FEASIBILITY ANALYSIS OF NAVAL BASE RELOCATION USING SWOT AND AHP METHOD TO SUPPORT MAIN DUTIES OPERATION

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Naval Base as part of Integrated Fleet Weapon System has an important role in maintaining the strategic environment in the region of Indonesia. Naval Base with a strategic location will support Indonesian Navy's main duty to carry out the administrative and logistical support. Due to the limitation of Naval Base's condition, feasibility study will be required to relocate the Naval Base. In this feasibility study, a combination of methods between SWOT analysis and Analytical Hierarchy Process (AHP) is used. The results of the Internal Factors Evaluation (IFE) Matrix Analysis is 4.72 and External Factors Evaluation (EFE) Matrix Analysis is 2.91. In general, the balance of power between the IFE Matrix and EFE Matrix is located in Quadrants I and thus, the Aggressive Strategy is supported. While the Matrix Analysis' result of Internal - External (IE) showed that the score of IFE and EFE located in Quadrant II and VII.

Key words: *Feasibility Study, Naval Base, SWOT, AHP*

1. INTRODUCTION

Indonesia is a maritime country comprising over 17.000 islands. It is located between the Pacific and Indian Oceans and links Asia land with the Pacific world (1). The geo-strategic of Indonesian is a potential tool to controls several critical path across the oceans in the world (2). Under the changing circumstances of operational environment and in the face of new security environment which is more complex and ambiguous than before, modern armies have started to look for alternatives or better options to surpass the challenge of transition in the new era (3). The prospect of declining budgets

and the changing geostrategic environment had also urged the Navy to change its strategy decision (4).

Therefore, to protect Indonesia's marine territory, Indonesian Navy holds a program to strengthen the defense with The Integrated Fleet Weapon System. That program consists of navy vessel, aircraft, troops (Marines) and Naval Base. As part of Integrated Fleet Weapon System, the Naval Base should be able to carry out its functions optimally to resolve cases of violations in Indonesia's marine territory (5). One of the Indonesian Navy strategic plans in the dynamics of change is to relocate the Naval Base into a better place because the current condition of the Naval Base is still lacking the ability to carry out its duties.

The feasibility study on the relocation of the Naval Base is carried out by doing an investigation the areas and supporting facilities in terms of technical and strategic aspects along with interviewing Indonesian Navy's officer. The technical aspects of a port include Hinterland/ Area of Influence aspect and Geography and Oceanography aspect (6). Geographically, military also considers of militarism perspective and spatial perspective (7). This is because globalization and economic power are worthless without the existence of military (8). A strategic position is an important element for the operation of a concept (9).

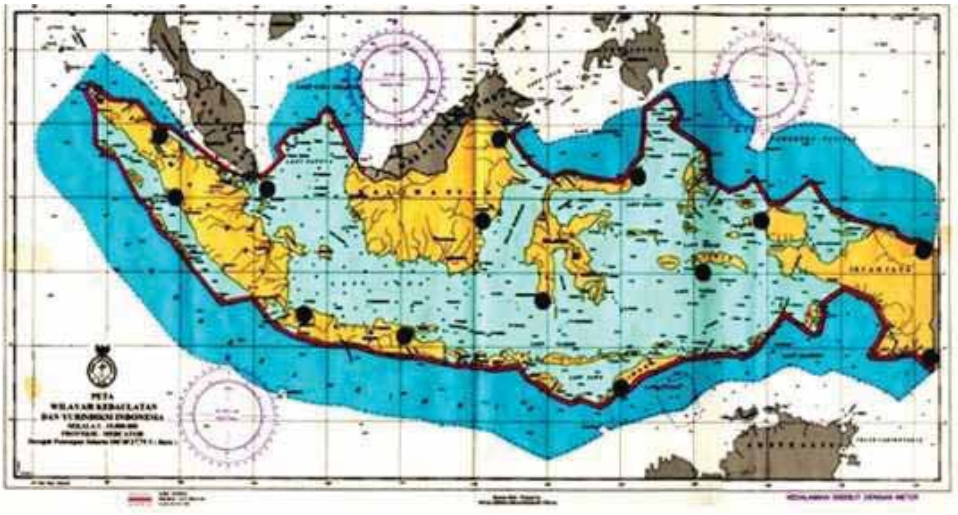

Fig. no. 1. *Map of the Indonesian Naval Main Base*

Strategic Decisions (SD) are made based on the special characteristics of the decision (both the perceived characteristics and typology objectives strategic decisions) which is part of the management leadership characteristics and has contextual factors refer to the external and internal environment (10). The purpose of this feasibility study is to provide a more realistic perspective from key decision makers in decision making process (11). This study is necessary to determine the effectiveness and to manage the risks of some system that will be used (12).

