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# ANALYSIS OF THE DETERMINED LOCATION OF THE SUBMARINE BASE IN THE AREAS OF FLEET COMMAND III USING HYBRID MCDM METHODS DELPHI, ANP, AND SAW

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## *ABSTRACT*

*The formation of the III Fleet Command in the development and development of the Indonesian Navy's strength has a strategy of developing a strong posture. The development of the TNI AL posture that has been determined includes the level of ability, strength, and pattern of strength degrees. One of the strength postures built and developed is submarines. To support the optimization of submarine operations in the Koarmada III area, it is necessary to build supporting facilities to extend the capability of the submarine's operating range, namely special submarine base facilities. The purpose of this study is to analyze the criteria that are considered and determine the priority of the location of the submarine base in the Koarmada III area. This research was carried out in three stages, namely the stage of determining the criteria using the Delphi method, the stage of weighting the criteria using the ANP method, the stage of ranking alternative locations using SAW. In the first stage of the analysis, ten main criteria were found in determining the location of the submarine base which were then used as the basis for the second stage of analysis, namely the determination of the structure and weighting of the ANP. The results of the weighting of the criteria are used for the third analysis process, namely the ranking of alternatives using the SAW method. The results of the SAW processing prove that Ambon is the main priority in determining the location of the submarine base in the Coarmada III Region with the SAW value = 0.858 with a weight of 27.8%. The results of this study are expected to be a consideration for the leadership of the Indonesian Navy in determining the location of submarines in the future.*

***Keywords:*** *Submarine Base, Delphi, ANP, SAW*

## 1. INTRODUCTION

The pattern of submarine operations needs to be optimized so that it can cover all Indonesian waters. This is to prevent illegal acts from foreign parties, especially in the three trouble spots and shipping lanes in Indonesian territory such as territorial violations, violations of the use of shipping lanes that are not in accordance with the right of innocent passage by foreign surface ships, and submarines, theft of resources and other violations that can threaten the sovereignty of the state. The existence of submarines throughout the year through an efficient operating pattern will optimize the role of submarines in increasing the deterrence effect for the enforcement of Indonesian sovereignty at sea.

To support the optimization of submarine operations, it is necessary to build supporting facilities to extend the operating range of the submarine. Therefore, it is necessary to prepare for the development and construction of a strategic submarine base so that it will produce an optimal deterrent impact. Currently, the Indonesian Navy only has one submarine base in Surabaya, so it is necessary to determine a strategic location for new submarine bases in other areas.

Currently in the area of Koarmada III there is no submarine base that can support submarine operations. Meanwhile, capacity building and strength development and support for base facilities must always be carried out in an integrated and sustainable manner. Determining the direction of future threats can determine strategic bases to be prepared, prepare integrated logistical support so that submarines can be projected into conflict areas quickly. Thus, it is hoped that in the Koarmada III area, with a strategic submarine base and with integrated logistical support, the submarine will have high mobility and hitting power as well as optimal deterrence impact, especially security in trouble spots and ALKI III.

Determining the location of the submarine base in the Koarmada III area must pay attention to several aspects, determining this location requires an appropriate method, both the selection of criteria and location, this is because the results obtained are as expected.

## 2. MATERIALS AND METHODS

### 2.1 Delphi method

The Delphi method is a process carried out in groups to survey and gather opinions from experts on a particular topic. This method is useful for structuring the group communication process so that the process will run effectively, so that the group can solve problems. This method is used when expert opinion

and judgment is required but other factors such as time or distance make it difficult for experts on a panel to sit together.

In the process this method involves interaction between the researcher and a group of experts related to a particular topic, usually through the help of a questionnaire. This method is used to gain consensus on future projections using a systematic information gathering process. This method is useful when opinions and judgments from experts and practitioners are needed in solving problems. The three main steps in this process are:

a. The first questionnaire was sent to the expert panelists to ask for some of their opinions (from experience or limited to their assessment), some predictions and also their recommendations.

b. In the second round, a summary of the results of the first questionnaire was sent to each expert panelist to be able to re-evaluate their first assessment of the questionnaire using the specified criteria.

c. In the third round, the questionnaire was given back with information about the results of the panelists' assessment and the consensus results. The panelists were asked again to revise their opinion or explain the reasons for disagreeing with the group consensus.

