Journal of Theoretical and Applied Information Technology
15th July 2018. Vol.96. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

HYBRID OF AHP AND TOPSIS FOR LOAN APPROVAL DECISION

[1]MERI AZMI, [2]YANCE SONATHA, [3]DWINY MEIDELFI, [4]RAHMAT HIDAYAT

[1,2,3,4]Department of Information Technology, Politeknik Negeri Padang, West Sumatera, Indonesia

Email : [1]meriazmi@gmail.com, [2]sonatha.yance@gmail.com, [3]dwiny9586@gmail.com,

[4]mr.rahmat@gmail.com

ABSTRACT

Cooperative in Indonesia, has shown positive effect on the community economic growth in general. It is due to its role in providing loan to community, particularly to lower-middle-economic community. However, all through these years, the verification process in approving the loan proposal from its members has been done manually through interview process conducted by the cooperative committee. Then, continued to evaluation in order to decide the eligible members for receiving the loan. As a result, invalid, less qualified, and subjective decisions are often occured. Therefore, changes are required to be made using the decision support system. In this research, a decision support system has been made by using the combination of two methods; AHP and TOPSIS methods. AHP method is taken in order to obtain the priority value (weight) of criteria and sub-criteria used, whereas TOPSIS method is concerned with the character of criteria used in this system. This system applies five critera where each criteria is consisted of sub-criteria. Further, the data is derived from five cooperative members' data. The result of this system shows that one member is absolutely adequate in receiving the loan, two members are adequate, and another two members are in adequate. This support system merely assists the cooperative committee in making their decision for those members who are eligible getting the loan, where the final decision is absolutely on the decision maker.

Keywords : *AHP, Decision Support System, Hybrid Method, Loan Approval, TOPSIS*

1. INTRODUCTION

According to the law No. 25 year 1992, Cooperative is a business actor that have members of individuals or cooperatives legal entities in which its operation is based on principles of cooperatives as well as treated as people economic movement based on familial principles [1] Based on this law, cooperatives shall be particularly aimed to develop social wealth, whereby the social element seen from its principles, familial principle [2].

One of the cooperative types is Saving and Loan. Here, at this type of cooperative, the society can feel safe and comfort in saving their money. Besides that, referring to the loan matter, its member can get the loan with the lowest interest in order to develop their planned businesses. Due to this reason, cooperative becomes an essential role in the economic growth of Indonesian community. Hence, cooperative always adapts with the development of the relevant knowledge, including the use of information technology in the term of managing a cooperative.

One of cooperatives in Padang Municipality is Civil Servant Cooperative (CSC) Kapur Warna which was established in 1984. In 2016 end of year book closing, CSC Kapur Warna had 316 members. [3] One of its running unit is Saving and Loan Unit. In this unit, members can propose a loan to the cooperative in accordance with terms and conditions applied, and is proceeded by verification stage. Usually, the verification process is performed by the committee through the interview with the members who proposed the loan. Then the interview result is going to be used as the decision foundation whether these members are eligible to receive the loan. This process is assumed to be ineffective and inefficient, and often the decision made is lack in validity and quality, tends to be subjective with low analytical ability which is at-risk toward right decision in loan approvement process.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Therefore, there should be a change from this manual system onto decision support base system that can provide best alternative and suggestion in deciding members who deserve to get the loan, by simplifying the verification process. It is expected that this system can assist the cooperative committee to come out with valid, qualified and subjective decision in inclining the members who can get the loan .

There are many methods that can be used in qualifying members who can get the loan. A few of them are AHP and TOPSIS methods. Many previous literatures associate with the implementation of these two methods, one of them was in the Decision Making in Best Course Selection after HSC[4]. Here, this research was aimed to choose the best course place after HSC, and resulted on the ranking of chosen course places. Priority value on each criteria was counted using AHP method, then the weight was used as the input for further measurement using TOPSIS method. Eventually, the ranking of each alternative was measured based on priority value obtained through the two methods. This research involved eight criteria and five alternatives.

