DELPHI-AHP METHOD APPLICATION IN ANALYSIS AND CRITERIA DETERMINATION OF WARSHIP TYPE

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ABSTRACT

Fleet Comando III is the Main Command of the Indonesian Navy as Operation City which is tasked with carrying out defense and security operations of the maritime dimension by carrying out security in the territorial waters of eastern Indonesia. The operation in these waters is faced with the vulnerability of frequent violations, geological conditions consisting of thousands of islands and shallow straits, extreme weather and also with limited state defense budget conditions. Therefore, it is very necessary that warship is appropriate and ready to face these challenges and obstacles so that the goals of the organization can be achieved. The purpose of this study was to analyze the criteria and determine the type of warship needed in accordance with the conditions in Fleet Comando III. This study uses an integration between the Delphi method and the AHP method. The Delphi method is used to determine criteria while the AHP method is used to evaluate qualitative data and determine the weight of each criterion / sub-criteria. Based on this research, it is concluded that from the available alternatives, the best type of warship is combatant warship with a value of 0.299 then fast warship with a value of 0.184, amphibious warship with a value of 0.154, auxiliary warship with a value of 0.131, mine warship with a value of 0.199 and finally submarines with a value of 0.144. The results of this study are expected to be input and consideration for the leadership of the Indonesian.

Keywords: *Fleet Comando III, Delphi, AHP*.

1. INTRODUCTION

In accordance with the mandate of the Republic of Indonesia Law Number 34 of 2004 concerning the TNI, the Navy has the task of carrying out the duties of the Navy in the defense sector, upholding the law and maintaining security in the marine area of national jurisdiction in accordance with the provisions of national law and international law that have been ratified, carry out the diplomatic duties of the Navy in order to support the foreign policy stipulated by the government, carry out TNI duties in the development of the strength of the marine dimension, and carry out the empowerment of the marine defense area. In carrying out the duties of the Indonesian Navy, it is supported by the existence of an organization which includes: leadership elements, leadership assistants, service elements, Central executing agency, main command for operations and guidance.

Fleet Comando III is the main Guidance and Operations Command, which is directly under the Chief of Staff Indonesian Navy in the field of training and combat readiness of his unit command and is directly under the TNI Commander in the field of operations. Koarmada III has the main task of fostering the capabilities of the elements of the Fleet's forces, fostering maritime potentials to become a state defense and security force at sea, carrying out daily marine operations and marine combat operations for sea control and projection of power to land by sea in the context of enforcing sovereignty and law at sea.

In terms of geographical conditions and marine resources, the working area of Fleet Comando III is a vast area of water with a variety of abundant wealth. The condition of the area has resulted in

vulnerabilities that can threaten Indonesia's security and sovereignty, including: Illegal, Unreported and Unregulated (IUU) Fishing, illegal surveys by foreigners which are packaged in the form of marine tourism activities, drug smuggling, firearms smuggling, marine pollution and Illegal use of Indonesian archipelago sea lanes rights of passage either by civilian ships or foreign military ships as well as other illegal activities. Therefore, sea operations are needed for sea control and power projection to land by sea in the context of enforcing sovereignty and law at sea.

In carrying out marine operations involving various Main Weapon System which are components of the Integrated Fleet Weapon System which consists of Warship, Aircraft, Marines and Bases as supporters. So that the Warship as one of the components of the Integrated Fleet Weapon System is the foremost defense force to protect the maritime territory of the Republic of Indonesia. The elements of Warship in the Indonesian Navy are grouped into 7 ship units, namely excorta ship umit, submarine unit, amphibious ship unit, fast boat unit), mine ship unit, unit patrol boat and Satban auxiliary ship unit. Therefore, it is necessary to choose the type of warship in accordance with the existing conditions in Fleet Comando III, which is adapted to geographical conditions, threats, support for repair and maintenance.

In carrying out the analysis of the selection of types of Warship requires analysis of information and identification of various criteria. So that in this study the approach method used is the Delphi method to determine criteria, the Analityc Hierarchy Process (AHP) method to determine the criteria weights and determine alternative priorities.

