

# MARITIME STRATEGY DEVELOPMENT TO ENCOUNTER THE THREAT OF NATIONAL SEA SECURITY IN INDONESIA TERRITORY

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*As a country with the largest sea area in Asia, Indonesia will certainly encounter the threats to the maritime aspect. The aim of this paper is to make an analysis of national maritime security of concerning the regional development effect. This paper uses a SWOT approach (Strengths, Weaknesses, Opportunities, and Threats), Fuzzy Multi-criteria Decision Making (FMCDM), and Borda method. SWOT analysis is used to identify internal and external factors in national maritime security, and strategic determination. Fuzzy MCDM (FMCDM) method is used to select the right strategy in maritime security control. The Borda method is used to define the sub-strategy, priorities of the selected strategy. The result of this paper with SWOT analysis is to identify four strategies, likely Strategy 1 (SO); Strategy 2 (WO); strategy 3 (WT); Strategy 4 (ST). Based on FMCDM method, Strategy 1 (SO) has a weight of 0.256 as a third rank; Strategy 2 (WO) has a weight of 0.26 as a second rank; Strategy 3 (WT) has a weight of 0.208 as a fourth rank; Strategy 4 (ST) has a weight of 0.276 as a first rank. Then, the strategy chosen is Strategy 4 (ST). Based on Borda method, the first priority of sub-strategy from strategy 4 (ST) is to increase the percentage of State Budget for the maritime sector in the development of Navy Capability and other stakeholder to carry out the operation of sea crime action with allocation of 22,587%.*

**Keywords:** *Maritime Security, Indonesian Sea, SWOT Analysis, Fuzzy MCDM, Borda Method.*

## 1. INTRODUCTION

Nowadays, Asia Pacific is a region in the world that is predicted to be part of the world greatest history of politics and economics in the 21st century [1],

it can be seen from the increasing number of New Emerging Countries (NEC). Asian economic revival is still led by two countries, namely China and India [2]. These countries have the largest human resources and the

biggest potential market in the world.

According to Global Trend 2030, the map of the countries in the world will change in 2030 [3]. Asia will overtake North America and Europe in terms of global power, primarily based on the Gross Domestic Product (GDP), population number, military allocation, and investment in technology [4]. In these projections, Indonesia is predicted as one of the countries that will have an increase of emerging power in 2030 [5].

The economic development of Indonesia and regional areas gives an effect on national security, including maritime security sectors. As one of the ASEAN countries, Indonesia makes for the territorial waters an important role in the connectivity mode for Asia Pacific [6]. With its position as a trade and maritime transportation routes [7], Indonesia has challenges to manage maritime security with various dimensions including defense and security perspective. Indonesia will certainly encounter the threats to the maritime aspect. The threat must be well identified to determine of maritime security strategy.

The aim of this paper is giving to make an analysis of national maritime security to encounter of

regional development effect. This paper uses a SWOT approach (Strengths, Weaknesses, Opportunities, and Threats), Fuzzy Multi-criteria Decision Making (FMCDM), and Borda method. SWOT analysis is used to identify internal and external factors in national maritime security, and strategic determination. Fuzzy MCDM (FMCDM) method is used to select the right strategy in maritime security control. The Borda method is used to define the sub strategy from the priorities of the selected strategy.

The inscriptive benefit of this paper is a literature for Indonesia maritime actors about maritime security strategy. It provides academic studies for maritime security.

To support the research, this paper has many literatures sources, such as literature about maritime security, Chapsos and Malcolm (2017) explains about analysis of the training needs of the key player of Indonesia maritime security, which consider how the ability of maritime security in Indonesia can be improved [8]. Zhang (2014) presents about some obstacles in maritime risk studies and how to overcome uncertainty of maritime transportation [9]. Klimov (2015) explains about the definition of hazard and threat in maritime

areas [10]. Bateman (2010) presents the threat effect of Asia Pacific toward maritime security in South East Asia [11]. Matthews (2016) presents ~~about~~ Indonesia's response in rejecting and accepting multilateral cooperation in the Malacca Strait to establish maritime security stability [12]. Ramadhani (2015) presents the enhancement of a cooperation for all actors in the maritime sector, to reduce the likelihood of increasingly deteriorating power competition [13]. Lin and Gertner (2015) present that the maritime territory gives unique risks with different solutions on the projection of state and land-based ??? [14].

