



Decision Support System Using the Analytical Hierarchy Process Method in Determining Credit Recipient Eligibility

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Abstract

Banks play a fundamental role in improving public welfare by collecting funds through savings and redistributing them as credit. Although credit is the primary source of bank revenue, it carries significant risks if the feasibility analysis of prospective borrowers is flawed, potentially leading to non-performing loans that disrupt financial stability. BPR Nusantara Bona Pasogit 17 faces this challenge as it currently lacks an automated decision support system, resulting in assessments that are often inconsistent or subjective. This research aims to develop a web-based decision support system using the Analytical Hierarchy Process (AHP) method to determine credit recipient eligibility. Developed using PHP and MySQL, the system incorporates criteria management, AHP calculation processing, and automated eligibility ranking. Comprehensive validation through black-box and white-box testing confirmed that all functional components performed correctly with consistent "PASS" results. The AHP implementation produced a Consistency Ratio (CR) of 0.03797, indicating high reliability in decision-making. Criterion priority weights were identified as: Income (0.386), Character (0.219), Loan Amount (0.162), Collateral (0.103), Loan Term (0.07), and Age (0.06). System testing on 100 customer records resulted in a maximum eligibility score of 0.93501 and a minimum of 0.41839.

Keywords: Decision Support System, Credit Eligibility, Analytical Hierarchy Process

1. Introduction

According to Law Number 10 of 1998 concerning Banking, Article 1, Paragraph 2, a bank is defined as a business entity that collects funds from the public as savings and redistributes them in the form of credit or other financial instruments to improve the community's standard of living [1]. Although credit serves as the primary revenue stream for banks, its implementation entails significant risks. A bank's sustainability is heavily influenced by its credit management performance, where failures often manifest as bad debts or Non-Performing Loans (NPL). These issues typically stem from analytical errors during the selection process and the absence of a rapid, accurate decision-making system, necessitating specialized assessments before approving or rejecting credit applications [2].

Bank Perkreditan Rakyat (BPR) focuses on providing credit specifically for the lower-middle-class segment, demanding a high degree of precision in determining eligibility [3]. BPR Nusantara Bona Pasogit 17 is a credit provider that still determines the eligibility of credit recipients manually, which can lead to assessment errors. To assist this process, it is deemed necessary to implement a Decision Support System (DSS) as a tool to streamline analysis and improve efficiency. DSS is a well-established framework for resolving semi-structured problems, including credit eligibility evaluation [4]. This study utilizes the Analytical Hierarchy Process (AHP) method, which facilitates multi-criteria decision-making by producing a systematic ranking of alternatives. This method is particularly effective in solving complex and unstructured problems through simplified yet robust calculations [5].

2. Literature Review

2.1. Credit

Credit is defined as a loan granted to an individual based on trust, established through an agreement between the lender and the borrower regarding the term, interest rate, and collateral—both physical and non-physical. The primary function of providing collateral is to grant the bank the right to obtain repayment by utilizing the pledged assets in the event that the debtor is unable to repay the loan within the agreed timeframe [6].

2.2. Bank Perkreditan Rakyat (BPR)

Bank Perkreditan Rakyat (BPR) functions as a collector of public funds by accepting deposits in the form of savings or time deposits. However, BPR activities are more restricted compared to commercial banks, as BPR is prohibited from accepting demand deposits (checking accounts), conducting foreign currency transactions, or offering insurance services [7]. In providing credit or other loans to prospective customers, BPR adheres to the following principles [8]:

1. Character: An evaluation of the debtor's reputation analyzed through credit history (BI checking), background checks, residential environment, occupation, hobbies, and lifestyle.
2. Capacity: An assessment of the debtor's ability to repay the loan by evaluating their business prospects and financial capacity.
3. Capital: The bank examines the debtor's financial statements to see how capital is utilized. The bank must verify the sources of the debtor's business capital.
4. Condition: This involves predicting the current and future prospects of the debtor's business by analyzing financial stability and the risk of potential default.
5. Collateral: The bank requires physical or non-physical guarantees with a value exceeding the total requested credit. This is conducted by analyzing the ownership status of the provided assets

