



## Selection of Virtual Meeting Platform Using AHP-Topsis Method (Case Study Indonesian Ministry of Defense Employees)

Nur Iskandar Zulkarnaen<sup>1</sup>, Agung Triayudi<sup>2</sup>, Endah Tri Esthi Handayani<sup>3</sup>

<sup>1,2,3</sup>Sistem Informasi, Fakultas Teknologi Komunikasi dan Informatika, Universitas Nasional  
Jl. Sawo Manila, Pasar Minggu, Kota Jakarta Selatan, Daerah Khusus Ibu kota Jakarta 12520

E-mail: <sup>1</sup>nuriskandarzulkarnaen@outlook.com, <sup>2</sup>agung.triayudi@civitas.unas.ac.id, <sup>3</sup>endahteh@gmail.com  
Correspondence Author : Agung Triayudi

### ARTICLE INFO

#### Article history:

Received: 01/11/2020

Revised: 10/11/2020

Accepted: 30/11/2020

#### Keywords:

Selection, Platform, AHP, TOPSIS

### ABSTRACT

This research combines the AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) methods which are implemented in the Decision Support System (DSS) for selecting a virtual meeting platform in work from home activities during the Covid-19 pandemic of the Indonesian Ministry of Defense employees. This research was conducted based on five criteria, namely price, maximum participant, ease of use, ease of setup, and user reviews. The spread of the COVID-19 virus is currently increasing every day and has become a global pandemic. Based on a circular from the Secretary General of the Ministry of Defense to reduce the risk of spreading the COVID-19 virus within the Indonesian Ministry of Defense, it is necessary to implement employee work from home (WFH) which is carried out alternately. For this reason, a suitable virtual meeting platform is needed to carry out WFH activities to carry out work assignments online. So far, some employees are still trying to compare the most ideal platform to be used for virtual meetings during WFH. With the existence of several advantages and disadvantages of each of these platforms, the author tries to research and help provide solutions by creating a decision support system for selecting the virtual meeting platform.

Copyright © 2020 Jurnal Mantik.  
All rights reserved.

## 1. Introduction

The spread of the COVID-19 virus has now become a global pandemic, experts agree that a physical distancing or quarantine policy is a necessity to reduce the spread of this deadly virus. This condition is of course dangerous, the spread of Covid 19 in such a great way requires serious handling. The COVID-19 outbreak in Indonesia has shown a critical point that affects multi-dimensional aspects in the social, political, economic and cultural fields [1]. Change occurs in almost all aspects of human life and only in a matter of months. One of them is how to work, employees in the Ministry of Defense are required to adopt new work patterns remotely from their homes. Working at home itself is often referred to as work from home (WFH). Work from home (WFH) is synonymous with doing office work, meetings, discussions, and coordination with colleagues and or work partners from the homes of their respective employees online. The media that can be used are video conference applications or virtual meetings. Several choices of virtual meeting application platforms currently vary, for example, namely Zoom Meetings (PRO), Cisco Webex Meeting (Starter), Microsoft Teams (Microsoft 365 Business Basic), Google Meet (Google Workspace Essentials) and GoToMeeting (Professional) and so on. In its implementation, considering the effectiveness and efficiency factors, a platform that is suitable for the expected needs of the Ministry of Defense employees is required. Therefore, in this study the author tries to help determine the choice of several existing virtual meeting application platforms. To make it easier to make decisions, the authors try to use several algorithms that are currently often used for decision support systems (DSS). In this research, the writer will apply the AHP method combined with TOPSIS. In the analytical hierarchy process (AHP) method, it is a method that has a hierarchical structure and provides convenience in simplifying a problem from complex criteria with various alternative options available, so as to accelerate the decision-making process in choosing a virtual meeting platform [2]. The technique for order preference by similarity to ideal solution (TOPSIS) method is a method based on the concept where the best selected alternative not only has the shortest distance from the positive ideal solution, but also has the longest distance from the negative ideal solution [3]. By applying the two



methods of AHP and TOPSIS in this decision support system (DSS), it is hoped that it can help choose a virtual meeting platform that suits your needs more accurately.

## 2. Research Methods

The preparation of a decision model is a way to develop the logical relationships that underlie the decision problem into a mathematical model that reflects the relationship between the factors involved. This process consists of six phases, namely:

### 2.1 Literature Study

At this stage, a literature review is carried out from various sources of scientific journals, books and websites that can help during the research process. Then after that do the problem formulation and determine the research objectives.