Paper literature about the method, such as Buyukozkan and Guleryuz (2016) presents ~~about~~ the Fuzzy MCDM uses to select alternative energy with the criteria of quantitative and qualitative analysis [15]. Toklu (2017) explains ~~about~~ how the Fuzzy MCDM is used to determine the level of customer loyalty [16]. Suharyo, et al (2017) presents ~~about~~ the Fuzzy MCDM to select the naval base location with ~~factor~~ of political, economic, and technical factors [17]. Lumaksono (2014) presents ~~about~~ SWOT analysis uses to obtain the weight value from the expert in identifying the internal and

external factors of traditional shipbuilding industry [18]. Malik, et al (2013) explain about SWOT analysis uses to determine the external and internal factors to support of the strategy formulation in business schools in the Kingdom of Saudi Arabia [19]. Shahbandarzadeh and Haghghat (2010) present the integration results of each level and provide a final assessment of the market selection strategy [20]. Junior, et al (2014) present the method to give a rank of countries in calculating the number of gold medals, silver medals and bronze medals won [21].

The paper is organized as follows. Section 2 reviews the basic concept of method and maritime security. Section 3 gives the result and discussion of the research. Section 4 describes the conclusion of maritime security strategies in Indonesia.

## **2. MATERIAL / METHODOLOGY**

### **2.1. Indonesia Maritime Security**

Indonesia is the largest archipelagic country in the world with a coastline of about 81,000 km [22]. Indonesia has more than 17,000 islands and its marine [23] area covers 5.8 million km<sup>2</sup> or

about 80% of the total area of Indonesia [24]. Maritime security is influenced by the actions and patterns of interaction between the actors involved. The concept of maritime security lies between two ideas: 1) groups using a traditional security framework, 2) groups using non-traditional framework [25].

According to Buerger (2015), there are three fields to identifying the concept of maritime security, such as: 1) Maritime security matrix, 2) “securitization” framework, which provides a means to understand how different threats are included in maritime security, 3) the theory of security practices with the purpose to understand what actions are carried out in the dimensions of maritime security [26].

The national security dimension relies on a traditional perspective that views national security as an effort to protect the

state's sustainability. Therefore, the sea power is represented by naval force as a dominant force in the maritime. Thus, maritime security is identical with the use of naval power [27]. There are several threats to maritime security, such as; 1) threats of violence (piracy, sabotage, and vital objects of terror); 2) navigation threats; 3) the threat of resources, such as damage and pollution of the sea and its ecosystem; 4) the threat of sovereignty [28].

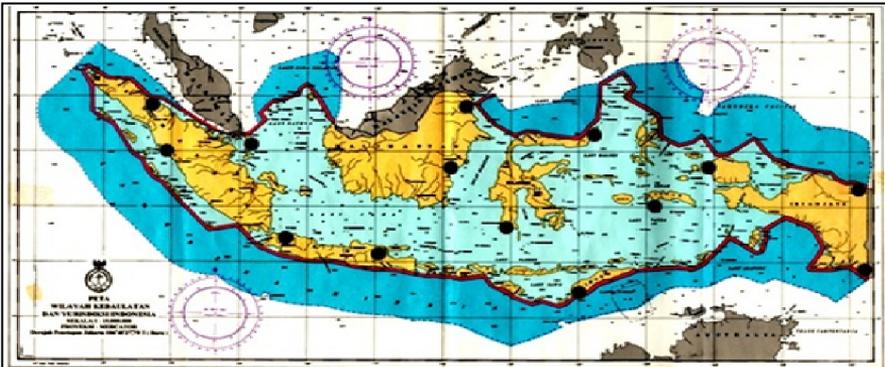


Figure 1. Map of Indonesia

There are also several actors involved in maritime security, such as [29] 1) Coordinating Ministry of Maritime Affairs; 2) Coordinating Ministry of Politics, Law, and Security; 3) Indonesian Maritime Security Agency (BAKAMLA); 4) Navy (TNI AL); 5) Indonesian National Police; 6) Dir. Gen. Sea Transportation (Hubla); 7) Dir. Gen. Custom and Excise (Bea and Cukai); 8) Dir. Gen. of Immigration (Ditjenim); 9) Ministry of Marine and Fisheries (KKP); 10) Indonesia Sea and Rescue Agency (BASARNAS).

