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DETERMINATION OF MAINTENANCE FACILITY LOCATIONS AND IMPROVEMENTS TO SUPPORT THE OPERATION OF INDONESIAN NAVY IN NORTH NATUNA SEA BY THE FUZZY MCDM METHODS

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ABSTRACT

Support the presence of the KRI elements it needs other supporting means such as Fasharkan (Maintenance and repair facilities) that serve as a supporter of logistics, especially repair and maintenance of KRI. The closest area of Fasharkan from the Sea of North Natuna today is Fasharkan Mentigi Lantamal IV Tanjung Pinang is approximately 510 Nm surely will be an obstacle when the presence of the KRI element in the North Natuna Sea operating area is shaken because The distance of Fasharkan from the distant waters of North Natuna to carry out maintenance and repair. So it is necessary to one more location of Fasharkan to support the operation of the KRI elements in the territorial waters of North Natuna so that the operation of the KRI elements can be carried out well.In the selection of Fasharkan location has several factors that must be considered so that categorized have multicriteria in the election. So to accommodate Multicriteria divided into Technical Requirements & Operational Requirements Then use the Fuzzy method MCDM (Multi-Criteria Decision Maker). Technical Requirement consisting of earthquake hazard, distance field operations (distance operations and ALKI 1), distance downtown (the distance of the center of the government and the settlement), and hydrography (depth, tidal, and speed of currents). While the Operational Requirement consists of the influence of other countries, threats (outside state threat and community conflicts), access transportation (military port and airport), supporting facilities (water facility, communication facilities, Electric facilities, transport facilities and sea flows), as well as operational costs. For the alternative location of Fasharkan consists of Lantamal XII Pontianak, Ranai Navy Base, and Tarempa Navy Base. Of the three alternative locations obtained the best alternative to the location of Fasharkan is Ranai Navy Base with the highest rank of 0.403 then Lantamal XII Pontianak with a value of 0.302 and Tarempa Navy base with a value of 0.295.

Keywords: Sea of North Natuna, Fasharkan, determination of the type of Fasharkan, determining the location of the Fasharkan, Fuzzy MCDM.

1. INTRODUCTION

1.1 The Background of the Study

Maintenance and repair facilities (Fasharkan) are part of the Indonesian Navy which has the duty and responsibility to provide material maintenance services, ship repair and manufacture of PC-class KRI (Patrol Craft) whose ship buildings are made of fiber or iron plates, the existence of Fasharkan is very much needed to support the maintenance and repair of KRI. According to SKEP KASAL number Kep / 1771 / XII / 2013 concerning the standardization administration manual of the Navy base (PUM-7.03) that a Main Navy base (Lantamal) must have Fasharkan class A whose ability is to be able to carry out maintenance and repairs up to the level of depo for all types of KRI, both ship building, ship machining, ship electricity, sewaco and ship weaponry.

Therefore, to support the readiness of KRI elements in the North Natuna Sea, it is necessary to have Fasharkan, which functions as a logistical supporter, especially for the improvement and maintenance of the KRI. According to data from the Ship Maintenance and Repair Office KOARMADA 1 the damaged ships and cannot be repaired organically should return to the nearest Fasharkan for the inspection and repair of the KRI ABCD case example which brought liquid logistics to support the KRI carrying out operations in Natuna. Jakarta due to engine damage, this certainly has an impact on the technical readiness of other ships in carrying out operations because the liquid logistics distribution of ships cannot be accommodated by KRI ABCD or Lanal Ranai.

Table 1.1 KRI Data Operating in North Natuna sea 2015

NO	KRI	Docking
1	Abcd	Main Engine (Injektor)
2	Efgh	Propeller
3	Ijkl	AC
4	Mno	Diesel Generator and anchor

Facts and conditions The closest Fasharkan mileage from the North Natuna Sea is Fasharkan Mentigi Lantamal IV Tanjung pinang about 510 Nm will certainly be an obstacle if the presence of KRI in the North Natuna sea operating area is disturbed because Fasharkan's distance from the North Natuna sea is far to carry out maintenance and repairs. So it is felt that one more Fasharkan location is needed to support the operation of KRI in the North Natuna sea so that the operation of KRI can be carried out properly. These policies and facts form the basis of policies that support the importance of Fasharkan development in the operational area around the northern Natuna Sea.

