Decision Support System for Determining the Village Secretary Using the Analytic Hierarchy Process Method in the Village of Kubah Sentang Pantai Labu

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ABSTRACT

The election of the village secretary is an election chosen by the village head himself and is not carried out in a democratic manner. So far, what the village government has done in the election of the village secretary has not been effective. This system was built using the Analytic Hierarchy Process (AHP) method, which is one of the methods used in decision support systems. The AHP method is by weighting each criterion and sub-criteria. The results of the study were in the form of a decision support system application for determining village secretaries using Visual Studio 2010 so as to be able to select several candidates for village secretaries who were worthy of the position as village secretary

Keywords*: Determination of Village Secretary, Decision Support System, Analytic Hierarchy Process*

1. Introduction

Indonesia is the largest archipelagic country in the world. With a population of about 260 million people. Indonesia has the largest number 4 (four) population in the world. Deli Serdang is one of the regencies in Indonesia, precisely in North Sumatra Province. Deli Serdang Regency has 22 (twenty two) sub-districts including Pantai Labu District. The Pantai Labu sub-district has 19 (nineteen) villages namely Bagan Serdang, Binjai Bakung, Denai Kuala, Denai Lama, Denai Serang Bird, Durian, Kelambir, Dome Sentang, Paluh Sebaji, Labu Baru Beach, Labu Pekan Beach, Pematang Monastery, Plantation Ramunia, Ramonia I, Ramonia II, Rantau Panjang, Regemuk, Sei Tuan, Tengah (Kampung Tengah).

The village is a community unit that has the authority to regulate and manage the interests of the local community. Villages also have the power to organize their own government within the bonds of the Unitary State of the Republic of Indonesia (NKRI). The village apparatus consists of the village head, village treasurer, village secretary and other village officials. The village secretary (Sekdes) is the one who plays a strategic role in the village, both in structuring village administration and managing village finances. Therefore, the village secretary must have abilities above the average of other village officials so that the wheels of government in the village can run well. The village secretary is required to be able to think critically and act professionally. Professional in this case is to work seriously as required in the profession.

In the village of Kubah Sentang, there are several candidates for the village secretary who have not yet been determined which one is eligible to occupy the village

secretary. The election of the village secretary is an election chosen by the village head himself and is not carried out in a democratic manner. So far, what the Kubah Sentang Village government has done in the election of the village secretary has not been effective. Due to the lack of attention in selecting who is worthy or not worthy to be the village secretary. There are 4 (four) candidates who have registered to become village secretaries and for the selection there are several criteria selected, namely Education, Work Experience, Behavior, Age, and Population Status. These criteria will be used in determining the village secretary,

Decision Support System (DSS) is an interactive information system that provides computer-based information aimed at assisting management in making decisions. Decision Support System can also be said as a computer system to manage data into information in making a decision from a specific semi-structured problem. Decision Support System (DSS) has several methods, one of which is the Analytic Hierarchy Process (AHP). The AHP method tests an alternative in making a decision, so when an inconsistency is found in giving a weight, it is necessary to do a revolution of the weights that have been given to each factor.

2. Methodology

According to Dr. Kusrini, M.Kom (2017: 135), the steps in the AHP method include: (a) Defining the problem and determining the desired solution, then compiling a hierarchy of the problems encountered. (b) Setting element priority, (c) Synthesis, (d) Measuring consistency, (e) Calculate Consistency index (Ci) with the formula:

$$Ci= (\lambda \text{ Max-n})/(n-1)$$

Where n = number of elements

1. Calculate the consistency ratio / Consistency Ratio (RI) with the formula:

$$CR = \text{CI/RC}$$

2. Check for consistency. If the value is more than 10%, then the data judgment assessment must be corrected. However, if the consistency (CI/CR) is less or equal to 0.1, then the calculation must be declared correct.

