



Artikel

Decision Support System for Home Loan Credit Using AHP and SAW methods (Study Case: PT. Bintang Baru)

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A B S T R A C T

In this era, the development of information technology is so fast that it cannot be looked away. This development of information technology is going to affect many kinds of fields, including developer. The point of this development is to help the work done by the people become easier. One of its benefit is in decision making. Decision mistakes is one of the general problems that usually happened in decision making. A system will be made with the purpose to ease the decisions making process through methods. The methods are Analytical Hierarchy Process (AHP) as weight calculation and Simple Addictive Weighting (SAW) as an alternative calculation media. In this system there are 5 criteria which are: non-fixed income, living cost, age, SPT Pph Ps. 21 for credit and paycheck. There are 11 alternative that can be used as a consideration for the manager. By using AHP method which has a consistent ratio reaching 96,62% and SAW, the selection process is going to be faster than it used to be, helping the Manager in making the decision also lessen the use of space and paper

INTRODUCTION

Information systems and computer technology develops rapidly in line with need for information. The development of information technology can not be separated from the rapid development of computer technology, because computers are the media that can provide convenience for humans in finishing a job. Changes and dynamics of society that are increasingly rather fast, requiring development time of technology that is accurate, quick and precise in information providing [1]. Information technology is one example of a rapidly

developing technology product that can help people process data and provide information. Computer technology can also help to analyze the quality of prospective house loan debtors. To ease debtors for the burden of paying for the purchase of a house, an intermediary (bank) is required to provide home ownership loans with the aim of helping prospective debtors who need funds to buy a house, requiring that the prospective debtor will pay home loans within a certain period, with the bank in accordance with the agreement when handing over a home loan credit [2]. For now, the method of processing data on the house developer side still uses manual processes with paper as the main

record. A large amount of data that is still archived in a room in the coffice, the quality of the paper that will not last long because of the aging of the paper itself, and paper is not resistant into hazards such as fire or flood. Also for consideration, the registration file that will be used for decision-making support and the registration file often contains incorrect data on prospective debtors. Because of that consideration, the system and the application will be created using the AHP and SAW methods [3]. AHP and SAW method was chosen because this method determines the weight value of each attribute, then proceed with a ranking process that will select the best alternative from a number of all alternatives. In this case the alternative is the prospective debtor who has criteria according to the all of the requirements set by the developer side. With this ranking method, it is expected that the assessment will be more appropriate because it is based on the criteria and weight values that have been determined. So the process will get more accurate and optimal results about the selected debtors and will be chosen by the decision makers.

I. LITERATURES REVIEW

In the journal Evaluation of Lecturer Teaching Performance Using AHP and SAW Methods The lecturer performance evaluation activity is the routine of an university in continuously improving internal quality as an evaluation and development of educational institutions. Buddhi Dharma University Tangerang, every semester evaluates lecturers' performance. But the results obtained are not optimal, this is due to the absence of an effective and efficient method in determining the results, especially in the Faculty of Science and Technology, Information System Departement. The assessment process is carried out by distributing questionnaire papers and filled out by students. This study aims to analyze the results of the questionnaire, calculated by combining the Analytical Hierarchy Process (AHP) method for weighting and combined

the Simple Addictive Weighting (SAW) method for ranking. The results obtained were the level of criteria weighting accuracy reached 90.39% with 28 lecturers which teaching 47 subjects in the Information Systems Departement [3].

The second journal Designing Decision Making System for Giving Approval to home loan Credit is a financial facility that allows a person or business entity to borrow money to buy a product and repay it within a specified period of time. PT. Bank Tabungan Negara (BTN) Branch office Serang is having several business activities, one of them is home loan credit. In the process of applying for a home loan credit, the Bank has ecountered difficulty determine the prospective debtors who are worth to receive a home loan credit and also the process of applying for a home loan credit conducted by prospective debtors requires a long process and time. From this conclusion, we need a system to support the decision making to grant mortgages at Bank BTN Serang branch office. Decision support system is a system that can help the provider in making decisions that are accurate and precise. One method used in DSS is simple additive weighting (SAW). SAW is the most widely used method in solving problems, such as in the DSS for determining the eligibility of home loan credit recipient customers. The SAW method of granting home loan credit has several criteria that form the basis of decision making, including character, capacity, capital, collateral and conditions. The results of this study are to make a support system that make it easier to make decisions regarding the granting of mortgages [4].

