

# Cooperative Health Performance and Assessment Information System Using the SAW (Simple Additive Weighting) Method

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## Abstract

The cooperative sector seeks to digitize all services, including the management of performance data that has duplicated data, the cooperative health assessment is slow in its calculations, the difficulty of communicating between cooperatives and the cooperative sector directly and reports that are difficult to obtain when needed. So a cooperative performance information and health assessment system was designed which is a performance data management system, cooperative health assessment using the SAW (Simple Additive Weighting) decision-making method, and there is a chat feature to communicate and report presentation features that are easy to obtain. The design and development of a cooperative health and performance information system adopts the waterfall method using UML (Unified Modeling Language) modeling and the implementation of the system uses the PHP (Hypertext Preprocessor) programming language in the codeigniter framework and blackbox testing is carried out with an average result of 100% and the test results UAT (User Acceptance Testing) with an average result of 95.66%.

**Keywords:** Information Systems, Cooperatives, Performance, Health, SAW, Chatting

## 1. Introduction

Cooperatives are business institutions that carry out a lot of transaction activities, where transaction activities currently require technology, especially information systems. The Subang Trade and Industry UMKM Cooperative Service (DKUPP) is an agency that assists the regent in carrying out government affairs in the fields of Cooperatives, UMKM, Trade and Industry in Subang Regency [1]. Cooperatives need a health assessment to convince or build the trust of their members and also as a form of proof of the activity of a cooperative, especially for savings and loan cooperatives. Currently, cooperative health assessments are carried out by the cooperative sector using paper or assessment forms. Problems often occur when carrying out cooperative health assessments, such as slow calculations and errors in dividing the health assessment aspects. The cooperative sector also has problems in storing cooperative performance data every year, because the current year's performance data is stored by combining files from previous years which causes data duplication.

Then, it is difficult for cooperative business entities to communicate by asking about performance data or asking about cooperative health assessments in the cooperative sector. This is because the task or work schedule of cooperative sector staff is uncertain and makes the information provided hampered. Performance data and health assessments of cooperatives are also often used by sections of the cooperative sector for work purposes or simply to report as a summary to the head of the cooperative sector, but data on performance and health assessments of cooperatives is difficult to obtain and is not available when needed.

Based on the problems that occur in the cooperative sector, an information system was created with functions that can manage performance data, manage general cooperative data, have chat features and more effective health assessments [2]. In its development, the method adopted was waterfall, this method has stages of completion, namely analysis, design, coding and testing. In calculating the cooperative health assessment, the SAW (Simple Additive Weighting) decision making method is used [3].

## 2. Method

The Waterfall method is one of the methods in SDLC where each phase in the waterfall must be completed first before proceeding to the next phase. The design and development of cooperative health and health information systems adopts the waterfall method[4]. The stages of this system include analysis, design, coding and testing stages. By using this waterfall method, each stage of the research will be much more systematically controlled, the stages of system completion can be seen in Figure 1.

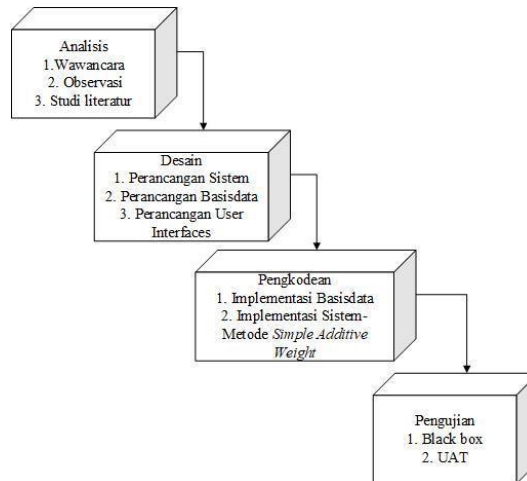


Fig. 1: Stages of system completion

The following are the stages of completing the system:

1. At this analysis stage, data collection uses three methods, namely observation, interviews and literature study [5].
2. At the design stage the author carries out the system design process using UML (Unified Modeling Language) modeling including use case diagrams, activity diagrams, sequence diagrams and class diagrams. Create a database design using the ERD (Entity Relationship Diagram) model. And design the appearance using balsamiq mockup [4].
3. At the coding stage, a database was implemented using MySQL. Next, to implement the system, the PHP (Hypertext Preprocessor) programming language is used in the CodeIgniter framework and uses the Simple Additive Weighting method. At this stage the Saw method is also applied [6]. SAW (Simple Additive Weighting) is a method that seeks a weighted sum of performance ratings based on alternatives for all criteria. SAW requires a matrix normalization process to compare with all existing alternative ratings [7].

