

Creditworthiness System Using Analytical Hierarchy Process Method

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Abstract—The role of savings and loans cooperatives is very important, so it is not surprising that cooperatives are always found where, especially in urban areas, even in remote areas, we can find cooperatives. Savings and loan cooperatives obtain capital from principal deposits and mandatory deposits of cooperative members. This makes owners sometimes cut off credit without paying attention to aspects of credit risk that should be consistently applied. The importance of quality of service to cooperatives greatly affects the progress of cooperative members, one of which is the speed and accuracy in making decisions to provide credit for Members or prospective borrowers. AHP is appropriate for use in decision making that involves comparing decision elements that are difficult to assess quantitatively. This is based on the assumption that the natural reaction of the human being when facing complex decision-making is to group the elements of the decision according to its characteristics in general. Based on the results of interviews with cooperatives, there are 5 criteria needed in determining the feasibility of providing credit, namely Character, Capacity, Capital, Condition of economy, and Collateral. The calculation results use AHP for each creditor, namely A2 creditors with a final value of 0.22785, A5 creditors with a final value of 0.21926, A3 creditors with a final value of 0.20459, A1 creditors with an end value of 0.1772, A4 creditors with an end value of 0.17111.

Keywords: AHP, Credit, Creditworthiness, Decision Making, Risk.

1. INTRODUCTION

The role of savings and loans cooperatives is very important, so it is not surprising that cooperatives are always found where, especially in urban areas, even in remote areas, we can find cooperatives. Savings and loan cooperatives obtain capital from principal deposits and mandatory deposits of cooperative members. Then the accumulated capital is lent to the members of the cooperative who need a loan of money. Cooperatives strive to be able to meet and meet the daily needs of their members. One of the cooperative business units is to provide savings and loans. The provision of credit is the most suitable cooperative business, so the cooperative needs to give an assessment of its members being able to return the credit they have received. Credit is the provision of money or bills that can be equated with it, based on an agreement or loan agreement with another party that requires the borrower to pay off his debt after a certain period of time with the provision of services. With the provision of these credits, it is hoped that their members can be utilized so that they can improve and improve their standard of living.

Related to the loan process, many of the members who are credit applicants often complain about the long and too convoluted credit application process. At this time, the maximum time limit from the registration stage to the credit realization stage, which is set by the Manajamen Party, is a maximum of 7 (seven) working days. Viewed from the Bank's side, with the increasing ratio of loans that are in arrears, credit initiators must be more careful and selective in providing credit to their members, while cooperatives are required to close the credit realization target every month and also factors of increasingly fierce competition between other competing cooperatives. This makes owners sometimes cut off credit without paying attention to aspects of credit risk that should be consistently applied. The importance of quality of service to cooperatives greatly affects the progress of cooperative members, one of which is the speed and accuracy in making decisions to provide credit for Members or prospective borrowers[1].

Decision Support Systems (DSS) is a computer-based information system including a system that focuses on science and knowledge expertise that is commonly used to support a decision in a group or company as a tool in every decision making to be more focused on a goal[2]–[4]. A decision support system is a system used to be able to make decisions in semi-structured and unstructured situations, where a person does not know exactly how a decision should be made[5]–[7]. Decision Support System is an interactive system, helping decision making through the use of data and decision models to solve semi-structured and unstructured problems, a decision support system has several functions, namely to improve the ability of decision makers by providing better decision alternatives, helping to formulate problems and the circumstances at hand. In addition, the decision support system can also increase the effectiveness and efficiency of decision making[7], [8].

One of the SPK methods that can help to support decision making is the Analytical Hierachy Process (AHP) method, providing a validity by assessing compound criteria with a comprehensive frame of mind



considering the hierarchical process which is then carried out weight calculations for each criterion in determining the feasibility of providing a loan that will produce Credit Risk Scoring (CRS) to determine the feasibility of prospective debtors, so as to increase the effectiveness and efficiency of the decision-making process itself[9], [10]. To create a system that can determine the feasibility of providing business credit effectively, precisely and quickly. Because the number of businesses focused on problems can be a development of business continuity itself, the creation of a DSS for business companies can be a reference to determine the stage of the problem that will be decided appropriately[11]–[14].