Therefore, this feasibility study to relocate the Naval Base is part of a research operation based on multi-criteria decision making (MCDM). The core of the operations research is to develop approaches for optimal decision making. A prominent class of such problems is multi-criteria decision making (MCDM). The typical MCDM problem deals with the evaluation of alternatives in a set of decision criteria (13). One way MCDM approach is to use a SWOT and AHP analysis. The combined use of the AHP and SWOT analysis has been widely used to support strategic decision- making processes (14).

SWOT analysis is an important part of feasibility study (15). A SWOT analysis is able to identify conditions, potentials, and problems with related aspects which resulted in the decision of a number of factors or variables (16). This combination can efficiently evaluate SWOT sub-criteria and thus give them priority in order to allow decision-makers to determine which of those should be given attention first (17). To obtain the scale ratio from the actual measurement or the fundamental scale that reflects the relative strength, AHP method is used (18). There are some basic principles in resolving the problems with the AHP method, namely Decomposition, Comparative Judgment, Synthesis of Priority, and Logical Consistency (19).

By combining SWOT and AHP analysis stages, the right strategies can be determined for planning the relocation of the Naval Base. Furthermore, this strategic planning can be used as a tool of organization to start and manage their strategic functions of the organization (20). This study is necessary in order for the Naval Base to function optimally and effectively. This study determines the strategic priorities of location and relocation of the Naval Base. It also provides a feasibility study for the development of Naval Base as a guideline in planning other Naval Bases and facilities in future.

Section 2 of this paper laid out the research methodology. The results are discussed in Section 3. Section 4 provides general discussion of the results, while conclusion of the study can be found in Section 5.

2. RESEARCH METHODOLOGY

SWOT and AHP integration is used for the flowchart in this research (21). SWOT provides the basic frame to perform an analysis of the decision situation, and the AHP assists in carrying out SWOT more analytical and elaborating the analysis so that alternative strategic decisions can be prioritized (22). The aim of applying the combined method is to improve the quantitative side of strategic planning (21).

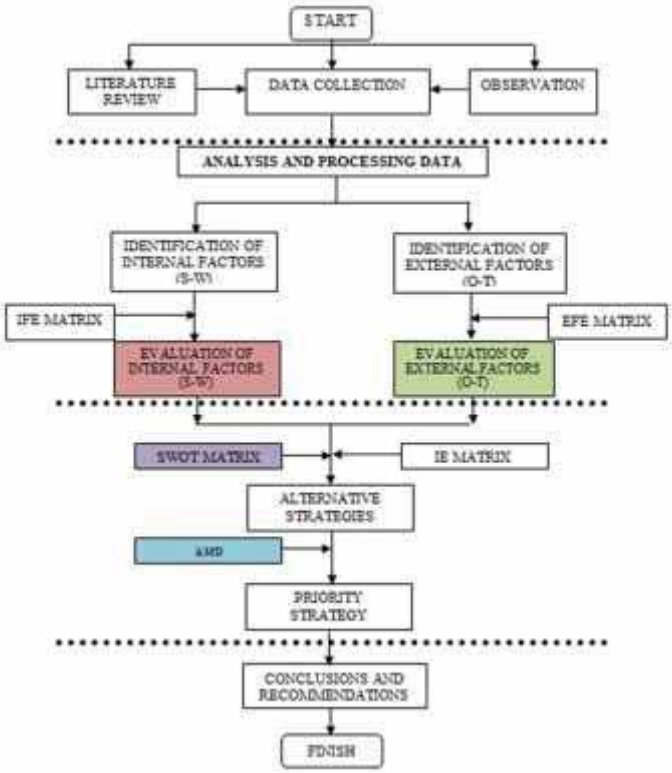

Fig. no. 2. *Research Integration SWOT and AHP Flowchart*

2.1. Naval Base Environment

Naval Base is expected to be the spearhead force in carrying out the task of supporting the warships operation (23). The main duty of the Naval Base is to carry out administrative and logistical support in order to develop the concept of logistics operations support (24). The requirements of Indonesian Naval Base include Port Facility, Maintenance and Repair Facility, Supplies or Logistics Facility, Personnel Care Facility, and Training Base Facility.