In the management of national maritime security, stakeholders are required to apply the strategy appropriately. In this case, there are several related strategic criteria, such as:

- a. Effective communication among stakeholders.
- b. The Strategy has good information about security and intelligence.
- c. There is continuous assessment of existing security processes, procedures and technologies.
- d. Strategy is supported by the ability and adequate the number of personnel-
- e. The Strategy supported by policies and funding from the Government.

- f. There is a good and effective interaction within the organization or between organizations.
- g. There is consistency in the application of systems, processes and protocols.
- h. Maritime security strategy shall synergize with risk management, quality, environment and other safety systems.
- i. There are metric measurements, accurate monitoring and reporting procedures.
- j. There is regular and ongoing training.
- k. There is an adequate control center.

## 2.2. SWOT Analysis.

SWOT analysis is an effective strategic planning tool for analyzing the organization of internal and external influences [29]. SWOT analysis consists of internal and external factors. Internal factors (strengths, weaknesses) are used to test assets within an organization. External factors are used (opportunities, threats) to investigate factors in the environment beyond the organizational control that affect organizational performance [30] [31]. Information obtained can be integrated in different matrix combinations of the four factors in

determining strategies for long-term progress [32].

The SWOT analysis shows the right strategy in four categories (SO, ST, WO and WT) [18]. Strength-Opportunity (SO), this strategy takes advantage of opportunities by using existing strengths. Strength-Threat (ST)-this strategy uses the strength to eliminate or reduce the effects of threats. Weakness-Opportunity (WO) strategies are used to take benefit from opportunities by external environmental factors with fixing the weaknesses. Last, Weakness-Threat (WT) strategies are used to reduce an impact from threat with fixing the weakness [32].

**Table 1.** Matrix SWOT

INTERNAL/EXTERNAL FAKTOR	STRENGTH (S) (Maximal)	WEAKNESS (W) (Minimal)
OPPORTUNITIES (O) (maximal)	S-O Strategy (Maximal-Maximal)	W-T Strategy (Minimal-Minimal)
THREATS (T) (Minimal)	S-T Strategy (Maximal-Minimal)	W-O Strategy (Minimal-Maximal)

**2.3. Fuzzy MCDM.**

Zadeh (1965) promoted the fuzzy set theory concept [33]. This concept is defined mathematically by specifying the value of each individual representing the

membership class in the fuzzy set [34]. Consequently, fuzzy theory has become a useful tool for automating human activity with information-based on uncertainty. This value represents the rate in which the individual is similar or compatible with the concept shown by the fuzzy set. Thus, an individual can enter in fuzzy formation to a bigger or lesser extent. This membership value is indicated by real numbers with ranges from closed intervals between 0 and 1. Therefore, the fuzzy set introduces obscurity (with the aim of reducing complexity) by eliminating the boundary that separates class members from non-members gradually.

**Linear Representation**

In a linear representation, the mapping to membership level is described as a straight line. This form is the simplest and most appropriate choice for a less obvious approach. There are 2 (two) fuzzy sets derived from linear conditions, the first is the set increment starting from the domain value with the zero membership level [0] to move right into the domain value with the higher membership level [17].

Membership functions:

$$\mu[x] = \begin{cases} 0; & x \leq a \\ (x - a)/(b - a); & a \leq x \leq b \\ 1; & x \geq b \end{cases} \quad (1)$$

Second, this condition is the opposite of the first. The straight line starts from the domain value with the highest membership level on the left side, then switches to the value of the domain that has a lower membership [35].