AHP is appropriate for use in decision making that involves comparing decision elements that are difficult to assess quantitatively[15]. This is based on the assumption that the natural reaction of the human being when facing complex decision-making is to group the elements of the decision according to its characteristics in general[16]. This grouping involves creating a hierarchy (ranking) of decision elements and then comparing each pair in each group, as a matrix. After that will be obtained the weight and inconsistency ratio for each element. Thus it will be easy to test the consistency of the data[9]. AHP is a systematic method of comparing a set of goals or alternatives. In this case, AHP is a process of policy formulation that is powerful and flexible in determining priorities, comparing alternatives and making the best decisions when decision makers have to consider quantitative and qualitative aspects[17]. AHP reduces the complexity of a decision into a series of comparisons one, then systematizes the results of those comparisons. Thus, AHP is not only beneficial in making the best decisions but also provides a solid basis that the decision is the best decision[18].

With the existence of a decision support system in determining the feasibility of providing credit so that cooperative problems can be resolved and computerized so that in providing credit to its members can be quickly and efficiently and minimize errors.

2. RESEARCH METHODS

2.1 Research Framework

The framework in making research becomes a collection of concepts that are arranged systematically so that the research objectives carried out are good again, so that the process of making this research concept framework is formed before the research step is carried out[19]–[21]. The research framework is a form of the whole process in research, starting with problem identification, data analysis and collection, AHP method, decision support system and recommendation Creditworthiness system. The framework of thought in the research can be seen in Figure 1.

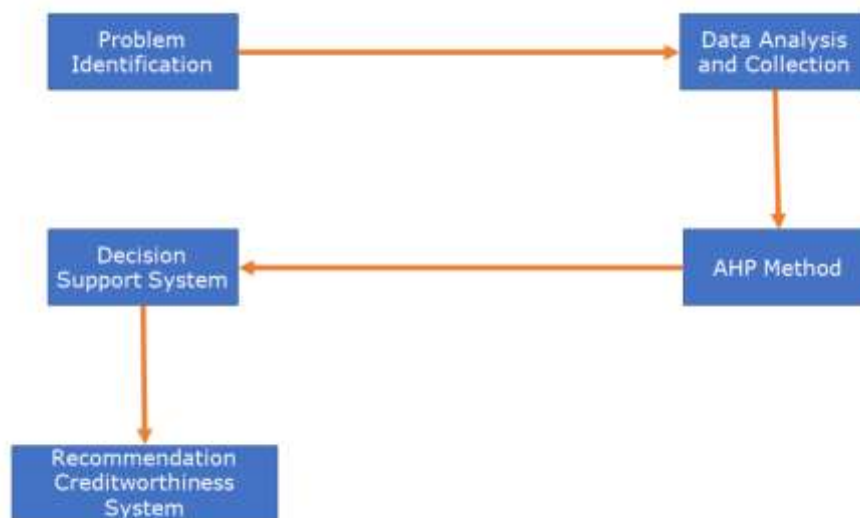


Figure 1. Research Framework

2.2 Analytical Hierarchy Process

In the Analytical Hierarchy Process method, the following steps are carried out:

- a. Defining the problem and determining the desired solution.

In this stage the author seeks to determine the problem that the author will solve clearly, in detail and easily understood. From the existing problems the author tries to determine a solution that may be suitable for the problem. The solution of the problem may amount to more than one. The solution will be further developed by the author in the next stage.

- b. Create a hierarchical structure that begins with the main goal.
 After compiling the main objectives as the top level, a hierarchy level will be compiled below it, namely suitable criteria for considering or assessing the alternatives that the author provides and determining these alternatives. Each criterion has a different intensity. The hierarchy continues with subcriteria (if possible necessary).
- c. Create a pairwise comparison matrix that describes the relative contribution or influence of each element to a goal or criterion that is at the level above it. The matrix used is simple, has a strong standing for a framework of consistency, obtains other information that may be needed with all possible comparisons and is able to analyze the sensitivity of overall priorities for changes in consideration. The matrix approach reflects the dual aspects in priorities that are dominating and dominated. Comparisons are made based on judgments from decision makers by assessing the importance of one element compared to other elements. To start the process of pairwise comparison is selected a criterion from the topmost level of the hierarchy e.g. K and then from the level below it is taken the element to be compared e.g. E1,E2,E3,E4,E5.
- d. Doing Defines pairwise comparisons so that a total number of assessments is obtained as $n \times [(n-1)/2]$ pieces, where n is the number of elements compared. The result of the comparison of each element will be a number from 1 to 9 indicating the comparison of the importance of an element. If an element in the matrix is compared with itself then the result of the comparison is given a value of 1. Scale 9 has been shown to be acceptable and can distinguish intensities between elements[22]–[25].