Another research was the one that combined AHP and TOPSIS methods in analyzing SCM base performance. This research carried out the selection on the best alternative in order to improve the management of electronic supply chained (e-SCM), the performance of India automotive industry located in Delhi [5]. AHP method was used in order to get priority weight of the existing criteria, while TOPSIS method was used for alternative measurement.

Moreover, AHP and TOPSIS combination was also implemented onto decision support system in evaluating the operational ability of electric power supplier using three criteria and 45 indexes taken from four links of electric power system [6].

Another previous research using the AHP and TOPSIS combination method was the determination on event budget allocation of Student Activity Unit at State Polytechnic of Padang [7]. The purpose of the decision support system within was to resolve the proposal eligibility in receiving the activity fund at that campus.

The next research that compared the performance of AHP and TOPSIS method was the one taken in choosing which student was eligible to receive an award at an enginering higher institution [8]. Derived from the implementation of the two methods, the result obtained was the ranking divergent.

Referred to the result of several researches mentioned above, shown that the combination of AHP and TOPSIS method shows good capability on this decision support system. However, for the current research object, which is loan and save cooperative, the combination method of AHP and TOPSIS has never been carried out. In contrast, a cooperative is really in need of this support system as it has a great influence on the existence of a cooperative in the future.

Thus, the aim of this current research is:

1. Designing and developing a decision support system using the combination of AHP and TOPSIS method.
2. Implementing this decision support system onto the object which has not yet been done previously; a loan and save cooperative.
3. Demonstrating that this combination method is more appropriate to be applied rather than AHP or TOPSIS itself.

2. METHODOLOGY

Decision Support Systems (DSS) was defined by Michael S. Scott Morton as interactive computer base system assissting the decision maker in utilizing the data and various models in order to solve unstructured problems. Where Little stated that DSS as a group of model base procedures for data processor and evaluation to support the manager in making the decision [9]

As for this research, AHP method was used in determining the weight of each criterion and sub-criterion, meanwhile TOPSIS method was aimed to manage the characteristic of criteria used in this decision support system. TOPSIS was performed as well in deciding the member with the highest priority in getting the loan.

In increasing the TOPSIS method performance, its combination with AHP method was considered necessary. In TOPSIS method, initial weight was needed for processing further data, and the weight value of each criterion and sub-criterion was determined subjectively depended on the decision maker desire. On the other hands, AHP method was going to produce the weight which was initially decided subjectively, then calculated objectively. Thus, its combination with AHP method in order to obtain the initial weight should be carried out.

2.1. AHP Method

AHP was developed by Thomas L. Saaty in 1980. It is a structured method used to manage

Journal of Theoretical and Applied Information Technology
15th July 2018. Vol.96. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

complex decision problem. By using AHP, the settlement of complex decision problem including the processes embedded within could be done comprehensively and rationally. It assisted in establishing the best decision among many options effectively [10][11]. In addition, it also had simple and easy calculation process.

Below were stages conducted using the AHP method [12] :

1. *Defining the problem and determining its final goal*. At this first step, the problem was defined and the final goal to be achieved was set.
2. *Arranging the hierarchy structure of the existing problem*. At this second stage, the hierarchy structure was arranged. The hierarchy itself was consisted of three levels, from the goal which was going to be analyzed, up to the most basic element which were criteria, sub-criteria, and interrelated alternatives, as seen in Figure 1.

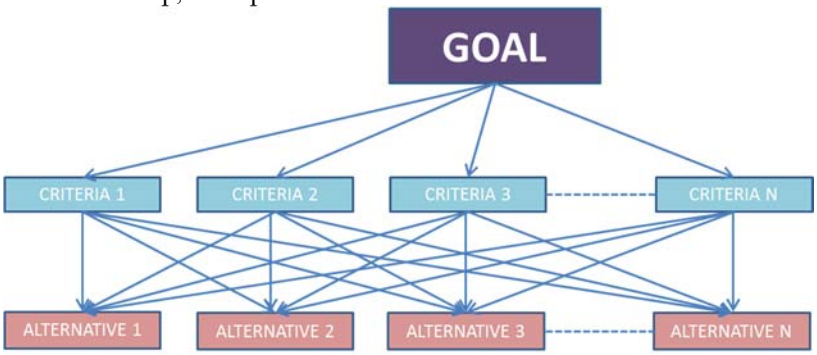

Figure 1: AHP Hierarchy

3. *Framing the pairwise comparison matrix*. This stage was determining the element priority by framing the pairwise comparison. It was carried out by comparing the element in pair in accordance with specified criterion. Further, pairwise comparison matrix was filled with numbers representing relative interest of an element against other elements. The value and qualitative opinion definition of Saaty Comparison Scale can be measured using Table 1.