Membership functions:

$$\mu[x] = \begin{cases} (b - x)/(b - a); & a \leq x \leq b \\ 0; & x \geq b \end{cases} \quad (2)$$

### Triangular Fuzzy Number (TFN)

In TFN, every single value has a member function that consists of three values. Each value represents the lower, middle and top values.

$$A = (a_1, a_2, a_3)$$

TFN membership functions for the image above is as follows:

$$\begin{aligned} \mu[x] &= 0 && \text{for } x < a_1 \\ &= \frac{x - a_1}{a_2 - a_1} && \text{for } a_1 < x < a_2 \\ &= \frac{a_3 - x}{a_3 - a_2} && \text{for } a_2 < x < a_3 \end{aligned} \quad (3)$$

### Linguistic Variables

The linguistic variable is a variable that has a description of a fuzzy number and is generally represented by a fuzzy set [35]. In this study, a fuzzy triangle number has been used to represent linguistic variables on a scale of 0 to 1 to assess criteria and alternatives. These linguistic variables are represented as very weak (VW), weak (W), medium (M), strong (S), very strong (VS).

Liang (1999) proposes a fuzzy Multi Criteria Decision Making (MCDM) based on ideal and anti-ideal concepts [36]. In this section, it describes the MCDM fuzzy approach introduced by Dursun and Karsak which based on fuzzy information integration and 2-tuple linguistic representation model [37]. The settlement procedure used is stated as follows:

*Step 1.* This step shows the weighted results from a qualitative criterion level assessment to obtain aggregate weighting values

*Step 2.* This step shows the result of the preference rating for each alternative based on the existing qualitative criteria

*Step 3.* This stage determines the middle value of the fuzzy number. This step sums the value at each level of the linguistic scale and divides the sum with the number of criteria. Mathematical notation is as follows:

$$a_t = \frac{\sum_{i=1}^k \sum_j T_{ij}}{\sum_{i=1}^k n_{ij}} \quad (4)$$

$a_t$  = median fuzzy numbers to levels

T = the level of assessment is very weak, weak, moderate, strong and very strong.

n = amount of scale linguistic scale factor for an alternative to T-1 of the i-th factor

$T_{ij}$  = numerical value of the scale for an alternative to linguistic T-1 of the j-th factor.

*Step 4.* This step determines the lower and upper limit values of the fuzzy numbers, where the lower bound value ( $c_t = b(i - 1)$ ) equals the average rate down, while the upper bound value ( $b_t = b(i - 1)$ ) is equal to the above average level.

*Step 5.* This step determines the aggregate weight of each qualitative criterion. The form of linguistic assessment has a definition of fuzzy triangle number, then aggregation process is done by finding the aggregate value of the lower limit value of each ( $c_t$ ), mean ( $a_t$ ) and upper limit value ( $b_t$ ). The equation is as follows:

$$c_t = \frac{\sum_{j=1}^n c_{tj}}{n} \quad a_t = \frac{\sum_{j=1}^n a_{tj}}{n} \quad b_t = \frac{\sum_{j=1}^n b_{tj}}{n} \quad (5)$$

$c_{tj}$  = lower limit value of qualitative criteria to-t by decision makers to-j

$a_{tj}$  = median qualitative criteria to-t by decision makers to-j

$b_{tj}$  = the value of the upper limit to the qualitative criteria-t by decision makers to-j

n = number of assessors (decision makers)

Aggregate value is  $N = (c_j, a_j, b_j)$  where:

$N_t$  = Value aggregation weights for qualitative criteria to-t

*Step 6.* This stage calculates the preference value of each alternative based on qualitative criteria. When calculating the aggregate weight, each alternative for each criterion will show fuzzy aggregate values with the following models:

$$q_t = \frac{\sum_{j=1}^n q_{tj}}{n} \quad o_t = \frac{\sum_{j=1}^n o_{tj}}{n} \quad p_t = \frac{\sum_{j=1}^n p_{tj}}{n} \quad (6)$$

$q_{itj}$  = lower limit value alternative to qualitative criteria by the manufacturer to  $t_j$ .

$o_{it}$  = value alternative to middle qualitative criteria to- $t$  by decision makers to  $j$ .

$o_{itj}$  = upper limit value alternative to qualitative criteria by the manufacturer to  $t_j$ .