Table 1.
List of Random Consistency Index

Matrix Size	IR value
1.2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56

14	1.57
15	1.59

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3. Results and Discussion

3.1 Define the problem and determine the desired solution

In determining the candidate for the village secretary, it can be broken down into several elements, namely criteria and alternatives. The criteria for determining the village secretary are:

a. Education

Education is learning, knowledge, skills through teaching, training or research. The educational provisions in determining the village secretary are:

Education :- SMA/SMK : Enough
- D3 : Okay
- S1 : Very Good

b. Work experience

Work experience is the process of forming knowledge or skills about the method of a job because of the employee's involvement in the implementation of work tasks. The sub-criteria of the criteria for work experience in determining the village secretary are as follows:

Work experience : - 1 – 5 years : Enough
- 6 – 10 years : Good
- 11 years and over : Very good

c. Behavior

Behavior is an action or activity of the human itself. The sub-criteria of the behavioral criteria in determining the village secretary are as follows:

Behavior :- Enough
- Well
- Very good

d. Age

Age is a unit of time that measures the time of existence of an object or living thing, both living and dead. The sub-criteria of the age criteria in determining the village secretary are as follows:

Age :- 17 – 25 Years : Enough
- 26 – 35 Years : Good
- 36 Years – 45 Years: Very Good

e. Resident Status

Population status is a person who resides or settles in a country or village. The sub-criteria of the population status criteria in determining the village secretary are as follows:

Resident Status : - Permanent
- Not fixed

The data from each candidate for village secretary are as follows:

Table 2.
Village Secretary Candidate Data

Candidate Name	Education	Work experience	Behavior	Age	Resident Status
Muhammad Helmi	S1	1 year	Well	27 years	Permanent
Muhammad Shahran	senior High School	20 years	Enough	31 years	Permanent
Sri Yusmawati	S1	15 years	Very good	39 years old	Permanent
Maulisa Puspa	senior High School	1 year	Well	23 years	Permanent

3.2 Creating a hierarchical structure

After defining the problem and determining the solution, a hierarchical structure is made for determining the village secretary according to the applicable criteria.

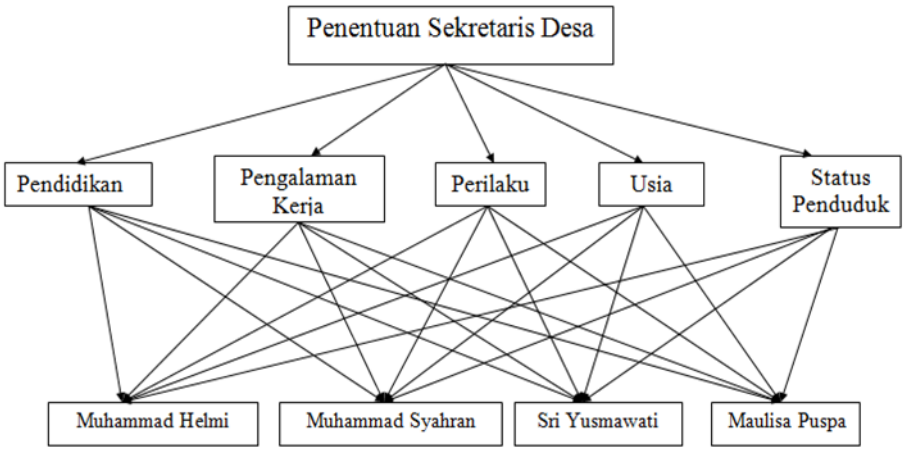

Figure 1. Village Secretary Determination Hierarchy

3.3 Creating a Comparison Matrix

After determining the criteria in determining the village secretary, the next step is to create a pairwise comparison matrix that describes the relative contribution or influence of each element on each criterion with other criteria.

Table 3.
Pairwise Comparison Rating Scale

Intensity of Interest	Information
1	Both elements are equally important.
3	One element is slightly more important than the other elements.
5	One element is more important than the other elements.
7	One element is clearly more absolutely important than

	the other elements.
9	One element is absolutely important than the other elements.
2,4,6,8	The values between the two values are related considerations.
opposite	If activity i gets one point compared to activity j, then j has the opposite value compared to i.