Table 1 : Saaty Scale Comparison [12]

Interest Intencity	Note
1	Both of the element are equally important
3	One element is slightly more important than another one.
5	One element is more important than another one.
7	One element is more absolutely important than another one.
9	One element is absolutely important than another one.
2,4,6,8	Values between two adjacent considerations.

4. *Synthesising*. At this stage, it concerned in adding the values of each column in the matrix, then dividing each value from the colum with the total number of relevant column in order to get the normalization matrix. Afterward, adding the value on each line and dividing it with the total number of the element to get the average value. It was aimed in order to get the whole priorities of considerations against pairwise comparison.
5. *Measuring the consistency*. At this stage, it was done by multiplying each value in the first column with the first relative element priority, whereas value on the second column with the second relative element priority, and so forth. After that, continued to adding each line. The sum then was divided by relative priority element from the relevant element. Further, adding the quotient with the total number of existing elements. The result was called λmax
6. *Counting Consistency Index* (CI) using the formula:
   $CI = (\lambda_{max} - n) / n$ (1)
   n is the total number of elements
7. *Counting Consistency Ratio* (CR) with the formula:
   $CR = CI / RC$ (2)
   RC is *index Random Consistency*
8. *Examining the hierarchy consistency*, if the value was more than 10%, then the data judgement should be repaired. However, if the consistency ratio (CI/CR) less or same with 0,1, then the result could be said correct. The

consitency ratio value reference is shown in Table 2.

Table 2 : Value of Random Consistency Index [12]

Number of items compared in Matrix	1	2	3	4	5	6	7	8	9	10
RC	0	0	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Priority value obtained within the AHP process then was set into weight within TOPSIS method [13]

2.2. TOPSIS Method

TOPSIS was developed in 1981. Its foundation was the existence of the chosen alternative which had 'the shortest distance' from positive ideal solution, and 'the farthest distance' from negative ideal solution [4][14][15][16]. Then, the ranking process was conducted in order to choose the best alternative [17]. This method has a simple and comprehensible concept from its proven uncomplicated method steps.

Regardless the decision making assistance, TOPSIS method uses indicator criteria and alternative variable. This method has an efficient and fast computation so it can be taken as the nomination of alternative performance. Other than that, it has a rangking process which can select the best alternative among several existing alternatives.

Steps taken in TOPSIS Methods were as follow:

1. Determining the criteria rating matrix.
   Performance rating matrix was the one consisting of sub-criterion value of each alternative.
2. Calculating normalized matrix.
   Each element in performance rating matrix was normalized in order to obtain R normalization matrix. Each normalization of r_{ij} value was computed as follow:
   $$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2_{ij}}} \quad (3)$$
   where i = 1,2,3,…,m and j = 1,2,3,…,n
3. Calculating the weighted normalized matrix.
   At this step, weighting the normalized matrix was by giving W weight = (w1, w2, … , wn), so that weight normalization of V matrix could be resulted as follow:
   $$V = \begin{bmatrix} w_{11}r_{11} & \cdots & w_{1n}r_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1}r_{m1} & \cdots & w_{nm}r_{nm} \end{bmatrix} \quad (4)$$
   where i=1,2,3,…,m and j=1,2,3,…,n
4. Calculating positive and negative ideal solution matrix.
   At this step, it was carried out by denoting positive ideal solution with A^+ and negative ideal solution with A^-.
   $$A^+ = \{(\max v_{ij} \mid j \in J)(\min v_{ij} \mid j \in J'), i = 1,2,3,...m\} = \{v_1^+, v_2^+, ...v_m^+\}$$
   $$A^- = \{(\max v_{ij} \mid j \in J)(\min v_{ij} \mid j \in J'), i = 1,2,3,...m\} = \{v_1^-, v_2^-, ...v_m^-\}$$
   (5)
   where,
   Vij = V matrix element, the -I line and the –j column
   J={j=1,2,3,…,n and j connected with benefit criteria}
   J'={j=1,2,3,…,n and j connected with cost criteria}
5. Calculating the distance between the value of each alternative with positive and negative ideal solution matrix.
   Separation measure positive ideal was formulated as follow :
   $$S_i^+ = \sqrt{\sum_{j=1}^{n}(Vij - V_j^+)^2}, where\ i = 1,2,3,\dots,n \quad (6)$$
   Separation measure negative ideal was formulated as follow :
   $$S_i^- = \sqrt{\sum_{j=1}^{n}(Vij - V_j^-)^2}, where\ i = 1,2,3,\dots,n \quad (7)$$
6. Calculating the relative closeness with positive ideal by representing the relative closeness of A+ alternative with A- ideal solution using the formula as follow :
   $$Ci = \frac{S_i^-}{S_i^- + S_i^+}, where\ 0 < Ci < 1\ and\ i = 1,2,3,\dots,m \quad (8)$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