### 2.2 Data Collection

At this stage, data collection was carried out by making observations and interviews with related parties.

### 2.3 Calculations Using the AHP-TOPSIS Method

At this stage, the calculation is carried out using the AHP-TOPSIS method manually first, before implementing it into the system.

### 2.4 Implementation of the AHP-TOPSIS Method in the System

At this stage, implement the AHP-TOPSIS method in the system. The system developed is web-based with the PHP programming language and MySQL database.

### 2.5 Conclusions and Suggestions

This stage is the final stage in the research, which contains conclusions that can be drawn from the research and suggestions for future system improvements.

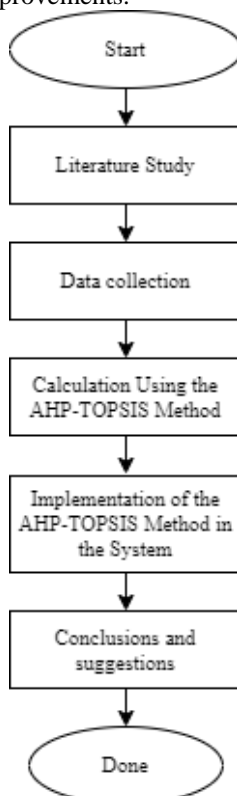


Fig 1. Stages of Research Methods

### A. Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a functional hierarchy with the main input being human perception [4]. This method was developed by an Iraqi-born University of Pittsburgh mathematics professor, Thomas L. Saaty. The method of making a decision in the AHP method is to describe the problem into a hierarchy based on the criteria used. In solving problems with AHP, there are several principles that must be understood, namely [5]:

- 1) Decomposition (create a hierarchy)

Complex systems can be understood by breaking them down into smaller, easier to understand

- elements.
- 2) Comparative judgment (assessment of criteria and alternatives) Criteria and alternatives are made with pair comparisons. So that the scale of importance of each criterion can be seen. Table 1 is the comparison scale presented by Saaty [6].
  - 3) Synthesis of priority (determine priority)
  - 4) Logical Consistency (logical consistency)

**Table 1.**

Pairwise Comparison Rating Scale [6]	
Level of Importance	Definition
1	Just as important than others
3	Moderate importance than others
5	Stronger importance than others
7	Very strong importance than others
9	Extreme / absolute importance than others
2 , 4 , 6 , 8	The score between two adjacent assessments
Respirokal	If element i has one of the numbers above when compared to element j, then j has the opposite value when compared to element i

AHP Method Steps In general, what must be done in using AHP for solving a problem is as follows:

- a. Breaking the existing problems into smaller elements so that a hierarchy is formed
- b. Determine the priority of the elements
  - 1) Making pair comparisons, which is comparing elements in pairs according to the given criteria.
  - 2) The method of filling in the pairwise comparison matrix uses the intensity of importance value which is used to represent the importance of one element to another.
- c. Synthesis
 

The things that are done in this step are:

  - 1) Sum the values of each column on the pairwise comparison matrix.
  - 2) Divide each value from the column by the column total in question to get the normalized matrix.
  - 3) Add the value of each row by the number of elements to find the average value.
- d. Measure Consistency
 

Measuring consistency is very important because a decision can be made or concluded if there is high consistency. The things that are done to measure the level of consistency are as follows:

  - 1) Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element and so on.
  - 2) Add up each row.
  - 3) The sum of the rows divided by the corresponding relative priority element.
  - 4) Add the quotient above with the number of elements present, the result is called  $\lambda$  max.
- e. Calculate the Consistency Index (CI) with the equation:

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

Where n = number of elements.

- f. Calculate the Consistency Ratio Ratio (CR) with the formula:

$$CR = \frac{CI}{IR} \dots\dots\dots(2)$$

Where :

CR = Consistency Ratio  
 CI = Consistency Index

IR = Random Consistency Index

- g. Check hierarchy consistency. If the score is more than 10%, then the data judgment must be corrected. However, if the Consistency Ratio (CI / CR) is less or equal to 0.1, the calculation result can be declared correct. Where RI is a random index whose value can be seen in table 2.



