Determination of Giving Money Loans to Cooperative Members Using the SAW and TOPSIS Methods in Savings and Loans Cooperatives

Amin Rizkiyanto

Computer Science Program, Budi Luhur University
Jakarta, Indonesia.
E-mail : aminrizky@gmail.com

ABSTRAK

The increasing volume of money lending transactions by employees of PT Sumi Indo Kabel and PT Karya Sumiden Indonesia has an impact on the difficulty of cooperative management in selecting the eligibility of members to be able to apply for money loans, this is because the process is still done manually, so the process of borrowing members becomes slow. Therefore, it is necessary to make a decision support system (DSS) to determine the feasibility of granting money loans to eligible members using the Simple Additive Weighting (SAW) method and the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS). With this decision support systems that can solved the problem in determining lending to eligible and the eligible members.

Keywords : Savings and Loans, Decision Support Systems, SAW, TOPSIS.

I. INTRODUCTION

The application of information technology in an organization is not easy to do because the application of new technology will affect all activities in the organization, especially human resources. The user factor is very important to consider in the implementation of a new information system, because the level of user readiness to accept the new system has a major influence in determining the success or failure of the implementation of the information system. The impact that needs to be studied from the presence of information systems in the organization is the occurrence of changes in several things, including the way of working and the service process. According to Sung (1987) in Trisna (1998) which states that technical factors, behavior, situation and IT user personnel need to be considered before Information Technology is implemented. User behavior and personal system are needed in system development, and this is related to the understanding and perspective of the system user.

As time goes by, the transactions that occur in this cooperative become increasingly complex, the most important of which is the transaction of applying for a loan of money both for the personal needs of members and for the business needs of their members (business loans). In addition, there are many benefits that can be received by members when borrowing from this cooperative, namely the ease of making loans, and also because the interest rates set are lower than conventional financial institutions (Banks). This makes it very

difficult for the cooperative management in determining and screening which members are entitled and eligible to receive loan money.

From these problems the author wants to help this business entity in making quick and accurate decisions, it occurred to the author's mind to make a research "Decision Support System for Giving Money Loans to members of the Savings and Loans Cooperative with the SAW and TOPSIS method at PT. Sumi Indo Kabel, Tbk.

II.   THEORITICAL BASIS

A.   Decision Support System
According to Turban et al (2005) "Decision support system is an approach or methodology to support decision makers in semi-structured decision situations." Decision Support System is expected to be a tool that can help decision makers (Decision Maker) in using data and models to solve a problem.

According to Kusrini (2007), "Decision Support System is an interactive information system that provides information, modeling, and manipulating data." The system is used to assist decision making in semi-structured and unstructured situations.

A decision support system is a computer-based system consisting of three interacting components, a language system (a mechanism to provide communication between users and other decision support system components), a knowledge system (a repository of problem domain knowledge that exists in a decision support system or as data or information). as a procedure) and processing systems or more general problem manipulation capabilities needed for decision making (Dicky Nofriansyah, 2014).

B.   Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).
According to Nofriansyah (2014) "TOPSIS is a decision-making method that uses the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution from a geometric point of view by using the Euclidean distance (distance between two points) to determine the relative closeness of an alternative.

The stages in the TOPSIS Method:
• Create a normalized decision matrix.
• Create a robot normalized decision matrix.
• Determine the positive ideal solution matrix and the negative ideal solution matrix.
• Determine the distance between the value of each alternative with a positive and negative ideal solution matrix.

The steps to solve the problem using the TOPSIS method:
1.   Determine the normalization of the decision matrix. The normalized value of the rij is calculated by the formula:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Information :
i = 1,2,… m
j = 1,2… n.

2.   Determine the normalized weight of the decision matrix. The normalized weight value of yij is as follows:

Information :
i = 1,2,… m
j = 1,2… n.

$$A^+ = (y_1^+, y_2^+, ..., y_n^+);$$
$$A^- = (y_1^-, y_2^-, ..., y_n^-);$$

With :

$$y_j^+ = \begin{cases} \min y_{ij} & \text{jika j adalah atribut biaya} \\ \max y_{ij} & \text{jika j adalah atribut keuntungan} \end{cases}$$

$$y_1^- = \begin{cases} \max y_{ij} = \text{Jika j adalah atribut keuntungan i} \\ \min y_{ij} = \text{jika j adalah atribut biaya i} \end{cases}$$

3. The distance between alternative Ai and the positive ideal solution is formulated as:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_{1-}^+ y_{ij})^2};$$

4. The distance between alternative Ai and the negative ideal solution is formulated as:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_1^-)^2};$$

5. The preference value for each alternative (Vi) is given as:

$$v_i = \frac{D_i^-}{D_1^- + D_1^+}; \quad i = 1, 2, ...m.$$

A larger Vi value indicates that the alternative Ai is preferred.