The matrix for determining who is worthy of the position as Village Secretary at the Kubah Sentang Village Office can be seen in the table below:

Table 4.
AHP Comparison Matrix

Criteria	Education	Work experience	Behavior	Age	Resident Status
Education	1	2	2	3	1/3= 0.33
Work experience	= 0.50	1	1/3= 0.33	3	1/5= 0.20
Behavior	= 0.50	3	1	3	1/5= 0.20
Age	1/3= 0.33	1/3= 0.33	1/3= 0.33	1	1/5= 0.20
Resident Status	3	5	5	5	1
Amount	5.33	11.33	8.67	15.00	1.93

Information :

a. Row 2, column 2, education – education has a comparison value of 1, meaning that the two elements are equally important.
b. Row two, column three, education – work experience has a comparison value of 2, meaning that education is slightly more important than work experience.
c. Row 3, column 2, work experience – education, the comparison value is =0.5, meaning that the element of work experience is slightly less important than the element of education.

After normalizing the comparison values, the comparison values for each column are added up. The sum of the columns for column 2 is: 1+0,50+0,50+0,33+3= 5.33. For the 3rd column, namely: 2+1+3+0,33+5=11,33. For the 4th column, namely: 2+0,33+1+0,33+5=8,67. For column 5, namely: 3+3+3+1+5=15. For the 6th column, namely: 0.33+0.20+0.20+0.20+1=1.93.3

3.4 Doing Pairwise Comparison

After doing the comparison matrix and calculating the number of comparison values with the number of columns, then next.

Table 5.
Pair Comparison

Criteria	Education	Work experience	Behavior	Age	Resident Status	Row Count Value	Average
Education	1/5.33= 0.19	2/11.33= 0.18	2/8.67= 0.23	3/15= 0.20	0.33/1.93= 0.17	0.97	0.19
Work experience	0.50/5.33= 0.09	1/11.33= 0.09	0.33/8.67= 0.04	3/15= 0.20	0.20/1.93= 0.10	0.52	0.10
Behavior	0.50/5.33= 0.09	3/11.33= 0.26	1/8.67= 0.12	3/15= 0.20	0.20/1.93= 0.10	0.78	0.16
Age	0.33/5.33= 0.06	0.33/11.33= 0.03	0.33/8.67= 0.04	1/15= 0.07	0.20/1.93= 0.10	0.30	0.06
Resident Status	3/5,33= 0.56	5/11.33= 0.44	5/8.67= 0.58	5/15= 0.33	1/1.93= 0.52	2.43	0.49
						Amount	1.00

3.5 Calculating the Eigenvector Values of Each Matrix

Ci= (λ Max-n)/(n-1)

n=5

max =(number of comparison matrix columns * average)+ (number of comparison matrix columns * average)+ (number of comparison matrix columns * average)+ (number of comparison matrix columns * average)+ (number of matrix columns comparison * average)

=(5.33*0.19)+(11.33*1.10)+(8.67*0.16)+(15*0.06)+(1.93*0.49)

=5.41

CI = (λmax –n)/(n-1)

= (5.41-5)/(5-1)

= 0.10

CR = (CI/IR)

= 0.10/1.12

= 0.09

If the results of the calculation of CR < 0.1 = 0.09 < 0.1 then the consistency ratio of the calculation is accepted. After calculating the priority of the criteria, the priority of the sub-criteria is also calculated according to the steps above. The priority steps for the sub-criteria are as follows:

3.6 Calculating the priority of sub-criteria from the Education criteria

a. Creating a comparison matrix

Table 6.
Comparison Matrix

Sub Criteria	very good	Well	enough
very good	1	3	5
Well	0.33	1.00	3
Enough	0.2	0.33	1

amount	1.53	4.33	9

Information :

a) Row two, column four, good-adequate, the comparison value of 5 means that one element is very good, one is more important than the element is sufficient.
b) Row four, column two, good enough, the comparison value of 1/5=0.2 means that one element is sufficient, not one is more important than the very good element.

b. Create sub-criteria value

Table 7.
Sub Criteria Value Matrix

Sub criteria	very good	Well	enough	row count value	average
very good	0.65	0.69	0.56	1.90	0.63
Well	0.22	0.23	0.33	0.78	0.26
Enough	0.13	0.08	0.11	0.32	0.11
				Amount	1.00

c) In the good column, the good row is divided by the number of good columns, the value is 1/1.53 = 0.65 and so on.
d) The value of 1.90 is obtained from the sum of 0.65+0.69+0,= 1.90. In the column the average is obtained through the value of the number of rows/n = 1.90/3 = 0.83 and so on. And the summed average value must be 1 and cannot be above one because the value is inconsistent.

