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A RANKING SYSTEM FOR HANDLING COVID-19 IN SOUTHEAST ASIAN USING AHP-COPRAS

Setyawan Wibisono[1*], Wiwien Hadikurniawati[1], Arief Jananto[2], Taufiq Dwi Cahyono[3]
[1]Program Studi Teknik Informatika, Universitas Stikubank Semarang
[2]Program Studi Sistem Informasi, Universitas Stikubank Semarang
[3]Jurusan Teknik Elektro, Fakultas Teknik, Universitas Semarang
email: *setyawan@edu.unisbank.ac.id

Abstract: One of the institutions that stated the poor handling of Covid-19 in Indonesia was the Lowy Institute. On March 13, 2021, Lowy Institute put Indonesia in 89th rank out of 102 countries that were successfully surveyed regarding the handling of the Covid-19 pandemic. This research is an attempt to critique the Lowy Institute's assessment. The COPRAS-AHP hybrid method was used. The AHP method, especially in the pairwise comparison section, is used as a method to determine the validity of the criterion weights. Five criteria were used in determining the ranking of the handling of the Covid-19 pandemic in countries in the Southeast Asian region. Each criterion is given a weight that is determined subjectively but by considering the level of importance of each criterion. The weighting of the criteria by using pairwise comparison resulted in: test per population, positive per test, vaccine per population, recovered per positive, deaths per positive. This study produces conclusions that are not much different from the Lowy Institute release. Indonesia is one of the countries where the handling of the Covid-19 pandemic is at a low level, Indonesia is ranked 10th out of 11 countries in the Southeast Asia region, with a utility value 16.29%.

Keywords: AHP; COPRAS; covid-19;pairwise comparison; ranking

Abstrak: Salah satu lembaga yang menyatakan buruknya penanganan Covid-19 di Indonesia adalah Lowy Institute. Pada 13 Maret 2021 menempatkan Indonesia di peringkat 89 dari 102 negara yang berhasil disurvei berkenaan dengan penanganan pandemi Covid-19. Penelitian ini merupakan upaya kritisi terhadap penilaian Lowy Institute. Digunakan metode hibrid COPRAS-AHP. Metode AHP, khususnya pada bagian *pairwise comparison* digunakan sebagai metode untuk menentukan validitas bobot kriteria. Digunakan lima kriteria dalam menentukan pemeringkatan penanganan pandemi Covid-19 pada negara-negara di kawasan Asia Tenggara. Masing-masing kriteria diberikan bobot yang ditentukan secara subjektif namun dengan mempertimbangkan tingkat kepentingan masing-masing kriteria. Pembobotan kriteria dengan menggunakan *pairwise comparison* menghasilkan: kriteria tes per populasi, positif per tes, vaksin per populasim, sembuh per positif, meninggal per positif. Penelitian ini menghasilkan kesimpulan yang tidak jauh berbeda dengan rilis Lowy Institute. Indonesia adalah salah satu negara dengan penanganan pandemi Covid-19 berada dalam level yang relatif rendah, peringkat 10 dari 11 negara di kawasan Asia Tenggara, dengan nilai utilitas 16,29 %.

Kata kunci: AHP; COPRAS; covid-19; pairwise comparison; pemeringkatan

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INTRODUCTION

Various mass media reported information about diseases that attack the respiratory system that can cause humans to die, at the beginning of 2020. The disease, which was originally only known as Corona, began to spread in China and began to spread to various countries. Moment the world community has not paid much attention to the spread of Corona disease [1]. People still think that a disease that is still in the same class as the flu is not too dangerous. The disease with the provisional name 2019 novel coronavirus (2019-nCoV) is considered no more dangerous than SARS (Severe Acute Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome). A disease that also attacks the respiratory tract with a contagious and sometimes fatal nature is caused by a coronavirus.