2. MATERIAL AND METHOD

2.1 Delphi Method

The Delphi method is a process carried out in groups to survey and collect 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 panel experts to sit down 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 the opinions and judgments of 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 some of their opinions (from experience or just their judgment), 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 on the questionnaire using the specified criteria.

c. In the third round, the questionnaire was returned with information regarding the panelists' assessment results and the consensus results. The panelists were asked again to revise their opinion or explain the reasons for disagreeing with the group consensus and convergence and carried out using statistical analysis with the following approach:

1) Standard Deviation

The first measure of convergence or consensus assessment is when the answers or assessments of all informants have a

standard deviation of <1.5. The Standard Deviation formula is as follows

$$s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}} \text{ atau } \sqrt{\frac{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}}{n-1}}$$

Where:

x = response to the criteria / subcriteria n

$\bar{x}$ = average respondent's answer to the criteria / sub-criteria n

2) Interquartile Range

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

IR = Q3 - Q1

Where Q3 is the Upper Quartile and Q1 is the Lower Quartile.

The above quartile formula is:

$$Q_1 = \frac{x_{\left(\frac{n-1}{4}\right)} + x_{\left(\frac{n+3}{4}\right)}}{2}$$

$$Q_2 = x_{\left(\frac{2(n+1)}{4}\right)}$$

$$Q_3 = \frac{x_{\left(\frac{3n+1}{4}\right)} + x_{\left(\frac{3n+5}{4}\right)}}{2}$$

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

2.2 Analytic Hierarchy Process (AHP)

Thomas L Saaty developed the Analytic Hierarchy Process (AHP) theory in 1970. AHP is an MCDM method as a structured technique to help the community determine the priority of several criteria by making pairwise comparisons of each criterion. In contrast to other MCDM methods, AHP is a decision support system that decomposes a complex multi-factor problem into a hierarchy, where each level is formed from specific unrelated elements. The main tool of AHP is a functional hierarchy with the main input being human perception. The existence of a hierarchy makes it possible to break down complex or unstructured problems into sub-problems, then arrange them into a hierarchical form. Three basic principles of the AHP process: (Saaty, 1993).

a. Describe and describe a hierarchy called arranging hierarchically, which is to break down the problem into separate elements.

b. Differentiation of priorities and systems, which is called priority setting, which is to determine the level of elements according to their relative importance.

c. Logical consistency, which ensures that all elements are grouped logically and ranked consistently according to a logical criterion.

2.2.1 Pairwise Comparison

Pairwise comparison based on the judgment of the decision maker by assessing the importance of an element compared to other elements. This comparison value is determined by the quantitative scale proposed by Saaty (1994). This scale starts from 1 to 9. Comparisons are made until a total judgment is obtained of n x [(n-1) / 2] pieces, where n is the number of elements being compared.

Table 1. Scale of Intensity of Importance

Intensity of Importance	Definition
1	Equally important
2	Between equally and moderately important
3	Moderately important
4	Between moderately and strongly important
5	Strongly important
6	Between strongly and very strongly important
7	Very strongly important
8	Between very strongly and extremely important
9	Extremely important

2.2.2 Consistency Ratio (CR)

Consistency deviation is expressed by the equation:

$$CI = \frac{\lambda_{maks} - n}{n-1},$$

where, CI = Consistency Index
λ_{maks} = nilai eigen terbesar

AHP measures the entire consistency of the assessment using the Consistency Ratio (CR), which is formulated as follows:

$$CR = \frac{CI}{Random\ Consistency\ Index}$$

The Random Consistency Index is abbreviated as RI, which is a certain level of consistency that is needed in determining priorities for valid results. The CR value should be no more than 10%. If not, the assessments that have been made may be random and need revision.

n	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
RI	*0,00*	*0,00*	*0,58*	*0,90*	*1,12*	*1,24*	*1,32*	*1,41*	*1,45*	*1,49*	*1,51*	*1,48*	*1,56*

Figure 1. Random Consistency Index (RI)

3. RESULT AND DISCUSSION

3.1 Identification of Criteria and Subcriteria

This stage is carried out by means of brainstorming / interviews with the speakers. The resource persons consisted of experts from 1) Operations Staff; 2) Planning Staff and 3) Logistics Staff. The result of this stage is the identification of the initial criteria and sub-criteria in determining the type of warship which are as follows:

a. Task Operation. It is a series of operational activities carried out by units of the Indonesian Navy independently or jointly within a certain time bound to the objectives and plans to achieve strategic and tactical objectives.