Third Journal about The appliance of exponential comparison method in supporting system of deciding the scholarship for bright students in xyz vocational high school. Scholarships are used to award students who have achievements in learning. Recipients of donations for high achieving students at XYZ Vocational School used several criteria that are must be ranked such as achievement,

discipline, and attendance. The selection process through administration division will recapitulate student data to become the material for meetings between the teachers and homeroom teachers. This matter requires high carefulness to determine. The decision making support applications offers the ease of decision making. This system can literally mean to an interactive information system that provides information, modelling and data manipulation. To overcome the multiple criteria for decision making, this research uses the Exponential Comparison Method (MPE). MPE can reduce the bias that may occur in the analysis, because the value of the resulting score illustrates the order of priorities that becomes large so that the order of priority decisions is more real.

This research provides a decision making system for determining the recipient of the scholarship with the criteria of achievements, discipline, and attendance with the use of MPE method to implement the MPE method in the decision making support system for students scholarship, there will be some steps including arrange the alternatives of the chosen decision, determine the criteria, relativity of importance in every decision, determine the value of decision, and rank all of the alternatives with the form of score for each of the alternatives [5].

Fourth journal about New Employees Selection with AHP Method, acceptance of new employees in company is a very important thing as it affects the quality of the company in the future. In choosing employees requires a very high concentration in screening each applicant. One of the effective ways in screening new employees is by applying decision supporting system as it is able to make the right decision in screening new employees. This application applies analytical hierarchy process (AHP) method by doing a weighing on each criteria and applicants. The results of the research is a screening new employees application system by using web that gives recommendation as a consideration in making a right decision and

hoped to ease the process in screening new employees [6].

The fifth journal about Decision Support System For Election Of Members Unit Patents Pamong Praja Civil Service Police Unit (municipal police) is part of the area in the enforcement of legislation and arrangements for public order and public tranquility. Decision Support System or DSS (Decision Support System) is a computer-based information systems whose main goal is to help decision-making utilize data and models to solve the problems that are unstructured and semi structured. In accepting prospective members of the previous municipal police PSDM section sorting and selecting applicants one by one entering the data so that the data obtained is not clear didapt results of each participant. By using Fuzzy Multiple Attribute Decision Making (FMADM) is used to find an alternative from a number of alternatives to optimize certain criteria, while the Simple Additive Weighting method (SAW). SAW method is often also known term weighted summation method. The basic concept is to find a method SAW weighted summation of the performance ratings of all the attributes of each alternative [7].