$$R_{ij} = \left\{ \frac{X_{ij}}{\text{Max } X_{ij}} \right\} \dots \dots \dots (1)$$

Jika j adalah atribut keuntungan (Benefit)

$$R_{ij} = \left\{ \frac{\text{Min } X_{ij}}{X_{ij}} \right\} \dots \dots \dots (2)$$

Jika j adalah atribut biaya (cost)

Fig. 2: SAW (Simple Additive Weighting) Calculation Formula

Where:

- Rij = Normalized performance rating
- Maxij = The maximum value of each row and column
- Minij = The minimum of each row and column
- Xij = Rows and columns of a matrix

Where rij is the normalized work rating of alternative Ai on attribute Cj; I = 1,2 ...m and j = 1,2, ...n

$$V_i = \sum_{j=1}^n W_j R_{ij} \dots \dots \dots (3)$$

Fig. 3: SAW calculation formula

A greater Vi value identifies that alternative Ai is the more selected alternative. Where:

- Vi = The final value of the alternative
- Wi = Specified weight
- Rij = Matrix normalization

4. The testing phase uses two testing methods, namely Black Box Testing and UAT (User Acceptance Testing)[8].

### 3. Results and Discussion

#### 3.1. System Requirements Analysis

Based on the results of the interviews that have been conducted, the following is an analysis of the current system in the cooperative sector. The analysis is illustrated by a health assessment flowchart, which can be seen in Figure 4.

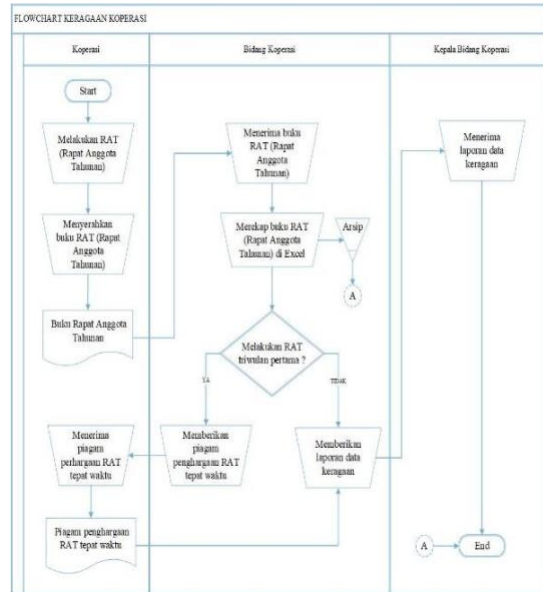


Fig. 4: Current business processes (performance data)

3.2. Design

The following is a use case diagram for the cooperative performance and health assessment information system, which can be seen in Figure 5.

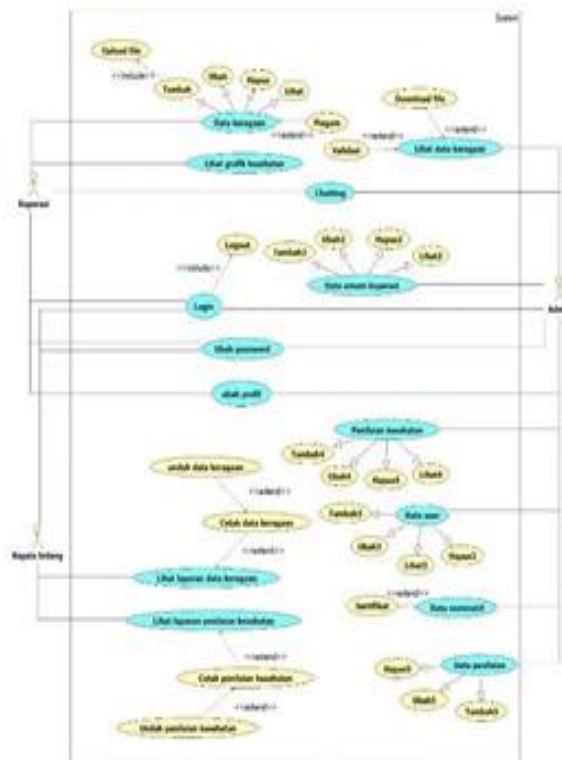


Fig. 5: Use case performance diagram and health assessment

There are 3 actors involved in the system to be built. The first actor, namely admin, plays the role of admin who manages user data, general cooperative data, performance data, chats and health assessments [9]. The second actor is the head of the cooperative department whose role is to view performance data reports and health assessments and the last actor is the cooperative who has the role of managing performance data, chatting and viewing the cooperative's annual health graph role is to view performance data reports and health

assessments and the last actor is the cooperative who has the role of managing performance data, chatting and viewing the cooperative's annual health graph.