Table 2. Subcriteria of Marine Operation

No	Subcriteria	Description
1.	Marine Combat Operation	Marine combat operations are carried out in the waters of the national jurisdiction of the Koarmada working area by presenting elements of the warship and air caraft in order to anticipate any form of threat to sovereignty in the national jurisdiction.
2.	Limited Security Operations	Operations to secure the borders of the sea and air territories directly bordering with neighboring countries to free and defend against any attempts by foreign parties to carry out violations of sovereignty and law in the territorial sea borders of Indonesia with neighboring countries.
3.	Security Operation Of Sea Lines	Operations to secure areas in the Indonesian Archipelago Shipping Lanes in the context of enforcing state sovereignty and implementing Sea lines

		rules in sea and air territory
4.	Coordinating Patrol Ausindo	It is an MOOTW with the aim of securing the border area to ensure the upholding of state sovereignty in the maritime border area with other countries and the outer islands and remote islands from all forms of threats and violations, preventing the exploitation of natural resources and territorial violations by parties. foreigners in the sea border area. In its implementation, it can be carried out in a coordinated manner with the Navy of neighboring countries in the form of coordinated patrols

b. Exercise. It is an activity that is repeated systematically in practice to acquire maximum proficiency and skills

Table 3. Subcriteria Of Exercise

No	Subcriteria	Description
1.	Matra Exercise	The implementation of training carried out by the Indonesian Navy which includes inter main command, unit, or special training in the marine environment in order to improve and / or maintain operational readiness
2.	Joint Exercise	Joint Training of the Indonesian Navy is a form of collaborative training carried out by involving the Indonesian Navy together with one or more other national navies
3.	Combined Exercises	The Joint Training is an exercise in the context of combat operations assisted by other operations as needed, is part of the defense operation pattern which is carried out pre-emptively, preventively or repressively by two or more forces under a joint command.

c. Base Support. The base's ability to carry out its function in providing optimal support for the smooth operation of other Integrated Fleet Weapon System components, both ships, aircraft and Marines. The form of support in question is in the form of both sea and air landing facilities, maintenance and repair facilities, provisioning facilities, personnel maintenance facilities and base development facilities.

Tabel 4. Subcriteria of Base Support

No	Subcriteria	Description
1.	Berth Facilities	The base's ability to provide a dock for warship
2.	Maintenace and Repair Facilities	The base's ability to carry out maintenance and

		repairs on both its sewaco and platform
3.	Provisioning Facilities	The base's ability to provide support for class I to class X supplies to warships
4.	Personnel Care Facilities	The base's ability to support personnel maintenance activities, includes: mess facilities, health facilities / rumkit, sports and recreation facilities, worship facilities, training facilities for all types of warships at least one task force
5.	Base Development Facilities	The base's ability to provide public facilities, transportation facilities

d. Special. Relates to special matters.

Table 5. Subcriteria of Special

No	Subcriteria	Description
No	Subcriteria	Deskripsi
1.	Detterence Effect	The value of the deterrence effect on the presence of warship when carrying out marines' operations
2.	Geographical	This criterion is related to the ability of warship in relation to the geographical conditions of the sea in fleet Comando III

3.2 Alternative Types of Warships

Alternative selection of the types of warships used in this study are the types of warships currently owned by Koarmada II, namely:

a. Combatant Ships.
b. Amphibious Ship.
c. Fast Ship.
d. Auxiliary Ship.
e. Mine Ships.
f. Submarines.

3.3 Determination of Criteria and Subcriteria

Determination of criteria and sub-criteria that affect the selection of warships is carried out using the Delphi method. This study involved three experts. Obtaining expert consensus on the criteria and sub-criteria in this study was carried out in two rounds. Because the results of the 2nd round Delphi questionnaire are not much different from the results of the 1st round Delphi questionnaire because the experts tend not to change their assessments. In Table 6, the results of the assessment of the level of importance of the criteria and sub criteria in the second round are presented.