II. FRAMEWORK

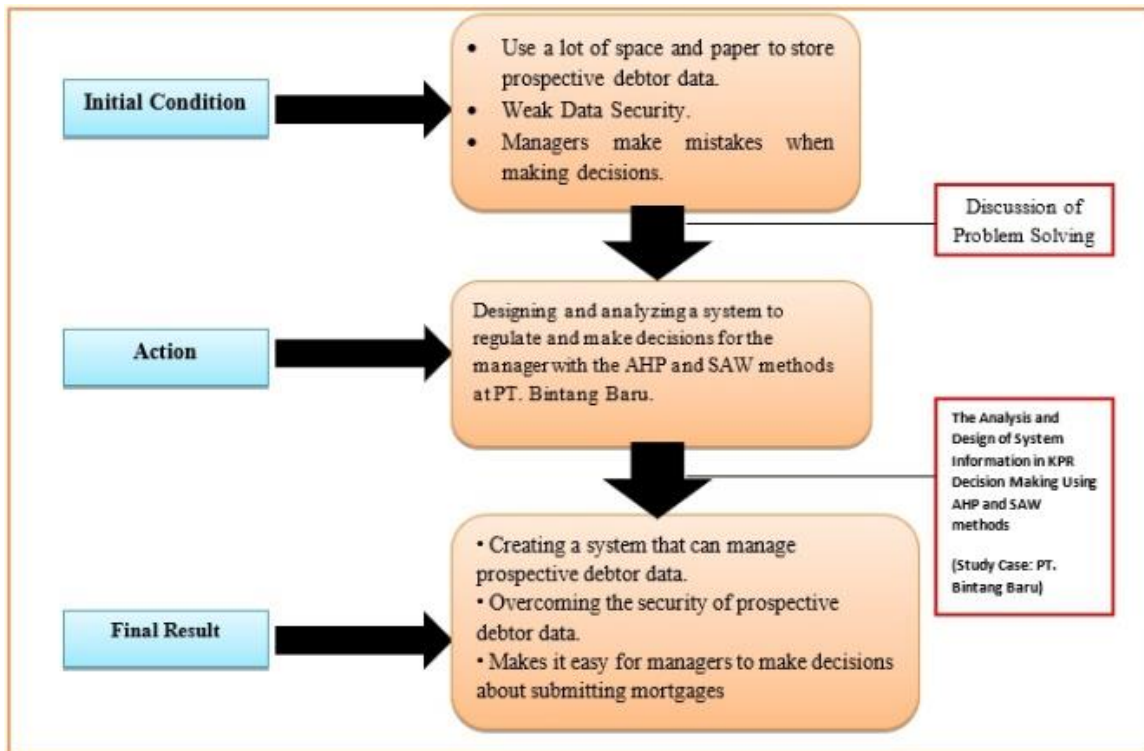


Figure 1. Home loan credit system using AHP and SAW methods

In figure 1 shows the problems exist in the current conditions in PT. Bintang Baru, by observing and interviewing for several days to the user, it can be concluded that PT. Bintang Baru requires a computerized system to solve the problems that have occurred. By using decision making system with AHP and SAW method, it will provide better result.

III. METHODS

Analytic Hierarchy Process (AHP) is a multicriteria decision making with the support of a methodology that has been recognized and accepted as a priority that can theoretically provide different answers to the problem of decision making and rank alternatives to the solution [8].

In solving problems with AHP has several principles that must be understood including [9]:

1. Make a hierarchy

Complex systems can be understood by breaking them into supporting elements, arranging elements in a hierarchy, and combining them.

2. Assessment of criteria and alternatives

Criteria and alternatives are carried out by pairwise comparisons, for various problems of scale 1 to 9 is the best scale for expressing opinions. The value and

definition of qualitative opinions from the Saaty comparison scale can be measured using the analysis table as follows [10].

Table 1. Saaty Scale [9]

Intensity of Interest	Definition	Explanation
1	Equal Importance	Both elements have an equally important influence.
3	Weak Importance One Over Another	One element is slightly more important than the other element or a very one-sided evaluation of the element compared to the partner
5	Essential or Strong Importance	One element is more important than the other elements.
7	Demonstrated Importance	One element is clearly more important than the other elements.
9	Extreme Importance	One element is absolutely important than the other elements at the highest level of confidence.

2,4,6,8	Intermediate Values Between the Two Adjacent Judgments	Values between two consideration values that are close together.
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3. Determine priorities

For each criterion and alternative, a pairwise comparison is needed. The relative comparison values of all alternative criteria can be adjusted according to the predetermined judgement to produce weights and priorities. Weight and priority are calculated by manipulating matrices or by solving mathematical equations.

4. Logical consistency

Consistency has two meanings. First, similar objects can be grouped according to uniformity and relevance. Second, concerning the level of relations between objects based on certain criteria.

Steps for AHP method are as follows:

Step 1: Represents n x n Matrix pairwise comparison

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ a_{21} & 1 & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix} \tag{1}$$

Step 2: Normalize the score

$$r_{ij} = \sqrt[j]{(xi1)(xi2) \dots \dots (xij)} \quad i, j = 1, 2, \dots, n$$

$$r = \begin{pmatrix} r1 \\ r2 \\ . \\ . \\ rn \end{pmatrix} \tag{2}$$

Step 3: Calculate *Priority Vector* or *Eigen Value* dan *Row Matrix*

$$PV = r_{ij} / \sum r_{ij}$$

$$Row \text{ matrik} = \sum_{j=1}^n a_{ij} * PV_{j1} \tag{3}$$

Step 4: Calculate λ max

$$\lambda \text{ max} = \sum Row \text{ Matrix} \tag{4}$$

Step 5: Calculate Consistency Index

$$CI = (\lambda \text{ max} - n) / (n - 1) \tag{5}$$

Step 6: Random Index Value

Table 2. Random Index

n	1	2	3	4	5	6	7	8
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41

n	9	10	11	12	13	14	15
RI	1.45	1.49	1.51	1.48	1,56	1,57	1,59

Step 7: Calculate Ratio Index

$$CR = CI / RI$$

If $CR \leq 0.1$ then the value is valid. (6)

After that using Simple Additive Weighting (SAW) method which known as the weighted sum method. The basic concept of the SAW method is to find a weighted sum of performance ratings on each alternative on all attributes [11]. The SAW method requires the process of normalizing the X decision matrix to a scale that can be compared with all available alternative ratings.