Table 1. *Indonesian Naval Base Standard Facility*

No.	Standard Bases of Indonesian Navy	Basic Building Coefficient
Port Facility	Capable in leaning all kinds of warships, at least one task force	20%
Maintenance and Repair Facility	Able to carry out maintenance and repairs up to the intermediate level for all types of warships both system, weapons and platform	10%
Supplies or Logistics Facilitiy	Able to support Class Logistics (food, individual field equipment, tools, oils, drugs) for at least one task	10%
Personnel Care Facility	Support personnel includes: messing, medical facilities/hospital, sports and recreation facilities, religious facilities, and training facilities to at least one task force.	30%
Training Base Facility	(1) The Common Facilities, capable of providing office facilities and infrastructure activities on the base. (2) Freight Services Facilities, able to support the transport and postal personnel by land, sea and air. (3) Defense Base Facilities, capable of providing defense and security against threats from the air, sea and land as well as infiltration / sabotage.	30%

The others general environment which includes the socioeconomic, educational, legal– political, and cultural aspects, usually operates within a specific geographic area. The specific environment is comprised of the suppliers, distributors, government agencies, and competitors which a military organization should interact (25), including the effect of the population, political institutions, geo-culture, and others in determining the exact location (26)

2.2. SWOT Analysis

SWOT is a method used to analyze operational environment with a systematic approach. This analysis is also utilized for strategic planning (27). SWOT analysis is based on the logic of maximizing the Strength and Opportunities as well as minimizing the Weaknesses and Threats simultaneously (28). SWOT analysis is obtained from the identification of the conditions, potentials

and problems with aspects related to use SO (Strength Opportunity)/ Maxi-Maxi Strategy, WO (Weakness Opportunity)/Mini-Maxi Strategy, ST (Strength Threat)/Maxi-Mini Strategy, WT (Weakness Threat)/Mini-Mini Strategy(29).

Table 2. *SWOT Matrix*

SWOT Matrix	**Strength (S)** Positive internal aspects that can be controlled and can be strengthened in the planning.	**Weakness (W)** The strategy of internal negative aspects that can be controlled and can be corrected in the planning.
Opportunity (O) Positive external conditions that can't be controlled and can be taken advantage.	**SO Strategy** Utilizing Internal strength to take advantage of external opportunities.	**WO Strategy** Improving internal weaknesses by taking the clappers of external opportunities
Threat (T) Negative external conditions that can't be controlled and may be minimized impact.	**ST Strategy** Using force to avoid or reduce the impact of external threats	**WT Strategy** Defensive tactics directed at reducing internal weaknesses and avoid external threats

2.3. Stages of AHP

Additional value from SWOT analysis can be achieved by performing pair-wise comparisons between SWOT factors and analyzing them by means of eigenvalue technique as applied in AHP means of eigenvalue technique as applied in AHP (29). Relative importance weights of the SWOT factors and sub-factors were obtained by Analytic Hierarchy Process (AHP) model, as well as the ranking of identified strategies. It was performed by several experts (30). The stages of decision-making with AHP method are as follows:

a. Define problems and determine solutions.

b. Creating a hierarchical structure

c. Pairwise comparison matrix formed by choice or judgment of the decision maker to assess the level of importance of an element than any other element.

d. Normalize the data

e. Calculating eigen values vector and tested for consistency

f. Repeat steps 3, 4, and 5 for all levels of hierarchy.

g. Calculating eigen vector of each pairwise comparison matrix.

h. Test the consistency of the hierarchy in the form of relationship priorities as eigen vector against consistency.

If that assessment is perfect in any comparison, then $a_{ij} \cdot a_{jk} = a_{ik}$ for all, and A matrix is called consistent (21).

$$\begin{bmatrix} 1 & a_1 & \cdots & a_{1n} \\ \frac{1}{a_1} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{1n}} & \cdots & 1 \end{bmatrix}$$

The values of the comparison matrix A can be expressed into the following forms:

$$a_i = \frac{w_i}{w_j}; (i, j = 1,2,3,\cdots,n) \quad (1)$$

$$a_i \cdot \frac{w_j}{w_i} = 1; (i, j = 1,2,3,\cdots,n) \quad (2)$$

Consequences:

$$\sum_{j=1}^{\bar{n}} a_i \cdot w_j \cdot \left(\frac{1}{w_i}\right) = 1; \ (i = 1,2,3,\cdots,n) \quad (3)$$

$$\sum_{j=1}^{n} a_i \cdot w_j = n \cdot w_i; \ (i = 1,2,3,\cdots,n) \quad (4)$$

Equation (4) in the form of a matrix becomes.