2.3 Calculation of Analytical Hierarchy Process Method

Calculations will be carried out using the Analitical Hierarchy Process (AHP) method.

- a. Drawing a decision hierarchy, in this decision hierarchy there are objects to be discussed, criteria and alternatives. The following is a picture of the decision hierarchy.
 1. The purpose or object to be discussed (selection of potential debtors who are worthy of credit).
 2. Criteria / indicators (character, capacity, capital, collateral, condition of economy).
 3. Alternative (name of the prospective creditor).

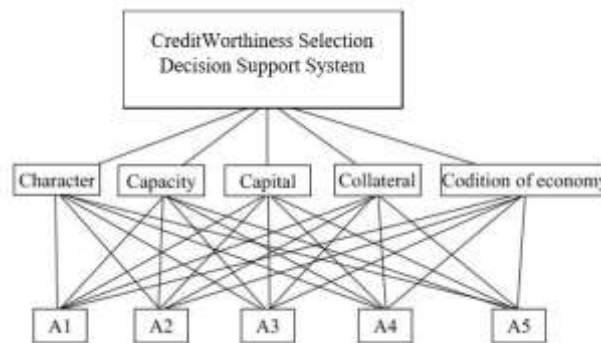


Figure 1. Decision Hierarchy

- b. Comparison matrix paired criteria

Table 1. Comparison matrix paired criteria

	C1	C2	C3	C4	C5
C1	1	1/3	½	1/5	3
C2	3	1	2	1/3	5
C3	2	1/2	1	¼	4
C4	5	1/3	4	1	7
C5	1/3	1/5	¼	1/7	1

- c. Calculation of the weight of the criterion

Table 2. Pairwise Comparison Matrix

	C1	C2	C3	C4	C5
C1	1	0,33	0,5	0,2	3
C2	3	1	2	0,33	5
C3	2	0,5	1	0,25	4
C4	5	3	4	1	7
C5	0,33	0,20	0,25	0,14	1

Total	11,33	5,03	7,75	1,92	20
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In the table above, change the matrix values in pairs in decimal form and look for the total of each row as follows:

$$\begin{aligned} \text{Character} &= 1 + 3 + 2 + 5 + 0.33 = 11.33 \\ \text{Capacity} &= 0.33 + 1 + 0.5 + 3 + 0.20 = 5.03 \\ \text{Capital} &= 0.5 + 2 + 1 + 4 + 0.25 = 7.75 \\ \text{Collateral} &= 0.2 + 0.33 + 0.25 + 1 + 0.14 = 1.92 \\ \text{Condition of economy} &= 3 + 5 + 4 + 7 + 1 = 20 \end{aligned}$$

The result of normalizing or dividing each element by the total number of each row, then looking for the average value of each column in the criteria.

Table 3. Priority Vector Values

	C1	C2	C3	C4	C5	W^T
C1	0,09	0,07	0,06	0,10	0,15	0,09
C2	0,26	0,20	0,26	0,17	0,25	0,23
C3	0,18	0,10	0,13	0,13	0,20	0,15
C4	0,44	0,60	0,52	0,52	0,35	0,48
C5	0,03	0,04	0,03	0,07	0,05	0,04

the result is that normalization is carried out. To find the priority value of a vector is to sum the entire value of the entire column divided by the number of elements or criteria.

$$\begin{aligned} \text{Collateral} &= \frac{0,09 + 0,07 + 0,06 + 0,10 + 0,15}{5} = 0,09 \\ \text{Capacity} &= \frac{0,26 + 0,20 + 0,26 + 0,17 + 0,25}{5} = 0,23 \\ \text{Capital} &= \frac{0,18 + 0,10 + 0,13 + 0,13 + 0,20}{5} = 0,15 \\ \text{Character} &= \frac{0,44 + 0,60 + 0,52 + 0,52 + 0,35}{5} = 0,48 \\ \text{Condition of economy} &= \frac{0,03 + 0,04 + 0,03 + 0,07 + 0,05}{5} = 0,04 \end{aligned}$$

- d. Next calculate the Consistency Ratio (CR) of the criteria pairwise comparison matrix. If the CR > 0.1 then it must be repeated in pairs until a CR < 0.1 is obtained

Here is the formula for calculating the CR value:

$$CR = \frac{CI}{IR}$$

Where:

CI = Consistency Index

IR = Random Index / random generating value

The formula for looking up the CI value,

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

Formula for looking up the value of λ_{\max} ,

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \left(\frac{\text{elemen ke-i pada } (A)(W^T)}{\text{elemen ke-i pada } W^T} \right)$$