C. Simple Additive Weighting (SAW)
The SAW algorithm is a weighted addition. The basic concept of the SAW algorithm is to find the weighted sum of the performance ratings for each alternative on all criteria. The SAW algorithm requires the process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The SAW algorithm recognizes 2 (two) attributes, namely the benefit criteria and the cost criteria. The basic difference between these two criteria is in the selection of criteria when making decisions (Usito, 2013).

The steps for solving it are :

1. Determine the alternative, namely Ai
2. Determine the criteria that will be used as a reference in decision making, namely Cj
3. Provide a rating of the suitability of each alternative on each criterion.
4. Determine the preference weight or importance level (W) of each criterion.
5. Create a match rating table for each alternative on each criterion.
6. Make a decision matrix (X) which is formed from the suitability rating table of each alternative on each criterion.
7. Normalize the decision matrix by calculating the value of the normalized performance rating (rij) from the alternative Ai on the Cj criteria.

If *j* is a profit attribute (*benefit*):

$$r_{ij} = \frac{X_{ij}}{\max x_{ij}}$$

If *j* is a cost attribute (*cost*):

$$r_{ij} = \frac{\min X_{ij}}{x_{ij}}$$

Information:
r_{ij} = normalized performance rating nilai
x_{ij} = attribute values owned by each criterion

max x_{ij} = the greatest value of each criterion

min x_{ij} = the smallest value of each criterion

benefit = if the biggest value is the best

cost = if the smallest value is the best

8. The results of the normalized performance rating value (rij) form a normalized matrix.

9. The final result of the preference value (Vi) is obtained from the sum of the normalized matrix row elements (R) with the preference weights (W) corresponding to the matrix column elements (W).

III. SYSTEM AND APPLICATION DESIGN

A. Sampling Method

According to Gay and Diehl (Gay and Diehl, 1992), the more samples taken, the more representative they will be and the results can be generalized. However, the size of the sample received will depend on the type of research. According to Roscoe (Roscoe, 1975) some guidelines for determining sample size are, for simple experimental research with strict experimental control successful research is possible with small sample sizes between 10 to 20.

There are two procedures in the sample selection process, namely Random Sampling and Non-Random Sampling. Random Sampling is a sample selection process in which all members of the population have an equal chance of being selected. There are several methods of random sampling including simple random sampling, stratified random sampling and cluster random sampling.

Which is the sampling used for the sampling of money loan analysts using

$$Vi = \sum_{j=1}^{n} W_j r_{ij}$$

Information:

Vi = value for each alternative

Wj = weight value of each criterion

rij = normalized performance rating nilai

The calculation result of the larger Vi value indicates that the alternative Ai is the best alternative.

saturated sampling. While the sampling for system testing uses the Slovin formula (Riduwan, 2005), as follows:

$$n = \frac{N}{(Nd^2)+1}$$

Information:

n : Number of samples

N : Population

d : Set precision 5% or (0.05)

B. Data Collection Method

The collection of data and information in this study was carried out by four methods, namely:

1. Observation

   Observations are made to obtain data and information needed on the current system, such as observing the process of analyzing money lending, the required criteria and their weighting. Observations were also made to determine the analyst who would fill out the questionnaire made by the researcher.

2. Questionnaire
Questionnaires were given to the Melati Darma Persada cooperative loan analyst regarding the ease of use of the system to be designed and its usefulness.

3. Literature Study
To obtain information and data that support this research, researchers use books, journals/scientific works and other scientific sources as well as other documents related to the design of this system.

4. Formation of Primary Data
Primary data is obtained by extracting several files consisting of the borrower's personal data file, collateral data and money loan data by taking the required fields for testing.

IV. RESULTS AND DISCUSSION

A. Determination of Criteria

The criteria used for the ranking of alternatives for determining the provision of money loans are carried out through interviews with experts in the field of savings and loan cooperatives and financial services as well as through library studies. So that obtained seven criteria as follows:

Criteria	Criteria Code	Criteria Name
Benefit	C1	Position
	C2	Membership Length
	C3	Length of work
	C4	Big Savings
	C5	Monthly Income
	C6	Installment Term
Cost	C7	Age

B. Data Alternative

From the results of interviews conducted, there are seven alternatives that can meet predetermined criteria.

Alternative	Alternative Code
Alternative eligibility for loan recipients	A1
	A2
	A3
	A4
	A5
	A6
	A7

C. Solution With SAW

The completion of the SAW method normalization is carried out with the X matrix, becoming an R matrix which is illustrated according to the following table.