Covid-19 was officially declared to have been found on March 2, 2020, in Indonesia, but health experts believe that Corona sufferers existed before that. The stuttering in handling Covid-19 does not only occur in Indonesia, but is evenly distributed throughout the world and is considered a global failure in handling a pandemic [2]. Indonesian government is classified as a government that is slow in dealing with the spread of Covid-19 in the management of handling Covid-19. One of the institutions that stated the poor handling of Covid-19 in Indonesia was the Lowy Institute. The results of a survey published by this agency on March 13 2021 placed Indonesia in 89th place out of 102 countries surveyed regarding the handling of the Covid-19 pandemic. The Lowy Institute created the term Covid Performance Index(CPI), a country's assessment index based on the handling of the Covid-19 pandemic. The countries in the Southeast Asian region that were successfully surveyed have ratings and scores as shown in table 1.

Table 1. CPI for Southeast Asian

No	Country	World Rangking	Value
1.	Thailand	4	82,6
2.	Singapore	14	73,3
3.	Malaysia	17	69,9
4.	Myanmar	24	62,4
5.	Philippines	81	32,0
6.	Indonesia	89	25,8

In this study, an attempt was made to confirm the Covid Performance Index. How to make critical efforts through research on ranking the handling of the Covid-19 pandemic using indicators that are different from those used by the Lowy Institute. The ranking uses the COPRAS (Complex Proportional Assessment) method, while the AHP (Analytical Hierarchy Process), especially in the pairwise comparison section, is used to determine the criterion weight values and validate each criterion weight [3].

AHP and COPRAS are methods in supporting decision making by considering several subjectively determined criteria. This system can help people weigh various factors and make the best decision based on all criteria [4].

AHP is a functional model in the form of a hierarchy with the main input coming from human perception. Complexity and unstructured problems are decomposed into parts which are then organized hierarchically. The emphasis on AHP's ability is in solving problems in the form of multiple criteria based on a comparison of the preferences of each element in the hierarchy [5].

The paired comparison matrix that appears in AHP describes the rela-

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tive contribution of each element affecting each objective criterion above the level. A valuation matrix is constructed based on the value maker's decisions. This matrix is used in calculating the level of importance of each element. Pairwise comparisons are represented in a table showing the level of importance scale proposed by Saaty [6].

This study used AHP and COPRAS hybrid methods. Specifically, AHP is used to calculate the weight of each criterion and the COPRAS method is used to rank and select alternatives [8]. COPRAS (Complex Proportional Assessment) is one of the MCDMs which has the working principle that the best alternative will be selected among various alternatives that are relatively feasible. The technique used is to determine a solution based on a direct and proportional ratio to the best solution with a ratio to the worst ideal solution [7]. This method makes decisions by building rankings in stages and then evaluating alternatives, followed by calculating the utility of each alternative [10].

METHOD

The research developed a ranking system for handling Covid-19 in Southeast Asian countries using the AHP and COPRAS combination method. This method is one method in the case of decision making. This series of methods begins with subjectively weighting the criteria based on the level of importance between the criteria. The results of the comparison are represented in the pairwise comparison table. The next process is to normalize the weights and carry out a validation test on the weight values that have been determined subjectively, so that the weight values can be accepted for validity.

The AHP method was used as the initial part of the ranking using the COPRAS method. This ranking is used to find the best alternative based on existing criteria using the Complex Proportional Assessment (COPRAS) method. The COPRAS method is used to analyze different alternatives, and estimate alternatives according to their utility level where the values of the attributes are expressed in intervals to increase efficiency and increase accuracy in the decision-making process [8].

The results of this study are a ranking of the handling of Covid-19 in Southeast Asian countries to confirm the results of a survey conducted by the Lowy Institute. The flow of system design to determine the ranking of Covid-19 treatments in Southeast Asian countries is shown in image 1.