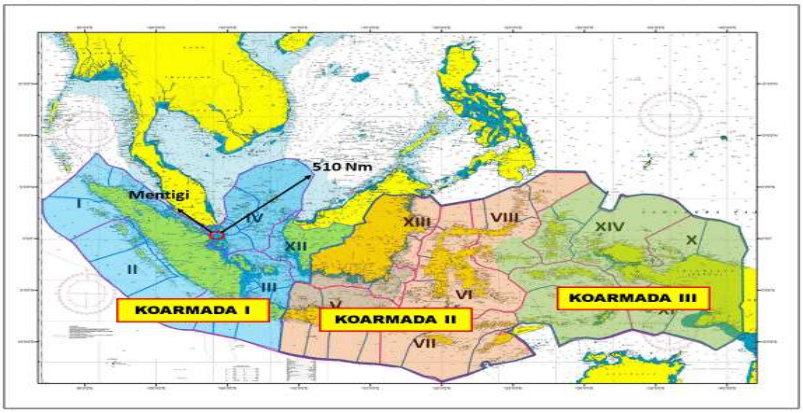

Figure 1.1 The working area

This final project research is expected to help provide advice and input to the leaders of the Indonesian Navy in choosing alternative locations for maintenance and repair facilities (Fasharkan) which will later be used to support KRI and other alusista operations in the North Natuna sea.

In this final project research, the author will determine the class or type of fasharkan that is used based on the highest wave height data in 2016,2017,2018 in North Natuna Sea and what kind of KRI criteria can carry out operations in North Natuna waters so that fasharkan has chosen can carry out its main tasks.

Furthermore, in the selection of an alternative, will be selected the best alternative / Mutually Exclusive will be chosen so that the chosen alternative can provide maximum benefits. Where the alternative choice of Fasharkan location in the North Natuna sea is Lanal Ranai Natuna islands, Lanal Tarempa Anambas Islands, and Lantamal XII Pontianak based on the distance of the base to the ability of KRI coverage areas operating in the North Natuna Sea, base capability and transportation access. This location determination process takes into account qualitative criteria namely safety, transportation access and supporting factors Fasharkan itself and criteria for quantitatively considering the distance to the operating area, distance to the city center, hydrographic conditions and earthquake natural disaster factors.

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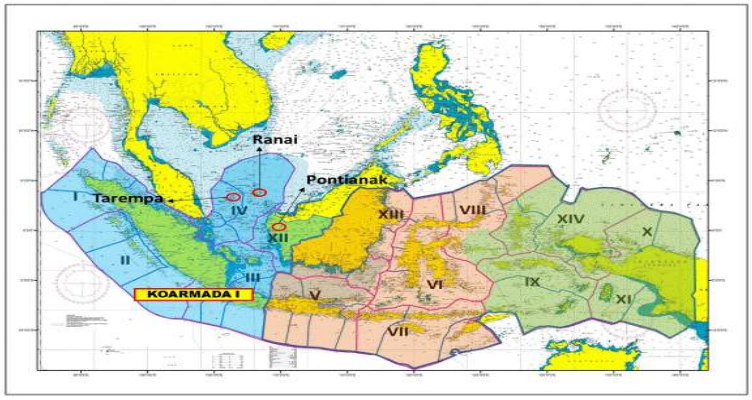

Figure 1.2 The Alternative location of Fasharkan

Research on the location model has been carried out by previous researchers including the selection of the Mentawai Navy base location with the Borda method and the promethee method by Buyung Kurniawan (2015) with the results of the first order location being in Semebai Bay. Dodi Priyanggo (2016) in his research determined the alternative location of OMSP aid warehouse for natural disaster emergency response using the Set Covering and ANP method with the results of the analysis using priority weights with the highest weight of 0.237 located in the district of central Cilacap. Ali Nurul Jamil (2016) in his research on location determination and design of Arsenal warehouse facilities using the Fuzzy MCDM method and Systematic Layout Planing in the Koarmada I area with the results of Jakarta's Lantamal III being the best alternative with a value of 0.218

Decision support systems that are often used today usually use quantitative data so that they can deal with structured problems with definite data. But in reality on the ground, it is not uncommon to find qualitative data and contain elements of uncertainty. Uncertainty data like this are not appropriate to be used as a reference in decision making. So to overcome this we can use the concept of fuzzy logic. This is because the concept of fuzzy logic has a tolerance for inaccurate or uncertain data. In addition, in fuzzy logic data obtained in the field can be classified into qualitative data (Liang & Wang 1999)

Fuzzy concept itself has been widely used as a model for building a decision support system, one of them is Fuzzy Multi Criteria Decision Making (FMCDM). In several studies stated that, MCDM is a method that refers to the process of screening, prioritizing, ranking, or choosing an alternative set. MCDM is very appropriate to be implemented in a multi-criteria case with all alternatives weighing criteria in nominal terms. But for the problem of determining the location of Fasharkan, not all alternatives have nominal weight criteria, for example security factors, transportation access, supporting facilities, etc. So to overcome this, the concept of Fuzzy is used for Multy Criteria Decision Making and is called Fuzzy MCDM which is considered very appropriate for the problem of criteria weighting that is uncertain (fuzzy) in his research.