2.3. Decision Support System (DSS)

A Decision Support System (DSS) is a computer-based system designed to assist in decision-making for semi-structured problems. DSS helps process data and information by applying mathematical or statistical methods to generate recommendations and decision options that support the decision-making process [9]. A decision support system possesses several characteristics, including [10]:

1. Providing decision-making support, particularly for unstructured and semi-structured problems.
2. Executing the stages of the decision-making process: intelligence, design, choice, and implementation.
3. Involving individuals or groups in finding solutions to unstructured problems.
4. Possessing a fast and flexible adaptation system.
5. Maintaining an interactive nature that is user-friendly.
6. The capability to access various data sources, formats, and types.
7. Granting decision-makers full authority in making decisions to solve a problem.
8. Allowing users to develop simple systems, while enabling the construction of more complex systems with the assistance of information system experts.

2.4. Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a decision support model created and developed by Thomas L. Saaty in the 1980s. AHP serves as a decision-making method that integrates the principles of subjectivity and objectivity. It decomposes complex multi-criteria problems into a hierarchy consisting of several levels: the primary goal, criteria, sub-criteria, and alternatives, all of which are interrelated with varying priority levels. The primary tool utilized is a hierarchy, with human perception as its fundamental input. In the AHP method, a hierarchy is defined as a representation of a complex problem within a multi-level structure. By employing a hierarchy, unstructured and complex problems can be segmented into specific categories, thereby providing a structured framework [11].

The Analytical Hierarchy Process (AHP) offers several advantages in decision-making compared to other methods, including [12]:

1. Flexibility in hierarchical modeling by integrating both qualitative and quantitative data.
2. The ability to resolve complex problems, thereby facilitating the analytical process.
3. Providing a measurement scale to establish priorities among criteria.
4. Incorporating logical consistency in evaluating the prioritization of criteria and alternatives through pairwise comparisons.

In solving problems using the Analytical Hierarchy Process (AHP) method, the computational workflow or steps are as follows [13]:

1. Constructing the Hierarchical Elements

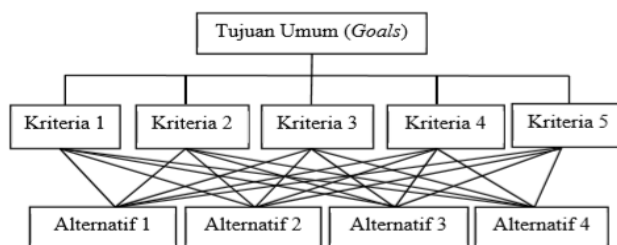


Fig. 1: Hierarchy Structure

2. Pairwise Comparison

Pairwise comparison aims to determine the level of importance of one element relative to another based on a pairwise comparison assessment scale.

Table 1: Paired Comparison Rating Scale

Priority Scale	Definition
1	Both elements are of equal importance
3	One element is slightly more important
5	One element is essential or significantly more important
7	One element is demonstrably much more important

9 2,4,6,8 Reciprocal	One element is absolutely more important Intermediate values between two adjacent judgments If element <i>i</i> has a specific importance value compared to <i>j</i> , then <i>j</i> has the reciprocal value of <i>i</i> .
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The importance values of each element are simplified by converting them into decimal form, followed by summing the values of the elements in each column.