Steps for using the SAW Method:

1. Determine the criteria that will be used as a reference in decision making.
2. Determine the suitability rating of each alternative on each criterion.
3. Make a decision matrix based on criteria, then normalize the matrix based on equations that are adjusted to the type of attribute (attribute Gain or Cost attribute) so that the normalized R.
4. The final results are obtained from the ranking process, namely the sum of the multiplications of normalized matrices R with the weight vector so that the largest value chosen as the best alternative is obtained as a solution.

The formulas for normalizing are as follows:

$$r_{ij} = \frac{X_{ij}}{\text{Max } X_{ij}} \quad \text{for Gain Attribut}$$

$$r_{ij} = \frac{\text{Min } X_{ij}}{X_{ij}} \quad \text{for Cost Attribut}$$

where $i, j = 1, 2, \dots, n$ (7)

r_{ij} = Normalized performance rating

from alternative A_i ($i = 2, \dots, m$)

Max_{ij} = Maximum value of each row and column.

Min_{ij} = Minimum value of each row and column.

X_{ij} = Row and column of the matrix.

The formula for finding preference values for each alternative (PV_i) is given as:

PV_i = The final value of the alternative

W_i = Predetermined weight

r_{ij} = Normalization of the matrix.

calculate the Priority Value.

a larger PV_i value indicates that the alternative A_i is more selected.

$$PV_i = \sum_{j=1}^n w_j r_{ij} \quad (8)$$

IV. RESULT

Calculate Pairwise Comparison Matriks for criteria

Table 3. Matriks Comparison

Criteria	Statement of Income	Life Cost	Age	Annual Income Tax Return for Loan	Salary
Statement of Income	1	1	1/3	3	1
Life Cost	1	1	1/3	3	1/3
Age	3	3	1	5	1
Annual Income Tax Return for Loan	1/3	1/3	1/5	1	1/5
Salary	1	3	1	5	1

Table 4. Priority Weight

Criteria	Statement of Income	Life Cost	Age	Annual Income Tax Return for Loan	Salary	Total	Priority Weight
Statement of Income	0,157894737	0,12	0,11628	0,17647059	0,2830189	0,853663263	0,170732653
Life Cost	0,157894737	0,12	0,11628	0,17647059	0,0943396	0,664984017	0,132996803
Age	0,473684211	0,36	0,34884	0,29411765	0,2830189	1,759657935	0,351931587
Annual Income Tax Return for Loan	0,052631579	0,04	0,06977	0,05882353	0,0566038	0,277826324	0,055565265
Salary	0,157894737	0,36	0,34884	0,29411765	0,2830189	1,443868461	0,288773692

After get the priority weight from AHP method, it will be used for SAW weighted, every criteria the stake holder has fill the score, there are follows:

Table 6. Statement of Income Score

Statement of Income	Score
> Rp. 1.800.000.-	5
<= Rp. 1.800.000.-	4
<= Rp. 1.100.000.-	3
<= Rp. 800.000.-	2
<= Rp. 100.000.-	1

Table 7. Life Cost Score

Life Cost	Score
<= Rp. 3.000.000.-	5
<= Rp. 2.200.000.-	4
<= Rp. 1.700.000.-	3
<= Rp. 1.200.000.-	2
<= Rp. 700.000.-	1

Table 8. Age Score

Age	Score
41 – 45	5
36 – 40	4
31 – 35	3
26 – 30	2
21 - 25	1

Table 9. Annual Income Tax Return for Loan Score

Annual Income Tax Return for Loan	Score
> Rp. 1.400.000.-	5
<= Rp. 1.400.000.-	4
<= Rp. 900.000.-	3
<= Rp. 500.000.-	2
<= Rp. 200.000.-	1