Opinion withdrawal and measurement of consensus and convergence are carried out using statistical analysis with the following approaches:

a. Standard Deviation

The first measure of convergence or consensus assessment is when answers or ratings from all sources have a standard deviation of <1.5. The standard deviation formula is as follows:

$$S = \sqrt{\frac{\sum(xi - x)^2}{n-1}} \quad \text{atau} \quad S = \sqrt{\frac{\sum xi^2 - \frac{(\sum xi)^2}{n}}{n-1}}$$

Where:

x = response A's answer to the criteria/subcriteria n

□= average of respondents' answers to criteria/subcriteria n

b. Interquartile Range

The second measure of convergence or consensus assessment is when answers or ratings from all sources have an Interquartile Range <2.5. The formula for the interquartile range is:

IR = Q3 – Q1

Where Q3 is the upper quartile and Q1 is the lower quartile.

The formula for the upper quartile is:

$$Q1 = \frac{x\left(\frac{n-1}{4}\right) + x\left(\frac{n+3}{4}\right)}{2}, Q2 = X\frac{2(n+1)}{4},$$

$$Q3 = \frac{x\left(\frac{3n+1}{4}\right) + x\left(\frac{3n+5}{4}\right)}{2}$$

Evaluation to express convergence or consensus on all criteria/sub-criteria is when the standard deviation is <1.5 and the interquartile range is <2.5. If either the standard deviation or the interquartile range is not <1.5 and <2.5, then the criteria/sub-criteria are declared not convergent or not agreed (consensus).

### 2.2 Analytical Network Process (ANP) Method

*Analytical Network Process*(ANP) is a mathematical theory that allows a decision maker to deal with interrelated factors and have systematic feedback. ANP is a decision-making method based on many criteria developed by Thomas L., Saaty. This method is a development of the Analytical Hierarchy Process (AHP) method. The ANP method is a method that produces a framework to overcome the problems of decision makers without involving assumptions related to the independence between high level elements and weak elements and the independence of these elements in one level.

ANP has basic principles, namely:

a. The Decomposition Principle is applied to structure complex problems into a hierarchical framework or network of clusters, sub-clusters, sub-sub-clusters, and so on. In other words, decomposition is modeling the problem into the ANP framework

b. Comparative judgments are applied to build pairwise comparisons of all combinations of elements in the cluster, seen from the parent cluster. This pair comparison is used to get the local priority of the elements in a cluster seen from the parent cluster.

c. Hierarchical composition or synthesis is applied to shift the local priority of the elements in the cluster to the global priority of the parent element, which returns the global priority of the entire hierarchy and sums it up to produce the global priority for the lowest level element (usually an alternative).

Pairwise comparison is based on the "judgment" of the decision maker by assessing the level of importance of an element compared to other elements. The value of this comparison is determined by the quantitative scale proposed by Saaty (1994). This scale starts from 1 to 9. The comparison is carried out until a total judgment is obtained as many as nx [(n-1)/2] pieces, where n is the number of elements being compared.

**Table 1.** Pairwise Comparison Scale

| Level of Interest | Definition |
|---|---|
| 1 | Both elements are equally important |
| 3 | 1 (one) element is slightly more important than the other elements. |
| 5 | 1 (one) element is actually more important than the other elements. |
| 7 | 1 (one) element is clearly more important than the other elements. |

| | |
|---|---|
| 9 | 1 (one) element is absolutely more important than the other elements. |
| 2,4,6,8 | The middle value between two adjoining ratings. |

(Source: Saaty, 1993)

### 2.3 Method *Simple Additive Weighting* (PBUH)

The SAW method is a method used to find the optimal alternative from a number of alternatives with certain criteria. The process is carried out by determining the weight value for each attribute, then followed by a ranking process that will select the alternatives that have been given. There are 3 approaches to find the attribute weight value, namely the subjective approach, the objective approach and the integration approach between subjective & objective.