	A_1	A_2	...	A_n
A_1	1	a_{12}	...	a_{1n}
A_2	$1/a_{12}$	1	...	$1/a_{2n}$
A_3	$1/a_{13}$	$1/a_{23}$...	$1/a_{3n}$
⋮	⋮	⋮	⋮	⋮
A_n	$1/a_{1n}$	a_{2n}	...	1
Jumlah	$\sum_{i=1}^n a_{i1}$	$\sum_{i=1}^n a_{i2}$...	$\sum_{i=1}^n a_{in}$

Fig. 2: Pairwise Comparison Matrix

3 Matrix Normalization

- a. Sum the results of dividing each criterion's priority value by the total value of its respective column to obtain the normalized values.
- b. Divide the total normalized value by the number of criteria to obtain the priority weight for each criterion.
- c. Multiply the obtained priority weight of each element by the comparison priority column to obtain the total row sum s

4 Consistency Calculation

- a. Sum the quotients of the total row sums divided by the priority weights, then divide the result by the total number of criteria to obtain the Maximum Eigenvalue (λ_{max}).
- b. Consistency Index (CI)

$$CI = \frac{(\lambda_{max} - n)}{(n - 1)}$$

- c. Consistency Ratio (CR)

$$CR = CI/IR$$

n	1	2	3	4	5	6	7	8	9	10
IR	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Fig. 3: Random Consistency Index (IR) Value

The weighting values are considered valid and applicable if the Consistency Ratio (CR) is less than 0.1 or 10%. However, if the CR exceeds 10%, the pairwise comparison process must be repeated.

2.5. System Development Environment

This system was developed using Visual Studio Code as the primary text editor, chosen for its IntelliSense features and extension flexibility across various operating systems. The core logic was built using PHP, an open-source server-side scripting language specifically designed for dynamic web development [14]. For data management, MySQL is integrated with PHP to process large-scale databases rapidly and efficiently. All components are run using the XAMPP software suite as a local server (localhost) for initial development and testing. Finally, the system is accessed and displayed via Web Browsers such as Google Chrome or Mozilla Firefox to verify user interface functionality.

The testing phase was conducted to identify errors or functional discrepancies within the system through two primary approaches: Black-Box Testing and White-Box Testing. Black-Box Testing, also known as behavioral testing, focuses on observing software inputs and outputs to ensure the system operates according to the specified requirements without examining the internal code structure. Conversely, White-Box Testing is applied to perform an in-depth evaluation of technical aspects, including design testing, program logic, and code structure, ensuring that all system workflows comply with established standards [15].

3. Methodology

This study is a Research and Development (R&D) project aimed at designing a credit eligibility analysis system for BPR Nusantara Bona Pasogit 17, utilizing customer document data as the primary source. The variables employed in this research include the prospective debtor's character, age, income, loan amount, loan term, and collateral, all of which serve as the evaluative basis for the credit feasibility process.

The research framework begins with the identification of problems related to the inefficiency of the current credit assessment process, followed by the formulation of objectives and a literature review to strengthen the theoretical foundation. Subsequently, data collection, criteria weighting using the AHP method, and system design and implementation were conducted. Analytical stages, such as pairwise

comparison, priority calculation, and consistency testing, were also performed to ensure that the resulting criteria weights are accurate and reliable as a basis for decision-making within the developed system.

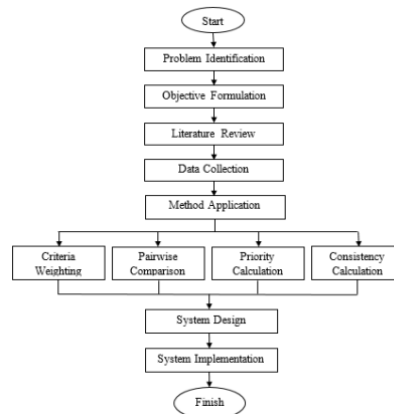


Fig. 4: Research Framework

4. Results and Discussion

4.1. Data Collection

The research data consists of 100 customer records from BPR Nusantara Bona Pasogit 17 from the 2022–2023 period, categorized into five credit performance levels. This data serves as the foundation for determining credit eligibility, with analytical variables including character, age, income, loan amount, term, and collateral. These variables are subsequently processed using the AHP method to derive the specific weights for each factor in the decision-making process.

