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Composite Performance Index in Decision Making for Social Assistance

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Abstract: The majority of the residents in this village, approximately 90%, worked as farmers or farm laborers. Given the economic conditions, social assistance became crucial in reducing social inequality and enhancing the welfare of vulnerable communities. The role of village governance was significant in improving community welfare. The Village Hall served as the center of village administration, managing various activities, including the distribution of social assistance. The Village Hall was responsible for ensuring that social assistance was distributed fairly and effectively to recipients according to prevailing policies. However, the Village Hall faced issues such as inefficiency and inequality in the distribution of social assistance. The process of selecting social assistance recipients was still conducted conventionally, where Village Hall staff collected data on the community based on certain criteria. This method was prone to errors in decision-making and incorrect distribution of assistance, such as recipients who did not actually qualify still receiving aid, while those in need often did not receive appropriate support. These issues were caused by a lack of thorough analysis. The village government needed to establish a decision-making system that was accurate and precise. The operation of this system included all steps of problem identification, selection of relevant information, and determination of the approach used for decision-making through to the resolution of the issues. To achieve accurate results, this research applied the Composite Performance Index method. The aim of this research was to create a decision support system (DSS) for selecting social assistance recipients in the village. This DSS was expected to help staff improve the speed of social assistance classification, avoid errors, and produce accurate decisions.

Keywords: DSS, Social Assistance, Composite Performance Index, UML

INTRODUCTION

As time progressed, information technology advanced rapidly, affecting various aspects of human life, including the economic sector (Pradana, 2021). The economy played a crucial role in enhancing the development of a region and the welfare of its community (Syarifah et al., 2021). Community welfare is a condition in which basic needs such as clothing, food, housing, health, education, and employment are fulfilled (Suminartini & Susilawati, 2020). When a region's economy functioned stably, it significantly impacted the prosperity and welfare of its inhabitants (Purwahita et al., 2021). However, economic inequality persisted in Aek Songsongan Village, Asahan Regency, North Sumatra. The majority of the village's population, around 90%, worked as farmers or farm laborers. In such an economic condition, social assistance became essential in reducing social disparities and improving the welfare of vulnerable communities (Muga et al., 2021). Social inequality is an imbalance in society that creates stark differences (Irawan & Sulistyo, 2022). It can also be interpreted as a condition where the wealthy have higher status and power compared to the poor (Septiani et al., 2022).

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In enhancing community welfare, the role of the village government was crucial. The Aek Songsongan Village Hall served as the village's administrative center, managing various activities, including the distribution of social assistance. Social assistance comprised aid from central or regional governments in the form of money, goods, or services provided to the underprivileged and socially vulnerable communities to improve their quality of life adequately (Wahidah et al., 2022). One of the primary tasks of the village hall was to distribute social assistance to those in need (Kasih, 2023). The village hall was responsible for ensuring that social assistance was distributed fairly and effectively to recipients in accordance with applicable policies. However, the village hall faced challenges such as inefficiency and inequity in the distribution of social assistance. The process of selecting social assistance recipients was still conducted conventionally, where village hall staff recorded the community based on specific criteria. This method was prone to errors in decision-making and inaccurate distribution, where ineligible recipients still received aid, while those in need often did not receive appropriate assistance. The reason of these problems was a deficiency of careful analysis. In light of the concerns found, the following formulation of the problem was made: How can the personnel of the Aek Songsongan Village Office be helped to swiftly and precisely categorize clients of social assistance through the development of a Decision Support System (DSS)? In addition, the issue formulation addressed how the application of the Composite Performance Index (CPI) technique may improve the accuracy and precision of the social assistance recipient selection process.

In response to these challenges, the village government needed to establish a decision-making system to generate precise and accurate decisions. Decision support system is a tool in making a decision that is semi-structured or unstructured. Where the workings of the Decision Support System (SPK) are by calculating with certain methods on criteria/attributes on an alternative then from the results of the calculation a recommendation will be produced that is most appropriate (Pratama et al., 2019). According to Kartiko, a Decision Support System (DSS) is a system capable of sharing expertise to solve problems and communicate information in the context of semi-structured and unstructured issues (Kartiko, 2021). This system's workflow encompassed all steps of problem identification, selection of relevant information, and determination of approaches used for decision-making processes until the resolution and solution of the issues (Suparmadi & Santoso, 2020). This study used the Composite Performance Index approach to get reliable results. A composite index called the Composite Performance Index (CPI) is used to evaluate or rank different alternatives (i) according to a number of criteria (j). Heterogeneous criteria, such as positive trend criterion (+) and negative trend criteria (-), can be applied with the CPI approach (Rustam et al., 2022).