The completion steps in using the SAW method are:

a. Determine the alternative, namely Ai.
b. Determine the criteria that will be used as a reference in making decisions, namely Cj.
c. Provide a value for the suitability rating of each alternative on each criterion.
d. Determine the preference weight or importance level (W) of each criterion. W = [ W1,W2,W3,…,WJ]
e. Create a match rating table for each alternative on each criterion.
f. Make a decision matrix (X) which is formed from the suitability rating table for each alternative on each criterion. The value of X for each alternative (Ai) on each criterion (Cj) that has been determined, where, i=1,2,…m and j=1,2,…n.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} \\ \vdots & \cdots & \cdots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} \end{bmatrix}$$

g. Normalize the decision matrix by calculating the value of the normalized performance rating (rij) from the alternative Ai on the Cj criteria.

$$rij = \begin{cases} \dfrac{X_{ij}}{Max_i \quad X_{ij}} \\ \dfrac{Min_i \quad X_{ij}}{X_{ij}} \end{cases}$$

If j is an attribute of benefit (benefit)
If j is a cost attribute (Cost)
Where :
Rij = normalized performance rating value
Xi = attribute value of each criterion
Max xij = the largest value of each criterion i
Min xij = the smallest value of each criterion i
Benefit = if the biggest value is the best
Cost = if the smallest value is the best
Where rij is the normalized performance rating of alternative Ai on attribute Cj; i=1,2,..., m and j=1,2,...,n.

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

$$R = \begin{bmatrix} R_{11} & R_{12} & \cdots & R_{1j} \\ \vdots & \cdots & \cdots & \vdots \\ R_{i1} & R_{i2} & \cdots & R_{ij} \end{bmatrix}$$

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

$$V_i = \sum_{j=0}^{n} W_j R_{ij}$$

Where : Vi = rank for each alternative
Wj = weight value of each criterion
Rij = normalized performance rating value

A larger Vi value indicates that alternative Ai is preferred.

## 3. RESULT AND DISCUSSION

### 3.1 Criteria Identification

This stage is carried out by means of brainstorming/interviews with resource persons. The resource persons consist of experts from 1) Operations Staff; 2) Planning Staff and 3) Logistics Staff 4) Base. The result of this stage is the identification of the initial criteria in determining the location of the submarine base in the Koarmada III area, namely as follows:

**Table 2**. List of Criteria

| No | Criteria | Description |
|---|---|---|
| 1. | Position | The location of the base must be a strategic place so that the impact of deterrence is optimal and the Endurance of the Submarine can reach the operational mandala. |
| 2. | Mobility | Can reach control in strategic funnels as a consequence of the geographical constellation of the Indonesian archipelago. |
| 3. | Support | Supported by dock facilities, tracktors, repairs, supply warehouses and personnel maintenance facilities. |
| 4. | Protection | Anticipating threats that are factors from the opposing party (covered from air monitoring while protecting the submarine body from the sun). |
| 5. | Security | Safe from the reach of enemy air attacks and natural factors (not a natural disaster area). |
| 6 | Natural Disaster Vulnerability | Considering the vulnerability to the possibility of natural disasters, especially earthquakes. To avoid destruction due to natural disasters, the location of the determination of the base is not held in areas prone to natural disasters. |
| 7 | Plot | Have easy entry points for yourself and difficult for the enemy's interests (For submarines, the base is close to the dive area). |

| | | |
|---|---|---|
| 8 | Communicati on | Have approach lines and communication networks for good command and control. |
| 9 | Confidentiality | The existence of the base or dock is expected to serve as a hiding place to keep the position of the submarine elements secret. |
| 10 | Anchor Anchor | Having a place to anchor the anchor in case at any time the base is in an unusable condition. |
| 11 | Depth | Submarines use marine media as a battlefield, making depth a very important thing so that it can hinder the movement (manuvra) of the submarine when exiting / entering the home base. |
| 12 | Current | Influencing the determination of a submarine base that has technical specifications and its specificity has limitations when exercising on the surface |
| 13 | Social Vulnerability | Considers vulnerability to possible social conflict. To avoid material damage and personnel safety due to social conflict, the location for determining the base is not held in areas prone to social conflict. |
| 14 | Seawater color transparency | Weather/climate conditions, sea state, water circulation and observer's height from the water surface will affect the transparency of sea water. Submarines can take advantage of this for the use of submarine combat tactics. |