4.2. Analytical Hierarchy Process (AHP)

4.2.1. Criteria Calculation

1. Identification of Criteria

Table 2: Criteria

No	Code	Criteria
1	K1	Character
2	K2	Age
3	K3	Loan Amount
4	K4	Income
5	K5	Loan Term
6	K6	Collateral

2. Pairwise Comparison Matrix

Table 3: Pairwise Comparison

	K1	K2	K3	K4	K5	K6
K1	1	3	2	0.333	3	3
K2	0.333	1	0.5	0.143	1	0.333
K3	0.5	2	1	0.5	3	2
K4	3	7	2	1	5	3
K5	0.333	1	0.333	0.2	1	1
K6	0.333	3	0.5	0.333	1	1
Total	5.5	17	6.333	2.51	14	10.333

3. Matrix Normalization

Table 4: Normalization of Pairwise Comparison Matrix

	K1	K2	K3	K4	K5	K6	Total	Priority Weights
K1	0.182	0.176	0.316	0.133	0.214	0.290	1.312	0.219
K2	0.061	0.059	0.079	0.057	0.071	0.032	0.359	0.060
K3	0.091	0.118	0.158	0.199	0.214	0.194	0.974	0.162
K4	0.545	0.412	0.316	0.398	0.357	0.290	2.319	0.386
K5	0.061	0.059	0.053	0.080	0.071	0.097	0.420	0.070
K6	0.061	0.176	0.079	0.133	0.071	0.097	0.617	0.103

The normalization values are obtained by dividing the importance level of each criterion by the corresponding column total (Table 3). Subsequently, the priority weights are derived by dividing the total row sum of the normalized pairwise comparison matrix

(Table 4) by the number of criteria. Finally, each priority weight is multiplied by the original importance level of each criterion to determine the total row sum.

Table 5: Row-wise Addition

	K1	K2	K3	K4	K5	K5	Total
K1	0.219	0.179	0.325	0.129	0.210	0.309	1.370
K2	0.073	0.060	0.081	0.055	0.070	0.034	0.373
K3	0.109	0.120	0.162	0.193	0.210	0.206	1.000
K4	0.656	0.419	0.325	0.386	0.350	0.309	2.444
K5	0.073	0.060	0.054	0.077	0.070	0.103	0.437
K6	0.073	0.179	0.081	0.129	0.070	0.103	0.635

4. Consistency Calculation

- $\lambda_{max} = \frac{(6.267 + 6.239 + 6.164 + 6.324 + 6.242 + 6.176)}{6} = 6.235$
- $CI = \frac{(6.235 - 6)}{(6-1)} = 0.047$
- $CR = \frac{0.047}{1.24} = 0.03797$ (Consisten)

4.2.2. Sub-criteria Calculation

Sub-criteria weights are determined by normalizing pairwise comparison matrices. All results are consistent. with Consistency Ratio (CR) values below 0.1, confirming that the comparisons are logically valid for the subsequent alternative evaluation phase.

Table 6: Sub-Criteria Priority Weights

	Character (K1)	Age (K2)	Loan Amount (K3)	Income (K4)	Loan Term (K5)	Collateral (K6)
Very Good	1.000	1.000	1.000	1.000	1.000	1.000
Good	0.648	0.591	0.616	0.629	0.578	0.606
Fair	0.415	0.356	0.395	0.387	0.302	0.357
Poor	0.218	0.213	0.180	0.237	0.163	0.166
Very Poor	0.116	0.122	0.095	0.150	0.083	0.082

4.2.3. Alternatives Calculation

Alternative evaluation multiplies criteria weights with sub-criteria priorities to produce objective preference scores, enabling BPR Nusantara Bona Pasogit 17 to determine credit eligibility with measurable and less subjective recommendations.

