

Financing Decision Support System Using Analytical Hierarchy Process (AHP) And Simple Additive Weighting (SAW) Methods (Case Study of a Cooperative in Bandung)

Moch Rifki Adriansyah¹, Lilis Emalia², Fikri Irawan Abdurahman³, Isak Ramlan⁴

STMIK Mardira Indonesia, Bandung ^{1,2,3,4}

Email: mochrifki98620@gmail.com¹, lilis@stmik-mi.ac.id², fikri.abdurahman@stmik-mi.ac.id³,
isak@stmik-mi.ac.id⁴

ABSTRACT

Cooperatives, as fundamental components of the people's economy, significantly enhance the well-being of their members. A primary problem encountered by cooperatives is the finance decision-making process, which frequently exhibits subjectivity and suboptimality. This may result in elevated credit risks and diminished trust among members. This project aims to design and construct a Decision Support System (DSS) that facilitates funding decision-making in a cooperative in Bandung with greater objectivity, transparency, and efficiency. The created Decision Support System (DSS) aims to reduce errors in decision-making and improve the quality of service offered by the cooperative to its members.

This research employs the Analytical Hierarchy Process (AHP) to determine the relative weights of pertinent variables for evaluating potential financial receivers. Thereafter, the Simple Additive Weighting (SAW) approach is utilised to compute the overall score for each funding choice according to the set criterion weights. The research findings demonstrate that the created Decision Support System (DSS) can offer more precise and reliable financing suggestions than the traditional approaches previously employed by the cooperative. This DSS can improve the efficiency of the decision-making process and ensure transparency for all stakeholders. The deployment of this Decision Support System is anticipated to enhance the cooperative's financial performance, mitigate credit risks, and bolster member faith in the cooperative. This DSS can serve as a paradigm for other cooperatives to implement information technology to improve their service quality.

Keywords: *Cooperatives, Financing, DSS, AHP, SAW*

INTRODUCTION

Indonesia possesses a substantial and important economic sector. Economic development in Indonesia can be attained through multiple avenues, one of which is cooperatives. Individuals frequently engage in saving and borrowing activities with cooperatives. Given the prevailing economic expansion, capital suppliers play a crucial role in facilitating economic activity. In this context, savings and loan cooperatives offer financial services.

A cooperative in Bandung provides loans or credit to alleviate financial challenges within the community. Government Regulation No. 9 of 1995 defines a loan as the provision of funds or equivalent claims based on an agreement between a cooperative and another party, obligating the borrower to repay the debt after a specified period, along with a predetermined reward payment. The cooperative engages in financing as a business activity, utilising funds derived from member savings to extend loans to members, so creating profits through profit-sharing, margins, and fees associated with loan disbursement.

The development of a cooperative in Bandung is substantially influenced by the number of members who possess financial resources. The extent of financing obtained influences the cooperative's profitability. An augmentation in finance immediately influences the cooperative's revenue. Furthermore, the cooperative's profits are derived from administrative fees and revenue generated through financing services.

The 2024 work plan for a cooperative in Bandung encompasses enhancing services for current and prospective members, alongside procuring equipment to facilitate efficient management operations and business unit oversight, while ensuring prompt reporting. In offering finance, the cooperative must conduct meticulous evaluations and computations concerning its members.

The finance approval process at this cooperative currently relies on estimates and committee evaluations, which may occasionally lead to inaccuracies in the analysis of financial data, such as payment calculations and residual living expenses. (Mukti et al., 2024) This cooperative lacks a mechanism for financing analysis. The financing process encompasses multiple stages: initially, members compile the requisite documentation for financing; subsequently, they collect member and funding data; finally, this information is presented to

the committee. The committee thereafter determines the acceptance or rejection of members based on their assessments. Essential factors for loan approval by the committee encompass collateral, income, loan amount, length, and repayment installments. Consequently, members must wait several days to determine the committee's conclusion. These factors pertain to the eligibility of members for financing, necessitating the cooperative to use prudence in selecting appropriate members. This strategy aims to prevent interruptions in fund circulation and reduce the incidence of non-performing loans. (Wanti et al., 2020)

The accountability report from the management and supervisory board, presented at the 2023 annual member meeting of Koperasi Baiturrahim Syariah Indonesia, indicated that the income from non-performing loans totalled IDR 225,200,000. This circumstance occurs due to the tardiness of certain members in fulfilling payments at maturity or encountering difficulties during the payment process. Consequently, a Decision Support System (DSS) is required to analyse loan data, formulate regulations, and evaluate member eligibility for borrowing based on financial assessments.