Based on the case, in this thesis the author will solve the problem using the Fuzzy MCDM method as a model that is applied in order to obtain priority values in the design of a decision support system to determine the Fasharkan location which will be used to support KRI operations in North Natuna Sea with pay attention to several criteria including Technical requirements and Operational requirements. In addition, the Fuzzy MCDM method will overcome the multi-criteria problem in the process of determining this Fasharkan location and overcome the possibility of data that is qualitative in nature or contains uncertain elements.

1.2. Formulation of the problem

Based on the background of study that has been submitted, the problem statement or problem that can be raised is how to determine the location of maintenance and repair facilities to support the Navy's operations in the North Natuna Sea. Based on the problem statement, several Research Questions / research questions were prepared, such as:

a. How to identify the Fasharkan criteria in North Natuna sea.
b. How to determine the best alternative Fasharkan location to support KRI operations in the North Natuna sea.

1.3. Objective of the Study

After determining the background of the study which is then described in the formulation of the problem, the objectives of this Final Project are determined. The purpose of this study are as follows:

a. Formulating criteria and modeling the Fuzzy Multy Criteria Decision Making (MCDM) approach to obtain Fasharkan locations based on predetermined criteria.
b. Determine the location of alternative Fasharkan the best of the alternatives available around the North Natuna sea based on existing criteria with the Fuzzy Multy Criteria Decision Making (MCDM) method.

1.4. Significance of the Study

a. For Practitioners. Get the optimal type and alternative location options to get the Fasharkan location in the area around the North Natuna sea.
b. For Organizations. Provide input to the leaders of Indonesian navy in building the MEF's strength in the field of logistics supplies in the context of selecting the best Fasharkan location in the area around the North Natuna sea.

1.5. Scope and Limitation

In solving the problem so that it does not deviate from the objectives to be achieved and the problem is easily understood, the author only discusses the alternative locations available at the nearest Koarmada I Naval

Base located in the North Natuna Sea operational area, namely Lantamal XII Pontianak, Lanal Ranai and Lanal Tarempa, which has the most possible criteria for the conditions of carrying out logistical support in the form of maintenance or repairs.

1.6. Assumption

a. There are no budget and land budget constraints needed to build a Fasharkan site.

b. There is land available at the Navy base or alternative locations

2. LITERATURE REVIEW

2.1 Definition of *Fuzzy*

Fuzzy logic is an appropriate way to map an input space into an output space. The starting point of the modern concept of uncertainty is the paper made by Lotfi A Zadeh in 1965, where Zadeh introduces a theory that has objects from the Fuzzy set that have imprecise limits and membership in the Fuzzy set, and not in the form of true logic (true) or false, but expressed in degrees. This concept is called fuzziness.

Barkeley in 1965. Fuzzy approach has advantages in the results related to human cognitive nature, especially in situations involving concept formation, pattern recognition, and decision making in an environment that is uncertain or unclear in other words Fuzzy approach method Reduces or minimizes results which is vague or uncertain.

2.2 Multiple Criteria Decision Making (MCDM)

MCDM is a sub-discipline of operations research that involves the analysis of a limited number of alternatives, which are explained in terms of evaluating criteria based on the values and preferences of decision makers (Guchhait, 2017). The MCDM method is a useful tool in many economic, manufacturing, material selection, military, construction, etc. issues that specifically play an important role in the field of investment decisions, project evaluation, evaluation of economic benefits, staff appraisal and so on (Gavade, 2014).

In MCDM, the use of conventional optimization methods is generally limited to only one selection criterion, where the selection taken is the choice that best meets the objective function. But the problems faced, especially those that are more practical, are not that simple.

Other advantages of MCDM can include: making decisions more transparent to others, providing means of structuring problems and working through information, providing focus for discussion, and helping people better understand problems from their own and others' perspectives. MCDM has been used at all levels of decision making relating to agriculture and the environment, from farmer level decisions to agricultural policy decision making. Environmental, economic, social and cultural considerations can be traded without changing all steps to the same unit (Dooley, Sheath, & Smeaton, 2005).

MCDM provides an alternative to utilize objective and subjective considerations as a basis for decision making. There are two groups in MCDM, namely the decision-making group based on the selected attribute or often known as the Multiple Attribute Decision Making (MADM) and the group based on the synthesis of the choice attribute or often referred to as Multi-Objective Decision Making (MODM).

Multiple Objective Decision Making (MODM) uses an optimization approach, so to solve it must be sought first mathematical model of the problem to be solved. Then only maximized or minimized according to the mathematical model that has been obtained. Whereas the Multiple Attribute Decision Making (MADM) uses a selection approach by first determining the quantitative and qualitative attributes of the components to be selected.