Table 4. Priority Vector Values

Criteria	A.W^T
Character	0,47492
Capacity	1,19039
Capital	0,75089
Collateral	2,54543
Condition of Economy	0,22639

In table 4 is the result of the multiplication of the matrix by the eigen of the normalization vector in the following way :

Where

A = Paired matrix value

W^T = Priority vektor

$$(1 \times 0,09) + (0,33 \times 0,23) + (0,50 \times 0,15) + (0,20 \times 0,48) + (3 \times 0,04) = 0,474925$$

$$(3 \times 0,09) + (1 \times 0,23) + (2 \times 0,15) + (0,33 \times 0,48) + (5 \times 0,04) = 1,190395$$

$$(2 \times 0,09) + (0,50 \times 0,23) + (1 \times 0,15) + (0,25 \times 0,48) + (4 \times 0,04) = 0,750891$$

$$(5 \times 0,09) + (3 \times 0,23) + (4 \times 0,15) + (1 \times 0,48) + (7 \times 0,04) = 2,545427$$

$$(0,33 \times 0,09) + (0,20 \times 0,23) + (0,25 \times 0,15) + (0,14 \times 0,48) + (1 \times 0,04) = 0,226392$$

Specifies the maximum eigenvalue (λ_{max}),

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^n \left(\frac{\text{elemen ke-i pada } (A)(W^T)}{\text{elemen ke-i pada } W^T} \right)$$

$$\lambda_{max} = \frac{1}{5} \left(\frac{0,47492}{0,09} + \frac{1,19039}{0,23} + \frac{0,75089}{0,15} + \frac{2,54543}{0,48} + \frac{0,22639}{0,04} \right)$$

$$\lambda_{max} = 5,127586$$

Menentukan Index Consistency (CI),

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

$$CI = \frac{5,127586 - 5}{5 - 1}$$

$$CI = 0,031897$$

Calculating the Consistency Ratio,

Table 5. Random Index (RI)

n	1	2	3	4	5	6	7	8	9	10	11	12
RI _n	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48

For n = 5, obtained RI_n = 1.24 so that,

$$CR = \frac{0,031897}{1,12}$$

$$CR = 0,028479$$

Because CR = 0.028479 <= 0.01 so it is consistent.

3. RESULTS AND DISCUSSIONS

The result of determining a consistent CR value then the hierarchy of the information obtained is complete with the weight of the criteria.

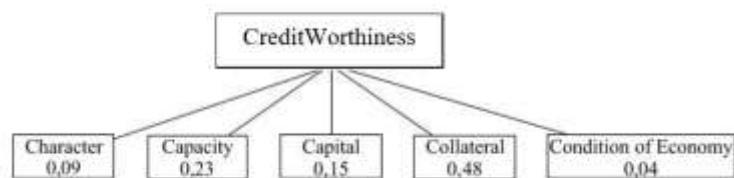


Figure 2. Hierarchy of Criteria Information and Weights

For example, for example, in a case there are 5 alternative prospective creditors who will be given credit, namely creditor 1, namely A1, creditor 2, namely A2, creditor 3, namely A3, creditor 4, namely A4 and creditor 5, namely A5. The value of each creditor is based on the criteria in table 6.

Table 6. Alternative Value of Creditors Based on Criteria

	C1	C2	C3	C4	C5
A1	3	5	2	4	3
A2	4	3	1	5	2
A3	5	2	2	3	5
A4	4	5	2	2	5

A5	5	4	1	5	5
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Based on the above values, alternative weights will be calculated for each criterion.

a. Calculation of alternative weights for character criteria

Determination of paired matrices from character criteria as in table 5

Table 5. Paired Matrix Character Criteria

	A1	A2	A3	A4	A5
A1	3/3	3/4	3/5	3/4	3/5
A2	4/3	4/4	4/5	4/4	4/5
A3	5/3	5/4	5/5	5/4	5/5
A4	4/3	4/4	4/5	4/4	4/5
A5	5/3	5/4	5/5	5/4	5/5
Result					
	A1	A2	A3	A4	A5
A1	1	0,75	0,6	0,75	0,6
A2	1,33333	1	0,8	1	0,8
A3	1,66667	1,25	1	1,25	1
A4	1,33333	1	0,8	1	0,8
A5	1,66667	1,25	1	1,25	1
Total	7	5,25	4,2	5,25	4,2

After obtaining the value of the matrix in pairs, it then calculates the division of each element and the priority vector. The result of the division of each element and priority vector can be seen in table 6.