The determination of finance receivers at this cooperative in Bandung entails various factors, necessitating the implementation of a multi-criteria decision support system (DSS). The techniques employed to construct this multi-criteria Decision Support System (DSS) comprise the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW). The AHP approach is used to determine the weights of each criterion for evaluating financial eligibility. In contrast, the SAW method is employed to identify the most qualified potential borrowers for financing.

System

The term 'system' derives from the Latin word 'systema' and the Greek word 'sustema.' A system is described as a cohesive entity composed of interconnected components or pieces that enable the transfer of information, materials, or energy to accomplish a specific objective. It can also be characterised as a compilation of interrelated parts that mutually impact one another in executing operations to achieve a shared aim. (UTAMA et al., 2020) Consequently, a system is a structured assemblage of interrelated components that constitute a whole. A system can also be defined as a compilation of perspectives, theories, principles, and similar elements. The term 'system' originates from the Greek word 'system,' denoting a

group of components or pieces that are methodically interconnected to attain a shared objective.

Information

Information constitutes a message (utterance or expression) or a compilation of messages comprising an arrangement of sequences of symbols or meanings that can be derived from a message or collection of messages. Information may be documented or conveyed. It can be documented as signs or as signals derived from waves. (Al Nawaiseh et al., 2022; Rojakul et al., 2024)

Information Systems

“Information Systems comprise individuals, technological tools, media, procedures, and controls designed to structure essential communication networks, routine processes or transactions, assist both internal and external management and users, and establish a foundation for informed decision-making.” (Riyanto & Yunus, 2021)

Economy

The term economy derives from ancient Greek, namely from 'ikos,' meaning family or household, and 'nomos,' meaning regulations. The term "economics," derived etymologically, signifies the management or regulation of household affairs. (Patriani, 2023)

Cooperative

A cooperative is an enterprise that embodies economic democracy by incorporating principles of cooperative commerce. Financial reports published by the cooperative are essential for evaluating its financial performance, enabling the analysis of both achievements and difficulties encountered in financial management. (Suhandi, 2020) Financial reports are statements that directly pertain to the cooperative's financial status and operations, offering insights into its financial condition.

Financing

Provided from one entity to another to facilitate intended investments, whether executed independently or via an organisation.

Analytical Hierarchy Process (AHP)

"The utilisation of tools in quality control operations is essential for the company's endeavours to identify the root causes of production issues; this research employs these tools" a(Arifitama, 2022)

Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) method is a weighted summation technique. The fundamental principle of the SAW technique is to determine the weighted sum of performance evaluations for each alternative across all criteria. The SAW approach necessitates a normalisation procedure for the choice matrix (X) to a scale suitable for comparison with all alternative ratings presented. (Aulawi et al., 2023)

This study identifies a problem with the financial approval procedure at a cooperative in Bandung, which currently relies on estimates and committee evaluations. This method occasionally yields inaccuracies in the analysis of financing data, such as installment computations and residual living expenses, which can lead to disruptions in fund circulation and the emergence of non-performing loans within the cooperative. The aims of this research, design, and development of the information system for this thesis are to create a decision support system for financing at the cooperative utilising the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods, implement this decision support system, and assess its performance at Koperasi Baiturrahim Syariah Indonesia. (Al Nawaiseh et al., 2022)

METHOD

This research was conducted in multiple phases, beginning with problem formulation, followed by data collection, data processing utilizing the AHP method, criteria weight determination, and concluding with data processing through the SAW method to establish the ranking of financing receivers. The research design is delineated as follows:

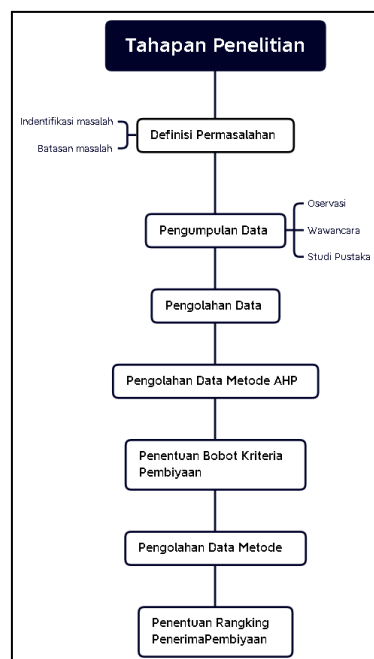


Figure 1. Research stages

The steps of this research, as indicated in the diagram above, are as follows:

Problem Definition: The identification phase entails recognising the challenges inherent in the financing application procedure for Mudharabah contracts. This phase outlines the study objectives and scope, identifies potential options for financing Mudharabah contracts through a Decision Support System (DSS), and specifies the methodologies to be employed by the DSS.

Data Collection: This study employs secondary data obtained via documentation analysis and literature reviews. The literature evaluation incorporates scientific journals and papers about finance data for Mudharabah contracts sourced from the Sharia Financial Services Unit.

Developing the Decision Support System: The methodologies utilised in this study are Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW). The implementation phases encompass AHP, which assigns weights to each criterion and sub-criterion, whilst SAW generates ranks for the available alternatives. The procedural sequence of the Decision Support System utilising the AHP-SAW hybrid methodology is as follows:

- a. AHP method

1. Pairwise comparison matrix
 2. Normalization of pairwise comparison matrix
 3. Calculate the criteria weight
 4. Check consistency
- b. SAW method
1. Create a decision matrix based on criteria (C_i)

Matrix Normalization Determines Ranking

DISCUSSION

Business process analysis

The following is the business process for applying for financing at Baiturrahim Syari'ah Indonesia Cooperative. A business process is a group of connected activities or tasks designed to solve a particular problem or create a product or service.

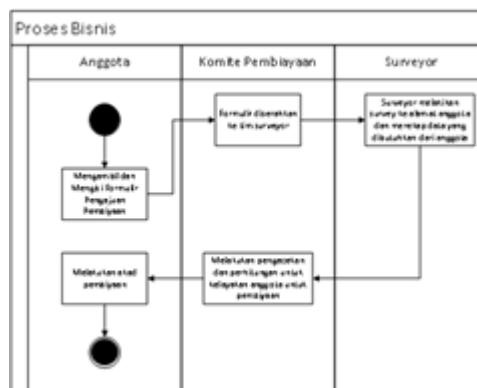


Figure 1. Business process analysis

System design

System design aims to specify the technical aspects of the solution in the design. At this point, the design will be defined in detail to address more technical problems related to implementation activities, such as use case diagrams, activity diagrams, sequence diagrams, class diagrams, and interface design.

1. Use Case Diagram

Suggested Use Case describes the activities performed within the system in detail. It presents a set of use cases and actors, along with their relationships, and provides a graphical representation of some or all of these actors and their interactions, introducing the system. It does not provide a detailed explanation of how a particular use case is utilized, but it offers a brief overview of the relationships between them.



Figure 2. Use Case Diagram

2. Activity diagram

The Activity Diagram shows how a system's activities move from one to another. The process starts with the user and moves to the next display.