c. Calculating the Eigenvector Values of Each Matrix

Table 8.
Eigenvector Value

lamda max	3.06
ci	0.03
Cr	0.05

Max value is obtained by = mean*number per column = (0.63*1.53)+(0.26*4.33)+(0.11*9)= 3.06
CI= (Max-n)/(n-1) = (3.06-3)/(3-1)=0.03
CR= CI/IR= 0.03/0.58=0.05

3.7 Calculating the priority of the sub-criteria from the Work Experience criteria

a. Creating a comparison matrix

Table 9.
Comparison Matrix

Sub Criteria	Very good	Well	Enough
Very good	1	3	5
Well	1/3= 0.33	1	3
Enough	1/5= 0.20	1/3= 0.33	1
Amount	1.53	4.33	9

Information :

Row two, column three, good-enough, the comparison value of 3 means that one very good element is slightly more important than the good element and so on.

b. Create sub-criteria value

Table 10.
Sub Criteria Value Matrix

Sub Criteria	Very good	Well	Enough	Row Count Value	Average
Very good	1/1.53= 0.65	3/4.33= 0.69	5/9= 0.56	1.90	0.63
Well	0.33/1.53= 0.22	1/4.33= 0.23	3/9= 0.33	0.78	0.26
Enough	0.20/1.53= 0.13	0.33/4.33= 0.08	1/9= 0.11	0.32	0.11
				Amount	1

a) In the very good column, the very good row divided by the number of very good columns, then the value is 1/1.53 = 0.65. In the very good column, the very good row is divided by the number of sufficient columns 3/4.33 = 0.69 and so on.
b) The value of 1.90 in the column for the number of rows is obtained through the sum of 0.65 + 0.69 + 0.56 = 1.90 and so on.
c) And the summed average value must be 1 and cannot be above one because the value is inconsistent.

c. Calculating the Eigenvector Values of Each Matrix

Table 11.
Eigenvector Value

Lambda Max	3.06
CI	0.03
CR	0.05

Max value is obtained by = mean*number per column = (0.63*1.53)+(0.26*4.33)+(0.11*9)= 3.06
CI= (Max-n)/(n-1) = (3.06-3)/(3-1)=0.03
CR= CI/IR= 0.03/0.58=0.05

3.8 Calculating the priority of the sub-criteria from the Behavior criteria

a. Creating a comparison matrix

Table 12.
Comparison Matrix

Sub Criteria	Very good	Well	Enough
Very good	1	2	5
Well	1/2 = 0.5	1	4
Enough	1/5 0.2	1/4= 0.25	1
Amount	1.7	3.25	10

Information :
Row two column four, very good - enough, the comparison value of 5 means that one element is very good, one is more important than the element is sufficient. Etc.

b. Create sub-criteria value

Table 13.
Sub Criteria Value Matrix

Sub Criteria	Very good	Well	Enough	Row Count Value	Average
Very good	0.59	0.62	0.5	1.70	0.57
Well	0.29	0.31	0.4	1.00	0.33
Enough	0.12	0.08	0.1	0.29	0.10
				Amount	1.00

a) In the good column, the row is very good divided by the number of very good columns, the value is 1/1,7 = 0,59 and so on.
b) In the column the value of the number of rows is obtained through the sum of 0.59 + 0.62 + 0.5 = 1.70 and so on.
c) In the column the average is obtained through the value of the number of rows/n = 1.70/3 = 0.57 and so on. And the summed average value must be 1 and cannot be above one because the value is inconsistent.

c. Calculating the Eigenvector Values of Each Matrix

Table 14.
Eigenvector Value

Lambda Max	3.03
CI	0.02
CR	0.03

a) Max value is obtained by = mean*number per column = (0.57*1.7)+(0.33*3.25)+(0,10*10)= 3.03
b) CI= (Max-n)/(n-1) = (3.03-3)/(3-1)=0.02
c) CR= CI/IR= 0.02/0.58=0.03