Table 7: Results of Criteria Weighting and Sub-criteria Priority Weighting

Criteria	Sub-Criteria				
	Very Good	Good	Fair	Poor	Very Poor
Income	15 M – 75 M	7 M – 15 M	3.5 M – 7M	1.5 M – 3.5M	500K – 1.5 M
	0.3865	0.2431	0.1496	0.0915	0.0579
Character	0.2186	0.1417	0.0908	0.0475	0.0254
	100 M – 300 M	60 M – 100 M	15 M – 60 M	8 M – 15 M	2 M – 8 M
Loan Amount	0.1623	0.0999	0.0599	0.0292	0.0155
	0.1028	0.0623	0.0368	0.0171	0.0084
Loan Term	3 – 24 month	25 – 48 month	49 – 60 month	61 – 84 month	85 – 120 month
	0.0700	0.0405	0.0211	0.0114	0.0058
Age	26 – 35 years	36 – 50 years	20 – 25 years	51 – 58 years	59 – 64 years
	0.0598	0.0354	0.0213	0.0127	0.0073

Following the formulation of the calculation logic, the system was tested using debtor data to evaluate the effectiveness of the priority weights in decision-making. The table 8 presents the final scores derived from the synthesized criteria for each respective debtor.

Table 8: Sample Results of Final Debtor Scores

No	K1	K2	K3	K4	K5	K6	Total	Status	Rank
Nsb 1	0.2186	0.0127	0.0599	0.2431	0.0405	0.1028	0.6776	Layak	45
Nsb 2	0.1417	0.0354	0.1623	0.3865	0.0405	0.0623	0.8286	Layak	20
Nsb 4	0.2186	0.0127	0.0599	0.2431	0.0700	0.1028	0.7071	Layak	36
Nsb 15	0.0254	0.0127	0.0599	0.2431	0.0405	0.0368	0.4184	Tidak Layak	100
Nsb 16	0.2186	0.0354	0.1623	0.3865	0.0700	0.0623	0.9350	Layak	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Nsbh 100	0.2186	0.0073	0.0999	0.3865	0.0700	0.0623	0.8446	Layak	18

The table illustrates the differentiation between high and low-scoring debtors. For instance, Nsbh 16 achieved the highest score (0.9350) as all criteria fell into the optimal categories, whereas Nsbh 15 received the lowest score (0.4184) due to unfavorable criteria values. These results demonstrate that the computational system effectively distinguishes between eligible and ineligible credit applicants.

4.3. System Implementation

The system is implemented as a web-based application designed to automate and enhance credit processing accuracy. It integrates AHP calculations into modules for criteria management, debtor profiling, and a calculation engine that synthesizes global weights with sub-criteria priorities. Technically, the system processes debtor parameters to automatically generate eligibility recommendations based on the predefined score threshold. This implementation transforms manual, subjective assessments into a standardized process, ensuring data security through restricted access for authorized bank personnel.