Table 10. Salary Score

Salary	Score
> Rp. 4.100.000.-	5
<= Rp. 4.100.000.-	4
<= Rp. 3.900.000.-	3
<= Rp. 3.800.000.-	2
<= Rp. 3.700.000.-	1

After get the weighting from 5 criteria, in this case using 11 Alternative for calculations:

- C1 : Statement of Income (Gain)
- C2 : Life Cost (Cost)
- C3 : Age (Cost)
- C4 : Annual Income Tax Return for Loan (Cost)
- C4 : Salary (Gain)

Table 11. Alternative Score

Alternative	C1	C2	C3	C4	C5
Rudi Prabowo	4	3	1	2	4
Parimin	5	3	5	3	3
Andi Wiguna	5	4	2	2	3
Sutiono	5	2	4	1	3
Imas Kurniawati	5	2	3	5	4
Nia Lisniawati	5	2	1	1	3
Kosim Nurseha	3	2	1	4	4
Rusmini	4	3	5	5	5
Desida Dwi Mahardika	5	3	3	4	3
Rohin	5	2	2	5	3
Wahyu	5	2	1	5	3

Normalize the alternative from r_{11} to $r_{11,5}$

$$r_{11} = \frac{X_{ij}}{\text{Max } X_{ij}} = \frac{4}{5} = 0.8000$$

$$r_{12} = \frac{\text{Min } X_{ij}}{X_{ij}} = \frac{2}{3} = 0.6667$$

$$r_{13} = \frac{\text{Min } X_{ij}}{X_{ij}} = \frac{1}{1} = 1.0000$$

$$r_{14} = \frac{\text{Min } X_{ij}}{X_{ij}} = \frac{1}{2} = 0.5000$$

$$r_{15} = \frac{X_{ij}}{\text{Max } X_{ij}} = \frac{4}{5} = 0.8000$$

Table 11. Normalization Result

Alternative	C1	C2	C3	C4	C5
Rudi Prabowo	0,8000	0,6667	1.0000	0,5000	0,8000
Parimin	1.0000	0,6667	0,2000	0,3333	0,6000
Andi Wiguna	1.0000	0,5000	0,5000	0,5000	0,6000
Sutiono	1.0000	1.0000	0,2500	1.0000	0,6000
Imas Kurniawati	1.0000	1.0000	0,33333	0,2000	0,8000
Nia Lisniawati	1.0000	1.0000	1.0000	1.0000	0,6000
Kosim Nurseha	0,6000	1.0000	1.0000	0,2500	0,8000
Rusmini	0,8000	0,6667	0,2000	0,2000	1.000
Desida Dwi Mahardika	1.0000	0,6667	0,3333	0,2500	0,6000
Rohin	1.0000	1.0000	0,5000	0,2000	0,6000
Wahyu	1.0000	1.0000	1.0000	0,2000	0,6000

Calculate the Priority Vector for eleven alternative, using Priority weight from AHP.

$$\begin{aligned}
 PV_1 &= ((0.170732653 * 0.8) + (0.132996803 \\
 &\quad * 0.667) + (0.351931587 * 1) + \\
 &\quad (0.055565265 * 0.5) + (0.288773692 * \\
 &\quad 0.8)) \\
 &= 0,835983831
 \end{aligned}$$

Table 12. AHP and SAW Result

Alternative	P.V	Rank
Rudi Prabowo	0,835983831	3
Parimin	0,521569476	11
Andi Wiguna	0,614243696	8
Sutiono	0,620541833	7
Imas Kurniawati	0,663171992	6
Nia Lisniawati	0,884490523	1
Kosim Nurseha	0,832278252	4
Rusmini	0,59552372	9
Desida Dwi Mahardika	0,563863249	10
Rohin	0,664072518	5
Wahyu	0,840038311	2

V. CONCLUSION

According to the result of the research taken from the home loan credit decision supporting system by using AHP and SAW method as in.

1. Reducing the usage of paper so the company no longer needed to spend a lot of budget for paper
2. Able to save debtor candidate's important datas in the system so it won't take to much space
3. To ease manager and marketing's work in finding debtor candidate's data
4. To help manager in decision making in selecting debtor that is quified to be given home loan credit from many kinds of criterias that have been decided by the manager.

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BIOGRAPHY

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