The Decision Support System utilizing the Composite Performance Index method had been extensively used in previous research to make decisions based on accurate data, reduce uncertainty, and enhance decision reliability. In Satria's research titled "IMPLEMENTATION OF COMPOSITE PERFORMANCE INDEX (CPI) AS A METHOD IN THE DECISION SUPPORT SYSTEM FOR SCHOLARSHIP RECIPIENT SELECTION," the objective was to create a decision support system using the composite performance index method to select scholarship recipients at AMIK Mitra Gama (Satria et al., 2022). With the creation of the system, data processing became swift. Another researcher, Dahlan in his research titled "DECISION SUPPORT SYSTEM FOR SELECTION OF ACHIEVEMENT SCHOLARSHIPS FOR THE UNDERPRIVILEGED USING THE COMPOSITE PERFORMANCE INDEX (CPI) METHOD," aimed to assist in determining the criteria for who deserved scholarships for the underprivileged (Dahlan et al., 2022).

Previous research using the Composite Performance Index did not provide a detailed explanation of system design. Specifically, the first study did not explain the system design using UML diagrams, making the understanding of the decision support system's workflow unclear. The second research did not use a decision support system; instead, it just used the Composite Performance Index approach for analysis. Thus, the goal of this study was to develop a decision support system (DSS) that Aek Songsongan Village could use to choose which residents would get social assistance. This DSS was expected to help staff improve the speed of social assistance classification, avoid errors, and produce accurate decisions.

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LITERATURE REVIEW

Decision Support Systems have been widely applied in previous studies for decision-making based on accurate data and information, reducing uncertainty, and improving decision reliability. Prior research employing the Composite Performance Index (CPI) method has been conducted for various purposes, such as selecting scholarship recipients, choosing external SSDs, and selecting shipping partners. For instance, the study by Satria et al. (2022) focused on the selection of scholarship recipients at AMIK Mitra Gama, Dahlan et al. (2022) on the selection of scholarships for underprivileged students, Nugroho (2022) on the selection of external SSDs, Rumandan (2022) on the selection of shipping partners, and Azzahra et al. (2022) on determining candidates for Non-Cash Food Assistance (BPNT).

This study, however, had a different focus, namely on improving community welfare through a Decision Support System (DSS) for the distribution of social assistance in Aek Songsongan Village. This research specialized in a different socio-economic context, addressing social inequality and improving the welfare of vulnerable communities in a village where the majority of residents work as farmers or farm laborers. The innovation of this study lay in the development of a DSS specifically designed to address social inequality and improve the welfare of the village community. This research integrated DSS in the context of village governance, particularly in the management of social assistance distribution, including coordination with the village office to ensure assistance was distributed fairly and effectively. The application of the CPI method in the context of social assistance distribution was expected to enhance the speed and accuracy of determining aid recipients, avoid distribution errors, and produce more precise decisions. With thorough and detailed analysis, the developed system aimed to provide more accurate and effective solutions to address social inequality issues, thereby making a significant contribution to improving the welfare of the Aek Songsongan Village community.

METHOD

To achieve optimal results, this research followed the framework outlined below.

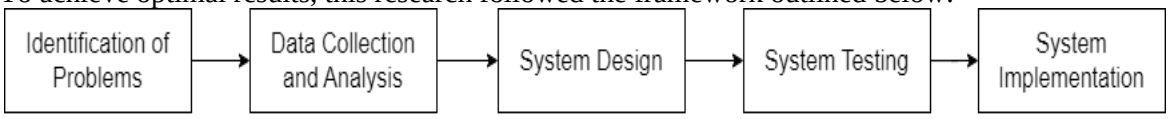

Fig. 1 Research Framework

a) Problem Identification

The process of selecting social aid recipients in Aek Songongan village is still conducted conventionally, where village office staff carry out citizen data collection based on certain criteria. However, this method is prone to errors in decision-making and inaccuracies in aid distribution, such as recipients who do not meet the requirements but still receive aid, while those in need often do not receive appropriate assistance. These issues arise due to a lack of meticulous analysis.

b) Data Collection and Analysis

Data on social aid candidates for 2024 will be obtained from the Aek Songongan village office and analyzed using the Composite Performance Index method.

c) System Design

The system design involves several UML diagrams such as use case diagrams, class diagrams, and entity-relationship diagrams to facilitate the development of the system.

d) System Testing

The system that has been developed will be thoroughly tested from beginning to end to ensure it meets all requirements and is ready for use by the village office staff.

e) System Implementation

After passing the testing phase, the system will be implemented as a website and made available for use by the Aek Songongan village office staff as a tool for selecting social aid recipients.