Table 6. Division of Each Element of Priority Vector

	A1	A2	A3	A4	A5	W ^T
A1	0,14286	0,14286	0,14286	0,14286	0,14286	0,14286
A2	0,19048	0,19048	0,19048	0,19048	0,19048	0,19048
A3	0,2381	0,2381	0,2381	0,2381	0,2381	0,2381
A4	0,19048	0,19048	0,19048	0,19048	0,19048	0,19048
A5	0,2381	0,2381	0,2381	0,2381	0,2381	0,2381

b. Calculation of alternative weights for capacity criteria

Determination of paired matrices from capacity criteria as in table 7

Table 7. Paired Matrix Character Criteria

	A1	A2	A3	A4	A5
A1	5/5	5/3	5/2	5/5	5/4
A2	3/5	3/3	3/2	3/5	3/4
A3	2/5	2/3	2/2	2/5	2/4
A4	5/5	5/3	5/2	5/5	5/4
A5	4/5	4/3	4/2	4/5	4/4
Result					
	A1	A2	A3	A4	A5
A1	1	1,66667	2,5	1	2,5
A2	0,6	1	1,5	0,6	1,5
A3	0,4	0,66667	1	0,4	1
A4	1	1,66667	2,5	1	2,5
A5	0,8	1,33333	2	0,8	2
Total	3,8	6,33334	9,5	3,8	9,5

After obtaining the value of the matrix in pairs, it then calculates the division of each element and the priority vector. The result of the division of each element and priority vector can be seen in table 8.

Table 8. Division of Each Element of Priority Vector

	A1	A2	A3	A4	A5	W ^T
A1	0,26316	0,26316	0,26316	0,26316	0,26316	0,26316
A2	0,15789	0,15789	0,15789	0,15789	0,15789	0,15789
A3	0,10526	0,10526	0,10526	0,10526	0,10526	0,10526

A4	0,26316	0,26316	0,26316	0,26316	0,26316	0,26316
A5	0,21053	0,21053	0,21053	0,21053	0,21053	0,21053

c. Calculation of alternative weights for capital criteria

Determination of paired matrices from capital criteria as in table 9

Table 9. Paired Matrix Character Criteria

	A1	A2	A3	A4	A5
A1	2/2	2/1	2/2	2/2	2/1
A2	1/2	1/1	½	1/2	1/1
A3	2/2	2/1	2/2	2/2	2/1
A4	2/2	2/1	2/2	2/2	2/1
A5	1/2	1/1	½	1/2	1/1
Result					
	A1	A2	A3	A4	A5
A1	1	2	1	1	2
A2	0,5	1	0,5	0,5	1
A3	1	2	1	1	2
A4	1	2	1	1	2
A5	0,5	1	0,5	0,5	1
Total	4	8	4	4	8

After obtaining the value of the matrix in pairs, it then calculates the division of each element and the priority vector. The result of the division of each element and priority vector can be seen in table 10.

Table 10. Division of Each Element of Priority Vector

	A1	A2	A3	A4	A5	W^T
A1	0,25	0,25	0,25	0,25	0,25	0,25
A2	0,125	0,125	0,125	0,125	0,125	0,125
A3	0,25	0,25	0,25	0,25	0,25	0,25
A4	0,25	0,25	0,25	0,25	0,25	0,25
A5	0,125	0,125	0,125	0,125	0,125	0,125

d. Calculation of alternative weights for collateral criteria

Determination of paired matrices from collateral criteria as in table 11

Table 11. Paired Matrix Character Criteria

	A1	A2	A3	A4	A5
A1	4/4	4/5	4/3	4/2	4/5
A2	5/4	5/5	5/3	5/2	5/5
A3	¾	3/5	3/3	3/2	3/5
A4	2/4	2/5	2/3	2/2	2/5
A5	5/4	5/5	5/3	5/2	5/5
Result					
	A1	A2	A3	A4	A5
A1	1	0,8	1,33333	2	0,8
A2	1,25	1	1,66667	2,5	1
A3	0,75	0,6	1	1,5	0,6
A4	0,5	0,4	0,66667	0,4	0,4
A5	1,25	1	1,66667	2,5	1
Total	4,75	3,8	6,33334	8,9	3,8

After obtaining the value of the matrix in pairs, it then calculates the division of each element and the priority vector. The result of the division of each element and priority vector can be seen in table 12.