7. Sorting the options by ranking the alternatives based on C_i, order. The best alternative was the one which had the shortest distance against positive ideal solution, and the farthest distance against negative ideal solution.

2.3. The Criteria for Giving Out Loan at CSC Kapur Warna and Research Data

Cooperative tremendously has helped society in financing matter covering many aspects so it could increase the income of its member.

Before approving the loan facility to its member, the cooperative committee as the decision maker should be confirmed that the loan given was going to be returned. The assurance was perceived from the loan survey result, before the loan being distributed. The survey could be carried out in many ways in order to get the assurance regarding to its customers through the true and earnest evaluation procedure. In evaluating, previously the criteria and the evaluation aspects should be set up. Usually, the general evaluation criteria should be done by the cooperative committee in order to get the eligible members for receiving the loan. Therefore, the 5C analysis was conducted (Character, Capacity, Capital, Condition, Collateral)) [18]

Based on the interview result with the cooperative committee, information was perceived that CSC Kapur Warna took these 5C Criteria, as shown in Table 3.

Table 3 : Criteria, Sub-Criteria, Section Of Sub-Criteria

No	Criteria	Sub-criteria		Section of Sub-criteria
1	Character (CHA)	a	Community Evaluation (PM)	Good
				Enough
				Less
		b	Family Member (AK)	1-3
				4-5
				6-7
				>= 7
2	Capacity (CAY)	a	Occupation	Civil Servant (PNS) level 4a-4d
				Civil Servant level 3a-3d
				Civil Servant level 2a-2d
				Civil Servant level 1a-1d
				BUMN (State Owned Enterprises)
				Private Sector Employee
				PNS, BUMN retirement
				Businessmen (Profit per Month > 5 million)
				Businessmen (Profit per Month 3-5 million)
				Businessmen (Profit per Month 2-3 million)
				Businessmen (Profit per Month 1-2 million)
				Businessmen (Profit per Month < 1 million)
				Farmer, Stock-Farmer
3	Capital (CAP)	a	Monthly Income (PP)	> 5
				3-5 million
				1-2 million
				< 1 million
		b	Debt in other places	Yes, Debt = Amount of Collateral

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

No	Criteria	Sub-criteria		Section of Sub-criteria
			(HU)	Yes, Debt < Amount of Collateral
				No
4	Collateral (COL)	a	Vehicle Ownership Book (BPKB) (BP)	Car
				Motorcycle
		b	House (RU)	Permanent, type > 70
				Permanent, type 60-65
				Permanent, type 50-54
				Permanent, type 36-45
				Permanent, type 25-29
				Permanent, type 15-21
		c	Size of the land (LT)	> 500m
				400-500m
				300-400m
				200-300m
				100-200m
				50-100m
				<50m
5	Condition (CON)	a	Job Prospect	Good
				Enough
				Less

The data for this study was the sample data taken from CSC Kapur Warna.

