes that the Promethee method is a reliable and effective approach for prioritizing beneficiaries in social assistance programs. By ranking candidates based on multiple predefined criteria, this method ensures a more objective and transparent selection process. The results confirm that Family 2 and Family 4 were the most eligible recipients, demonstrating the practical applicability of the Promethee method in optimizing aid distribution. Future research should focus on expanding the selection criteria and incorporating digital tools to further enhance the efficiency and effectiveness of the decision-making process in social assistance programs.

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