Table 6. Results of the second round Delphi questionnaire

No	Criteria	Sub Criteria	Expert				Avg.	Std. Dev	Modus	Q1	Q2	Q3	IR	Evaulation	
			I	II	III	IV								Std.Dev	IR
1	Task Operation	Marine combat operations	5	5	4	3	4.25	0.957	5	3.8	4.5	5	1.25	Kon	Kon
		Limited Security Operations	4	5	5	3	4.25	0.957	5	3.8	4.5	5	1.25	Kon	Kon
		ALKI security operations	5	5	5	2	4.25	1.5	5	4.3	5	5	0.75	Kon	Kon
		Ausindo coordinating patrols	5	5	5	3	4.5	1	5	4.5	5	5	0.5	Kon	Kon
2	Exercise	Matra Exercise	5	5	5	4	4.75	0.5	5	4.8	5	5	0.25	Kon	Kon
		Joint Exercise	5	5	4	4	4.5	0.577	5	4	4.5	5	1	Kon	Kon
		Combined Exercise	5	5	5	4	4.75	0.5	5	4.8	5	5	0.25	Kon	Kon
3	Base Support	Berthing facilities	5	5	4	5	4.75	0.5	5	4.8	5	5	0.25	Kon	Kon
		Repairing facilities	5	5	5	5	5	0	5	5	5	5	0	Kon	Kon
		Provisioning Facilities	5	5	5	5	5	0	5	5	5	5	0	Kon	Kon
		Personnel care facilities	2	1	2	5	2.5	1.732	2	1.8	2	2.75	1	**Div**	Kon
		Base Development	2	2	0	5	2.25	2.061	2	1.5	2	2.75	1.25	**Div**	Kon
4	Special	Detterence Efect	5	4	5	4	4.5	0.577	5	4	4.5	5	1	Kon	Kon
		Geographical	5	5	5	3	4.5	1	5	4.5	5	5	0.5	Kon	Kon

Based on table 3.5 above, it can be seen that there are 4 consensus criteria and 12 sub-criteria. Only 2 sub-criteria were not consensus, namely Personnel care facilities and Base Development sub-criteria.

Because the 2 sub-criteria have a standard deviation value > 1.5. So that the result of the second round of opinion withdrawals, which results from the evaulation of standard deviation and quartile coverage, is that the consensus will be used as the basis for building the AHP hierarchical structure in determining the type of warship.

3.4 Determine Criteria and Subcriteria Weights

3.4.1 Hierarchy Structure

The complete AHP model is shown in Figure 3.2. The goal to determine the type of Warship is seen on the left and the decision alternatives are located at the right. Between the goal and the decision alternatives lie the criteria and subcriteria.

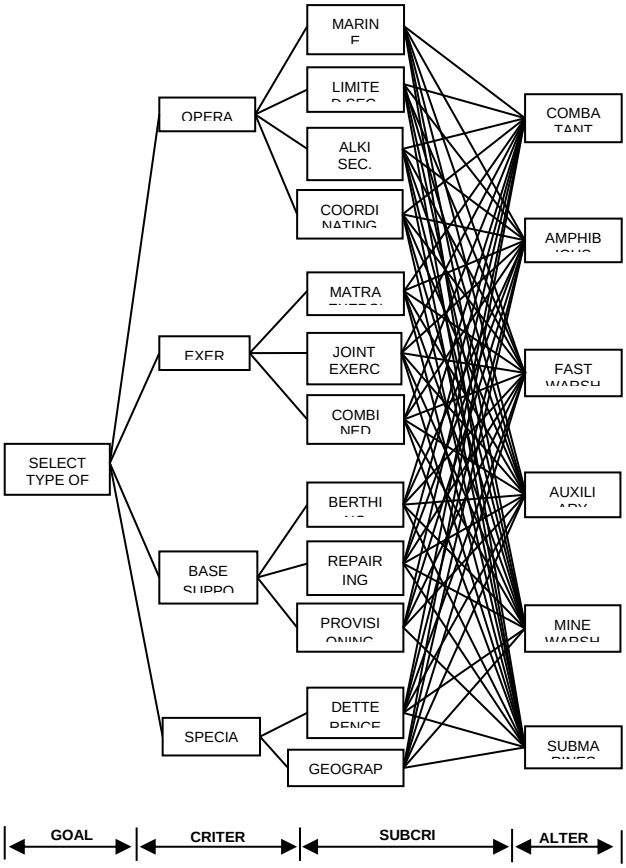

Figure 2. Hierarchy structure of determining the type of warship

3.4.2 Pairwise Comparison

Pairwise comparisons were carried out on 12 sub-criteria in each of the criteria for operation, exercise, base support and special. Pairwise comparisons were carried out with the help of the Exspert Choice V11 software. With this software allows a relatively fast calculation time. Furthermore, a pairwise comparison calculation process against the criteria and sub-criteria is shown in Figure 3 below.

Figure 3. Pairwise Comparison

3.4.3 Consistency Ratio

With the Exspert Choice V11 software, the Consistency Ratio value can be seen when inputting pairwise comparison data. So that the incontency value can be found easily if more than 10%. Furthermore, one of the Consistency Ratio values is shown in Figure 4 below.