Table 12. Division of Each Element of Priority Vector

	A1	A2	A3	A4	A5	W^T
A1	0,21053	0,21053	0,21053	0,21053	0,21053	0,21053
A2	0,26316	0,26316	0,26316	0,26316	0,26316	0,26316
A3	0,15789	0,15789	0,15789	0,15789	0,15789	0,15789
A4	0,10526	0,10526	0,10526	0,10526	0,10526	0,10526

A5	0,26316	0,26316	0,26316	0,26316	0,26316	0,26316
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- e. Calculation of alternative weights for condition of economy criteria
 Determination of paired matrices from condition of economy criteria as in table 13

Table 13. Paired Matrix Character Criteria

	A1	A2	A3	A4	A5
A1	3/3	3/2	3/5	3/5	3/5
A2	2/3	2/2	2/5	2/5	2/5
A3	5/3	5/2	5/5	5/5	5/5
A4	5/3	5/2	5/5	5/5	5/5
A5	5/3	5/2	5/5	5/5	5/5
Result					
	A1	A2	A3	A4	A5
A1	1	1,5	0,6	0,6	0,6
A2	0,66667	1	0,4	0,4	0,4
A3	1,66667	2,5	1	1	1
A4	1,66667	2,5	1	1	1
A5	1,66667	2,5	1	1	1
Total	6,66668	10	4	4	4

After obtaining the value of the matrix in pairs, it then calculates the division of each element and the priority vector. The result of the division of each element and priority vector can be seen in table 14.

Table 14. Division of Each Element of Priority Vector

	A1	A2	A3	A4	A5	W^T
A1	0,15	0,15	0,15	0,15	0,15	0,15
A2	0,1	0,1	0,1	0,1	0,1	0,1
A3	0,25	0,25	0,25	0,25	0,25	0,25
A4	0,25	0,25	0,25	0,25	0,25	0,25
A5	0,25	0,25	0,25	0,25	0,25	0,25

The hierarchical form of the information obtained is complete with the weight of the criteria and the weight of alternative weights.

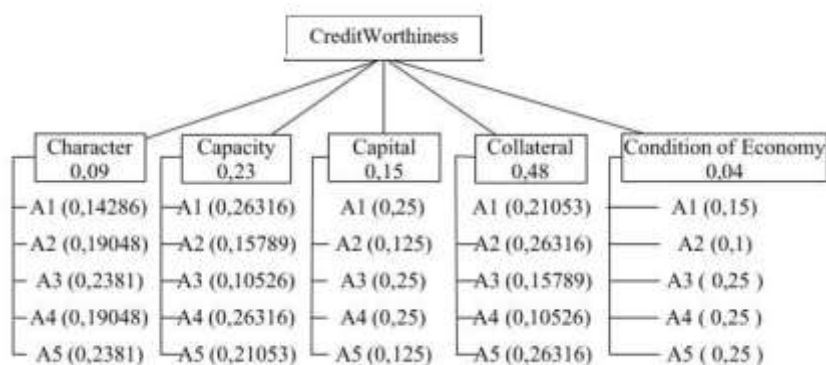


Figure 3. Hierarchy with Weight Criteria and Alternatives

Next, calculate the ranking of each alternative. The final value of each alternative to each criterion as in table 15.

Table 15. Alternative End Value

	Priority Matriks					Bobot Kriteria	Nilai akhir
	C1 W^T	C2 W^T	C3 W^T	C4 W^T	C5 W^T		
A1	0,14286	0,26316	0,25	0,21053	0,15	0,09	0,21926
A2	0,19048	0,15789	0,125	0,26316	0,1	0,23	0,20459
A3	0,2381	0,10526	0,25	0,15789	0,25	0,15	0,17111
A4	0,19048	0,26316	0,25	0,10526	0,25	0,48	0,1772
A5	0,2381	0,21053	0,125	0,26316	0,25	0,04	0,22785

The ranking obtained sums the results of the multiplication of the alternative weight with the weight of the criteria, the highest value is an alternative that deserves credit. Here's how to calculate manually,

$$A1 = (0,14286 \times 0,09) + (0,26316 \times 23) + (0,25 \times 0,15) + (0,21053 \times 0,48) + (0,15 \times 0,04) = 0,21926$$

$$A2 = (0,19048 \times 0,09) + (0,15789 \times 23) + (0,125 \times 0,15) + (0,26316 \times 0,48) + (0,1 \times 0,04) = 0,20459$$

$$A3 = (0,2381 \times 0,09) + (0,10526 \times 23) + (0,25 \times 0,15) + (0,15789 \times 0,48) + (0,25 \times 0,04) = 0,17111$$

$$A4 = (0,19048 \times 0,09) + (0,26316 \times 23) + (0,25 \times 0,15) + (0,10526 \times 0,48) + (0,25 \times 0,04) = 0,1772$$

$$A5 = (0,2381 \times 0,09) + (0,21053 \times 23) + (0,125 \times 0,15) + (0,26316 \times 0,48) + (0,25 \times 0,04) = 0,22785$$