1. Table Value Weight

Data Alternative	Score in Each Criterion						
	C1	C2	C3	C4	C5	C6	C7
A1	0.5	1	0.7	0.7	0.8	0.6	0.5
A2	1	0.5	1	0.7	1	0.6	0.5
A3	0.6	0.8	0.7	1	0.7	1	1
A4	1	0.3	0.4	0.7	1	0.5	1
A5	0.2	1	0.5	0.9	0.7	0.9	1
A6	0.8	0.7	1	0.5	1	0.9	0.4
A7	0.5	1	0.7	0.7	0.8	1	0.6

2. Table of Weights for Each Criterion

	Criteria							Total
	C1	C2	C3	C4	C5	C6	C7	
Bobot	0.15	0.20	0.10	0.20	0.10	0.10	0.15	1

3. Table Result Normalization

0.50	1.00	0.70	0.70	0.80	0.60	0.80
1.00	0.50	1.00	0.70	1.00	0.60	0.80
0.60	0.80	0.70	1.00	0.70	1.00	0.40
0.20	0.30	0.40	0.70	1.00	0.50	0.40
1.00	1.00	0.50	0.90	0.70	0.90	0.40
0.80	0.70	1.00	0.50	1.00	0.90	1.00
0.50	1.00	0.70	0.70	0.80	1.00	0.67

4. Table of Ranking Results
The ranking process is obtained from the value of the preference weight multiplied by the normalized matrix

A1	0.745
A2	0.770
A3	0.750
A4	1.215
A5	0.800
A6	0.800
A7	0.765

So that the results obtained that have the highest value are: Alternative **A4** with a value of **1,215**. And **A4** is determined as the most eligible Prospective Borrower to receive a loan.

D. Solution With TOPSIS

1. Value Weight Table

Alternative Data	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	0.10	0.20	0.15	0.15	0.15	0.15	0.10
A2	0.20	0.10	0.20	0.15	0.20	0.15	0.10
A3	0.10	0.15	0.15	0.20	0.15	0.20	0.20
A4	0.20	0.10	0.10	0.15	0.20	0.10	0.20
A5	0.10	0.20	0.10	0.15	0.15	0.15	0.20
A6	0.15	0.15	0.20	0.10	0.20	0.20	0.10
A7	0.10	0.20	0.15	0.15	0.15	0.20	0.10

Criteria	Weight	Level of importance
C1	0.15	Important
C2	0.20	Very Important
C3	0.10	Quite important
C4	0.20	Very Important
C5	0.10	Quite important
C6	0.10	Quite important
C7	0.15	Important

2. Normalized Matrix Table Formula :

$$R_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	1.32	0.46	0.37	0.37	0.33	0.34	0.25
A2	0.53	0.23	0.49	0.37	0.44	0.34	0.25
A3	0.26	0.35	0.37	0.50	0.33	0.45	0.50
A4	0.53	0.23	0.24	0.37	0.44	0.23	0.50
A5	0.26	0.46	0.24	0.37	0.33	0.34	0.50
A6	0.40	0.35	0.49	0.25	0.44	0.45	0.25
A7	0.26	0.46	0.37	0.37	0.33	0.45	0.25

3. Weighted Normalization Table Formula:

Weighted Normalization = Normalized Data x Criteria Weight

Alternative	C1	C2	C3	C4	C5	C6	C7
A1	0.199	0.093	0.037	0.074	0.033	0.034	0.038
A2	0.079	0.046	0.049	0.074	0.044	0.034	0.040
A3	0.040	0.070	0.037	0.099	0.033	0.045	0.080
A4	0.079	0.046	0.024	0.074	0.044	0.023	0.080
A5	0.040	0.093	0.024	0.074	0.033	0.034	0.080
A6	0.060	0.070	0.049	0.050	0.044	0.045	0.040
A7	0.040	0.093	0.037	0.074	0.033	0.045	0.040

4. Finding the Max and Min

Finding the max and min values from the weighted normalization can be done with the following formulation:

Criteria are Benefit (the bigger the better) then
Y+ = *max* and Y- = *min*

Criteria are Cost (the smaller the better) then
Y+ = *min* and Y- = *max*

	C1	C2	C3	C4	C5	C6	C7
A1	0.198679 85	0.092 99811	0.0 37	0.07 4	0.033	0.03 4	0.03 8
A2	0.07 9	0.046	0.0 49	0.07 4	0.044	0.03 4	0.03 8
A3	0.04 0	0.070	0.0 37	0.09 9	0.033	0.04 5	0.07 5
A4	0.07 9	0.046	0.0 24	0.07 4	0.044	0.02 3	0.07 5
A5	0.04 0	0.093	0.0 24	0.07 4	0.033	0.03 4	0.07 5
A6	0.06 0	0.070	0.0 49	0.05 0	0.044	0.04 5	0.03 8
A7	0.04 0	0.093	0.0 37	0.07 4	0.033	0.04 5	0.04 0
Ma x	**0.19 9**	**0.093**	**0.0 49**	**0.09 9**	**0.044**	**0.04 5**	**0.07 5**
Mi n	**0.04 0**	**0.046**	**0.0 24**	**0.05 0**	**0.033**	**0.02 3**	**0.03 8**