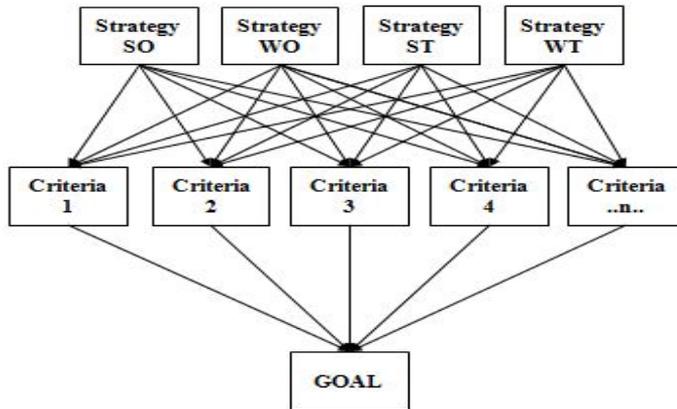
$N$  = number of assessors (decision makers).

Aggregate value is  $M_{itj} = (q_{it}, o_{it}, p_{it})$ , where:

$M_{itj}$  = weighted aggregation value for the  $i$ -th alternative to qualitative criteria to- $t$ .

*Step 7.* This step calculates the fuzzy index value of each alternative appraisal result for qualitative criteria denoted by  $G_i$ . First, we get the value of  $M_{it}$  and  $N_t$ , to get the fuzzy match index value for each subjective criteria  $G_i$

$$G_i = (Y_i, Q_i, Z_i, H_{i1}, T_{i1}, H_{i2}, U_{i1}), \quad i = 1, 2, \dots, m$$



**Figure 2.** Fuzzy MCDM Diagram for Strategy

The fuzzy index values are obtained by operating each element of triangular fuzzy

numbers from the numbers 2 and 4 with the following notations:

$$T_{i1} = \frac{\sum_{t=1}^k (\sigma_{it} - q_{it})(\alpha_t - c_t)}{k} \quad (7)$$

$$T_{i2} = \frac{\sum_{t=1}^k [q_{it}(\alpha_t - c_t) + c_t(\sigma_{it} - q_{it})]}{k} \quad (8)$$

$$U_{i1} = \frac{\sum_{t=1}^k (p_{it} - \sigma_{it})(b_t - \alpha_t)}{k} \quad (9)$$

$$U_{i2} = \frac{\sum_{t=1}^k [b_t(\sigma_{it} - p_{it}) + p_{it}(\alpha_t - b_t)]}{k} \quad (10)$$

$$H_{i1} = \frac{T_{i2}}{2T_{i1}} \quad (11)$$

$$H_{i2} = -\frac{U_{i2}}{2U_{i1}} \quad (12)$$

$$Y_i = \frac{\sum_{t=1}^k q_{it} c_t}{k} \quad (13)$$

$$Q_i = \frac{\sum_{t=1}^k \sigma_{it} \alpha_t}{k} \quad (14)$$

$$Z_i = \frac{\sum_{t=1}^k p_{it} b_t}{k} \quad (15)$$

*Step 8.* This step calculates the value of the utility in each alternative to qualitative criteria.

$$U_t(G_t) = \frac{1}{2} \left[ H_{i2} - \left( H_{i2}^2 + \frac{X_R - Z_i}{U_{i1}} \right)^{\frac{1}{2}} + 1 + H_{i1} - \left( H_{i1}^2 + \frac{X_L - Y_i}{T_{i1}} \right)^{\frac{1}{2}} \right] \quad (16)$$

$$X_R = \frac{1}{2} \left\{ 2x_1 + 2H_{i2}(x_2 - x_1) + \frac{(x_2 - x_1)^2}{U_{i1}} - (x_2 - x_1) \left[ \left( 2H_{i2} + \frac{(x_2 - x_1)^2}{U_{i1}} + 4 \frac{X_L - Z_i}{U_{i1}} \right)^{\frac{1}{2}} \right] \right\} \quad (17)$$

$$X_L = \frac{1}{2} \left\{ 2x_2 + 2H_{i1}(x_2 - x_1) + \frac{(x_2 - x_1)^2}{T_{i1}} - (x_2 - x_1) \left[ \left( 2H_{i1} + \frac{(x_2 - x_1)^2}{T_{i1}} + 4 \frac{X_L - Y_i}{T_{i1}} \right)^{\frac{1}{2}} \right] \right\} \quad (18)$$