2.4. A Model of AHP-TOPSIS Combination Approach in Determining The Members' Eligibiliy in Getting The Loan.

AHP method was used in identifying the weight of each criterion and sub-criterion taken from pairwise comparison matrix [19]. In the other hand, TOPSIS method was used to determine members who get the highest priority in getting the loan facility from the cooperative. The procedure of this AHP-TOPSIS combination approach can be viewed in Figure 2.

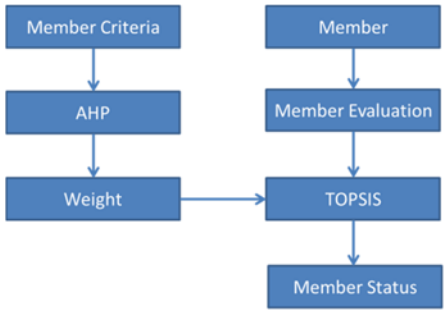

Figure 2 : Procedure of AHP-TOPSIS combination approach in deciding the member priority

Journal of Theoretical and Applied Information Technology
15th July 2018. Vol.96. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3. RESULT AND ANALYSIS

The member (further written as A1, A2, ..., A5) who proposed the loan to the cooperative had to go through this five-criteria evaluation (further written in abbreviation), and sub-criteria embedded within, as shown in Table III. Afterward, each criterion was given evaluation for each alternative with the value started from 1 to 10.

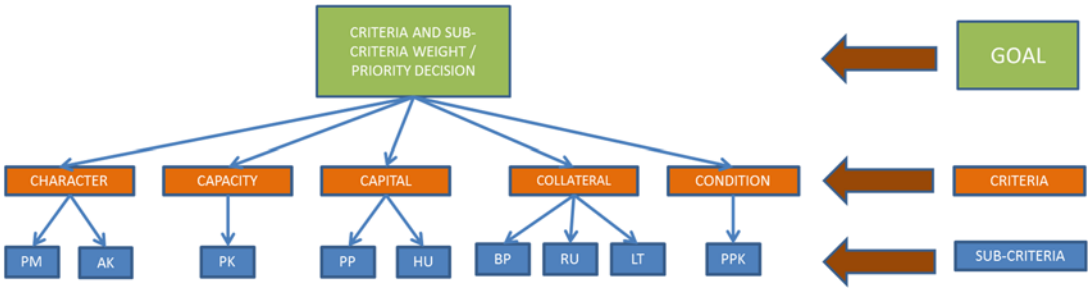

Figure 3. Hierarchy model of criteria and sub-criteria

In AHP computation procedure, the first stage was designing hierarchy structure as seen in Figure 3. The next stage in the analysis was the consistency testing applying AHP method.

In the analysis stage, the initial step was started from determining the criteria priority by denoting the pairwise comparison matrix on each criterion. The pairwise matrix of each criterion can be seen in Table 4.

Table 4 : Pairwise Matrix

	CHA	CAY	CAP	COL	CON
CHA	1	2	2	2	4
CAY	0,5	1	3	3	3
CAP	0,5	0,5	1	3	2
COL	0,5	0,333333	0,333333	1	2
CON	0,25	0,333333	0,5	0,5	1
Total	**2,75**	**4,166667**	**6,833333**	**9,5**	**12**

Further continued with synthesizing the criteria matrix, where the synthesis can be viewed in Table 5.

Table 5 : Synthesis of Matrix Criteria

	CHA	CAY	CAP	COL	CON	Sum	Priority
CHA	0,3636	0,4800	0,2927	0,2105	0,3333	1,6802	**0,3360**
CAY	0,1818	0,2400	0,4390	0,3158	0,2500	1,4266	**0,2853**
CAP	0,1818	0,1200	0,1463	0,3158	0,1667	0,9306	**0,1861**
COL	0,1818	0,0800	0,0488	0,1053	0,1667	0,5825	**0,1165**
CON	0,0909	0,0800	0,0732	0,0526	0,0833	0,3800	**0,0760**
Total	**1**	**1**	**1**	**1**	**1**	**5**	**1**

Next, arranging the matrix of each line summation (Table 6).