### 3.2 Determination of Criteria

Determination of the influential criteria in determining the location of the submarine base is carried out using the Delphi method. In this study involved four experts. Obtaining expert consensus on the criteria in this study was carried out three times with the following results:

a. First round opinion results

**Table 3.** Results of the first round of opinion

| NO | KRITERIA | RESPONDEN | | | | RATA2 | STD.DEV | MODUS | Q1 | Q2 | Q3 | IR | EVALUASI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1 | R2 | R3 | R4 | | | | | | | | Std.Dev | IR |
| 1 | K1 | 9 | 8 | 7 | 8 | 8 | 0,816 | 8 | 7,75 | 8 | 8,25 | 0,5 | Kon | Kon |
| 2 | K2 | 7 | 7 | 7 | 3 | 6 | 2,000 | 7 | 6 | 7 | 7 | 1 | Div | Kon |
| 3 | K3 | 8 | 7 | 7 | 6 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 4 | K4 | 3 | 8 | 5 | 5 | 5,25 | 2,062 | 5 | 4,5 | 5 | 5,75 | 1,25 | Div | Kon |
| 5 | K5 | 8 | 7 | 7 | 4 | 6,5 | 1,732 | 7 | 6,25 | 7 | 7,25 | 1 | Div | Kon |
| 6 | K6 | 7 | 8 | 4 | 7 | 6,5 | 1,732 | 7 | 6,25 | 7 | 7,25 | 1 | Div | Kon |
| 7 | K7 | 7 | 8 | 8 | 7 | 7,5 | 0,577 | 7 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 8 | K8 | 7 | 8 | 8 | 8 | 7,75 | 0,500 | 8 | 7,75 | 8 | 8 | 0,25 | Kon | Kon |
| 9 | K9 | 8 | 6 | 6 | 7 | 6,75 | 0,957 | 6 | 6 | 6,5 | 7,25 | 1,25 | Kon | Kon |
| 10 | K10 | 7 | 6 | 3 | 6 | 5,5 | 1,732 | 6 | 5,25 | 6 | 6,25 | 1 | Div | Kon |
| 11 | K11 | 7 | 7 | 6 | 8 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 12 | K12 | 8 | 7 | 8 | 7 | 7,5 | 0,577 | 8 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 13 | K13 | 7 | 7 | 7 | 7 | 7 | 0,000 | 7 | 7 | 7 | 7 | 0 | Kon | Kon |
| 14 | K14 | 3 | 6 | 7 | 6 | 5,5 | 1,732 | 6 | 5,25 | 6 | 6,25 | 1 | Div | Kon |

Based on table 3. above, it can be seen that there are 8 (eight) criteria that are convergent. There are 6 (six) divergent criteria, namely the criteria for mobility (K2), protection (K4), security (K5), vulnerability (K6), anchorage (K10) and seawater transparency (K14). The six criteria are divergent because the 6 criteria have a standard deviation value of > 1.5. This is due to the difference in the value given by the informants to these criteria.

**b. Second round Opinion Results**

**Table 4.** Results of the second round of opinion

| NO | KRITERIA | RESPONDEN | | | | RATA2 | STD.DEV | MODUS | Q1 | Q2 | Q3 | IR | EVALUASI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1 | R2 | R3 | R4 | | | | | | | | Std.Dev | IR |
| 1 | K1 | 9 | 8 | 7 | 8 | 8 | 0,816 | 8 | 7,75 | 8 | 8,25 | 0,5 | Kon | Kon |
| 2 | K2 | 8 | 7 | 6 | 4 | 6,25 | 1,708 | #N/A | 5,5 | 6,5 | 7,25 | 1,75 | Div | Kon |
| 3 | K3 | 8 | 7 | 7 | 6 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 4 | K4 | 4 | 8 | 5 | 5 | 5,5 | 1,732 | 5 | 4,75 | 5 | 5,75 | 1 | Div | Kon |
| 5 | K5 | 8 | 6 | 6 | 4 | 6 | 1,633 | 6 | 5,5 | 6 | 6,5 | 1 | Div | Kon |
| 6 | K6 | 7 | 8 | 5 | 7 | 6,75 | 1,258 | 7 | 6,5 | 7 | 7,25 | 0,75 | Kon | Kon |
| 7 | K7 | 7 | 8 | 8 | 7 | 7,5 | 0,577 | 7 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 8 | K8 | 7 | 8 | 8 | 8 | 7,75 | 0,500 | 8 | 7,75 | 8 | 8 | 0,25 | Kon | Kon |
| 9 | K9 | 8 | 6 | 6 | 7 | 6,75 | 0,957 | 6 | 6 | 6,5 | 7,25 | 1,25 | Kon | Kon |
| 10 | K10 | 8 | 7 | 4 | 7 | 6,5 | 1,732 | 7 | 6,25 | 7 | 7,25 | 1 | Div | Kon |
| 11 | K11 | 7 | 7 | 6 | 8 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 12 | K12 | 8 | 7 | 8 | 7 | 7,5 | 0,577 | 8 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 13 | K13 | 7 | 7 | 7 | 7 | 7 | 0,000 | 7 | 7 | 7 | 7 | 0 | Kon | Kon |
| 14 | K14 | 3 | 6 | 7 | 6 | 5,5 | 1,732 | 6 | 5,25 | 6 | 6,25 | 1 | Div | Kon |