3. RESEARCH METHODS

3.1 Quantitative Research Approach

Based on the focus and purpose of the study, the research approach used in this evaluation research is to use a quantitative approach, because this study is presented with numbers. This is in accordance with the opinion of (Arikunto, 2006) opinion that suggests quantitative research is a research approach that is widely demanded to reveal numbers, starting from data collection, interpretation of the data, and the appearance of the results.

In this study describes the stages of data collection, including: tests, questionnaires, interviews, observations, diaries, journals and so forth. In the quantitative method used closed tests and questionnaires in collecting, analyzing and interpreting data.

3.2 Data Sources, Subjects, and Research Objects

3.2.1 Data sources

Primary data sourced from interviews and questionnaires from 4 (four) selected experts namely from KOARMADA 1. The

experts provide an information that will be used as the main data source in the initial stages of research development.

In addition there are also several secondary data sources derived from books, journals, planning policies (Jakren), and a compilation of regulations related to research.

3.2.2 Research subject

The research subjects are people or objects that are observed with certain characteristics to be studied then a conclusion can be obtained from the learning process (Sugiyono, 2014). The subjects of this study were selected according to the needs of the Indonesian Navy which is the site of the study, including: main naval base and Armada I.

Table 3.1 Research Subject Plans

NO	RESPONDENT EXPERT	UNIT	TOTAL
1	SOPS ARMADA1	KOARMADA 1	1
2	SLOG ARMADA 1	KOARMADA 1	1
3	DISHARKAP ARMADA 1	KOARMADA 1	1
4	KRI COMMANDER	KOARMADA 1	1

3.2.3 Object of research

The object of research is everything that is the core of the formulation of the problem in research (Sugiyono, 2014). The objects in this study are alternative locations in determining Fasharkan to support operations

in North Natuna sea, 3 alternative locations are:

a. Lantamal XII Pontianak
b. Lanal Ranai
c. Lanal Tarempa

3.3 Research Flow Chart

The flow chart in this study is shown in Figure 3.2

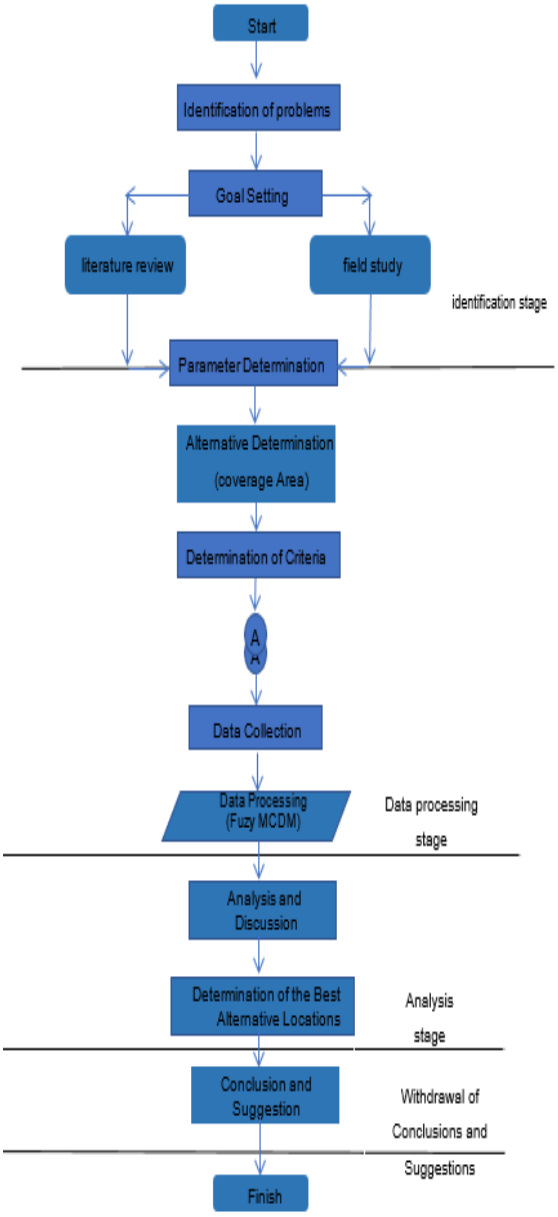

Figure 3.1 *Research Flow Chart*

4. ANALYSIS AND DISCUSSION

4.1 Data Processing

1. create a table of criteria level assessment results.

Labeling the results of weighting there are two scales in the assessment of the linguistic scale and numerical scale. Linguistic scale is divided into 5 levels of assessment, namely "very low", "low", "medium", "high" and "very high", while the assessment for numerical scale is between 1-10. In

table 4.1 shows the results of the recapitulation of questionnaire and respondent data for the level of importance of operational requirements or qualitative criteria and the results of the questionnaire for each alternative based on quantitative criteria.