**Table 2.**  
Ratio Index (RI)

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

**B. Technique For Order Preference by Similarity to Ideal Solution(TOPSIS)**

TOPSIS is one of the multicriteria decision making methods that was first introduced by Yonn and Hwang (1981). A method that selects the chosen alternative which has the closest distance to the positive ideal solution and has the farthest distance from the negative ideal solution. Here is an example of a matrix with alternatives and criteria [7].

$$D = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{1m} & \dots & x_{mn} \end{bmatrix} \dots\dots\dots(3)$$

Where:

D = matrix

m = alternative

n = criteria

$x_{ij}$  = the  $i$ th alternative and the  $j$ th criterion

a. Decision Matrix Normalization

Each input element is normalized using the following formula and is given the name Matrix (R):

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \dots\dots\dots(4)$$

Where:

$i = 1,2,3,\dots,m;$

$j = 1,2,3,\dots,n;$

b. Weighted Normalized Matrix.

$$V = \begin{bmatrix} w_{11}r_{11} & \dots & w_{1n}r_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1}r_{m1} & \dots & w_{nm}r_{nm} \end{bmatrix} \dots\dots\dots(5)$$

Value  $i$  is represented by  $1, 2, 3, \dots, m;$  and the value of  $j$  is represented by  $1, 2, 3, \dots, n;$

c. Positive Ideal Solution and Negative Ideal Solution.

Determining the positive (+) ideal solution and the negative (-) ideal solution, the positive ideal solution is denoted as  $A^+$  and  $A^-$  for the negative ideal solution. to find it, the following formula can be used:

$$A^+ = \{(\max v_{ij} | j \in J) | (\min v_{ij} | j \in J')\} \dots\dots\dots(6)$$

$$A^- = \{(\min v_{ij} | j \in J) | (\max v_{ij} | j \in J')\} \dots\dots\dots(7)$$

Notation:

$V_{ij}$  = element of the matrix  $V$  row  $i$  and column  $j$

$J$  = criteria with benefit properties and the value  $1,2,3,\dots, n$

$J'$  = criteria with the nature of cost and value  $1,2,3,\dots, n$

d. Separation Measure.

Calculate the Separation Measure value. The notation used to represent Separation Measure for positive ideal solutions is  $D^+$  and Separation Measure for negative ideal solutions denoted by  $D^-$ .

The equation is used to determine the separation measure value of the positive ideal solution.

$$D_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2} \dots\dots\dots(8)$$

The equation is used to determine the separation measure value of the negative ideal solution.

$$D_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \dots\dots\dots(9)$$

e. Preference Value.

Calculating the Preference value. The calculation of the preference value can be done using the following equation:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \dots\dots\dots(10)$$



- f. Sorting Options.  
The best alternative and can be used as a recommendation for solving decision-making problems using the TOPSIS method is the alternative with the greatest preference value.

### 3. Results and Discussion

#### 3.1 Criteria Hierarchy Structures

The criteria for selecting the virtual meeting platform were obtained from the results of the field analysis conducted by the author. These criteria include price criteria, maximum number of participants, ease of use, ease of preparation, and criteria for the number of reviews. Furthermore, these criteria are given the weight obtained based on the results of the author's direct observation and interviews with a sample of employees in the Ministry of Defense of the Republic of Indonesia. Table 3 is the weighted value obtained from the results of interviews and field observations.

**Table 3.**  
Weights

Criteria	Degree of Interest	Criteria
Price	3x	Maximum Participants
Price	4x	Ease of use
Price	6x	Ease of setup
Price	9x	User Reviews
Maximum Participants	3x	Ease of use
Maximum Participants	5x	Ease of setup
Maximum Participants	7x	User Reviews
Ease of use	2x	Ease of setup
Ease of use	5x	User Reviews
Ease of setup	4x	User Reviews

For the criteria weight, the price is three times more important than the maximum number of participants, so the weighting of the criteria for the maximum number of participants compared to the price is the opposite, which is 1/3 times more important and so equal for the other criteria. Table 4 is a sample data for calculations using the AHP-TOPSIS method. The data source to fill in the value of the data sample is the author obtained from the official website of each virtual meeting platform and also from the website <https://www.g2.com/>. G2 is a verified platform and helps to objectively evaluate software.