Composite Performance Index

The Composite Performance Index method was employed to determine the best alternatives by considering various criteria, including positive and negative trends. According to (Efendi et al., 2023), there are several stages in the Composite Performance Index:

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a) Identification of trend criteria, namely positive and negative trends:
The initial step involved identifying criteria categorized as either positive or negative trends. Positive trends refer to criteria that aim for the highest values, while negative trends refer to criteria that aim for the lowest values.

b) Transformation of values for positive and negative trends:
To determine which values within each criterion were divided by the lowest value for criteria that were classified as positive trends, and then multiply the resulting values by 100. Alternatively, the lowest value was divided by the other values within each criterion and the results were further multiplied by 100 for the criteria that were classified as negative trends.

c) Calculation of alternative index values:
The alternative index values were calculated by multiplying the criterion values by their corresponding weights.

d) Calculation of composite index values:
The composite index value was derived by adding together the alternative index values.

For the calculation steps of the Composite Performance Index (CPI) outlined above, they can be implemented using the following equations: (1), (2), (3), and (4).

$$Aij = (\text{xij } (min) / \text{xij } (min)) \times 100 \quad (1)$$

$$A(i+1.j) = (\text{x}(i+1.j) \ (min) / \text{xij}(min)) \times 100 \quad (2)$$

$$Iij = Aij \times Pj \quad (3)$$

$$Ii = \sum Iijni=1 \quad (4)$$

Explanation:

Aij	: The alternative value of alternative i on criterion j.
xij(minf_0)x_{ij}(\min)xij(min)	: The minimum initial alternative value of alternative i on criterion j.
(i+1,j)(i+1, j)(i+1,j)	: The alternative value of alternative i+1 on criterion j.
x(i+1,j)x(i+1, j)x(i+1,j)	: The initial alternative value of alternative i+1 on criterion j.
PjP_jPj	: Weight for each criterion.
IijI_{ij}Iij	: Value for the alternative index.
IiI_iIi	: Value for the composite index for each criterion.

RESULT

Data Analysis

The social aid data obtained from the Aek Songsongan Village Hall was analyzed using the Composite Performance Index method. The data used for this research is a sample of social aid recipients' data for the year 2024. Each recipient's data includes important information categorized based on several factors such as age, income, number of dependents, housing status, and marital status. The detailed breakdown of this data is presented in Table 1.

Table 1. Recipients of Social Assistance 2024

Alternative	Age	Income	Dependents	Housing status	Status
Jumirah	84	IDR 500.000	8	Semi-Permanent	Dissolution by death
Sri Murni	64	IDR 800.000	2	Semi-Permanent	Marriage
Nurbaiti	52	IDR 600.000	1	Semi-Permanent	Dissolution by death
Mariana	52	IDR 1.000.000	4	Permanent	Marriage

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B.Supriadi	66	IDR 1.000.000	4	Semi-Permanent	Marriage
Seniati	57	IDR 300.000	0	Non Permanent	Single
Sugiran	72	IDR 1.300.000	7	Permanent	Marriage
Sukatma	80	IDR 500.000	5	Non Permanent	Marriage
Jasem	65	IDR 800.000	3	Semi-Permanent	Marriage
Iskandar	69	IDR 1.500.000	4	Permanent	Marriage
Legiem	72	IDR 3.000.000	3	Permanent	Dissolution by death
Sakini	80	IDR 1.000.000	7	Permanent	Dissolution by death
Harto	58	IDR 3.500.000	5	Permanent	Marriage
Parjono	68	IDR 1.500.000	6	Permanent	Marriage
Majenah	68	IDR 1.000.000	5	Permanent	Dissolution by death
Ponimah	69	IDR 1.500.000	3	Permanent	Marriage
Mesnah	66	IDR 2.800.000	3	Permanent	Dissolution by death
Miswanto	63	IDR 500.000	4	Semi-Permanent	Marriage
Wagimen	65	IDR 1.500.000	4	Permanent	Marriage
Tukiman	60	IDR 2.000.000	4	Permanent	Marriage

To determine the results of the analysis of the social assistance data in Table 1, the initial step that needed to be taken was to establish the criteria and weighting of the criteria, considering whether the trends were positive or negative.