$$A \cdot w = n \cdot w \quad (5)$$

If Z_1, Z_2, Z_3, ..., Z_n are numbers that is in accordance with equation $A \cdot w = n \cdot w$ (Z is eigen value of A matrix, and if $a_{ii} = 1$ to i) then an equation becomes

$$\sum_{i=1}^{n} Z_i = n \quad (6)$$

If A is a pairwise comparison matrix, to obtain the priority should be sought w vector satisfying the equation.

$$A = Z_m \cdot w \quad (7)$$

Indicators of consistency measured using Consistency Index (CI) were formulated

$$c = \frac{z_m - n}{n - 1} \quad (8)$$

And for measuring the $C = \frac{C}{R}$tency of assessment is used Consistency Ratio (CR)

(9)

A certain level of consistency is required in determining the priority to obtain valid results. CR value should not be more than 10% or 0.10. If not then need to be revised (21). Random Index (RI) value can be seen in the following table:

Table 3. *Random Index (RI)*

n	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	+1.49	1.51	1.54	1.56

3. NUMERICAL CALCULATION RESULT

SWOT data processing in primary data collection is done by interviewing officer of Indonesian Naval Base Facilities Services, Hydro-oceanographic Office and Naval expertise competence. The results of the interview data were processed by Expert Choice Software into criteria and weighting data in accordance with the numerical calculation.

3.1. Internal Criteria

Table 4. *Primary Data of Strengths and Weaknesses*

No	Internal Criteria	Total Count
	Strengths	
S.1	Policy	52
S.2	Main Duties Naval Base	48
S.3	General Requirements of Naval Base	47
S.4	Availability of Logistics Region	47
S.5	Topography	47
S.6	Classificationof Naval Base	47
S.7	Function of Naval Base	47
S.8	Personnel Readiness	47
	Weaknesses	
W.1	Areas of Operation	44
W.2	Supporting Facilities	43
W.3	Layout Design	43
W.4	Geology	42
W.5	Availability of Shipyard	40
W.6	Availability of Public Facilities	40

3.2. External Criteria

Table 5. *Primary Data of Opportunities and Threats*

No	External Criteria	Total Count
	Opportunities	
O.1	Regional Spatial	48
O.2	Availability of Land	47
O.3	Oceanography	47
O.4	Sedimentation	47
O.5	Geostrategic and Geo-economy	47
O.6	Unit Support	45
O.7	Availability of Public Pier	44
	Threats	
T.1	Community Support	38
T.2	Sailing Volume	38
T.3	Road Access	38
T.4	Supporting Facilities	36
T.5	Level of Insecurity	28

3.3. Weight Determination and Critical Value

Data processing in Critical Weight Determination and Value at AHP SWOT performed using Expert Choice Software. Furthermore, the data was presented in Excel format to determine the criteria for scale rating score.

Table 6. *Critical Value Weighting of SWOT Criteria*

SWOT GROUPS	Importance of the SWOT Criteria	SWOT sub-criteria	Local importance of SWOT sub-criteria	Weight Total (N)	Score (J)	Rating score (N) x (J)
Strengths (S)	0.337	1 Policy	0.239	0.081	52	4.19
		2 Main Duties Naval Base	0.157	0.053	48	2.54
		3 General Requirements Naval Base	0.147	0.050	47	2.33
		4 Availability of Logistics Region	0.123	0.041	47	1.95
		5 Topography	0.109	0.037	47	1.73
		6 Classification of Naval Base	0.087	0.029	47	1.38
		7 Function of Naval Base	0.081	0.027	47	1.28
		8 Personnel Readiness	0.058	0.020	47	0.92
		Total	1.00	0.337		
Weaknesses (W)	0.295	9 Areas of Operation	0.244	0.072	44	3.17
		10 Supporting Facilities	0.202	0.060	43	2.56
		11 Layout Design	0.182	0.054	43	2.31
		12 Geology	0.140	0.041	42	1.73
		13 Availability of Shipyard	0.122	0.036	40	1.44
		14 Availability of Public Facilities	0.111	0.033	40	1.31
		Total	1.00	0.295		
Opportunities (O)	0.223	15 Regional Spatial	0.228	0.051	48	2.44
		16 Availability of Land	0.214	0.048	47	2.24
		17 Oceanography	0.142	0.032	47	1.49
		18 Sedimentation	0.126	0.028	47	1.32
		19 Geostrategic and Geo-economy	0.123	0.027	47	1.29
		20 Unit Support	0.085	0.019	45	0.85
		21 Availability of Public Pier	0.083	0.019	44	0.81
		Total	1.00	0.223		
Threats (T)	0.146	22 Community Support	0.291	0.042	38	1.61
		23 Volume Sailing	0.246	0.036	38	1.36
		24 Road Access	0.206	0.030	38	1.14
		25 Supporting Facilities	0.152	0.022	36	0.80
		26 Level of Insecurity	0.104	0.015	28	0.43
		Total	1.00	0.146		