Based on table 4. above, it can be seen that the results of withdrawing opinions in round 2 are different from the results of withdrawing opinions in round 1.

**c. The results of the third round of opinion**

**Table 5**. Results of the third round of opinion

| NO | KRITERIA | RESPONDEN | | | | RATA2 | STD.DEV | MODUS | Q1 | Q2 | Q3 | IR | EVALUASI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1 | R2 | R3 | R4 | | | | | | | | Std.Dev | IR |
| 1 | K1 | 9 | 8 | 7 | 8 | 8 | 0,816 | 8 | 7,75 | 8 | 8,25 | 0,5 | Kon | Kon |
| 2 | K2 | 8 | 7 | 7 | 4 | 6,5 | 1,732 | 7 | 6,25 | 7 | 7,25 | 1 | Div | Kon |
| 3 | K3 | 8 | 7 | 7 | 6 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 4 | K4 | 4 | 8 | 8 | 7 | 6,75 | 1,893 | 8 | 6,25 | 7,5 | 8 | 1,75 | Div | Kon |
| 5 | K5 | 8 | 7 | 7 | 6 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 6 | K6 | 7 | 8 | 6 | 7 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 7 | K7 | 7 | 8 | 8 | 7 | 7,5 | 0,577 | 7 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 8 | K8 | 7 | 8 | 8 | 8 | 7,75 | 0,500 | 8 | 7,75 | 8 | 8 | 0,25 | Kon | Kon |
| 9 | K9 | 8 | 6 | 6 | 7 | 6,75 | 0,957 | 6 | 6 | 6,5 | 7,25 | 1,25 | Kon | Kon |
| 10 | K10 | 8 | 7 | 4 | 7 | 6,5 | 1,732 | 7 | 6,25 | 7 | 7,25 | 1 | Div | Kon |
| 11 | K11 | 7 | 7 | 6 | 8 | 7 | 0,816 | 7 | 6,75 | 7 | 7,25 | 0,5 | Kon | Kon |
| 12 | K12 | 8 | 7 | 8 | 7 | 7,5 | 0,577 | 8 | 7 | 7,5 | 8 | 1 | Kon | Kon |
| 13 | K13 | 7 | 7 | 7 | 7 | 7 | 0,000 | 7 | 7 | 7 | 7 | 0 | Kon | Kon |
| 14 | K14 | 4 | 6 | 8 | 8 | 6,5 | 1,915 | 8 | 5,5 | 7 | 8 | 2,5 | Div | Kon |

Based on table 5. above, it can be seen that there are 10 criteria that are in consensus because these criteria have a standard deviation value of <1.5, there are 6 criteria that are not consensus due to the standard deviation value > 1.5. So the results of the third round of opinion withdrawals where the evaluation results of standard deviation and quartile range are consensus will be used as the basis for building the ANP network structure in determining the position of the submarine base.

### 3.3 Criteria Weighting

Processing of data for determining the weight of criteria in decision making to determine the location of

the submarine base in the Koarmada III area using the ANP method.

**a. ANP Network Structure**

After doing research on the relationship between the criteria to the informants, then make an ANP network model using super decision software. There are 10 (ten) criteria that exist according to the results of the previous Delphi method, namely 1 (one) Goal, and 4 (four) Alternatives. The following is an overview of the ANP Network structure.