Table 4.1 Recapitulation of Expert Data Values for Criteria Level

NO	CRITERIA	SUB CRITERIA	EXPERT 1	EXPERT 2	EXPERT 3	EXPERT 4
			N	N	N	N
	Operational Requirement					
1	effect on other countries		7	7	7	6
2	Security	safe from enemies	8	8	7	8
		free of social conflict	7	7	7	8
3	Transportation access	military port	7	8	8	10
		Airport	7	7	8	8
4	Supporting facilities	communication	8	8	10	9
		electricity	9	8	8	10
		water	8	8	8	10
		transport	7	8	8	10
5	Operating costs		7	7	7	8
NO	**CRITERIA**	**SUB CRITERIA**	**EXPERT 1**	**EXPERT 2**	**EXPERT 3**	**EXPERT 4**
			N	N	N	N
	Technical Requirement					
1	Operating field distance	ALKI 1	7	7	8	8
		LCS	9	8	8	8
2	City center distance	City center	6	6	6	5
		settlement	5	6	6	5
3	Hydrography	The depth of the sea	9	8	8	8
		tidal	9	8	8	8
		Flow Speed	9	8	9	8
4	Earthquake threat		8	8	8	8

2. Label the results of alternative rating ratings.

Labeling the results of alternative rating ratings can be seen in table 4.2 with the same scale as the evaluation criteria namely linguistic scale and numerical scale.

Table 4.2 Expert Data Recapitulation for Alternative Assessments
Source : Expert Data Collection

NO	CRITERIA SUB CRITERIA	ALTERNATIVE	EXPERT 1	EXPERT 2	EXPERT 3	EXPERT 4
			N	N	N	N
1	influence on other	LANT XII	6	6	6	3
		LAN RANAI	**8**	**8**	**8**	**6**

	countries		LAN TAREMPA	**7**	**7**	**7**	**6**
2	Security	Safe From Enemies	LANT XII	8	8	8	7
			LAN RANAI	7	9	8	5
			LAN TAREMPA	6	7	7	3
		without conflict	LANT XII	8	7	7	3
			LAN RANAI	8	8	8	7
			LAN TAREMPA	7	8	8	7
3	Transportation Access	military port	LANT XII	7	7	7	7
			LAN RANAI	6	6	6	6
			LAN TAREMPA	5	4	5	3
		Airport	LANT XII	7	7	7	8
			LAN RANAI	6	7	7	8
			LAN TAREMPA	5	5	4	3
4	Supporting facilities	communication	LANT XII	8	8	8	8
			LAN RANAI	6	6	6	5
			LAN TAREMPA	5	5	5	3
		electricity	LANT XII	7	8	8	8
			LAN RANAI	6	7	7	5
			LAN TAREMPA	5	6	6	3
		water	LANT XII	8	8	8	8
			LAN RANAI	7	7	7	5
			LAN TAREMPA	6	4	4	3
		transport	LANT XII	8	8	8	8
			LAN RANAI	6	6	6	5
			LAN TAREMPA	6	4	4	3
		Sea channel	LANT XII	6	6	5	5
			LAN RANAI	8	8	8	8
			LAN TAREMPA	7	7	7	7
5	Operating costs		LANT XII	5	6	7	6
			LAN RANAI	7	8	8	8
			LAN TAREMPA	7	7	6	7

3. Determine the middle value of a fuzzy number.

Fuzzy middle numbers are numbers obtained from the sum of the values that appear at each level of the linguistic scale divided by the number of scales by formula (3.1). The calculation results are then used to make TFN.

4. Determine the lower, middle and top boundary values.

a. Medium linguistic level: for the lower value c_t = 1 (as the lowest limit), the middle limit: $a_t = \frac{6+5}{2}$ = 5,5 (c_t level above), b_t = a_t he level above it..

b. High linguistic level: value c_t = 6 (a_t low level), $a_t = \frac{7+7+7+7+7+7+8+8+8+8}{11}$= 7,36 ($b_t$ medium level and ct level very high) dan b_t = a_t very high level.

c. Very high level: ct = at high level, $a_t = \frac{9(5)+10(1)}{6}$ = 9,16 and bt = 10. Calculation of experts 2, 3 and 4 using Microsoft Excel.