Tabel 2.32 Rangkang Alternatif

Alternative	Rangking
A2	0,22785
A5	0,21926
A3	0,20459
A1	0,1772
A4	0,17111

Then the alternative with the highest value is Alternative (A2) with a final value of 0.22240.

4. CONCLUSION

From the results of the research conducted, it can be concluded as follows that a Creditworthiness System has been successfully built using the Analytical Hierarchy Process (AHP) Method for Cooperatives in determining the feasibility of crediting. Based on the results of interviews with cooperatives, there are 5 criteria needed in determining the feasibility of providing credit, namely Character, Capacity, Capital, Condition of economy, and Collateral. The calculation results use AHP for each creditor, namely A2 creditors with a final value of 0.22785, A5 creditors with a final value of 0.21926, A3 creditors with a final value of 0.20459, A1 creditors with an end value of 0.1772, A4 creditors with an end value of 0.17111. Based on the final score results, the recommendation for the creditworthiness of all creditors is that A2 creditors occupy the first rank.

REFERENCES

- [1] J. Jusuf, *Analisis Kredit Untuk Credit (Account) Officer*. Gramedia Pustaka Utama, 2014.
- [2] S. D. Hapid, M. I. Dzulhaq, and T. Mulyono, "Sistem Pendukung Keputusan Penyeleksian Supplier Bahan Produksi Dengan Metode Simple Additive Weighting (SAW)," *vol*, vol. 10, pp. 33–37, 2020.
- [3] E. Ernain, R. Rusliyawati, and I. Sinaga, "Sistem Pendukung Keputusan Pembiayaan Mikro Berbasis Client Server Studi Kasus Pada Perusahaan Pembiayaan Bandar Lampung," 2011.
- [4] A. Irawan, R. Rohaniah, H. Sulistiani, and A. T. Priandika, "Sistem Pendukung Keputusan Untuk Pemilihan Tempat Servis Komputer di Kota Bandar Lampung Menggunakan Metode AHP," *J. Tekno Kompak*, vol. 13, no. 1, pp. 30–35, 2019.
- [5] V. Sihombing, V. M. M. Siregar, W. S. Tampubolon, M. Jannah, and A. Hakim, "Implementation of simple additive weighting algorithm in decision support system," in *IOP Conference Series: Materials Science and Engineering*, 2021, vol. 1088, no. 1, p. 12014.
- [6] Y. Zhao, F. Cheng, S. Yüksel, and H. Dinçer, "Integer code series enhanced IT2 fuzzy decision support system with alpha cuts for the innovation adoption life cycle pattern recognition of renewable energy alternatives," *IEEE Access*, vol. 9, pp. 34906–34920, 2021.
- [7] A. Karthikeyan, A. Garg, P. K. Vinod, and U. D. Priyakumar, "Machine learning based clinical decision support system for early COVID-19 mortality prediction," *Front. public Heal.*, vol. 9, p. 626697, 2021.
- [8] R. Garg and D. Jain, "Fuzzy multi-attribute decision making evaluation of e-learning websites using FAHP, COPRAS, VIKOR, WDBA," *Decis. Sci. Lett.*, vol. 6, no. 4, pp. 351–364, 2017.
- [9] V. H. Valentino, H. S. Setiawan, A. Saputra, Y. Haryanto, and A. S. Putra, "Decision support system for thesis session pass recommendation using AHP (analytic hierarchy process) method," *Int. J. Educ. Res. Soc. Sci.*, vol. 2, no. 1, pp. 215–221, 2021.
- [10] A. U. Khan and Y. Ali, "Analytical hierarchy process (AHP) and analytic network process methods and their applications: a twenty year review from 2000-2019: AHP & ANP techniques and their applications: Twenty years review from 2000 to 2019," *Int. J. Anal. Hierarchy Process*, vol. 12, no. 3, 2020.
- [11] S. Kittipongvises, A. Phetrak, P. Rattanapun, K. Brundiers, J. L. Buizer, and R. Melnick, "AHP-GIS analysis for flood hazard assessment of the communities nearby the world heritage site on Ayutthaya Island, Thailand," *Int. J. Disaster Risk Reduct.*, vol. 48, p. 101612, 2020.
- [12] K. C. Swain, C. Singha, and L. Nayak, "Flood susceptibility mapping through the GIS-AHP technique using the cloud," *ISPRS Int. J. Geo-Information*, vol. 9, no. 12, p. 720, 2020.
- [13] Z. Wang, Y. Ran, Y. Chen, H. Yu, and G. Zhang, "Failure mode and effects analysis using extended matter-element model and