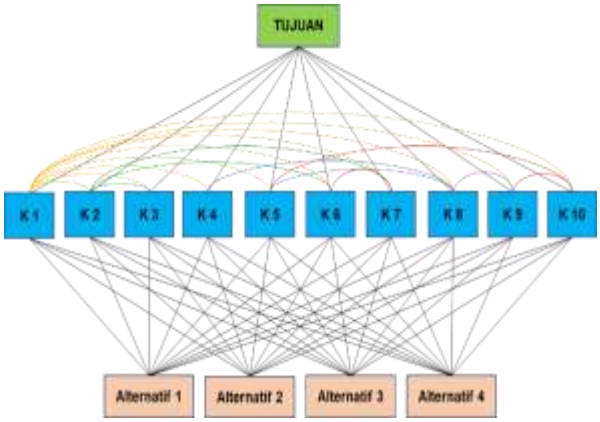


**Figure 1.** ANP Network Structure

**b. Pairwise Comparison**

At this stage, the researcher distributed the pairwise comparison questionnaire to the experts who were the resource persons at the criteria/sub-criteria identification stage. The assessment carried out in this study is based on the analytical process method, where the assessment is carried out by means of comparative judgment.

Furthermore, the results of the calculation of pairwise comparisons between criteria and between sub-criteria are shown in the figure below. The assessment in the form of a questionnaire obtained from the respondents will be combined using the formulation of the geometric mean. The geomean data from the comparison calculations obtained from the distribution of questionnaires to the respondents are in accordance with Table 6. as follows:

**Table 6**. Geomean Matrix Pairwise Comparison

| | K1 | K2 | K3 | K4 | K5 | K6 | K7 | K8 | K9 | K10 |
|---|---|---|---|---|---|---|---|---|---|---|
| K1 | | 3,02 | 2,87 | 1,96 | 4,87 | 3,94 | 4,03 | 2,10 | 4,64 | 4,92 |
| K2 | | | 1,19 | 1,86 | 2,91 | 2,03 | 2,14 | 2,06 | 3,18 | 2,96 |
| K3 | | | | 1,93 | 2,85 | 2,29 | 2,18 | 2,25 | 2,77 | 3,06 |
| K4 | | | | | 4,08 | 3,22 | 2,81 | 1,09 | 3,22 | 4,11 |
| K5 | | | | | | 2,33 | 1,80 | 4,20 | 1,30 | 1,15 |
| K6 | | | | | | | 1,25 | 3,20 | 1,83 | 2,29 |
| K7 | | | | | | | | 3,04 | 2,21 | 1,77 |
| K8 | | | | | | | | | 3,83 | 3,97 |
| K9 | | | | | | | | | | 1,09 |
| K10 | | | | | | | | | | |

The next step after obtaining one pairwise comparison value for each relationship is to calculate the local priority weights into the superdecision software. Pairwise comparisons are used to determine the value and relationship between criteria.

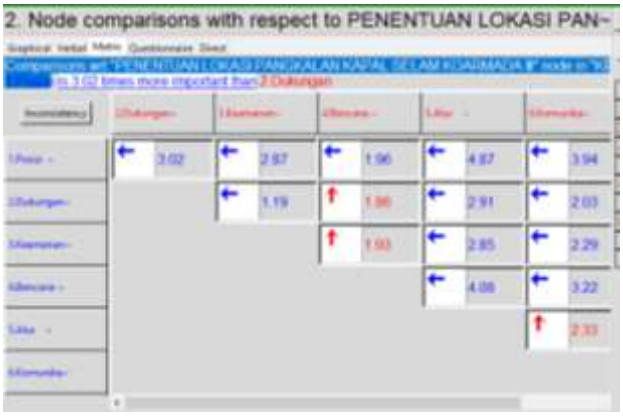


**Figure 2.** Pairwise comparison matrix between criteria

**c. Calculation of the value of the priority weight of the criteria**

This calculation aims to determine the weight of each interrelated element. Whenever local priority is weighted, the consistency value must be considered, the inconsistency value should not exceed 0.1 or 10%.