### 3.3. Implementation

#### a. Database

The following is the implementation of the database in the cooperative performance and health assessment system (SIKPenKes) which can be seen in Figure 6 [4].

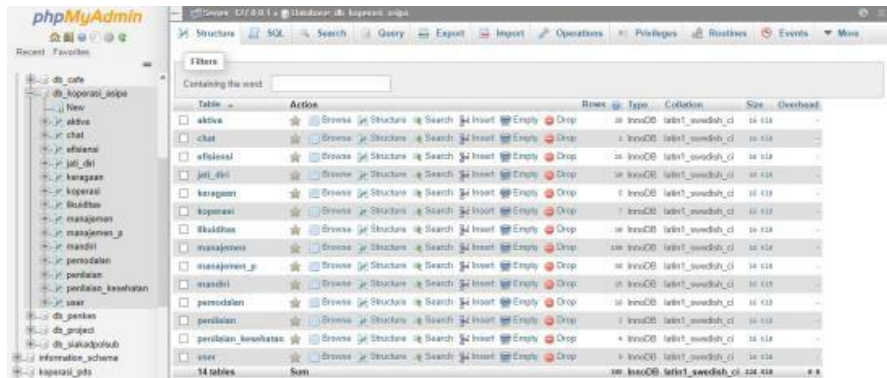


Fig. 6: Database implementation

There are 14 tables consisting of tables of assets, chat, efficiency, identity, performance, cooperatives, liquidity, management, capital management, independence, capital, assessment, health and user assessment.

#### b. System

The implementation of the performance data page can be seen in Figure 7.

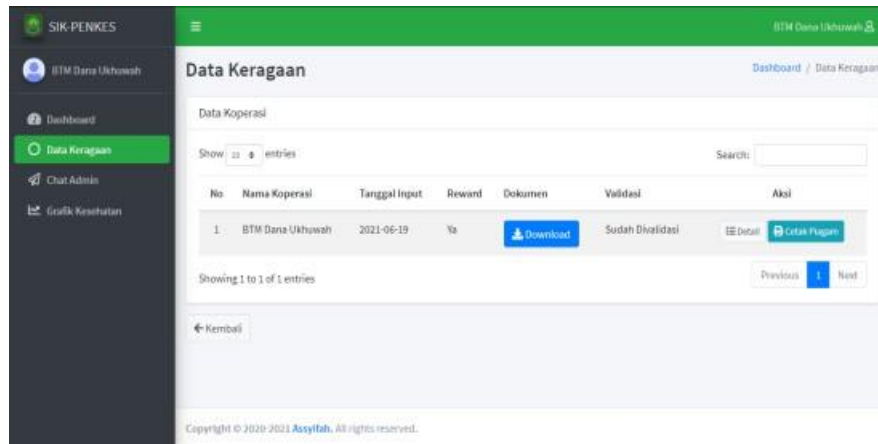


Fig. 7: Implementation of performance data

The implementation of the health assessment page can be seen in Figure 8.

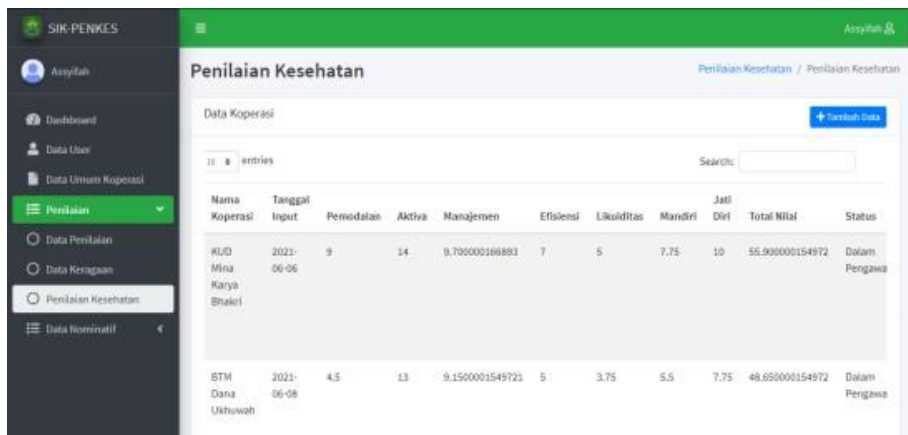


Fig. 8: Implementation of health assessment

In the picture you can see the implementation of the health assessment page consisting of number, cooperative name, input date, capital, assets, management, efficiency, liquidity, independence, identity, total value and health assessment status.