Table 6 : Matrix Of Each Line Summation

	CHA	CAY	CAP	COL	CON	Total
CHA	0,3360	0,5707	0,3722	0,2330	0,3040	1,8160
CAY	0,1680	0,2853	0,5584	0,3495	0,2280	1,5893
CAP	0,1680	0,1427	0,1861	0,3495	0,1520	0,9983
COL	0,1680	0,0951	0,0620	0,1165	0,1520	0,5937

CON	0,0840	0,0951	0,0931	0,0583	0,0760	0,4064
						5,4037

CON	0,4064	0,0760	0,4825
	5,4037	1,0000	6,4037

As a note, n=5, λ_{max} = 1,2807, so that CI value was known: -0,7439, and CR value =-0,6642. As CR value was under 0,1, thus CR was accepted.

Taking the same steps, prorities of each sub-criterion could be calculated as well. The result is shown in Table 8.

After that, calculating consistency ratio as shown in Table 7.

Table 7 : Consistency Ratio

	Amount/Line	Priority	Result
CHA	1,8160	0,3360	2,1520
CAY	1,5893	0,2853	1,8746
CAP	0,9983	0,1861	1,1845
COL	0,5937	0,1165	0,7102

Table 8 : Sub-Criteria Priority

No	Criteria	Priority		Sub-Criteria	Priority	Topsis Weight
1	Character	**0.34**	a	Community Evaluation	**0.67**	**0.22**
			b	Family Member	**0.33**	**0.11**
2	Capacity	**0.29**	a	Occupation	**1.00**	**0.29**
3	Capital	**0.19**	a	Monthly Income	**0.67**	**0.12**
			b	Debt in other Places	**0.33**	**0.06**
4	Collateral	**0.12**	a	Vehicle Ownership Book (BKPB)	**0.48**	**0.06**
			b	House	**0.35**	**0.04**
			c	Size of the land	**0.17**	**0.02**
5	Condition	**0.08**	a	Job Prospect	**1.00**	**0.08**

TOPSIS weight was obtained from the multiplication result of criteria and sub-criteria priority value on the analysis result using AHP method. Hence, this weight value was then taken as the weight in TOPSIS ranking process.

The next stage was TOPSIS computation determining the eligible cooperative members in getting the loan.

Table 9 : Evaluation On Each Member

No	Criteria		Sub-Criteria	A1	A2	A3	A4	A5
1	Character	a	Community Evaluation	5.00	5.00	2.00	2.00	5.00
		b	Family Member	9.00	8.00	8.00	8.00	8.00
2	Capacity	a	Occupation	10.00	7.00	8.00	9.00	8.00
3	Capital	a	Monthly Income	10.00	8.00	5.00	7.00	8.00
		b	Debt in other Places	10.00	2.00	1.00	2.00	10.00
4	Collateral	a	Vehicle Ownership Book (BKPB)	10.00	10.00	5.00	5.00	5.00
		b	House	9.00	8.00	10.00	7.00	5.00
		c	Size of the land	10.00	9.00	8.00	7.00	5.00
5	Condition	a	Job Prospect	5.00	5.00	5.00	2.00	2.00

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Steps taken in TOPSIS method were as follow:

1. Determining performance rating matrix
   This stage was done through the evaluation of each member who proposed for a loan. It was in order to ascertain the obtained value amount of each member. Each alternative was given the evaluation started from 1 to 10 as seen in Table 9.
2. Calculating normalized matrix
   Referring to the equation (3) of the sample above, the element in the normalized matrix was going to be perceived, as presented in the equation below:

$$R_{11} = \frac{x_{11}}{\sqrt{\sum_{i=1}^{10} x_{11}^2}}$$

$$R_{11} = \frac{5}{\sqrt{5^2+5^2+2^2+2^2+5^2}} = 0.55$$

Take into account, by applying the similar way, other elements of normalized matrix were going to be obtained. Referring to the equation (3), normalized matrix was constructed, as listed below:

$$R = \begin{vmatrix} 0.55 & 0.49 & 0.35 & 0.58 & 0.69 & 0.60 & 0.50 & 0.56 & 0.55 \\ 0.55 & 0.44 & 0.41 & 0.46 & 0.14 & 0.60 & 0.45 & 0.50 & 0.55 \\ 0.22 & 0.44 & 0.47 & 0.29 & 0.07 & 0.30 & 0.56 & 0.45 & 0.55 \\ 0.22 & 0.44 & 0.52 & 0.40 & 0.14 & 0.30 & 0.39 & 0.39 & 0.22 \\ 0.55 & 0.44 & 0.47 & 0.46 & 0.69 & 0.30 & 0.28 & 0.28 & 0.22 \end{vmatrix}$$