In Figure 3.3 below, it can be seen that the inconsistency of the results of pairwise comparisons between criteria is 0.02844. This value is still below 0.1, which means the data is consistent because it does not exceed the maximum limit of 0.1 inconsistency ratio.

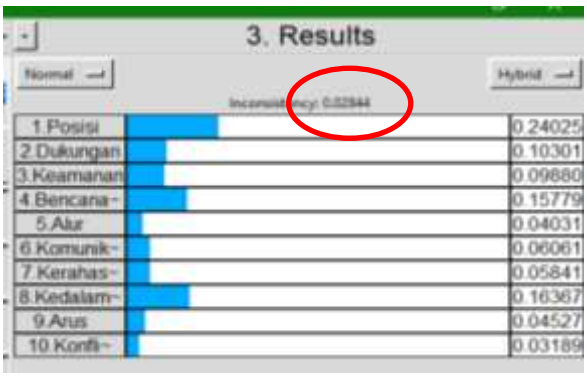


**Figure 3.** Criteria weight

From the results of the above data processing obtained from the input of the experts, it can be seen that for determining the location of the submarine base, the position criteria has the largest weight, which is 0.24025. This criterion is related to the strategic position of the base for submarines so that they can reach all areas of operation, especially strategic funnels quickly. The last criterion is the conflict area vulnerability criteria with a weight value of 0.0389.

**3.4 Alternative Priority Determination**

The next stage is determining alternative priorities using the SAW method. At this stage the data

collection for calculations using the SAW method was obtained from primary and secondary data. . Secondary data was obtained from data on the condition of the bases obtained from the Operational Area Analysis Report (ADO), while primary data was obtained from discussions with expert resource persons.

a. Determining Alternative Submarine Base Locations

The alternative for choosing the location of the submarine base used in this study is a strategic location in the current Koarmada III area, namely:

1) Morotai Island.
2) Ambon Island.
3) Kai Island (Tual).
4) Tanimbar Island (Saumlaki).

b. Determining Criteria and Weighting Criteria

In the next stage, namely the determination of criteria, the stage of determining the criteria here is to determine the criteria according to the type of criteria. The criteria are the result of determining the criteria by the Delphi method and the weighting of the criteria by the previous ANP method. Meanwhile, the classification of this type of criteria is sourced from the results of interviews with several sources. The considerations in classifying these types of criteria are: Criteria that have a higher value, the better are classified as benefits, while the criteria that are rated the higher the less good are classified as cost. The criteria that are considered in determining these criteria are in accordance with table 7. below:

**Table 7.** Criteria Weights and Attributes

| No | CRITERIA | CODE | WEIGHT | ATTRIBUTE |
|---|---|---|---|---|
| 1. | Position | K1 | 0.24025 | *Benefits* |
| 2. | Support | K2 | 0.10301 | *Benefits* |
| 3. | Security | K3 | 0.09880 | *Benefits* |
| 4. | Natural Disaster Vulnerability | K4 | 0.15779 | *Cost* |
| 5. | Plot | K5 | 0.04031 | *Benefits* |
| 6. | Communication | K6 | 0.06061 | *Benefits* |
| 7. | Confidentiality | K7 | 0.05841 | *Benefits* |
| 8. | Depth | K8 | 0.16367 | *Benefits* |
| 9. | Current | K9 | 0.04527 | *Benefits* |
| 10. | Vulnerability of Social Conflict | K10 | 0.03189 | *Cost* |

b. Provide an alternative rating value on the criteria.

The next stage is to provide a suitability rating value for each alternative on each criterion. To make this assessment easier, the author makes a scale of values for each criterion is a scale of 1 to 5. The data displayed is the result of calculating the geomatrix values given through questionnaires by experts using the formula of the geometric mean.