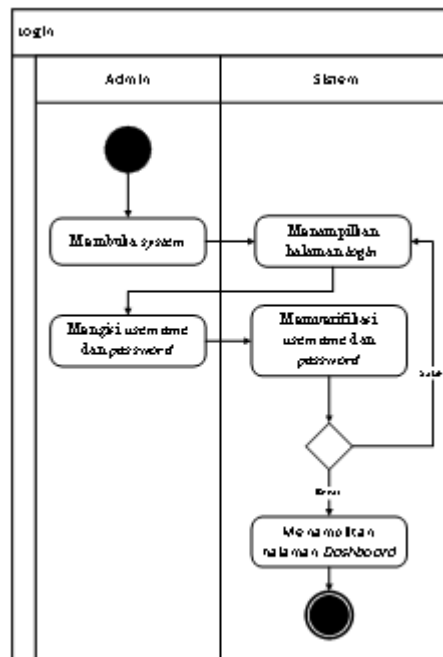


Figure 3. Activity diagram

3. Sequence Diagram

The Login Sequence Diagram explains the login flow to the system according to the actor.

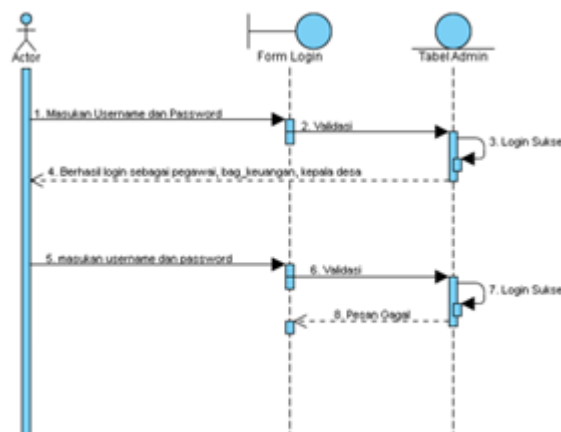


Figure 4. Sequence Diagram

4. Class Diagram

The class diagram illustrates the various classes within the software system being developed. It also illustrates the relationships between the classes and how they collaborate to achieve a specific goal. The class diagram for the Decision Support System for Financing, which utilizes the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods, is shown below.

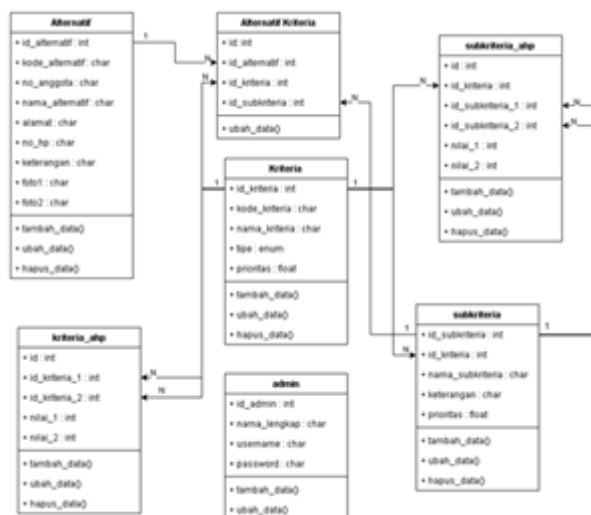


Figure 5. Class Diagram

5. Interface design

For the program, the menu structure is designed to make navigation easier for users. It also serves as a guide to running the Decision Support System for Financing using Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) techniques.



Figure 6. interface Design

System implementation

Based on the design results in the previous chapter, the program discussion page has been created.