c. **SAW**

Below are several criteria and their weight values. Determination of criteria can be seen in table 1

**Table 1: Health assessment criteria**

Code Criteria	Criteria Terms
C1	Capital
C2	Quality of Productive Assets
C3	Management
C4	Efficiency
C5	Liquidity
C6	Independence and Growth
C7	Cooperative identity

The following is an alternative table containing the names of cooperative business entities in Subang Regency, which can be seen in table 2.

**Table 2: Alternatif Business entity**

Code Alternative	Business entity
A1	KUD Mina Karya Bhakri
A2	BTM Dana Ukhuwah
A3	KPRI Kasomalang
A4	KPRI Tanjungsiang
A5	KSP Maduma
A6	KSP Terbit Mutiara
A7	KSP Sahabat Setia Utama

Next, the table for determining the value weights is based on predetermined criteria. The determination of value weights can be seen in table 3.

**Table 3: Value weights**

Criteria Code	Criteria Code
C1	15
C2	25
C3	15
C4	10
C5	15
C6	10
C7	10
Total	100

After determining the criteria, weights, sub-criteria, values and knowing the standard values or predicates of the assessment results, a suitability rating table is created for each alternative for each criterion [10]. The matrix table can be seen in table 4.

**Table 4:** Matriks

	C1	C2	C3	C4	C5	C6	C7
A1	15	25	10.5	8	5	10	10
A2	10.5	18	13.5	8	5	5.5	7.75
A3	10.5	20	12.5	9	7.5	8.5	8.5
A4	12	25	13.5	8	7.5	5.5	7.75
A5	12	25	9.75	7.5	7.5	10	8.25
A6	10.5	17.5	10.4	8.5	7.5	10	10
A7	10.5	22.5	13.90	6.5	7.5	7.75	10

Giving the normalization matrix:

- a. Capital
  - $R11 = 15/15 = 1$
  - $R21 = 10.5/15 = 0.7$
  - $R31 = 10.5/15 = 0.7$
  - $R41 = 12/15 = 0.8$
  - $R51 = 12/15 = 0.8$
  - $R61 = 10.5/15 = 0.7$
  - $R71 = 10.5/15 = 0.7$
- b. Quality of Productive Assets
  - $R12 = 25/25 = 1$
  - $R22 = 18/25 = 0.72$
  - $R32 = 20/25 = 0.8$
  - $R42 = 25/25 = 1$
  - $R52 = 25/25 = 1$
  - $R62 = 22.5/25 = 0.9$
  - $R72 = 17.5/25 = 0.7$
- c. Managemen
  - $R13 = 10.5/15 = 0.7$
  - $R23 = 13.5/15 = 0.9$
  - $R33 = 12.5/15 = 0.83$
  - $R43 = 13.5/15 = 0.9$
  - $R53 = 9.75/15 = 0.65$
  - $R63 = 10.4/15 = 0.69$
  - $R73 = 13.90/15 = 0.92$
- d. Efficiency
  - $R14 = 8/10 = 0.8$
  - $R24 = 8/10 = 0.8$
  - $R34 = 9/10 = 0.9$
  - $R44 = 8/10 = 0.8$
  - $R54 = 7.5/10 = 0.75$
  - $R64 = 8.5/10 = 0.85$
  - $R74 = 6.5/10 = 0.65$
- e. Liquidity
  - $R15 = 5/15 = 0.33$
  - $R25 = 5/15 = 0.33$
  - $R35 = 7.5/15 = 0.5$
  - $R45 = 7.5/15 = 0.5$
  - $R55 = 7.5/15 = 0.5$
  - $R65 = 7.5/15 = 0.5$
  - $R75 = 7.5/15 = 0.5$
- f. Independence
  - $R16 = 10/10 = 1$
  - $R26 = 5.5/10 = 0.55$
  - $R36 = 8.5/10 = 0.85$
  - $R46 = 5.5/10 = 0.55$
  - $R56 = 10/10 = 1$
  - $R66 = 10/10 = 1$
  - $R76 = 7.75/10 = 0.775$
- g. Identity
  - $R17 = 10/10 = 1$

$$R_{27} = 7.75/10 = 0.775$$

$$R_{37} = 8.5/10 = 0.85$$

$$R_{47} = 7.75/10 = 0.775$$

$$R_{57} = 8.25/10 = 0.825$$

$$R_{67} = 10/10 = 1$$

$$R_{77} = 10/10 = 1$$

The following is a normalization matrix table with each criterion which can be seen in table 5.