3.3.1. Internal Factors Evaluation (IFE) Matrix Analysis

Table 7. *IFE Analysis*

SWOT GROUPS Level 1	Internal SWOT sub-criteria	Local importance	Rating	Score (2)x(3)
	(1)	(2)	(3)	(4)
Strengths (S)	1 Policy	0.239	4.19	1.00
	2 Main Duties Naval Base	0.157	2.54	0.40
	3 General Requirements of Naval Base	0.147	2.33	0.34
	4 Availability of Logistics Region	0.123	1.95	0.24
	5 Topography	0.109	1.73	0.19
	6 Classification of Naval Base	0.087	1.38	0.12
	7 Function of Naval Base	0.081	1.28	0.10
	8 Personnel Readiness	0.058	0.92	0.05
	Total	1.00		2.45

SWOT GROUPS Level 1	Internal SWOT sub-criteria	Local importance	Rating	Score (2)x(3)
	(1)	(2)	(3)	(4)
Weaknesses (W)	9 Areas of Operation	0.244	3.17	0.77
	10 Supporting Facilities	0.202	2.56	0.52
	11 Layout Design	0.182	2.31	0.42
	12 Geology	0.140	1.73	0.24
	13 Availability of Shipyard	0.122	1.44	0.18
	14 Availability of Public Facilities	0.111	1.31	0.15
	Total	1.00		2.27

From the analysis above, the score of 4.72 was relatively obtained. This result was ranging in the scale of 4 and indicates that these factors are very strong in influencing internal factors of Naval Base relocations.

3.3.2. External Factors Evaluation (EFE) Matrix Analysis

Table 8. *EFE Analysis*

SWOT GROUPS Level 1	External SWOT sub-criteria	Local importance	Rating	Score (2)x(3)
	(1)	(2)	(3)	(4)
Opportunities (O)	1 Regional Spatial	0.228	2.44	0.56
	2 Availability of Land	0.214	2.24	0.48
	3 Oceanography	0.142	1.49	0.21
	4 Sedimentation	0.126	1.32	0.17
	5 Geostrategic and Geo-economy	0.123	1.29	0.16
	6 Unit Support	0.085	0.85	0.07
	7 Availability of Public Pier	0.083	0.81	0.07
	Total	1.00		1.71
Threats (T)	8 Community Support	0.291	1.61	0.47
	9 Sailing Volume	0.246	1.36	0.33
	10 Road Access	0.206	1.14	0.23
	11 Supporting Facilities	0.152	0.80	0.12
	12 Level of Insecurity	0.104	0.43	0.04
	Total	1.00		1.20

From the analysis above, the score of 2.91 was obtained. This result is ranging in the scale of 3, indicating that these factors had a higher response above than the average in influencing external factors of Naval Base relocation..

3.4. Sensitivity Analysis

A sensitivity AHP analysis on the weight of the priority criteria can determine the order of priority strategy. Dynamic graph sensitivity can also be characterized as the table below.