Figure 7. Login Form Display



Figure 8. Dashboard View

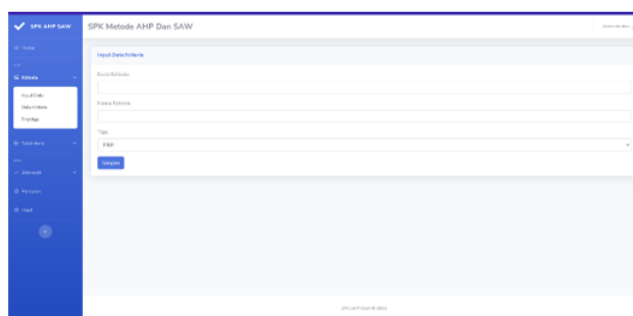


Figure 9. Criteria Data Input Display

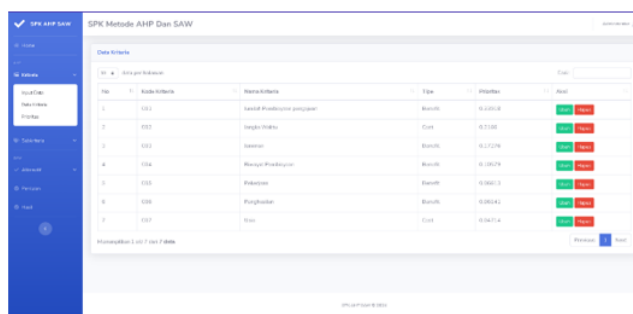


Figure 10. Criteria Data Display

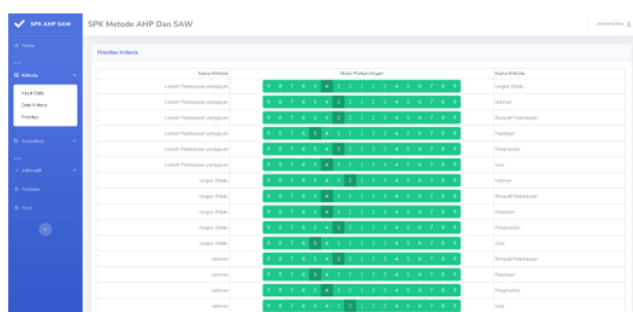


Figure 11. Priority Criteria Display

Figure 12. Sub-Criteria Data Input Display

No	Kriteria	Nama Subkriteria	Bobot	Prioritas	Aksi
1	C01 - Kualitas Produk	<= 10 gms	1	1	[Edit] [Hapus]
2	C01 - Kualitas Produk	<= 15 gms	0.33333	1	[Edit] [Hapus]
3	C01 - Kualitas Produk	<= 20 gms	0.33333	1	[Edit] [Hapus]
4	C01 - Kualitas Produk	<= 25 gms	1	1	[Edit] [Hapus]
5	C01 - Kualitas Produk	<= 30 gms	0.33333	1	[Edit] [Hapus]
6	C01 - Kualitas Produk	<= 35 gms	0.33333	1	[Edit] [Hapus]
7	C01 - Kualitas Produk	<= 40 gms	1	1	[Edit] [Hapus]
8	C01 - Kualitas Produk	<= 45 gms	0.33333	1	[Edit] [Hapus]
9	C01 - Kualitas Produk	<= 50 gms	0.33333	1	[Edit] [Hapus]
10	C01 - Kualitas Produk	<= 55 gms	1	1	[Edit] [Hapus]

Figure 13. Sub-Criteria Data Display

No	Kriteria	Nama Subkriteria	Prioritas	Aksi
1	C01 - Kualitas Produk	<= 10 gms	1	[Edit] [Hapus]
2	C01 - Kualitas Produk	<= 15 gms	0.33333	[Edit] [Hapus]
3	C01 - Kualitas Produk	<= 20 gms	0.33333	[Edit] [Hapus]
4	C01 - Kualitas Produk	<= 25 gms	1	[Edit] [Hapus]
5	C01 - Kualitas Produk	<= 30 gms	0.33333	[Edit] [Hapus]
6	C01 - Kualitas Produk	<= 35 gms	0.33333	[Edit] [Hapus]
7	C01 - Kualitas Produk	<= 40 gms	1	[Edit] [Hapus]
8	C01 - Kualitas Produk	<= 45 gms	0.33333	[Edit] [Hapus]
9	C01 - Kualitas Produk	<= 50 gms	0.33333	[Edit] [Hapus]
10	C01 - Kualitas Produk	<= 55 gms	1	[Edit] [Hapus]

Figure 14. Sub-Criteria Priority Display

The screenshot shows the SPK AHP web application interface. The left sidebar contains navigation links: Home, Laporan, Transaksi, and Pengguna. The main content area displays a table titled "Data Pengguna" with the following columns: No, Kode Pengguna, Nama Anggota, and Aksi. The table lists 10 users, each with a "Detail" (blue button) and "Hapus" (red button) action. At the bottom, there is a pagination bar showing "1 of 10 data" and buttons for "Previous" and "Next".