Figure 4. Consistency Ratio

3.4.4 Weighted Value of Criteria and Subcriteria

By using the AHP method, the weight value is obtained for each of the criteria and sub-criteria in selecting the type of warship. The results of weighting the criteria and sub criteria are shown in Figure 5.

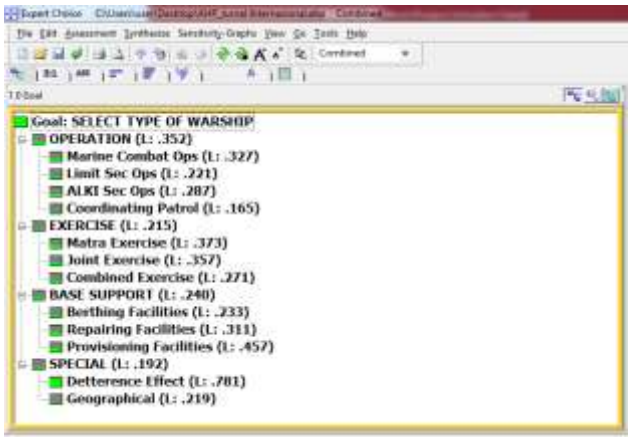

Figure 5. Weight Value

3.4.5 Determination of Alternative Priorities

Data processing using Expert Choice software which can manage the relationship between criteria, between sub-criteria or between alternatives provides the final calculation result in the form of a ranking value of the priority of each alternative to determine the type of warship.

Figure 6. Weighted Value of Alternatives

From the picture above, it can be seen that the alternative priorities are based on the weight value of each criterion. The alternative priority ranking is in accordance with the table below.

Table 7. Priority Ranking for Types of Warship

Rank	Type of Warship	Weight
1	Combatant warship	0.299
2	Fast warship	0.184
3	amphibious warship	0.154
4	auxiliary warship	0.131
5	mine warship	0.119
6	submarines	0.144

3.4.6 Sensitivity Analysis

The priority weight obtained from the results of the assessment data processing is highly dependent on the hierarchical structure developed and on the relative pairwise comparation given from various problem elements. Changes in the hierarchy or ratings can change the weighted priority generated.

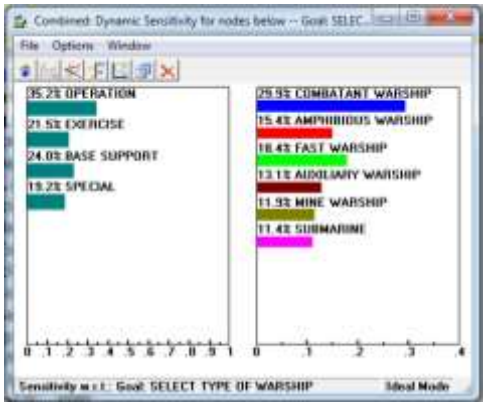

Figure 7. Initial Performance of Criteria Againts Priority Order

Priority order Figure 7. Above shows the performance/ sensitivity for each of the criteria considered in determining the pririty of a warship with an initial operating criterion weight of 35.2 %, exercise criteria 21.5 %, base support criteria 24.0 % and special criteria 19.2 %. Figure 3.8 shows the performance after changing the weight of the special criteria specifically for 25 %, which thwn affects the order of priority of warship types.

Figure 8. Criteria performance against priority order after weight change

The study of the two images above shows that the shift in priority order will only occur in the order of Submarines and Mine warships. Meanwhile, Combatant warship, Fast warship, Amphibious warship and Auxiliary warship are still in the order they were started.

4. CONCLUSION

The study succeeded in obtaining a consensus of significant criteria and sub-criteria in the process of selecting the appropriate type of warship. A total of four criteria and 12 sub-criteria have been validated by the expert group to be used in making decisions about choosing the type of warship. These criteria are Operations (marine combat operations, limited security operations, sea-line operations, coordination patrols), Exercises (field training, joint training, joint training), Support bases (berthing facilities, repair facilities, supply facilities), Special (prevention, geographical). Operational criteria are the top priority in determining the type of warship, the next priority is base support, training and special. Based on the AHP results, the type of warship is recommended as the top priority.

ACKNOWLEDGEMENTS

The authors greatly acknowledge the support from Naval Technology College, STTAL Surabaya Indonesia for providing the necessary resources to carry out this research work. The authors are also grateful to the anonymous reviewers and journal editorial board for their many insightful comments, which have significantly improved this article.

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