NO	LEVEL	EX 1			EX 2			EX 3			EX 4		
	LINGUISTICS	qit	oit	pit	qit	oit	pit	qit	oit	pit	qit	oit	pit
1	VERY LOW												
2	LOW												
3	MEDIUM	1.0	5.50	7.4	1.0	6.0	7.7	1.0	6.0	7.2	1	5.3	8
4	HIGH	5.5	7.4	9.2	6.0	7.7	9.0	6.0	7.2	9.0	5.3	8.0	9.8
5	VERY HIGH	7.4	9.2	10.0	7.7	9	10	7.2	9	10	8.0	9.8	10.0

Table 4.6 TFN Expert for assessing location criteria
Source: Data Processing

Table 4.7 TFN Expert for alternative assessments
Source: Data Processing

NO	LEVEL	EX 1			EX 2			EX 3			EX 4		
	LINGUISTICS	qit	oit	pit	qit	oit	pit	qit	oit	pit	qit	oit	pit
1	VERY LOW												
2	LOW				1	4	5.7	1	4	5.6	1	3	5.4
3	MEDIUM	1	5.6	7.4	4.0	5.7	7.5	4.0	5.6	7.5	3	5.4	7.5
4	HIGH	5.6	7.4	10.0	5.7	7.5	9.0	5.6	7.5	10.0	5.4	7.5	10.0
5	VERY HIGH				7.5	9.0	10.0						

5. Determine the aggregate weights of each operational requirement criterion..

Respondents evaluate each selection criteria by using a linguistic scale to get the level of weight for the benefit of the criteria. Expert weight values for krteria on the linguistic scale shown in table 4.1 are then evaluated against TFN experts for criteria evaluation (table 4.6).

Then the calculation will get the aggregate weights for each operational requirement criterion, which will be used in defuzzification. The results of the average Aggregate Weight for the sake of operational requirements are shown in the following table:

Table 4.8 The aggregate weights of operational requirements

NO	CRITERIA	AVERAGE VALUE		
		ct	at	bt
1	INFLUENCE ON OTHER COUNTRIES	4.625	6.900	8.790
2	SAFE FROM ENEMIES	5.700	7.575	9.240
3	WITHOUT COMMUNITY CONFLICT	5.700	7.575	9.240
4	MILITARY PORT	6.375	8.025	9.290
5	AIRPORT	5.700	7.575	9.240
6	COMMUNICATION SUPPORT	6.675	8.475	9.540
7	ELECTRICITY SUPPORT	6.850	8.500	9.500
8	WATER SUPPORT	6.375	8.025	9.290
9	TRANSPORT	6.375	8.025	9.290
10	SEA CHANNEL	7.000	8.800	9.950
11	OPERATING COST	5.700	7.575	9.240

6. Calculate the preference value of each alternative based on operational requirements criteria

To calculate the preference value of each alternative based on operational requirements criteria, an aggregate weight calculation is performed for each alternative for each operational requirement criterion to obtain an alternative preference value in the table as follows:

Tabel 4.9 Value of Alternative Preference

NO	CRITERIA	ALT	RATA RATA			NO	CRITERIA	ALT	AVERAGE		
			Qit	Oit	pit				qit	Oit	pit
1	INFLUENCE ON OTHER COUNTRIES	1	2.500	4.975	6.950	6	COMMUNICATION SUPPORT	1	5.575	7.425	9.750
		2	4.975	6.950	9.125			2	3.000	5.575	7.475
		3	4.975	6.950	9.125			3	2.500	4.975	6.950
2	SAFE FROM ENEMIES	1	5.575	7.475	9.750	7	ELECTRICITY SUPPORT	1	5.575	7.425	9.750
		2	5.425	7.325	9.375			2	3.825	6.500	8.475
		3	3.325	5.900	7.950			3	2.500	4.975	6.950
3	WITHOUT COMMUNITY CONFLICT	1	4.475	6.350	8.600	8	FRESH WATER SUPPORT	1	5.575	7.425	9.750
		2	5.575	7.325	9.750			2	4.975	6.950	9.125
		3	5.575	7.325	9.750			3	1.000	4.150	6.025
4	MILITARY PORT	1	5.575	7.425	9.750	9	TRANSPORT	1	5.575	7.425	9.750
		2	3.000	5.575	7.475			2	3.000	5.575	7.475
		3	1.750	4.550	6.500			3	1.000	4.150	6.025
5	AIRPORT	1	5.575	7.425	9.750	10	SEA CHANNEL	1	3.000	5.575	7.475
		2	4.425	7.025	9.100			2	5.575	7.475	9.750
		3	1.750	4.575	6.475			3	5.575	7.475	9.750
11	OPERATING COST	1	3.400	6.050	8.100						
		2	5.575	7.475	9.750						
		3	5.175	7.000	9.125						

7. Calculate the value of the Fuzzy index from the results of the assessment of each alternative for the Operational Requirements criteria.

By using the existing equation, the Fuzzy Index value is obtained

Table 4.10 Value of Evaluation Formation

ALT	INDEX								
	Yi	Qi	Zi	Ti1	Ti2	Ui1	Ui2	Hi1	Hi2
1	29,34	54,29	80,35	3,82	21.13	3,09	-33.10	2.76	5.35
2	27,03	53,02	78,64	4,04	21.95	2,98	-32.10	2.72	5.39
3	19,04	44.56	68,46	4,43	21.10	2.91	-30.12	2.38	5.18

8. Calculates the utility value of each alternative for the Operational Requirements criteria

Before calculating the utility value, the defuzzification process is done using the centroid method. By using the equation in the calculation using the microsoft mathematic program.