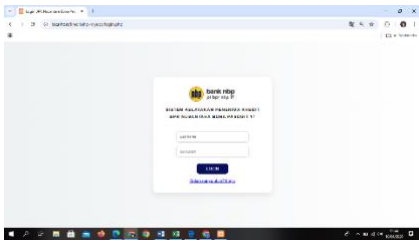


Fig. 5: Login Page

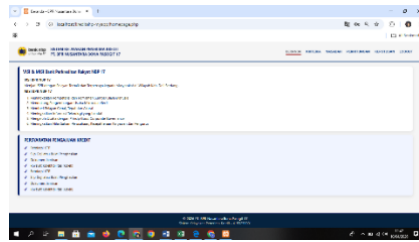


Fig. 6: Home Page

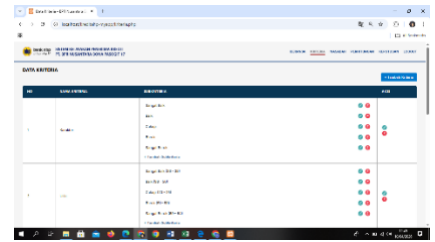


Fig. 7: Criteria and Sub criteria Page

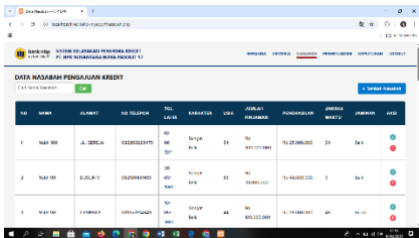


Fig. 8: Customer Data Page

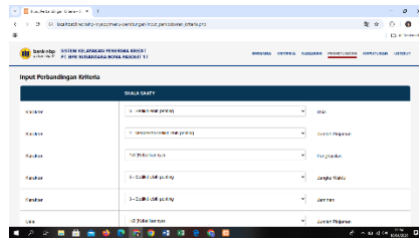


Fig. 9: Criteria Comparison Page

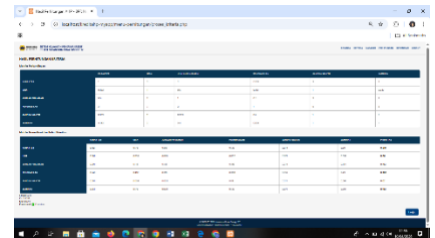


Fig. 10: Criteria comparison result

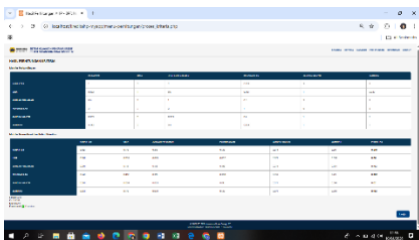


Fig. 11: Sub criteria comparison



Fig. 12: Alternative Calculation Page

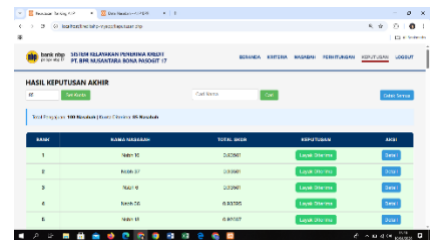


Fig. 13: Results and Ranking Page

4.4. System Testing

System testing was conducted to ensure that the credit eligibility application functions correctly and follows the intended program logic. The testing process was divided into two stages: Black Box and White Box testing. Black Box testing focused on functional aspects, including data input validation, database storage processes, and the accuracy of final score displays. Results indicated that all primary features operated smoothly without any interface-related issues.

Subsequently, White Box testing was performed to evaluate the internal logic of the code, specifically within the AHP calculation module. Based on flowgraph analysis, the Cyclomatic Complexity value was determined to be $V(G) = 3$, indicating three primary independent paths for testing. These paths include:

1. A consistent matrix resulting in eligibility;
2. A consistent matrix resulting in ineligibility;
3. The handling of inconsistent matrix inputs.

The test results across all three paths demonstrate that the system is stable and produces accurate recommendations aligned with the designed mathematical formulas. Consequently, the system is declared feasible for implementation.

5. Conclusion

This research successfully designed and implemented a web-based credit eligibility system using PHP and MySQL. The system facilitates criteria and debtor data management while automating the ranking process through the Analytic Hierarchy Process (AHP) method. The

AHP implementation established the following priority weights for each criterion: Income (0.386), Character (0.219), Loan Amount (0.162), Collateral (0.103), Time Period (0.07), and Age (0.06). These calculations are confirmed consistent and valid for decision-making.

System evaluations using both Black Box and White Box testing achieved a "PASS" status, verifying that all functions operate correctly. Testing on 100 debtor records yielded preference scores ranging from a high of 0.93501 to a low of 0.41839, with 85 applicants declared eligible based on a threshold of 0.6. Overall, this system enables BPR Nusantara Bona Pasogit 17 to perform credit assessments that are more structured, objective, and efficient in prioritizing prospective debtors.