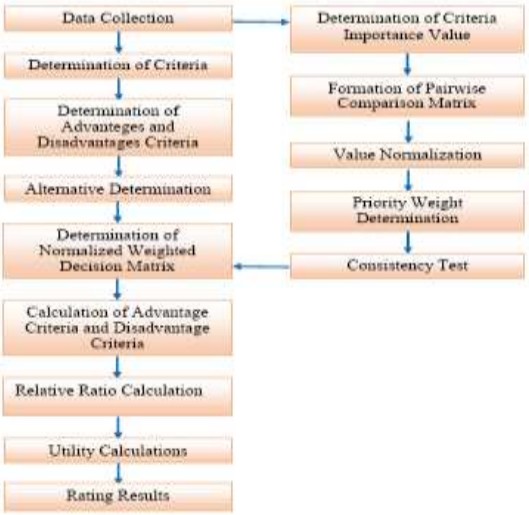

Image 1. System Design Flow

In solving problems using COPRAS, after the alternatives and criteria are determined, the next step is [9]:
Step 1 - Choose the most important set of criteria and alternatives.

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Step 2 – Create a table or matrix from alternative data and predetermined criteria.

$$x = [x_{ij}]_{m\times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

Step 3 - Normalizing the decision matrix, if xij is the decision matrix of alternative j on the evaluation criteria, then the normalized decision matrix is:

$$R = [r_{ij}]_{m\times n} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (2)$$

Step 4 - Calculating the weighted normalized decision matrix.

$$D = [y_{ij}]_{m\times n} = r_{ij} \times w_{ij} \quad (3)$$

Step 5 - Performing the calculation of advantages criteria and disadvantages criteria. The criteria must be identified as advantages or disadvantages [10].

$$S_{+i} = \sum_{j=1}^{n} y_{+ij} \quad (4)$$

$$S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad (5)$$

The variable n serves as the width of the matrix which represents the number of criteria that are included in the advantages criteria for S+i and the disadvantages criteria for S-i, y is a criterion value of the normalized matrix and multiplied by the weight.

Step 6 - Calculating the relative ratio between advantages criteria and disadvantages criteria.

$$Q_i = S_{+i} + \frac{1 \times \sum_{i=1}^{m} S_{-i}}{S_{-i} \times \sum_{i=1}^{m} \left(\frac{1}{S_{-i}}\right)} \quad (6)$$

S+i is the criterion value that benefits the i-th alternative, S-i is the criterion value that is detrimental to the i- alternative, S-min is the smallest value of all S-i values in all alternatives.

Step 7 - Calculate the level of utility for each alternative.

$$U_i = \frac{Q_i}{Q_{max}} \times 100\% \quad (7)$$

i is the i-th alternative, Q is the relative ratio value in the fifth stage. Qmax is the maximum value of all Q from all alternatives.

RESULTS AND DISCUSSION

The data set used in this study is data on the handling of Covid-19 in Southeast Asian countries originating from the worldometer.com website which provides real-time data on Covid-19 cases. Meanwhile, Covid-19 vaccination data in Southeast Asian countries comes from the ourworldinda-ta.org website. This data was accumulatively obtained on April 28, 2022. The compiled data is shown in table 2. It contains the name of the country, population level, number of tests recorded, number of positives recorded, number of recoveries recorded, number of people who died gal as well as the total number of vaccinations. The total number of vaccinations obtained is based on the number of people who have been vaccinated both in the first phase of the vaccination, the second phase of the vaccination and the booster vaccination.

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Table 2. Basisdata for Handling Covid-19 in the Southeast Asia

No	Country	Population	Total Tests	Positive	Recovered	Deaths	Vaccination
1.	Vietnam	98.929.083	85.792.898	10.631.516	9.163.132	43.034	203.144.374
2.	Indonesia	278.776.055	95.279.624	6.045.660	5.880.319	156.199	399.513.940
3.	Malaysia	33.119.023	58.544.609	4.440.383	4.346.421	35.526	70.158.087
4.	Thailand	70.118.054	17.270.775	4.224.008	4.036.969	28.274	132.478.971
5.	Philippines	112.229.517	29.495.310	3.685.029	3.614.238	60.215	150.857.283
6.	Singapore	5.933.900	23.712.995	1.190.560	1.120.059	1.334	13.964.302
7.	Myanmar	55.072.219	7.924.721	612.802	591.740	19.434	53.750.345
8.	Laos	7.467.264	1.232.128	206.512	7.660	737	10.594.229
9.	Brunei	445.086	717.784	141.531	140.422	218	1.084.543
10.	Cambodia	17.139.118	2.950.598	136.235	132.994	3.056	37.654.417
11.	Timor-Leste	1.364.035	262.382	22.862	22.722	130	1.417.237