Table 2. Criteria Values

Criteria	Description	Trend	Weight
C1	Age	Positive	20%
C2	Income	Negative	30%
C3	Dependents	Positive	20%
C4	Housing status	Negative	20%
C5	Status	Positive	10%

Subsequently, to facilitate the evaluation of alternatives, it was necessary to convert the weight values of each criterion, as shown in Table 3.

Table 3. Data Transformation Rules

Criteria	Criteria value	Weight Value
Age (C1)	Every 1 year	0,1
Income (C2)	Every IDR100.000	1
Dependents (C3)	Every 1 dependent	1
Housing status (C4)	Non-permanent	1
	Semi-permanent	2
	Permanent	3
Age (C1)	Single	1
	Married	2
	Divorced	3
	Widowed	4

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The social assistance statistics might be changed by modifying the weight values of each criterion as indicated in Table 3 once the criteria, their trends, and their weights were established. The data transformation is presented in Table 4:

Table 4. Data Transformation

Alternative	C1	C2	C3	C4	C5
Jumirah	8,4	5	8	2	4
Sri Murni	6,4	8	2	2	2
Nurbaiti	5,2	6	1	2	4
Mariana	5,2	10	4	3	2
B.Supriadi	6,6	10	4	2	2
Seniati	5,7	3	0	2	1
Sugiran	7,2	13	7	3	2
Sukatma	8,0	5	5	2	2
Jasem	6,5	8	3	2	2
Iskandar	6,9	15	4	3	2
Legiem	7,2	30	3	3	4
Sakini	8,0	10	7	3	4
Harto	5,8	35	5	3	2
Parjono	6,8	15	6	3	2
Majenah	6,8	10	5	3	4
Ponimah	6,9	15	3	3	2
Mesnah	6,6	28	3	3	4
Miswanto	6,3	5	4	2	2
Wagimen	6,5	15	4	2	2
Tukiman	6,0	20	4	3	2
Minimum Value	5.2	3	1	2	1

The lowest value was used as the divider for the other values within each criterion for criteria with positive trends in order to obtain the weighted values for each criterion in each option. The result was then multiplied by one hundred. The lowest value for each criterion that showed a negative trend was divided by the other values in each criterion, and the resulting number was then multiplied by 100. Based on the data in Table 4, the following is a sample calculation for each criterion using the alternative Jumirah.

Tren(+) = Nilai N / Nilai min × 100
C1 Jumirah = 8,4 : 5,2 = 1,6154× 100 = 161,54
Tren(-) = Nilai min / Nilai N × 100
C2 Jumirah = 3 : 5 = 0,6× 100 = 60
Tren(+) = Nilai N / Nilai min × 100
C3 Jumirah = 8 : 1= 8× 100 = 800

Tren(-) = Value N / Value min × 100
C 4 Jumirah = 2 : 2 = 1 × 100 = 100
Tren(+) = Value N / Value min × 100
C5 Jumirah = 4 : 1 = 4 × 100 = 100

The complete calculation results for each criterion across all alternatives are presented in Table 5.

Table 5. Calculation of Each Criterion

Alternative	C1	C2	C3	C4	C5
Jumirah	161.54	60	800	100	400
Sri Murni	123.08	37.50	200	100	200
Nurbaiti	100	50	100	100	400
Mariana	100	30	400	66.67	200
B. Supriadi	126.92	30	400	100	200
Seniati	109.62	100	100	100	100
Sugiran	138.46	23.08	700	66.67	200
Sukatma	153.85	60	500	100	200

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Jasem	125	37.50	300	100	200
Iskandar	132.69	20	400	66.67	200
Legiem	138.46	10	300	66.67	400
Sakini	153.85	30	700	66.67	400
Harto	111.54	8.57	500	66.67	200
Parjono	130.77	20	100	66.67	200
Majenah	130.77	30	500	66.67	400
Ponimah	132.69	20	300	66.67	200
Mesnah	126.92	10.71	300	66.67	400
Miswanto	121.15	60	400	100	200
Wagimen	125	20	400	100	200
Tukiman	115.38	15	400	66.67	200

After the calculation process for each alternative, the results were summed to obtain the Composite Performance Index (CPI) for each criterion as follows:

CPI Jumirah = Value C1 * weight + value C2 * weight + value C3 * weight + value C4 * weight + value C5 * weight
161,64*0,2 + 60*0,3 + 800*0,2 + 100*0,2 + 400*0,1 = 270,31

CPI Jumirah =

The complete results of the CPI calculations and the rankings are presented in Table 6.