- AHP,” *Comput. Ind. Eng.*, vol. 140, p. 106233, 2020.
- [14] I. D’Adamo, P. M. Falcone, M. Gastaldi, and P. Morone, “RES-T trajectories and an integrated SWOT-AHP analysis for biomethane. Policy implications to support a green revolution in European transport,” *Energy Policy*, vol. 138, p. 111220, 2020.
- [15] K. Gompf, M. Traverso, and J. Hetterich, “Using analytical hierarchy process (AHP) to introduce weights to social life cycle assessment of mobility services,” *Sustainability*, vol. 13, no. 3, p. 1258, 2021.
- [16] A. Alosta, O. Elmansuri, and I. Badi, “Resolving a location selection problem by means of an integrated AHP-RAFSI approach,” *Reports Mech. Eng.*, vol. 2, no. 1, pp. 135–142, 2021.
- [17] P. Amenta, A. Lucadamo, and G. Marcarelli, “On the choice of weights for aggregating judgments in non-negotiable AHP group decision making,” *Eur. J. Oper. Res.*, vol. 288, no. 1, pp. 294–301, 2021.
- [18] S. Kayapinar Kaya and E. Aycin, “An integrated interval type 2 fuzzy AHP and COPRAS-G methodologies for supplier selection in the era of Industry 4.0,” *Neural Comput. Appl.*, vol. 33, no. 16, pp. 10515–10535, 2021.
- [19] S. Setiawansyah, H. Sulistiani, and V. H. Saputra, “Penerapan Codeigniter Dalam Pengembangan Sistem Pembelajaran Dalam Jaringan Di SMK 7 Bandar Lampung,” *J. CoreIT J. Has. Penelit. Ilmu Komput. dan Teknol. Inf.*, vol. 6, no. 2, pp. 89–95, 2020.
- [20] A. A. Aldino and H. Sulistiani, “DECISION TREE C4. 5 ALGORITHM FOR TUITION AID GRANT PROGRAM CLASSIFICATION (CASE STUDY: DEPARTMENT OF INFORMATION SYSTEM, UNIVERSITAS TEKNOKRAT INDONESIA),” *Educat-Scientific J. Informatics Educ.*, vol. 7, no. 1, 2020.
- [21] D. A. Megawaty and R. Y. Simanjuntak, “Pemetaan Penyebaran Penyakit Demam Berdarah Dengue Menggunakan Sistem Informasi Geografis Pada Dinas Kesehatan Kota Metro,” *Explor. J. Sist. Inf. dan Telemat. (Telekomunikasi, Multimed. dan Inform.)*, vol. 8, no. 2, 2017.
- [22] M. Mojaver, R. Hasanzadeh, T. Azdast, and C. B. Park, “Comparative study on air gasification of plastic waste and conventional biomass based on coupling of AHP/TOPSIS multi-criteria decision analysis,” *Chemosphere*, vol. 286, p. 131867, 2022.
- [23] M. Irfan, R. M. Elavarasan, M. Ahmad, M. Mohsin, V. Dagar, and Y. Hao, “Prioritizing and overcoming biomass energy barriers: Application of AHP and G-TOPSIS approaches,” *Technol. Forecast. Soc. Change*, vol. 177, p. 121524, 2022.
- [24] L. P. Raghav, R. S. Kumar, D. K. Raju, and A. R. Singh, “Analytic hierarchy process (AHP)–swarm intelligence based flexible demand response management of grid-connected microgrid,” *Appl. Energy*, vol. 306, p. 118058, 2022.
- [25] O. S. Albahri *et al.*, “New mHealth hospital selection framework supporting decentralised telemedicine architecture for outpatient cardiovascular disease-based integrated techniques: Haversine-GPS and AHP-VIKOR,” *J. Ambient Intell. Humaniz. Comput.*, vol. 13, no. 1, pp. 219–239, 2022.