Secondary data in this study were taken on April 28 2022 from the worldometer.com website which provides real-time Covid-19 case data and the ourworldindata.org website which provides vaccination data. The data collected is then compiled in relation to the indicators used as the basis for handling Covid-19 in countries in the Southeast Asian region. In the early stages, the data is used to obtain alternatives that will later be determined. Alternative data is data for countries in the Southeast Asian region which will be assessed in handling the Covid-19 pandemic.

Criteria data is indicator data which becomes a parameter in determining the ranking of countries in Southeast Asia in handling Covid-19. In the criteria, the level of importance of each criterion is determined. Determination of the level of criteria is usually carried out by resource persons. In determining the level of importance of a criterion, each calculation may be different. This depends on the point of view of the source in determining the level of importance of a criterion for its role in influencing the rating [11]. The grouping of criteria based on the level of importance is shown in table 3.

Table 3. Criteria

Code	Criteria	Interest Level
C1	Test per Population (TPOP)	Important
C2	Positive per Test (PTES)	More Important
C3	Recoverd per Positive (SPOS)	Very Important
C4	Death per Positive (MPOS)	Most Important
C5	Vaccine per Population (VPOP)	More Important

The indicators used as criteria will be grouped into two types of criteria, namely advantages criteria and disadvantages criteria. Advantages criteria are criteria when the value is higher it will have a positive impact on the value of handling Covid-19, while the disadvantage criteria are criteria where if the value is higher it will have a negative impact on the value of handling Covid-19. Advantages criteria groups and disadvantages criteria are shown in table 4.

Determination of candidates who will be alternative countries in the South-

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east Asia region who will be assessed for the level of handling of Covid-19 based on predetermined criteria, as shown in table 5.

Table 4. Criteria Type

Code	Criteria Name	Group
C1	TPOP	Advantages
C2	PTES	Disadvantages
C3	SPOS	Advantages
C4	MPOS	Disadvantages
C5	VPOP	Advantages

Pairwise Comparison

At this stage, calculations are carried out to determine the weights using the AHP method, by creating a pairwise comparison matrix based on the importance value. The level of importance and weight values are given in a simulation with subjective values, but still taking into account the general level of appropriateness. The level of importance and weight values are given as follows:

1. Test per Population (TPOP) with a level of importance = "Important"
2. Positive per Test (PTES) and Vaccine per Population (VPOP) with a level of importance = "More Important"
3. Recovery per Positive (SPOS) with a level of importance = "Very Important"
4. Deaths per Positive (MPOS) with a level of importance = "Most Important"

So that a pairwise comparison matrix is produced as shown in table 6.

Based on table 9, the process of multiplying each weight with each parameter is carried out. The next step is to determine the maximum eigen by adding up the multiplication values of the number of columns of the pairwise comparison matrix in decimal number format. The consistency index calculation is also calculated, then the consistency ratio is determined, if the consistency ratio value is still less than 10 percent, then this value is still acceptable. The final result obtained from this series of parameter weighting processes is that each criterion gets a valid weight as shown in table 7.