5. Determine the Positive Ideal Solution (D+) and Negative Ideal Solution (D-)
Formula:

$$Dx^+ = \sqrt{(AxC1 - Y1+)2_+ (AxC1 - Y2+)2_+ \ldots + (AxCn - Yn+)^2}$$

$$Dx^- = \sqrt{(AxC1 - Y1+)2_+ (AxC1 - Y2-)2_+ \ldots + (AxCn - Yn-)^2}$$

	D+	D-

V. CONCLUSIONS

The conclusions that can be drawn from this research are

1. Based on the comparison of the Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method and the Simple Additive Weighting (SAW) method, there are differences in results, which can be seen during the ranking process.

2. The results of the ranking using the Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method obtained that Alternative A4 got the highest score as a recipient of a savings and loan

BIBLIOGRAPHY

[1] Gay, L.R. dan Diehl, P.L. 1992. *Research Methods for Business and. Management*. New York : MacMillan Publishing Company.

[2] Kusrini, 2007. Konsep dan Aplikasi Sistem Pendukung Keputusan. Yogyakarta: Andi Offset.

A1	0.049	0.168
A2	0.137	0.054
A3	0.161	0.071
A4	0.135	0.185
A5	0.163	0.065
A6	0.153	0.047
A7	0.165	0.059

6. Determine the preference value for each alternative

Formula :

$$V_i = \frac{D_i}{D_i^- + D_i^+}$$

Alternative	Value	Rank
A1	0.775	1
A2	0.285	5
A3	0.305	3
A4	0.578	2
A5	0.286	4
A6	0.234	7
A7	0.262	6

So it can be concluded that Alternative **A1** with a value of **0.775** is designated as the most eligible Prospective Borrower to receive a loan.

cooperative loan of PT. Sumi Indo Kabel Tbk.

3. The results of ranking using Simple Additive Weighting (SAW) obtained Alternative A1 got the highest score as a recipient of a savings and loan cooperative loan of PT. Sumi Indo Kabel Tbk.

4. The two methods, namely the Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method and the Simple Additive Weighting (SAW) method can assist in the process of determining the provision of money loans to members of the savings and loan cooperatives of PT. Sumi Indo Kabel Tbk.

[3] Nofriansyah, Dicky. 2014. Konsep Data Mining Vs Sistem Pendukung Keputusan. Yogyakarta: Deepublish.

[4] Nugroho J. Usito, 2013. Sistem Pendukung Keputusan Penilaian Proses Belajar Mengajar Menggunakan Metode *Simple Additive Weighting*(SAW). Semarang: Universitas Diponegoro.

[5]   Riduwan. 2005. Belajar Mudah Penelitian Untuk Guru, Karyawan dan Peneliti Pemula, Bandung : Alfabeta.

[6]   Roscoe, J. T. 1975. *Fundamental research statistics for the behavioural sciences.(2nd ed.).* New York: Holt Rinehart & Winston.

[7]   Trisnawati Rina. 1998."Pertimbangan prilaku dan factor penentu keberhasilan pengembang system informasi". Yogyakarta: Jurnal kajian bisnis, edisi September.

[8]   Turban, Efraim, dan Jay E. Aronson. 2005. *Decision Support Systems and Intelligent Systems* (Sistem Pendukung Keputusan dan Sistem Cerdas). Jilid 1. Yogyakarta: Andi Offset.

[9]   H. N. Sari and A. Fatmawati, "Sistem Pendukung Keputusan Rekomendasi Penentu Beras Miskin Menggunakan Metode SAW Dan TOPSIS (Studi Kasus: Desa Semagar Girimarto Wonogiri)," J. Mitra Manaj., vol. 3, no. 1, pp. 96–108, 2019, doi: 10.52160/ejmm.v3i1.185.

[10]   R. Hardianto, "Spk Pemilihan Presiden Mahasiswa Unilak Menggunakan Metode Simple Additive Weighting (Saw)," Zo. J. Sist. Inf., vol. 1, no. 2, pp. 97–103, 2020, doi: 10.31849/zn.v1i2.3123.

[11]   Sunarti, "Perbandingan Metode TOPSIS dan SAW Untuk Pemilihan Rumah Tinggal," J. Inf. Syst., vol. 3, no. 1, pp. 69–79, 2018, [Online].Available:https://publikasi.dinus.ac.id/index.php/joins/article/view/1883/1289.

[12]   A. Rikki, "Pengujian Sistem Pendukung Keputusan Metode Simple Additive Weighting dan Weighted Product dengan Matlab," MEANS (Media Inf. Anal. dan Sist., vol. 2, no. 1, pp. 47–51, 2017.