Fig. no. 3. *Dynamic Graph Sensitivity to Goal*

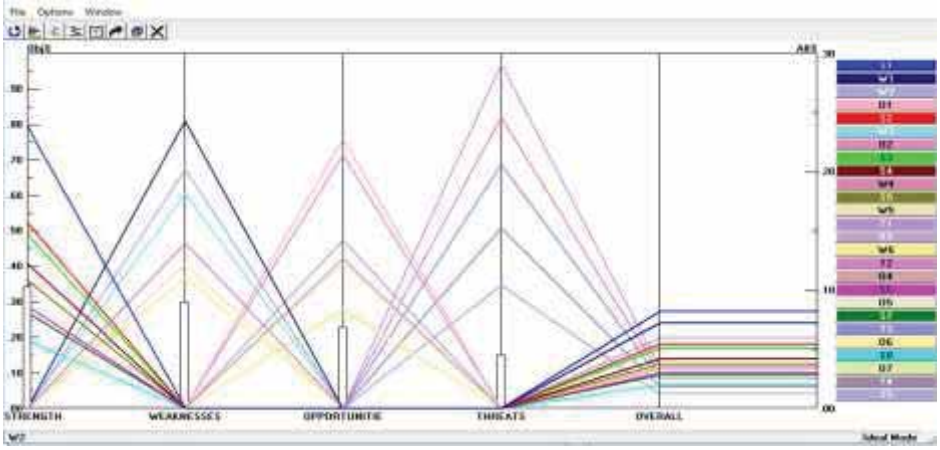

Fig. no. 4 *Performance Graph Sensitivity To Goal*

From the condition above, the priority Strength was 33.7% and in those conditions, the global priorities of Strength was 33.7%, then Weaknesses 29.5%, Opportunities 22.3% and Threats 14.6%.

4. DISCUSSION

The formulation of the Strategic Priorities from IFE and EFE matrix results, it is showed that the intersection of the four lines namely Strength, Weaknesses, Opportunities and Threats factor are as follows.

Scores Strengths - Weaknesses score = 2.45 to 2.27 = 0.17

Scores Opportunity - Threat Score = 1.71 to 1.20 = 0.51

In the chart above, the data were obtained through EFI and EFE matrix. The strength comparison stands in Quadrant I and it supports The Aggressive Strategy. It is depicted in the graph below:

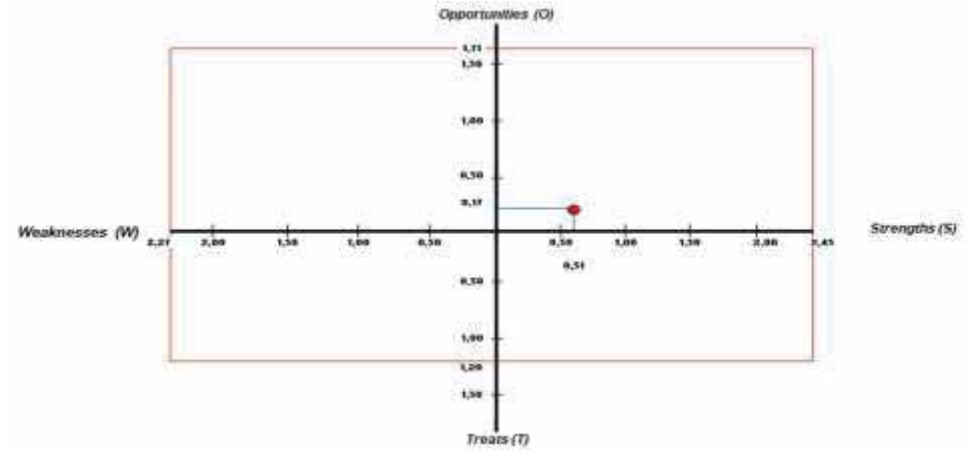

Fig. no. 5. *SWOT Analysis Graph*

4.1. SWOT Matrix Analysis Priority Based on AHP

Table 9. *SWOT Matrix Research*

INTERNAL FACTOR / EXTERNAL FACTOR	STRENGTHS (S) 1. Policy 2. Main Duties Naval Base 3. General Requirements Base 4. Availability of Logistics Region 5. Topography 6. Classification of Naval Bases 7. Function of Naval Base 8. Personnel Readiness	WEAKNESSES (W) 1. Areas of Operation 2. Supporting Facilities 3. Layout Design 4. Geology 5. Availability of Shipyard 6. Availability of Public Facilities
OPPORTUNITIES (O) 1. Regional Spatial 2. Availability of Land 3. Oceanography 4. Sedimentation 5. Geostrategic and Geo- economy 6. Unit Support 7. Availability of Public Pier	SO STRATEGY 1. Preparation of the administration of relocation 2. Design Plan of Naval Base **(S1)(S2)(S5)(O2)(O3)(O4)**	WO STRATEGY 1. Cooperation of area development 2. The establishment of economic centers **(W2)(W3)(O1)(O2)(O5)**
THREATS (T) 1. Community Support 2. Sailing Volume 3. Road Access 4. Supporting Facilities 5. Level Of Insecurity	ST STRATEGY 1. Empowerment of maritime potency 2. Development of the surrounding area **(S2)(S7)(O1)(O2)**	WT STRATEGY 1. Cooperation with local companies 2. Utilization of the existing contour 3. Implementation of routine operations. **(W2)(W3)(W6)(T1)(T2)**