The first step to do is to look for the criteria and preferences of defuzzification value alternative to the criteria, where the

defuzzification method used is the centroid method. The formula of defuzzification criteria is as follows:

$$\text{Defuzzification } N_{it} = \left[ \int_{c_t}^{a_t} \frac{(x-c_t)}{(a_t-c_t)} x dx + \int_{a_t}^{b_t} \frac{(x-b_t)}{(a_t-b_t)} x dx \right]$$

t = criteria 1,2,3.....n

While the formula for determining the value of defuzzification alternative preference for qualitative criteria is as follows:

$$\text{Defuzzification } M_{it} = \frac{\left[ \int_{q_{it}}^{o_{it}} \frac{(x-q_{it})}{(o_{it}-q_{it})} x dx + \int_{o_{it}}^{p_{it}} \frac{(x-p_{it})}{(a_t-p_{it})} x dx \right]}{\left[ \int_{q_{it}}^{o_{it}} \frac{(x-q_{it})}{(o_{it}-q_{it})} dx + \int_{o_{it}}^{p_{it}} \frac{(x-p_{it})}{(a_t-p_{it})} dx \right]} \quad (20)$$

i = alternative 1,2,3.....m;

t = criteria 1,2,3.....n

*Step 9.* This step calculates the ranking value of each alternative based on qualitative criteria by using the following formula:

$$ST_i = \frac{u_T(G_i)}{\sum_{i=1}^m u_T(G_i)} \quad (21)$$

ST<sub>i</sub> = the value of the i-th rank alternatives based on qualitative criteria.

T<sub>ij</sub> = value (score) of the i-th alternative to quantitative criteria to-j  
M = number of alternatives  
P = number of quantitative criteria  
OT<sub>i</sub> = the value of the i-th rank alternatives based on quantitative criteria

*Step 10.* This step calculates the ranking value of each alternative based on quantitative criteria by the following formula:

$$OT_i = \frac{\sum_{j=1}^p [T_{ij} \cdot (\sum_{i=1}^m T_{ij})]}{p} \quad (22)$$

*Step 11.* This step calculates the total of ranking value in each alternative to qualitative and quantitative criteria by the following formula:

$$FT_i = \frac{ST_i + OT_i}{\sum v_k}, 0 \leq x \leq 1 \quad (23)$$

$ST_i$  = the value of the  $i$ -th rank alternatives based on qualitative criteria.

$OT_i$  = the value of the  $i$ -th rank alternatives based on quantitative criteria

$\sum V_k$  = number of variables

$FT_i$  = rank total value for the alt to- $i$

*Step 12.* This step is selecting the best alternative based on the value of the highest rank.

### 2.4. Borda Method.

Borda Rules (Borda 1781) are included in the class of ranking rules in which points are awarded to each candidate or alternate according to rank in voter preferences [38]. Each decision maker must order an alternate

option according to the preference specified. One point is given to the highest choice alternative; the second receives two points and so on.

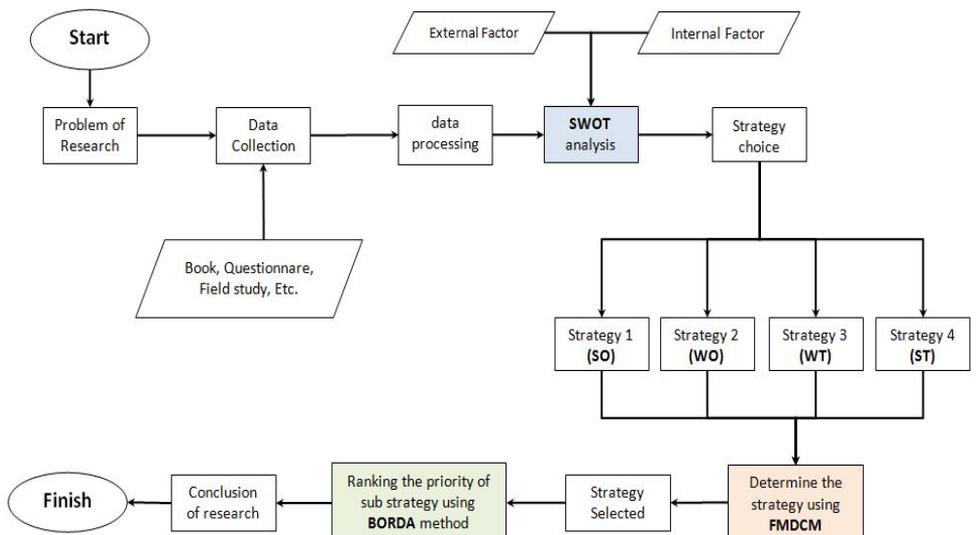
In this method if there are  $n$  alternatives, the first choice of voters is given  $(m - 1)$  points, the second point  $(m - 2)$  and so on to the last option, which is 0 points. Then, in each alternative, summaries of all points are given from all decision makers (or by criteria). The alternative is to rank in the order corresponding to the number, the fewer points gained, the better the alternate in the rankings.