Table 4.11 Defuzzyfication

NO	CRITERIA	DEFUZZYFICATION WEIGHT	DEFUZZYFICATION ALTERNATIVE		
			ALT 1	ALT 2	ALT 3
1	INFLUENCE ON OTHER COUNTRIES	6.771	4.808	7.016	7.016
2	SAFE FROM ENEMIES	7.505	7.600	7.375	5.725
3	WITHOUT COMMUNITY CONFLICT	7.505	6.475	7.600	7.600
4	MILITARY PORT	7.897	7.600	5.350	4.322
5	AIRPORT	7.505	7.600	6.850	4.266
6	COMMUNICATION SUPPORT	8.230	7.600	5.412	4.808
7	ELECTRICITY SUPPORT	8.275	7.600	6.266	4.808
8	FRESH WATER SUPPORT	7.897	6.600	6.798	3.725
9	TRANSPORT	7.897	7.600	5.350	3.725
10	SEA CHANNEL	8.550	5.350	7.600	7.600
11	OPERATING COST	7.505	5.878	7.600	7.100

Table 4.12 Alternative Performance Value

NO	ALTERNATIVE	Gi
1	LANTAMAL 12 PONTIANAK	53,688
2	LANAL RANAI	51,627
3	LANAL TAREMPA	42,737

9. Calculating the ranking value of each alternative based on Operational Requirements criteria.
After all calculations are done, the ranking for alternatives based on operational requirements is as follows:

Table 4.13 Utility forming index

NO	ALTERNATIVE	Gi
1	LANTAMAL XII PONTIANAK	1.040
2	LANAL RANAI	0.974
3	LANAL TAREMPA	0.870

Table 4.14 Alternative ranking on operational requirements criteria

NO	*ALTERNATIF*	*STi*
1	LANTAMAL XII PONTIANAK	0,360
2	LANAL RANAI	0,338
3	LANAL TAREMPA	0,302

From the ranking based on the Operation Requirement criteria above, it can be seen that from the three alternative locations for fasharkan development in order to support the Indonesian Navy operations in the North Natuna Sea, the first alternative is Pontianak Lantamal XII the best choice with a value of **0.360**

10. Calculating alternative ranking values based on the Technical Requirements criteria
The calculation on this criterion is the same as the calculation on the operational requirements criterion and an aggregate weighting is obtained

Table 4.15 Aggregate technical requirements

NO	CRITERIA	AVERAGE WEIGHTED		
		ct	At	Bt
1	DISTANCE OPS-ALKI1	5.7	7.6	9.24
2	DISTANCE OPS-LCS	6.2	8	9.45
3	GOVERNMENT CENTER	1	5.7	7.58
4	SETTLEMENT DISTANCE	1	5.7	7.58
5	SEA DEPTH	6.1	8	9.45
6	SEA CURRENT SPEED	6.5	8.6	9.7
7	TIDAL	6.1	8.	9.45
8	EARTHQUAKE THREATS	5.7	7.6	9.24

From the table of aggregate weights of the Technical Requirements criteria above, the defuzzification method is done using the centroid method. The defuzzification results are obtained for the Technical Requirements criteria in the following table, then unit normalization is performed.

Tabel 4.16 *Defuzzyficaton* Technical requirement

NO	CRITERIA	CRITERIA WEIGHT	
1	DISTANCE OPS-ALKI1	7.505	0.133
2	DISTANCE OPS-LCS	7.883	0.139
3	GOVERNMENT CENTER	4.758	0.084
4	SETTLEMENT DISTANCE	4.758	0.084
5	SEA DEPTH	7.811	0.138
6	SEA CURRENT SPEED	8.490	0.150
7	TIDAL	7.811	0.138
8	EARTHQUAKE THREATS	7.505	0.133

The weights of the Technical Requirements criteria above are then multiplied by the alternative Technical Requirement data of the Fasharkan location.