3.9 Calculating the priority of the sub-criteria from the Age criteria

a. Creating a comparison matrix

Table 15.
Comparison Matrix

Sub Criteria	Very good	Well	Enough
Very good	1.00	3.00	5.00
Well	0.33	1.00	3.00
Enough	0.20	0.33	1.00
Amount	1.53	4.33	9.00

Information :

a) Row two, column two, very good – very good, the comparison value of 1 means that the youth element is as important as the youth element.
b) Row three, column two, good – very good, the comparison value 1/3 = 0.33 means that the good element is not one more important than the very good element.

b. Create sub-criteria value

Table 16.
Sub Criteria Value Matrix

Sub Criteria	Very good	Well	Enough	Row Count Value	Average
Very good	0.65	0.69	0.56	1.90	0.63
Well	0.22	0.23	0.33	0.78	0.26
Enough	0.13	0.08	0.11	0.32	0.11
				Amount	1.00

a) In the teenage column, the very good row is divided by the number of very good columns, the value is 1/1.53 = 0.65 and so on.
b) In the column the value of the number of rows is obtained through the sum of 0.65 + 0.69 + 0.56 = 1.90 and so on.
c) The value of 1.33 in the average column is obtained through the value of the number of rows/n = 1.90/3 = 0.63 and so on. And the summed average value must be 1 and cannot be above one because the value is inconsistent.

c. Calculating the Eigenvector Values of Each Matrix

Table 17.
Eigenvector Value

lamda max	2.559965316
ci	-0.220017342
Cr	0

a) Max value is obtained by = mean*number per column = (0.63*1.53)+(0.26*4.33)+(0.11*9)= 2.55
b) CI= (Max-n)/(n-1) = (2-2)/(2-1)=-0.22
c) CR= CI/IR= 0/0=0

3.9 Calculating the priority of the sub-criteria from the Population Status criteria

a. Creating a comparison matrix

Table 18.
Comparison Matrix

Sub Criteria	Permanent	Not fixed
Permanent	1	7
Not fixed	1/7= 0.14	1
Amount	1.14	8

Information :

a) Row two column three, fixed and variable, the comparison value of 7 means that the fixed element is clearly more absolutely important than the variable element.
b) Row two column three, fixed and variable, the comparison value of 1/7 = 0.14 means that the variable element is clearly not more absolutely important than the fixed element.

b. Create sub-criteria value

Table 19.
Sub Criteria Value Matrix

Sub Criteria	Permanent	Not fixed	Row Count Value	Average
Permanent	0.88	0.88	1.75	0.88
Not fixed	0.13	0.13	0.25	0.13
			Amount	1

a) In a fixed column of a fixed row divided by the number of fixed columns, the value is 1/1.14 = 0.88. In fixed column, variable row, the value is divided by the number of variable column 7/8 = 0.88 and so on.
b) The value of 1.75 in the column for the number of rows is obtained through the sum of 0.88 + 0.88 = 1.75 and so on.
c) The value of 0.88 in the average column is obtained through the value of the number of rows/n = 1.75/2 = 0.88 and so on. And the summed average value must be 1 and cannot be above one because the value is inconsistent.

c. Calculating the Eigenvector Values of Each Matrix

Table 20.
Eigenvector Value

Lambda Max	2
CI	0
CR	0

a) Max value is obtained by = mean*number per column = (0.88*1.14)+(0.13*8)= 2.
b) CI= (Max-n)/(n-1) = (2-2)/(2-1)=0
c) CR= CI/IR= 0/0=0

After determining the value of the criteria and sub-criteria, the priority of the calculation results on the criteria and sub-criteria is then poured into the result matrix.

Table 21.
Result Matrix

Education	Work experience	Behavior	Age	Resident Status
0.19	0.10	0.16	0.06	0.49
Very good	Very good	Very good	Very good	Permanent
0.63	0.63	0.57	0.63	0.875
Well	Well	Well	Well	Not fixed
0.26	0.26	0.33	0.26	0.125
Enough	Enough	Enough	Enough	

0.11	0.11	0.10	0.11	

Then the results of the determination of those who are eligible to occupy the village secretary are calculated as the final value of the decision as shown in the table below.