4.2. Matrix Internal - External (I-E) Analysis

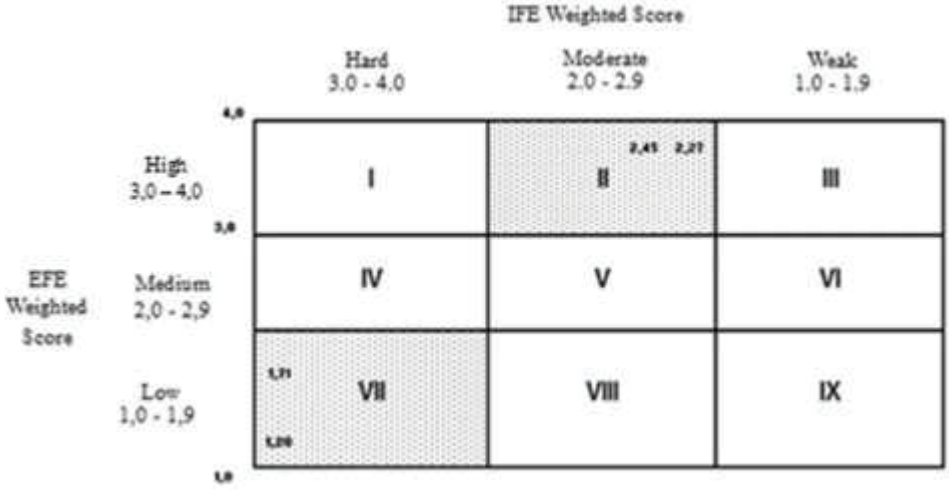

Fig. no. 6. *I-E Matrix*

4.3. Priority Strategies

S-O Strategy was selected as a priority strategy to relocate the Naval Base. This strategy can succeed by preparing the location details in advance. Furthermore, the implementation of the relocation of the Naval Base implemented according to plan with the support of local topography and oceanography state.

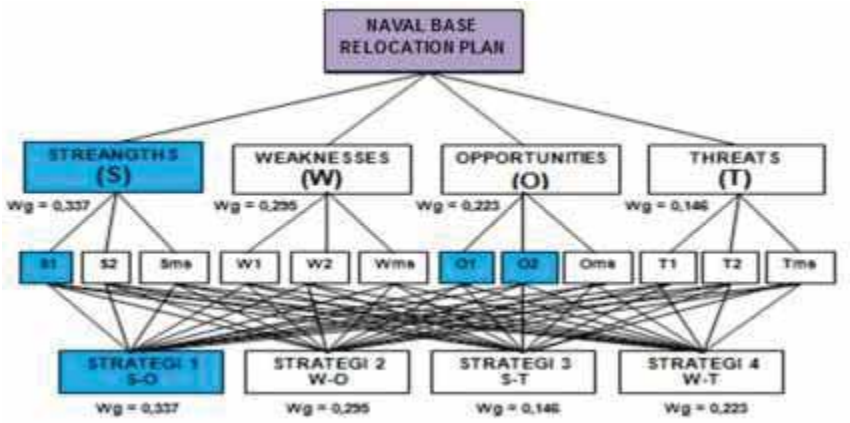

Fig. no. 7. *SWOT Hierarchy of the Priority Strategies*

5. CONCLUSION

In this paper, we have determined the strategic factors significant to relocate Naval Base by combining the SWOT method with AHP technique. Strength and Opportunities (S-O) strategy is a strategic priority to support the relocation of the Naval Base. So that the main duties of the Naval Base can be successful, especially for warships operation in the Indonesian territory. Chart analysis of IFE and EFE matrix shows that the strategy is in Quadrant I, which supports an aggressive strategy by leveraging existing strengths and opportunities. Expectations of future research on any MCDM techniques also can use CBA (Cost Benefit Analyze) method to determine the cost of relocating Naval Base.

Acknowledgement

This research has been supported by Indonesia Naval Technology College (STTAL) and Indonesian Naval Base Facilities Services.

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