3. Calculating weighted normalized matrix
   To calculate weighted normalized matrix, priority value in AHP calculation result was going to be used as (W) preference weight in TOPSIS calculation as seen in Table 9, as the example for sub-criteria, priority value (weight) of each criterion.
   (W) = (0.22, 0.11, 0.29, 0.12, 0.06, 0.06, 0.04, 0.02, 0.08)

Furthermore, calculation determining the value element of the weighted normalized matrix based on equation (4) was constructed, with the result obtained as follow:

$$y_{11} = w_1 r_{11}$$

$$y_{11} = 0.22\ x\ 0.55 = 0.12$$

And so forth. Referring to the equation (4), the weighted normalized matrix was obtained as follow:

$$Y = \begin{vmatrix} 0.12 & 0.05 & 0.15 & 0.07 & 0.04 & 0.03 & 0.02 & 0.01 & 0.04 \\ 0.12 & 0.05 & 0.11 & 0.06 & 0.01 & 0.03 & 0.02 & 0.01 & 0.04 \\ 0.05 & 0.05 & 0.12 & 0.04 & 0.00 & 0.02 & 0.02 & 0.01 & 0.04 \\ 0.05 & 0.05 & 0.14 & 0.05 & 0.01 & 0.02 & 0.02 & 0.01 & 0.02 \\ 0.12 & 0.05 & 0.12 & 0.06 & 0.04 & 0.02 & 0.01 & 0.01 & 0.02 \end{vmatrix}$$

4. Calculating positive ideal and negative ideal solution matrix.
   At this stage, firstly, the sub-criteria characteristic was determined in order to ascertain the benefit and cost of each sub-criterion. Here, for this example, the whole criteria and sub-criteria were considered as benefit.
   Referring to the equation (5), the obtained positive ideal matrix (A+) was:
   A^+ = (0.12, 0.05, 0.15, 0.07, 0.04, 0.03, 0.02, 0.01, 0.04)

   Referring to the equation (6), the obtained negative ideal solution matrix (A-) was:
   A- = (0.05, 0.05, 0.11, 0.04, 0.00, 0.02, 0.01, 0.01, 0.02).

5. Calculating the alternative distance.
   Referring to the equation (7), also based on the R normalized matrix, and the Y weighted normalized matrix, the (Di+) alternative distance with positive ideal solution was obtained as follow:

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

$$D_1^+ = \sqrt{(0.12-0.12)^2+(0.05-0.05)^2+(0.15-0.15)^2+(0.07-0.07)^2+(0.04-0.04)^2+(0.03-0.03)^2+(0.02-0.02)^2+(0.01-0.01)^2+(0.04-0.04)^2} = 0{,}00$$

$$D_2^+ = \sqrt{(0.12-0.12)^2+(0.05-0.05)^2+(0.11-0.15)^2+(0.06-0.07)^2+(0.01-0.04)^2+(0.03-0.03)^2+(0.02-0.02)^2+(0.01-0.01)^2+(0.04-0.04)^2} = 0{,}06$$

Referring to the equation (8), the (Di-) alternative distance with negative ideal solution was as follow:

$$D_1^- = \sqrt{(0.12-0.15)^2+(0.05-0.05)^2+(0.15-0.11)^2+(0.07-0.04)^2+(0.04-0.00)^2+(0.03-0.02)^2+(0.02-0.01)^2+(0.01-0.01)^2+(0.04-0.02)^2} = 0{,}11$$

$$D_2^- = \sqrt{(0.12-0.15)^2+(0.05-0.05)^2+(0.11-0.11)^2+(0.06-0.04)^2+(0.01-0.00)^2+(0.03-0.02)^2+(0.02-0.01)^2+(0.01-0.01)^2+(0.04-0.02)^2} = 0{,}08$$

And so forth until it reached the result of alternative distance computation as listed in Table 10.