References

- [1] Republik Indonesia, Undang-Undang Nomor 10 Tahun 1998 tentang Perbankan. 1998.
- [2] Baidhowi, Rizky Ramadhani, and Surya Wira Yudhayana, "Implementasi Prinsip Kehati-hatian dalam Praktik Kredit Perbankan: Tinjauan Yuridis terhadap Tanggung Jawab Bank," *PENG J. Ekon. dan Manaj.*, vol. 2, no. 3, pp. 3407–3416, Apr. 2025, doi: 10.62710/gmcqnv91.
- [3] H. D. Fata, G. I. Marthasari, and Y. Azhar, "Sistem Pendukung Keputusan Kelayakan Kredit pada PT. BPR Mitra Catur Mandiri Menggunakan Metode Credit Scoring," *REPOSITOR*, vol. 2, no. 5, 2020.
- [4] M. J. Maulana, I. Rahdiana, and F. Aprilyani, "Sistem Pendukung Keputusan Penerimaan Karyawan Baru Pada PT. Visiontech Indograha Menggunakan Metode Analytical Hierarchy Process," *J. Sist. Inf. STMIK ANTAR BANGSA*, vol. XIII, Feb. 2024.
- [5] B. Asmanto, "Pemberian Kredit Dengan Menggunakan Metode Analytic Hierarchy Process (AHP) Pada Perbankan," *JMIK (JURNAL Mhs. ILMU KOMPUTER)*, vol. 4, no. 1, pp. 76–86, 2023.
- [6] E. R. Muffiyah and A. Akhirudding, "Analisis Kredit Pada Perusahaan Umum Daerah BPR Bank Gresik," *J. Ilmu Ekon.*, vol. 8, no. 1, 2025.
- [7] H. Maradona, D. Sukriantoro, and D. A. Maulana, "Sistem Pendukung Keputusan Kelayakan Pemberian Kredit Umum Menggunakan Metode Promethee," *RJTI Riau J. Tek. Inform.*, vol. 4, no. 2, pp. 374–376, 2025.
- [8] universalbpr, "Mengenal Prinsip 5C Pemberian Kredit."
- [9] I. D. Pratiwi, A. Argianto, R. G. Wardani, B. C. S. Sarmenda, M. R. P, and R. Aprillia, "Sistem Pendukung Keputusan Pemilihan Perguruan Tinggi di Surakarta Menggunakan Metode AHP," *Neptunus J. Ilmu Komput. dan Teknol. Inf.*, vol. 2, no. 3, pp. 109–116, 2024.
- [10] E. Turban, J. E. Aronson, and T.-P. Liang, "DECISION SUPPORT SYSTEMS AND INTELLIGENT SYSTEMS," 7th ed., USA: Asoke K. Ghosh, Prentice-Hall of India Limited, 2007, p. 103.
- [11] T. Novianti, S. Amar, I. Cahyadi, I. D. Anna, and M. F. Arief, *MULTI-CRITERIA DECISION MAKING*. Media Nusa Creative, 2023.
- [12] A. T. Qurrota'ayun, B. S. Mukty, N. F. Amalia, S. A. Putri, and Y. Nabilah, "Sistem Pendukung Keputusan Pemilihan Jasa Pengiriman dengan Metode Analytical Hierarchy Process (AHP)," *J. Sist. Inf. STMIK ANTAR BANGSA*, pp. 24–33, Feb. 2024.
- [13] A. Astari and H. L. H. S. Warnars, "Menentukan Prediksi Kredit Nasabah Menggunakan Metode Analytical Hierarchy Process (AHP) pada PD BPR Kerta Raharja," *PETIR J. Pengkaj. dan Penerapan Tek. Inform.*, vol. 13, pp. 58–71, 2020.
- [14] Suhartini, M. Sadali, and Y. K. Putra, "SISTEM INFORMASI BERBASIS WEB SMA AL-MUKHTARIYAH MAMBEN LAUK BERBASIS PHP DAN MYSQL DENGAN FRAMEWORK CODEIGNITER," *Infotek J. Inform. dan Tek.*, vol. 3, no. 1, 2020.
- [15] H. Nurfauziah and I. Jamaliyah, "PERBANDINGAN METODE TESTING ANTARA BLACKBOX DENGAN WHITEBOX PADA SEBUAH SISTEM INFORMASI," vol. 8, no. 2, 2022.