**Table 5:** Normalization matrix table

1	1	0.7	0.8	0.33	1	1
0.7	0.72	0.9	0.8	0.33	0.55	0.775
0.7	0.8	0.83	0.9	0.5	0.85	0.85
0.8	1	0.9	0.8	0.5	0.55	0.775
0.8	1	0.65	0.75	0.5	1	0.825
0.7	0.9	0.69	0.85	0.5	1	1
0.7	0.7	0.92	0.65	0.5	0.775	1

(0,15),(0,25),(0,15),(0,10),(0,15),(0,10),(0,10) based on value weights

$$V1 = (1*0.15)+(1*0.25)+(0.7*0.15)+(0.8*0.10)+(0.33*0.15)+(1*0.10)+(1*0.10) = 0,8345*100 = 83,45$$

$$V2 = (0.7*0.15)+(0.72*0.25)+(0.9*0.15)+(0.8*0.10)+(0.33*0.15)+(0.55*0.10)+(0.775*0.10) = 0,682 *100 = 68,2$$

$$V3 = (0.7*0.15)+(0.8*0.25)+(0.83*0.15)+(0.9*0.10)+(0.5*0.15)+(0.85*0.10)+(0.85*0.10) = 0,762*100 = 76,45$$

$$V4 = (0.8*0.15)+(1*0.25)+(0.9*0.15)+(0.8*0.10)+(0.5*0.15)+(0.55*0.10)+(0.775*0.10) = 0,7925*100 = 79,25$$

$$V5 = (0.8*0.15)+(1*0.25)+(0.65*0.15)+(0.75*0.10)+(0.5*0.15)+(1*0.10)+(0.825*0.10) = 0,8*100 = 80$$

The following are the calculation results and preference predicates for each alternative which can be seen in table 6.

**Table 6:** Table of calculation results and predicates

Koperasi	Mark	Information
KUD Mina Karya Bhakri	83,45	Healthy
BTM Dana Ukhuwah	68,2	Pretty Healthy
KPRI Kasomalang	76,45	Pretty Healthy
KPRI Tanjungsiang	79,25	Pretty Healthy
KSP Maduma	80	Healthy
KSP Terbit Mutiara	79,35	Pretty Healthy
KSP Sahabat Setia Utama	73,55	Pretty Healthy

### 3.4. Testing

From black box testing, this system has 110/11= 100% functionality based on test results from 5 respondents. Consisting of the admin user who has 4 test pages and gets 100% functionality, then the cooperative user who has 3 test pages and gets 100% functionality, finally the head of field user has 2 test pages and gets 100% functionality[8].

Based on the UAT test results, an average of 96% for system aspects agreed that this system had a good appearance in development. In the user aspect, it is known that the average is 95%. This can be said that this system is easy to operate and is able to carry out good assessments and help the system that is running. And finally, the interaction aspect is known, an average of 96% agree that this system is running normally and helps in assessing the health of the cooperative[11].

## 4. Conclusion

Based on the results of the analysis of the design and development of the cooperative performance and health assessment information system (SIKPenKes) by adopting the waterfall method, the system design process uses UML modeling and database design with ERD, the database implementation process uses MySql and the system implementation with the CodeIgniter Framework uses the PHP programming

language, and has been tested using black box testing with an average result of 100% and UAT testing results with an average result of 95.66%, so it can be concluded that this system produces the following conclusions:

1. SIKPenKes has a health assessment management feature and calculations using the SAW (Simple Additive Weighting) method, based on criteria or assessment aspects that produce a cooperative health assessment certificate.
2. SIKPenKes has a more efficient performance data management feature by separating data (per year or month) and avoiding data duplication.
3. SIKPenKes has a chat feature, this feature makes it easier for cooperatives and cooperatives to communicate online.
4. SIKPenKes has a performance report and health assessment report feature that can be accessed anywhere by the head of the department online.

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