6. Calculating the preference value.
   Based on Table 4.22, the preference value of each proposal could be computed. Referring to the equation (9), the (Vi) preference value for all evaluated proposals could be computed as shown in the equation below:

   $V_1 = \frac{0.011}{0.00+0.11} = 1$

   $V_2 = \frac{0.08}{0.06+0.08} = 0.58$

   The (Vi) preference value is presented in Table 10.

7. Determining status
   Next, the (Vi) preference value listed in Table 10 was classified into three groups:
   - If Vi < 0.5, the member status was INADEQUATE
   - If 0,5 ≤ Vi < 0.7, the member status was ADEQUATE
   - If Vi ≥ 0.7, the member status was ABSOLUTELY ADEQUATE

   Hence, the status of each member can be seen in Table 10.

Table 10 : Alternative Distance and Preference Value

No	Member	Di+	Di-	Vi	Status
1	A1	0.00	0.11	1.00	Absolutely Adequate
2	A2	0.06	0.08	0.58	Adequate
3	A3	0.10	0.03	0.25	Inadequate
4	A4	0.09	0.03	0.27	Inadequate
5	A5	0.05	0.09	0.65	Adequate

The members with 'Absolutely Adequate' was those who were definitely eligible in getting the loan, meanwhile for those with 'Adequate' status was meant as just eligible, and those with 'Inadequate' status were the ones who were totally ineligible in getting the loan. Presented in the table that A1 members were absolutely adequate receiving the loan, A2 and A5 members were adequate, whereas A3 and A5 were inadequate receiving the loan.

Moreover, this Decision Support System had been implemented onto the CSC Kapur Warna. Taken from the observation result, it was clearly seen that this system had worked well, as it was able to simplify the verification process for members who was able to get the loan. To add, by applying this system, the decisions made was valid , qualified and subjective ones.This support system could also be carried out onto other similar cooperatives in Indonesia, due to the comparable problems experienced by them. Apprehended that this system could be a pinoneer and exemplar model for other systems within the category.

4. CONCLUSION

Saving and Loan Cooperative is an organisation offering a feasible alternative for society in financing. Before giving the loan facility, the cooperative committee as the decision maker should feel confident that the given loan is going to be returned. However, the limited fund and the needs for comprehensive verification on to the members, a decision support system using the AHP and TOPSIS method combination is required as it can solve the related problem.

The implementation of AHP method is used in order to get the weight of each criterion taken from the pairwise combination matrix. Whereby, TOPSIS method is taken in order to determine the cooperative members who receive priority in getting the loan. By combining the two methods: AHP and TOPSIS, it can reduce the weakness of using TOPSIS method itself in weighting subjectively.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

There are five sample data used within this study, with five criteria, and nine sub-criteria chosen in evaluating the members. Taken from AHP computation in calculating weight of each criterion, and sub-criterion, resulted that the most significant criterion is Character. The second one is Capacity, the third is Capital, and for the fourth and the fifth are Collateral and Condition. As an addition, the most significant sub-criterion is the Community Evaluation, and the least is the Size of the Land. The ranking of each interest is acceptable as it has the value of CR<0,10. Then, the priority value of criteria and sub-criteria is multiplied in order to obtain the weight value which is going to be used in TOPSIS computation. Noting from TOPSIS computation, A1 member is absolutely adequate in getting the loan from the cooperative, whereas A2 and A5 are just adequate, and both A3 and A5 members are inadequate receiving one. This computation result can be considered by the decision maker at CSC Kapur Warna in giving the loan to its members who propose one.

Furthermore, this research has demonstrated that the AHP and TOPSIS combination method can be implemented well into the decision support system. Nonetheless, it should be taken into consideration that this system is designed in order to assist or reinforce the decision maker by providing alternatives of members who deserve to get the loan, and does not to take over the decision-making. Hence, this system is still in need of regular transformation in adjusting to the constantly changing environment [9].

To optimize its performance, further development can be carried out by adding another method like Fuzzy Multiple Atribut Decision Making (FMADM) into the system.

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