**Table 4.**  
Sample data from G2

Virtual Meeting Platform	Price	Maximum Participants	Ease of Use from g2.com	Ease of Setup from g2.com	User Reviews from g2.com
Zoom Meetings (PRO)	\$ 12.49 /bulan	100	9,0	8,9	30.327
Cisco Webex Meeting (Starter)	\$13.50 /bulan	50	8,6	8,3	11.845
Microsoft Teams (Microsoft 365 Business Basic)	\$ 2.78 /bulan	250	8,6	8,5	8.106
Google Meet (Google Workspace Essentials)	\$ 8 /bulan	150	9,1	9,1	4.719
GoToMeeting (Professional)	\$ 14 /bulan	150	8,7	8,5	11.595

#### 3.2 Calculation Using the AHP Method

The first step in calculating using AHP is to determine the pairwise comparison between the criteria in the form of a matrix. Pairwise comparison values are based on weighting obtained from the results of direct observations of the author and interviews with several samples of Ministry of Defense employees who often serve as operators in every virtual meeting activity in the Indonesian Ministry of Defense. The diagonal value of the matrix for the comparison of an element with the element itself or other elements is filled with the weight values in table 4 and filled with the inverse value when the conditions are proportional, then added per column The results can be seen in table 5.



**Table 5.**  
Pairwise Comparison Value

Criteria	Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
Price	1	3	4	6	9
Maximum Participants	0.333	1	3	5	7
Ease of Use	0.25	0.333	1	2	5
Ease of Setup	0.167	0.2	0.5	1	4
User Reviews	0.111	0.143	0.2	0.25	1
Jumlah	1.861	4.676	8.7	14.25	26

The next step is to calculate the priority of each criterion, by dividing the contents of the pairwise comparison matrix by the number of columns that corresponds to it, then adding up each line.

**Table 6.**  
Calculation of Criteria Priority Matrix

Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews	Number of Rows
0,5373	0,6415	0,4598	0,4211	0,3462	2,4058
0,1791	0,2138	0,3448	0,3509	0,2692	1,3579
0,1343	0,0713	0,1149	0,1404	0,1923	0,6532
0,0896	0,0428	0,0575	0,0702	0,1538	0,4138
0,0597	0,0305	0,0230	0,0175	0,0385	0,1692

The value in the priority column is the sum of each row divided by the number of criteria used using equation 11.

$$w_i = \frac{a_i}{n} \dots\dots\dots(11)$$

$$W_i = \frac{2,4058}{5}$$

$$W_i = 0,4812$$

In detail, the results of the criteria priority matrix using equation 2 can be seen in table 7.

**Table 7.**  
Results of the Criteria Priority Matrix

W(Price)	W(Maximum Participants)	W(Ease of Use)	W(Ease of Setup)	W(User Reviews)
0,4812	0,2716	0,1306	0,0828	0,0338

The next step is to make the addition matrix by multiplying the priority values in the criteria priority table by the pairwise comparison matrix, the results can be seen in table 8.

**Table 8.**  
Calculation of the Addition Matrix for Each Row

Criteria	Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews	Amount
Price	0,4812	0,8147	0,5226	0,4966	0,3046	2,6197
Maximum Participants	0,1604	0,2716	0,3919	0,4138	0,2369	1,4747
Ease of Use	0,1203	0,0905	0,1306	0,1655	0,1692	0,6762
Ease of Setup	0,0802	0,0543	0,0653	0,0828	0,1354	0,4180
User Reviews	0,0535	0,0388	0,0261	0,0207	0,0338	0,1729

Next, calculate the consistency ratio by dividing the number of matrices per row in table 8 with the results of the criteria priority matrix in table 7. So that the following calculations are obtained:

**Table 9.**  
Calculation of Eigenvalues (λ) for each criterion

Criteria	Amount	Priority	Eigen (λ)
Price	2,6197	0,4812	5,4444
Maximum Participants	1,4747	0,2716	5,4299
Ease of Use	0,6762	0,1306	5,1762
Ease of Setup	0,4180	0,0828	5,0505
User Reviews	0,1729	0,0338	5,1088
Amount λ			26,2098

Next, look for the value of λmax, where the number of criteria (n) is five:



$$\lambda \max = \frac{\text{amount } \lambda}{n} \dots\dots\dots(12)$$

$$\lambda \max = \frac{26,2098}{5}$$

$$\lambda \max = 5,2420$$

Then find the CI value:

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

$$CI = \frac{5,2420 - 5}{5 - 1}$$

$$CI = 0,0605$$

After finding the CI value, then calculating the CR value. It is known that n = 5, the value of IR = 1.12.