Table 6. Ranking Results of Social Assistance Recipients

Ranking	Alternative	CPI
1	Jumirah	270.31
2	Sakini	233.10
3	Sugiran	207.95
4	Sukatma	188.77
5	Majenah	188.49
6	Miswanto	162.23
7	Harto	158.21
8	B. Supriadi	154.38
9	Wagimen	151
10	Iskandar	145.87
11	Legiem	144.03
12	Mariana	142.33
13	Mesnah	141.93
14	Tukiman	140.91
15	Jasem	136.25
16	Ponimah	125.87
17	Sri Murni	115.87
18	Nurbaiti	115
19	Seniati	101.92
20	Parjono	85.49

The table above shows the results of calculations made using the Composite Performance Index technique. Jumirah has the greatest value with a score of 270,31, while Parjono has the lowest score with 85,49.

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Design

a) UML Design

Software system design and documentation are done using UML (Unified Modeling Language) (Batubara & Nasution, 2023). Modeling the system is the goal of UML design in order to make the system design process easier

Use Case Diagram

In object-oriented software modeling, the use case diagram is a diagram that has to be created first (Syahranitazli & Samsudin, 2023). The system's use case diagram, which represents the functionality of the system from the viewpoint of the user, is shown below.

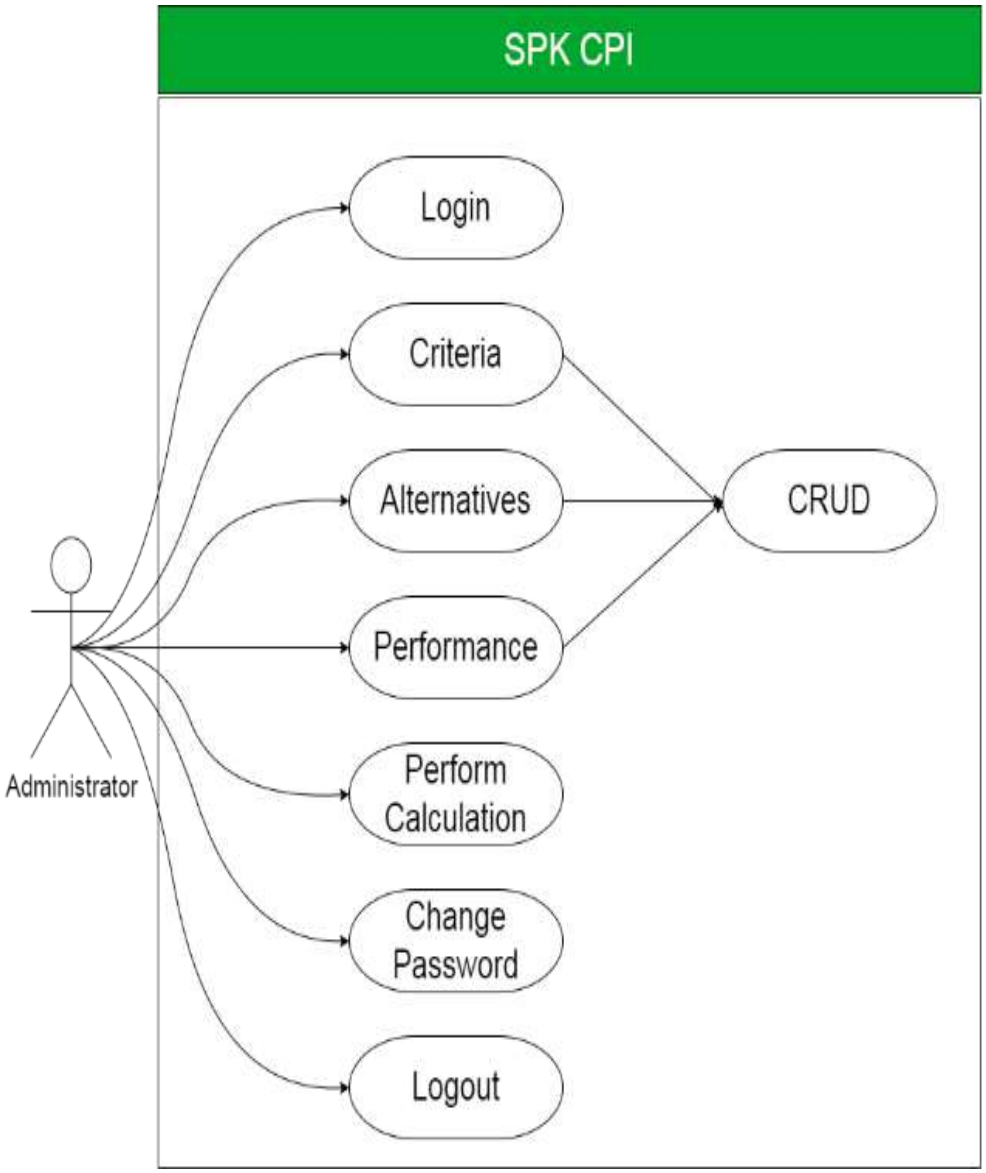

Fig 2. Use Case Diagram of the System

Entity Relationship Diagram

ERD illustrates the relationships between entities or tables, which can be classified into three types of relationships: one-to-one, one-to-many, and many-to-many (Kakihary et al., 2021). Below is the Entity Relationship Diagram (ERD) of the system.

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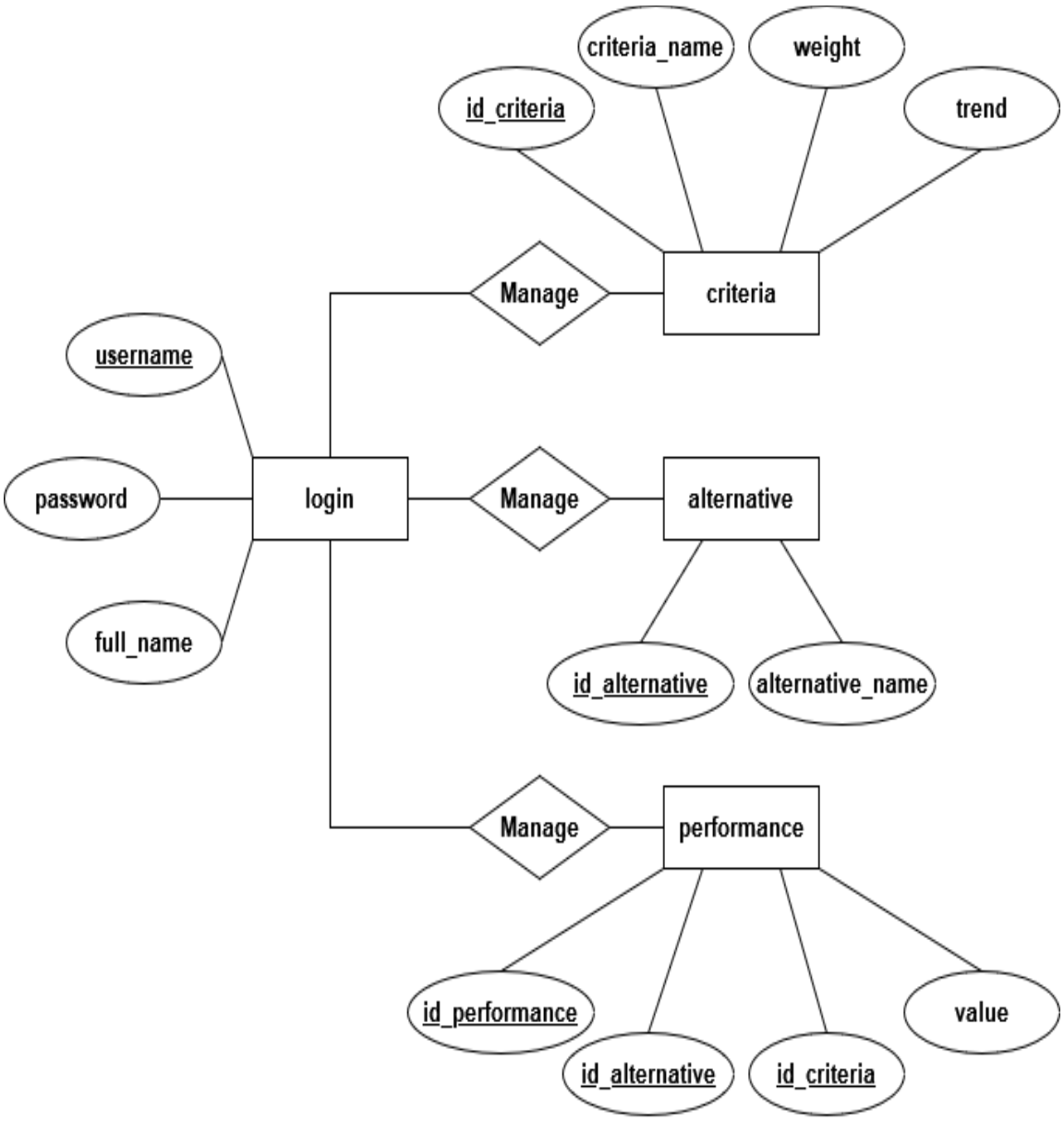