No	Kode Pengguna	Nama Anggota	Aksi
1	A001	Rita Elvoni	Detail Hapus
2	A002	Sapriani	Detail Hapus
3	A003	Alghimar Darmawan	Detail Hapus
4	A004	Nubani Elvoni Lestari	Detail Hapus
5	A005	Wahani Darmawan	Detail Hapus
6	A006	Dina Yuliyah	Detail Hapus
7	A007	Rizka April	Detail Hapus
8	A008	Rani	Detail Hapus
9	A009	Laili Elvoni	Detail Hapus
10	A010	Dia Nurani	Detail Hapus

1 of 10 data

Previous Next

No	Kode	Alternatif	Jumlah Penanaman pengujian	Jumlah Waktu	Lemari	Ukuran Penanaman	Keterangan	Penggunaan	Uk
1	0001	Buku	<10 peng	<10 Bab	0001 Kertas	Tegak vertikal	Horisontal	<1 peng	<10 Bab
2	0002	Diagram	10 - 20 peng	<10 Bab	Tidak ada	Angka/teks	Horisontal	<10 peng	<10 Bab
3	0003	Media elektronik	<10 peng	<10 Bab	0003 Kertas	Horisontal	Horisontal	<1 peng	<10 Bab
4	0004	Visualisasi/Animasi	10 - 20 peng	<10 Bab	0004 Kertas	Horisontal	Horisontal	<1 peng	<10 Bab
5	0005	Visualisasi/Animasi	10 - 20 peng	<10 Bab	0005 Kertas	Tegak vertikal	Horisontal	<1 peng	<10 Bab
6	0006	Real Time/Animasi	10 - 20 peng	<10 Bab	0006 Kertas	Tegak vertikal	Horisontal	<1 peng	<10 Bab
7	0007	Visualisasi/Animasi	<10 peng	<10 Bab	0007 Kertas	Horisontal	Horisontal	<1 peng	<10 Bab
8	0008	Simulasi	10 - 20 peng	<10 Bab	Tidak ada	Tegak vertikal	Horisontal	<1 peng	<10 Bab
9	0009	Simulasi/Animasi	10 - 20 peng	<10 Bab	Tidak ada	Horisontal	Horisontal	<1 peng	<10 Bab
10	0010	Visualisasi/Animasi	<10 Bab	<10 Bab	0010 Kertas	Tegak vertikal	Horisontal	<1 peng	<10 Bab

The screenshot shows the 'Hasil Perangkingan' (Ranking Results) page of the SPK Matrika AHP Dan SAW application. The page features a sidebar menu on the left and a main content area. The main content area has a title 'Hasil Perangkingan' and a table with the following data:

No	Kode	Nama Anggot	Nilai	Kelipatan
1	A0007	Fahima Rajad	0.77718	100%
2	A0001	Reza Nurul	0.71407	100%
3	A0000	Samud	0.60360	100%
4	A0003	Adrianus Shamsul	0.59333	100%
5	A0001	Melanie Darmawati	0.50998	100%
6	A0010	Eisa Nurjan	0.50377	100%
7	A0006	Eisa Nurulnangih	0.51184	100%
8	A0007	Teguhari	0.49383	100%
9	A0009	Eisa Nurulnangih	0.44007	100%
10	A0004	Yusuf Nurulnangih	0.44007	100%

CONCLUSION

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the cooperative can efficiently assess diverse financing options against criteria relevant to its members.

This study provides rankings of cooperative members in Bandung, serving as a significant reference for fund distribution. By integrating the AHP and SAW methodologies, the cooperative can ensure its decisions are both objective and transparent. This improves the cooperative's financial management and promotes equity among members. This method ultimately aims to help the cooperative make informed decisions that align with its objectives and enhance its members' welfare.

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