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

$$CR = \frac{0,0605}{1,12}$$

$$CR = 0,0540$$

Then the consistency ratio of the calculation is acceptable. Because CR <= 0.1, it means that the calculation consistency ratio is acceptable and can go to the next stage.

**3.3 Calculation Using the TOPSIS Method**

Make a decision matrix that shows the weight value of each alternative against the existing criteria. In this case, the determination of the weight value is carried out by selecting the suitability ranking value between the alternatives and the criteria with a value interval from 1 to 5, with the following conditions:

- 1 = very bad
- 2 = bad
- 3 = enough
- 4 = good
- 5 = very good

So that based on the weight value taken from the data in table 4, a decision matrix can be obtained. The decision matrix can be seen in table 10.

**Table 10.**  
Decision Matrix

Virtual Meeting Platform	Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
Zoom Meetings (PRO)	3	3	4	4	5
Cisco Webex Meeting (Starter)	2	2	2	2	4
Microsoft Teams (Microsoft 365 Business Basic)	5	5	2	3	2
Google Meet (Google Workspace Essentials)	4	4	5	5	1
GoToMeeting (Professional)	1	4	3	3	3

The next step is to normalize the decision matrix using formula (4). The results of the calculations can be seen in table 11.

**Table 11.**  
Normalization of the decision matrix

Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
0,405	0,359	0,525	0,504	0,674
0,270	0,239	0,263	0,252	0,539
0,674	0,598	0,263	0,378	0,270
0,539	0,478	0,657	0,630	0,135
0,135	0,478	0,394	0,378	0,405

Next, perform weighting calculations on the normalized matrix as in formula (5). The calculation result looks like table 12.



**Table 12.**  
Normalized matrix weighting calculation

Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
0,19488	0,09749	0,06858	0,04173	0,02281
0,12992	0,06490	0,03436	0,02087	0,01824
0,32431	0,16238	0,03436	0,03130	0,00914
0,25936	0,12980	0,08582	0,05216	0,00457
0,06496	0,12980	0,05147	0,03130	0,01371

Then, determine the positive ideal solution (A+) and the negative ideal solution (A-) based on equation (6) and equation (7). The results of the calculations can be seen in table 13 and table 14.

**Table 13.**  
Positive Ideal Solution (A+)

Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
0.32431	0.16238	0.08582	0.05216	0.02281

**Table 14.**  
Negative Ideal Solution (A-)

Price	Maximum Participants	Ease of Use	Ease of Setup	User Reviews
0.06496	0.0649	0.03436	0.02087	0.00457

After that, calculations are carried out to find the ideal ideal solution distance (Di+) and the ideal ideal solution distance (Di-) based on equation (8) and equation (9). The next stage then determines the preference value for each alternative (Vi) which is calculated based on equation (10). The results of the calculations can be seen in table 15.

**Table 15.**  
Calculation of separation measure

D <sub>i+</sub>	D <sub>i-</sub>	V <sub>i</sub>
<b>0,14618</b>	0,14100	0,491
<b>0,22569</b>	0,06638	0,227
<b>0,05719</b>	0,27730	0,829
<b>0,07492</b>	0,21361	0,740
<b>0,26462</b>	0,06854	0,206

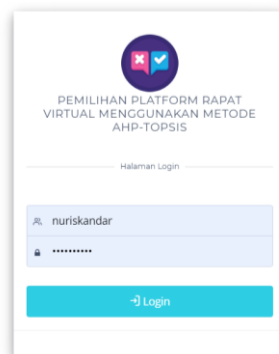
After obtaining the preference value, then a ranking is made based on the preference value. The results of the alternative data ranking calculations can be seen in table 16.