Fig 3. Entity Relationship Diagram of the System

b) System Flowchart

The system flowchart is used to illustrate the process flow of the system to be designed. Below is the flowchart of the system to be developed.

*name of corresponding author

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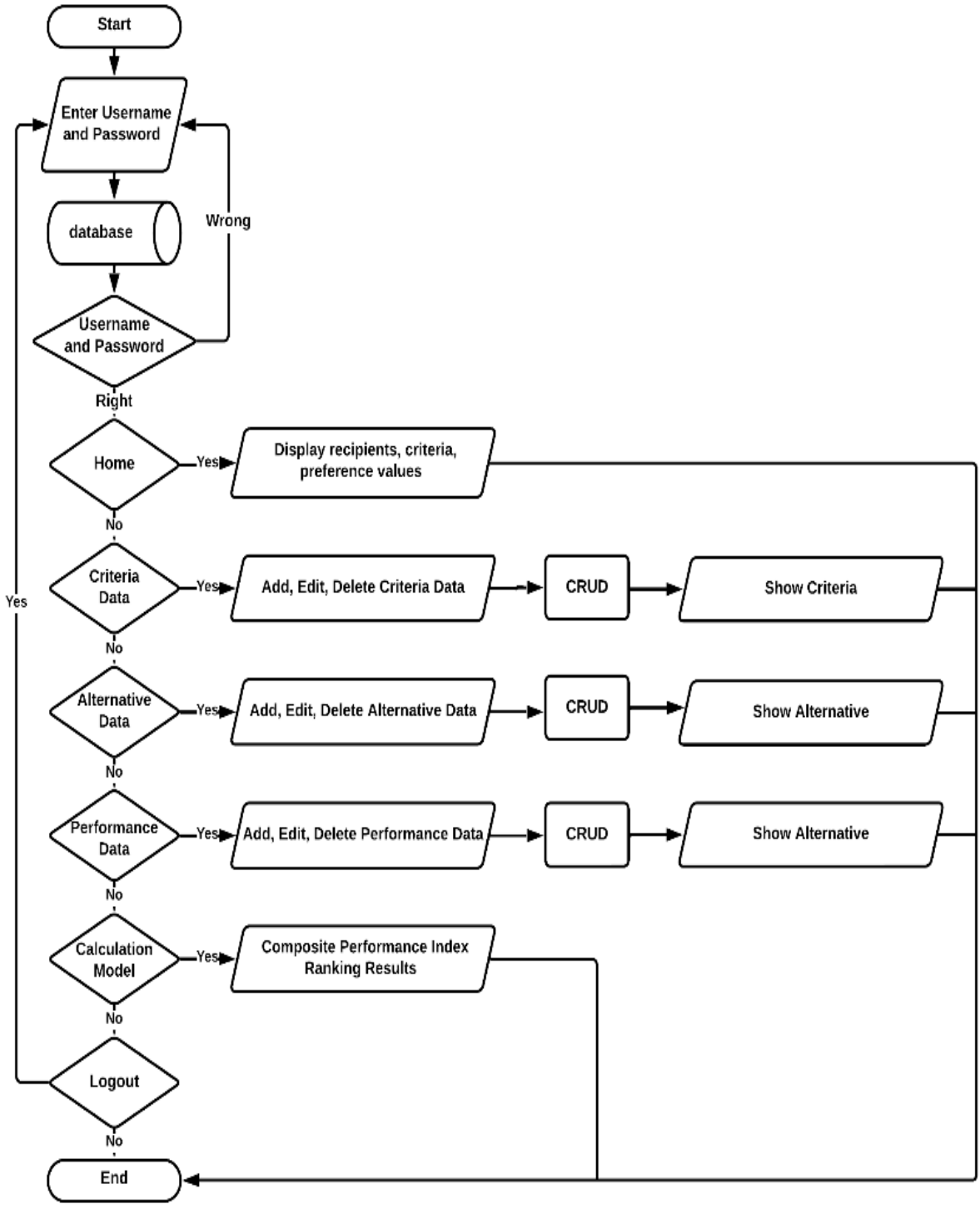