The formula describes as [21]:

$$P_a = \sum_{i=1}^n r_{ai} \quad (24)$$

Where  $P_a$  is the total number of points obtained by alternative  $a$  and  $r_{ai}$  is the rank of alternative  $a$  in criterion  $i$ .

### 2.5. Flowchart.



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**Figure 3.** Flowchart of Research

### 3. RESULTS AND DISCUSSION

#### SWOT Analysis

This sub section describes the results of research conducted in order to develop maritime security strategy with the SWOT analysis approach. SWOT analysis is used to capture expert judgment on

internal and external factors, and then the factors of strength, weakness, opportunity, and threat are found.

Based on the results of respondents' judgment, there are several internal factors that become strengths and weaknesses as contained in the table:

**Table 2 . Internal Factors from SWOT Analysis**

INTERNAL FACTOR			
STRENGTH (S)		WEAKNESS (W)	
S1	Geographical position of Indonesia between two oceans and continents.	W1	Maritime security policy that still overlap between stakeholders.
S2	Physical form and area of country.	W2	The high rate of unemployment and social inequality.
S3	Good political stability in the country	W3	Natural resources are still managed by many foreign parties.
S4	The national economic growth is quite high.	W4	The gap of educational level between regions in the border state of country.
S5	Natural marine resources both inside and on the surface are abundant.	W5	infrastructure development in regional still uneven
S6	Demographic bonus of the population with a large workforce.	W6	Vulnerable to illegal levies, abuse of authority and corruption from stakeholders.
S7	Maritime-oriented from the Government Policy	W7	Information systems are still vulnerable to attacks from cyber enemy
S8	free-active politics from the country.	W8	Military technology still linger
S9	Character and history as a maritime nation.	W9	welfare for the crew of the Navy and other stakeholders is still limited.

EXTERNAL FACTOR			
OPPORTUNITY (O)		THREAT (T)	
O1	Indonesia has the opportunity to become the second largest maritime country in the world.	T1	Piracy
O2	As a new hegemony in Asia-pacific, a counterweight of China and US	T2	Illegal Imigrant and human trafficking
O3	The high economic growth encourages the growth of goods traffic by sea.	T3	Drug trafficking, smuggling of goods, weapons and military technology.
O4	A good national state budget encourages increased strength for the Navy capability and other	T4	The threat of terrorism both from inside and outside the country.
O5	Demographic bonus as a large market and abundant labor for the Navy and other stakeholders.	T5	Armed attacks, and violations of territorial boundaries from other countries.
O6	The growth of maritime domain awareness for the people.	T6	The threat of cyber attack.
O7	The existence of technology transfer for maritime service industry.	T7	Hunting and looting of marine resources, and illegal fishing.
O8	Utilization of marine resources for the welfare of the people.	T8	As a logistical shift path and war equipment, in case of armed conflict between other countries.
O9	Participate in the determination of world maritime security policy as a member of IMO.	T9	Threats from loss of natural resources and outer islands.

Based on table 2 upon, we have nine points for strength analysis factor and nine points for weakness analysis factor. Based on table 3 upon, we have nine points for opportunity analysis factor and nine points for threat analysis factor.