Table 4.17 Recapitulation of Technical requirements data weighting

CRITERIA	CRITERIA WEIGHT	ALTERNATIVE			TOTAL VALUE
		ALT 1	ALT 2	ALT 3	
DISTANCE OPS-ALKI1	**0.132**	135.000	32.000	110.000	277
DISTANCE OPS-LCS	**0.141**	350	220	320	890
GOVERNMENT CENTER	**0.084**	5	65	2	72
SETTLEMENT DISTANCE	**0.084**	55.000	500	50	605
SEA DEPTH	**0.145**	4	12	11	27
SEA CURRENT SPEED	**0.141**	50	119	72	241
TIDAL	**0.141**	0.400	0.400	0.200	1
EARTHQUAKE THREATS	**0.132**	25	5.	5	35

		NORMALIZATION OF UNITS			
DISTANCE OPS-ALKI1	**0.132**	0.513	0.884	0.603	2.000
DISTANCE OPS-LCS	**0.141**	0.607	0.753	0.640	2.000
GOVERNMENT CENTER	**0.084**	0.067	0.905	0.028	1.000
SETTLEMENT DISTANCE	**0.084**	0.091	0.826	0.083	1.000
SEA DEPTH	**0.145**	0.148	0.444	0.407	1.000
SEA CURRENT SPEED	**0.141**	0.793	0.506	0.701	2.000
TIDAL	**0.141**	0.400	0.400	0.200	1.000
EARTHQUAKE THREATS	**0.132**	0.286	0.857	0.857	2.000
		NORMALIZATION OF UNITS			
DISTANCE OPS-ALKI1	**0.132**	0.256	0.442	0.301	1.000
DISTANCE OPS-LCS	**0.141**	0.303	0.376	0.320	1.000
GOVERNMENT CENTER	**0.084**	0.067	0.905	0.028	1.000
SETTLEMENT DISTANCE	**0.084**	0.091	0.826	0.083	1.000
SEA DEPTH	**0.145**	0.148	0.444	0.407	1.000
SEA CURRENT SPEED	**0.141**	0.396	0.253	0.351	1.000
TIDAL	**0.141**	0.400	0.400	0.200	1.000
EARTHQUAKE THREATS	**0.132**	0.143	0.429	0.429	1.000
	1.000	0.244	0.468	0.288	1.000

The data above uses a variety of units so it is needed for unit normalization. Furthermore, by using equation (3.27) ranking values can be calculated for the Technical Requirements criteria..

Tabel 4.18 Alternative ranking on the technical requirements criteria

NO	ALTERNATIVE	Otj
1	LANTAMAL XII PONTIANAK	0.244
2	LANAL RANAI	0.468
3	LANAL TAREMPA	0.288

Based on the Technical Requirements criteria in the table above it can be seen that of the three alternatives, the second alternative, **Lanal Ranai** has the highest ranking value with a ranking value of **0.469.**

11. Calculate the total (final) ranking value of each alternative for the Operational Requirements and Technical Requirements criteria.

With equation (3.28) the total ranking can be calculated for the best alternative, it can be calculated:

$$FT_i = \frac{ST_i + OT_i}{\sum Vk} \quad \text{where } \Sigma\, Vk = 2$$

(quantitative and qualitative criteria)

$$= \frac{0{,}360 + 0{,}244}{2}$$

= 0,302 (for alternative 1)

Other alternative calculations using Microsoft Excel, so that the calculation results can be found in the table below.

Tabel 4.19 *Total alternative ranking of locations for determining Fasharkan.*

NO	ALTERNATIVE	Fti	RANK
1	LANTAMAL XII PONTIANAK	0.302	II
2	LANAL RANAI	0.403	I
3	LANAL TAREMPA	0.295	III

12. Choose the best alternative based on the highest ranking value.

From table 4.27 above, it can be seen then choosing the best alternative with the highest total ranking value. The best alternative fasharkan location is the second alternative, **Lanal Ranai** with a total value of **0.403**

5. CONCLUSION AND SUGGESTION

5.1 Conclusion

After carrying out the entire process of carrying out the final project, conclusions can be formulated based on the results of research methods and data processing and analysis, conclusions can be drawn as follows:

a. Based on the results of literature studies and consultations with experts, 19 criteria were obtained, consisting of 11 operational requirements and 8 technical requirements as consideration in determining Fasharkan location to

support the operation of Indonesian Navy in North Natuna Sea..

b. The decision making process for determining the Fasharkan location can be modeled by applying the Fuzzy Multi Criteria Decision Maker model.

c. Proses The decision-making process in determining the location of Fasharkan was carried out by several experts as decision makers namely Kadisfaslanal, Asops KOARMADA I, Aslog KOARMADA I, Kadisharkap KOARMADA I, and Commander of KRI Bung Tomo so that each decision maker will provide a different subjective assessment of the alternative choice locations. there is. Fuzzy algorithm is applied to determining the location of Fasharkan, because it can eliminate the fuzziness or fuzziness of operational requirements criteria data which have high subjectivity values.

d. Based on data processing using the Fuzzy MCDM method, the best location for Fasharkan location placement is Lanal Ranai with the highest total ranking value, 0.403 then Pontianak Lantamal XII with a value of 0.302 and Lanal Tarempa with a value of 0.295

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Note : Because of Confidential, all of data is Simulation only (not real), and purpose educational only for Improving Model.

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