Fig 4. System Flowchart.

Testing and System Implementation

a) Calculation of each criterion's value

This display shows several alternatives consisting of 5 criteria such as age, income, dependents, type of house, and status. Each alternative has different criterion values.

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Perhitungan Nilai Setiap Kriteria

Alternatif Penerima	Matriks Transformasi Nilai				
	Umur	Penghasilan	Tanggungan	Jenis Rumah	Status
Jumirah	161.54	60	800	100	400
Sri Murni	123.08	37.50	200	100	200
Nurbaiti	100	50	100	100	400
Mariana	100	30	400	66.67	200
B. Supriadi	126.92	30	400	100	200
Seniati	109.62	100	100	100	100
Sugiran	138.46	23.08	700	66.67	200
Sukatma	153.85	60	500	100	200
Jasem	125	37.50	300	100	200
Iskandar	132.69	20	400	66.67	200
Legiem	138.46	10	300	66.67	400
Sakini	153.85	30	700	66.67	400
Harto	111.54	8.57	500	66.67	200
Parjono	130.77	20	100	66.67	200
Majenah	130.77	30	500	66.67	400
Ponimah	132.69	20	300	66.67	200

Fig 9. Calculation Menu Interface

b) Calculation Process Interface

Display of the overall ranking results of alternative data using the Composite Performance Index. In the image, the highest score is achieved by Jumirah with a score of 270,31.

Perangkingan Penerima Bantuan Sosial (BANSOS)

Ranking	Alternatif	Nilai
1	Jumirah	270.31
2	Sakini	233.10
3	Sugiran	207.95
4	Sukatma	188.77
5	Majenah	188.49
6	Miswanto	162.23
7	Harto	158.21
8	B. Supriadi	154.38
9	Wagimen	151
10	Iskandar	145.87
11	Legiem	144.03
12	Mariana	142.33
13	Mesnah	141.93
14	Tukiman	140.91
15	Jasem	136.25
16	Ponimah	125.87

Fig 10. Calculation Process Interface

*name of corresponding author

DISCUSSIONS

The use of Composite Performance Index (CPI) in determining social assistance recipients at the Aek Songsongan Village Office yielded accurate and objective results. This study utilized a sample of 20 individuals and considered five determining factors for social assistance recipients: age, income, dependents, housing status, and status. Each criterion was assigned an appropriate trend, whether positive or negative. Subsequently, suitable weights were assigned to each criterion to ensure precise decision-making. The CPI calculations for each individual showed significant variation, with Jumirah identified as the highest-scoring social assistance recipient with a score of 270,31, and Parjono scoring the lowest with 85,49.

In a previous study, conducted with a sample of 10 individuals as scholarship candidates, the determination of recipients considered only four factors: parents' income, GPA, electricity usage, and semester. The calculation results from these criteria showed significant value variation. Furthermore, the CPI calculations for each individual resulted in the highest score being RWP with a score of 134.14.

These findings underscore the CPI method's capability in effectively processing criterion data. The strengths of the CPI method include its ability to integrate various criteria with appropriate weights, thereby reducing subjectivity in determining social assistance recipients. However, a primary challenge in implementing this method lies in ensuring the availability and accuracy of complete data to avoid biases in calculation outcomes.

CONCLUSION

Jumirah had the highest score of 270,31, according to study results utilizing the Composite Performance Index based on data from possible receivers of social assistance from the Aek Songsongan Village Office. More accurate rating of possible users of social assistance was achieved through the use of the Composite Performance Index technique.

The decision support system created using the CPI method could facilitate the Aek Songsongan Village Office staff in identifying and determining eligible social assistance recipients more easily and quickly, thus reducing the risk of errors and inequities in aid distribution.

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