Table 5. Ranking Alternative Candidates

Alternative	C1	C2	C3	C4	C5
A1	0,86721615	0,12392070	0,86188386	0,00404778	2,05343432
A2	0,34177836	0,06345176	0,97265129	0,02583655	1,43309991
A3	1,76770338	0,07584615	0,97883921	0,00800066	2,11836222
A4	0,24630996	0,24457548	0,95572002	0,00669364	1,88937033
A5	0,26281241	0,12493610	0,98078957	0,01634044	1,34418544
A6	3,99619053	0,05020707	0,94078333	0,00112048	2,35330929
A7	0,14389689	0,07732790	0,96563001	0,03171334	0,97599744
A8	0,16500394	0,16760596	0,03709228	0,00356880	1,41875645
A9	1,61268609	0,19717770	0,99216426	0,00154030	2,43670437
A10	0,17215577	0,04617200	0,97621022	0,02243183	2,19698686
A11	0,19235723	0,08713250	0,99387630	0,00568629	1,03900340

Table 6. Pairwise Comparison

	MPOS	SPOS	PTES	VPOP	TPOP
MPOS	1	3	5	5	7
SPOS	0,333	1	3	3	5
PTES	0,2	0,333	1	1	3
VPOP	0,2	0,333	1	1	3
TPOP	0,143	0,2	0,333	0,2	1

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Table 7. Weight

Code	Criteria	Weight
C1	TPOP	0,041091059
C2	PTES	0,104228189
C3	SPOS	0,247170961
C4	MPOS	0,503281602
C5	VPOP	0,104228189

Based on normalized weighted decision values, calculations are based on the type of criteria in the Max column and Min column. The Max column states that the column value is a favorable type of criterion, meaning that the higher the value in the Max column, the better it will give a good value in ranking calculations. The Min column states that the value of the column is a disadvantageous type of criterion, meaning that the higher the value in the Min column, the more it gives a bad score in the rating calculation.

The advantages criteria are criteria C1, C3, C5. Criteria that are detrimental are criteria C2 and C4. From this stage each candidate will have an S+i value (advantages criteria) and an S-i value (disadvantages criteria. The relative ratio calculation is based on the results of S+i and S-i values. Calculation of the value of the relative ratio will be the basis for determining the ranking of each alternative. The process of calculating the utility value is done by changing the value in the relative ratio to a value in the form of a percentage. By displaying the value in the form of a percentage, it will make it easier to read the ranking results. The final process is the presentation of the level of handling of Covid-19, as shown in table 8.

From the results of this study it can be seen that the handling of Covid-19 in Indonesia is lagging far behind when compared to neighboring countries in Southeast Asia. The factor that makes Indonesia quite lagging behind is the ratio of the death rate which is quite high compared to the total population. Even though the death rate is the criterion that is given the highest weight, because the death rate is the most fatal end of a Covid-19 treatment.

Table 8. Ranking of Handling Covid-19

Rangking	Country	Utility Value
1	Singapore	100 %
2	Brunei	48,19 %
3	Vietnam	40,36 %
4	Timor-Leste	35,41 %
5	Malaysia	35,28 %
6	Thailand	28,66 %
7	Laos	27,85 %
8	Philippines	22,32 %
9	Cambodia	22,24 %
10	Indonesia	19,83 %
11	Myanmar	17,29 %

CONCLUSION

In this study the COPRAS-AHP hybrid method was able to provide results for ranking the handling of Covid-19 in countries in the Southeast Asian region. The AHP method, especially in the pairwise comparison section, can be used as a method to determine the validity of subjectively determined criteria weights. Each criterion is given a weight which is determined subjectively but by considering the level of importance of each criterion. The AHP method is combined with the COPRAS method to calculate the results of ranking the handling of Covid-19 in countries in the Southeast Asian region.

In a release by the Lowy Institute using the CPI method, it was stated that Indonesia is one of the countries where the handling of the Covid-19 pandemic is at a low level. It turns out that by determining the weights using pairwise com-

parison, as well as ranking using the AHP-COPRAS method, this confirms that things are not much different. Indonesia is at a low level in handling Covid19 in the Southeast Asia region by being ranked 10th out of 11 countries in the Southeast Asian region, with a utility value of 19.83%.

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