Table 22.
Final Result of AHP Method

Village Secretary Candidate Data	Education	Work experience	Behavior	Age	Resident Status	Total	Ket
Muhammad Helmi	0.12	0.01	0.05	0.02	0.43	0.63	Not feasible
Muhammad Shahran	0.02	0.07	0.02	0.02	0.43	0.54	Not feasible
Sri Yusmawati	0.12	0.07	0.09	0.04	0.43	0.74	worthy
Maulisa Puspa	0.02	0.01	0.05	0.01	0.43	0.52	Not feasible

From the table above, it can be seen from table 2 and the results of table 22 are obtained from the results of multiplying the priority value multiplied by the sub-priority value, then the results obtained for each criterion are added to each criterion so as to produce a total value. Then the highest value that deserves to be in the position of village secretary.

4. Conclusion

The Analytic Hierarchy Process (AHP) method can be applied to the decision support system for determining the village secretary by defining the problem by determining the criteria, namely Education, Work Experience, Behavior, Age, and Population Status, then making a hierarchical structure, namely in determining the village secretary there are 5 criteria and 4 candidates named Muhammad Helmi, Muhammad Syahran, Sri Yusmawati and Maulisa Puspa who are interrelated with each other, then make a comparison matrix, then perform pairwise comparisons, after that calculate the eigenvector value of each matrix and the final result of the calculation can be accepted if CR calculation result < 0.1.

References

[1] Aji Sasongko, Indah Fitri Astuti & Septya Maharani, "Selection of New Employees with the AHP (Analytic Hierarchy Process) Method", 2017.
[2] Anita Sindar RMS, and Jamal Purba. “Determination of Overtime Employees Using the Analytical Hierarchy Process (AHP) Method”, Inkofar Journal, December 2018.

[3] Dewi Lestari, and Anita Sindar RMS. “Determination of Contract Employees to Permanent Employees of PT. Weigh Deli with Analytical Hierarchy Process (AHP)”, Jurnal Teknologi, 2 October 2018.
[4] Diah Permatasari., Dewi Sartika., & Suryati, "Application of the AHP and SAW Methods for Determining Employee Promotion", Journal of Informatics Engineering and Information Systems, September 2018.
[5] Dr. Kusrini, M.Kom. “Decision Support System Concepts and Applications”, 2017.
[6] Ebedia Hilda Am., Erna Kumalasari N., & Rr. Yuliana Rachmawati K, “Application of the Analytical Hierarchy Process (AHP) Method in a Decision Support System for Selection of Outstanding Students Using the Laravel Framework (Case Study: AKPRIND Institute of Science & Technology Yogyakarta)”, Jurnal Script, 2015.
[7] Eka Wiyanti and Anita Sindar. "Implementation of the Analytical Hierarchy Process in Determining the Satisfaction Level of E-KTP Services (Case Study: Pagar Merbau Sub-district Office)", National Journal of Computing and Information Technology, 2018.
[8] Gathot Pujo Santoyono., Rani Irma Handayani., & Euis Widanengsih, “Decision Support System for Selection of Laptops for Operational Needs Using the AHP Method (Case Study: Directorate of Course Development and Training of the Ministry of Education and Culture)”, Journal of Pilar Nusa Mandiri, 2017.
[9] Hamin Tohari. "Analysis and Design of Information Systems Through the UML Approach", 2017.
[10] Heri Nurdiyanto., Heryanita Meilia, “Decision Support System for Prioritizing Industrial and Medium Development in Central Lampung Using Analytical Hierarchy Process (AHP)”, 2016.
[11] Murni Marbun, S.Si., MM., M.Kom., & Bosker Sinaga, S.Kom., M.kom. “Learning Outcome Assessment Decision Support System Textbook Using the TOPSIS Method”, 2018.
[12] Raden Budianto “Scholarship Management Information System STI&K Based on Decision Support System Using AHP Method”.
[13] Rosa, AS, Salahuddin, M. "Software Engineering-Structured and Object-Oriented". Bandung: INFORMATION, 2018.
[14] Rosnani Ginting. “Decision Support System”, 2014.