**Table 16.**  
Ranking of alternative data

<b>Microsoft Teams (Microsoft 365 Business Basic)</b>	0.829
<b>Google Meet (Google Workspace Essentials)</b>	0.740
<b>Zoom Meetings (PRO)</b>	0.491
<b>Cisco Webex Meeting (Starter)</b>	0.227
<b>GoToMeeting (Professional)</b>	0.206

### 3.4 Implementation of the AHP-TOPSIS Method in the System

- a) Login page on the system



**Fig 2.** Login page

b) Pairwise Comparison Value in the System

NILAI PERBANDINGAN BERPASANGAN				
Harga	Maksimal Partisipan	Kemudahan Penggunaan	Kemudahan Penyiapan	Ulasan Pengguna
1	3	4	6	9
0.333	1	3	5	7
0.25	0.333	1	2	5
0.167	0.2	0.5	1	4
0.111	0.143	0.2	0.25	1

Fig 3. Pairwise Comparison Value

c) Preference Value (V<sub>i</sub>) and Ranking in the System

NILAI PREFERENSI (V <sub>i</sub> )	
Zoom Meetings (PRO)	0.491
Cisco Webex Meeting (Starter)	0.227
Microsoft Teams (Microsoft 365 Business Basic)	0.829
Google Meet (Google Workspace Essentials)	0.74
GoToMeeting (Professional)	0.206

PERANGKINGAN	
Microsoft Teams (Microsoft 365 Business Basic)	0.829
Google Meet (Google Workspace Essentials)	0.74
Zoom Meetings (PRO)	0.491
Cisco Webex Meeting (Starter)	0.227
GoToMeeting (Professional)	0.206

Fig 4. Value Preference (V<sub>i</sub>) and Ranking

4. Conclusion

Based on the results of the above changes, the conclusions obtained in this study are as follows:

- a. From the results of the virtual meeting platform alternative data ranking, it was found that Microsoft Teams (Microsoft 365 Business Basic) was in first place followed by Google Meet (Google Workspace Essentials), Zoom Meetings (PRO), Cisco Webex Meeting (Starter) and the last rank, namely GoToMeeting (Professional).
- b. The application of a decision support system for selecting a virtual meeting platform using the AHP-TOPSIS method begins with a pairwise comparison, determining the priority of the criteria, looking for the value of  $\lambda_{max} = 5.2420$ ,  $CI = 0.0605$ , and the value of  $CR = 0.0540$  using the AHP method. Then make a decision matrix, normalize the decision matrix, weight the normalized matrix, determine the positive ideal solution (A<sup>+</sup>), determine the negative ideal solution (A<sup>-</sup>), determine the preference value for each alternative (V<sub>i</sub>), and finally rank it based on the preference value using the method. TOPSIS.
- c. In this study using a combination of AHP and TOPSIS methods to help solve decision-making problems using five criteria and five alternative data. The data sources for the criteria and alternatives for virtual meeting platforms are taken from the official websites of each virtual meeting platform and <https://www.g2.com/>. G2 is a verified platform and helps to objectively evaluate software.
- d. The criteria and weights in this system are still relevant today, but in practice the value will change in the future. For this reason, further development is needed, it is expected to be able to update the number of criteria and change the value of the criteria weight that follows the times.



## 5. Reference

- [1] Harirah, Z., and Rizaldi, A., 2020, Merespon Nalar Kebijakan Negara Dalam Menangani Pandemi Covid 19 di Indonesia, *Jurnal Ekonomi dan Kebijakan Publik Indonesia*, Vol. 7, No. 1, hal 36-53.
- [2] Narti, Sriyadi, Rahmayani, N., and Syarif, M., 2019, Pengambilan Keputusan Memilih Sekolah Dengan Metode AHP, *Jurnal Informatika*, No.1, Vol.6, hal 143-150.
- [3] Yoon, K.P. and Hwang, C.L. 1995. *Multiple Attribute Decision Making: An Introduction*, Sage Publications, Thousand Oaks, CA.
- [4] Purnomo, E.N.S., Sihwi, S.W., and Anggrainingsih, R., 2013, Analisis Perbandingan Menggunakan Metode AHP, TOPSIS, dan AHP-TOPSIS dalam Studi Kasus Sistem Pendukung Keputusan Penerimaan Siswa Program Akselerasi, *Jurnal Itsmart*, Vol.2, No.1.
- [5] Saaty, T.L, 2000, *The Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process*, RWS Publication University of Pittsburgh, Pittsburgh.
- [6] Saaty, T.L, 2008, Decision Making with Analytic Hierarch Process, *International Journal Services Sciences*, Vol. 1, No 1.
- [7] Niswara, B.A.T.H., Putri, R.R.M., and Hidayat, N., 2018, Rekomendasi Pemilihan Paket Personal Computer Menggunakan Metode AHP-TOPSIS, *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*, Vol. 2, No. 5, hal 1998-2007.