**Table 8.** Alternative Weight Geomeans and Criteria Attributes

| LT | CRITERIA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | ,449 | ,956 | ,224 | ,929 | ,729 | ,224 | ,968 | ,229 | ,956 | ,958 |
| 2 | .080 | ,229 | ,968 | ,711 | ,693 | ,862 | ,342 | ,342 | ,729 | ,862 |
| 3 | ,722 | ,591 | ,342 | ,449 | ,707 | .080 | ,729 | ,328 | ,328 | ,449 |
| 4 | ,000 | ,130 | .064 | ,328 | ,729 | ,859 | ,113 | ,862 | ,722 | ,577 |

c. Calculate normalized performance rating value (rij)

Normalize the decision matrix by calculating the value of the normalized performance rating (rij) from the alternative Ai on the Cj criteria using the formula:

$$rij = \begin{cases} \dfrac{X_{ij}}{Max_i \quad X_{ij}} \\ \dfrac{Min_i \quad X_{ij}}{X_{ij}} \end{cases}$$

From the results of calculating the normalization of the above criteria, a normalized matrix (R) is formed below.

$$R = \begin{bmatrix} 0{,}600 & 0{,}699 & 0{,}812 & 1{,}000 & 1{,}000 & 0{,}663 & 0{,}839 & 0{,}870 & 0{,}625 & 1{,}000 \\ 1{,}000 & 1{,}000 & 1{,}000 & 0{,}712 & 0{,}781 & 1{,}000 & 0{,}707 & 0{,}687 & 1{,}000 & 0{,}403 \\ 0{,}912 & 0{,}849 & 0{,}842 & 0{,}788 & 0{,}361 & 0{,}839 & 1{,}000 & 0{,}479 & 0{,}492 & 0{,}799 \\ 0{,}735 & 0{,}740 & 0{,}772 & 0{,}829 & 1{,}000 & 0{,}794 & 0{,}870 & 1{,}000 & 0{,}787 & 0{,}760 \end{bmatrix}$$

d. Calculating preference value (Vi)

The next step is to calculate the preference value of the decision matrix (Vi) by multiplying the weight value (Wj) of the criteria with the alternative normalization value on these criteria (Rij) using the formula:

$$V_i = \sum_{j=0}^{n} W_j R_{ij}$$

Where the weight value (Wi) is as follows:

$$\mathrm{W} = \left(0{,}24025 \middle| \begin{matrix} 0{,}10301|0{,}09880|0{,}15779|0{,}04031| \\ 0{,}06061|0{,}05841|0{,}16367|0{,}04527|0{,}03189 \end{matrix}\right)$$

Furthermore, the calculation of the preference value from the Decision Matrix (Vi) using Excel Software is carried out as shown in Table 9. below:

**Table 9.** Preference Calculation

| W = | 0,240 | 0,103 | 0,099 | 0,158 | 0,040 | 0,061 | 0,058 | 0,164 | 0,045 | 0,032 | Vi |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R = | 0,600 | 0,699 | 0,812 | 1,000 | 1,000 | 0,663 | 0,839 | 0,870 | 0,625 | 1,000 | 0,642117988 |
| | 1,000 | 1,000 | 1,000 | 0,712 | 0,781 | 1,000 | 0,707 | 0,687 | 1,000 | 0,403 | 0,858322424 |
| | 0,912 | 0,849 | 0,842 | 0,788 | 0,361 | 0,839 | 1,000 | 0,479 | 0,492 | 0,799 | 0,76411497 |
| | 0,735 | 0,740 | 0,772 | 0,829 | 1,000 | 0,794 | 0,870 | 1,000 | 0,787 | 0,760 | 0,822688062 |

Then the final result of the preference value of the decision matrix, the weight and ranking of the alternatives is obtained according to the following table below:

**Table 10**. Ranking of Alternatives

| No | Alternative | Code | Vi | Weight (%) | Rank |
|---|---|---|---|---|---|
| 1 | Morotai | A1 | 0.642117988 | 0.208 | 4 |
| 2 | Ambon | A2 | 0.858322424 | 0.278 | 1 |
| 3 | Tual | A3 | 0.76411497 | 0.248 | 3 |
| 4 | Saumlaki | A4 | 0.822688062 | 0.266 | 2 |

## 4. CONCLUSION

This study succeeded in obtaining a significant consensus of criteria in the process of determining the location of a suitable submarine base. There are ten criteria that have been validated by the expert group for use in decision making. The criteria are position, support, security, vulnerability to natural disasters, flow, communication, confidentiality, depth, flow, vulnerability to social conflict. The alternative priorities for choosing a submarine base in the Koarmada III area are 1. Ambon 27.8%, 2. Saumlaki 26.6%, 3. Tual 24.8%, 4. Morotai 20.8%.

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