From the result of SWOT analysis, it was obtained SWOT matrix which gives a description about maritime security strategy. The strategy is contained in the SWOT matrix table below:

**Table 3.** Matrix Strategy of SWOT Analysis

		INTERNAL FACTORS			
		STRENGTH (S)		WEAKNESS (W)	
		Strategy I (SO)		Strategy II (WO)	
EXTERNAL FACTORS	OPPORTUNITY (O)	(SO)1	<ul style="list-style-type: none"> <li>Utilization of marine resources to support renewable energy at sea, and open employment for the community.</li> </ul>	(WO)1	<ul style="list-style-type: none"> <li>Establish an integrated task force with fellow stakeholders in maritime security.</li> </ul>
		(SO)2	<ul style="list-style-type: none"> <li>Development of infrastructure and connectivity at sea.</li> </ul>	(WO)2	<ul style="list-style-type: none"> <li>Implementing re-negotiations with foreign parties in the management of marine resources.</li> </ul>
		(SO)3	<ul style="list-style-type: none"> <li>Increase of state budget percentage for the maritime sector in the development of Navy capability and other stakeholders.</li> </ul>	(WO)3	<ul style="list-style-type: none"> <li>Development of educational infrastructure in every coastal area and the addition of teacher quota.</li> </ul>
		(SO)4	<ul style="list-style-type: none"> <li>Utilization of the abundant labor force in recruitment of Navy crew and other stakeholders.</li> </ul>	(WO)4	<ul style="list-style-type: none"> <li>Establish a task force to eradicate corruption and illegal levies on marine sector.</li> </ul>
		(SO)5	<ul style="list-style-type: none"> <li>Rebuild culture as a maritime nation.</li> </ul>	(WO)5	<ul style="list-style-type: none"> <li>Cooperation with developed countries with technology transfer for military infrastructure development.</li> </ul>
		(SO)6	<ul style="list-style-type: none"> <li>The use of the country's active-free politics as a mediator for China and US hegemony in Asia Pacific.</li> </ul>	(WO)6	<ul style="list-style-type: none"> <li>Build a strong foundation of information systems in maritime areas.</li> </ul>
		(SO)7	<ul style="list-style-type: none"> <li>Development of maritime services industry and technology transfer cooperation with developed countries.</li> </ul>	(WO)7	<ul style="list-style-type: none"> <li>Equitable development of maritime infrastructure and connectivity in coastal and border areas.</li> </ul>
	THREAT (T)	(ST)1	<ul style="list-style-type: none"> <li>Increase of state budget percentage for the maritime sector in the development of Navy capability and other stakeholders.</li> </ul>	(WT)1	<ul style="list-style-type: none"> <li>Establish an integrated task force with fellow stakeholders in maritime security.</li> </ul>
		(ST)2	<ul style="list-style-type: none"> <li>Development of maritime infrastructure and connectivity in coastal and border areas to open logistics channels.</li> </ul>	(WT)2	<ul style="list-style-type: none"> <li>Equitable development of maritime infrastructure and connectivity in coastal and border areas.</li> </ul>
		(ST)3	<ul style="list-style-type: none"> <li>Rebuild culture as a maritime nation.</li> </ul>	(WT)3	<ul style="list-style-type: none"> <li>Cooperation with developed countries with technology transfer for military infrastructure development.</li> </ul>
		(ST)4	<ul style="list-style-type: none"> <li>Negotiations with neighboring countries in trans-state sea border agreements.</li> </ul>	(WT)4	<ul style="list-style-type: none"> <li>Development of maritime services industry in coastal areas, for the opening of employment in each region.</li> </ul>
		(ST)5	<ul style="list-style-type: none"> <li>Development of shipping education infrastructure in every coastal area and the addition of teacher.</li> </ul>	(WT)5	<ul style="list-style-type: none"> <li>Development of educational infrastructure in every coastal area and the addition of teacher quota.</li> </ul>
		(ST)6	<ul style="list-style-type: none"> <li>Implementing re-negotiations with foreign parties in the management of marine resources.</li> </ul>	(WT)6	<ul style="list-style-type: none"> <li>Build a strong foundation and infrastructure of information systems in the maritime sector.</li> </ul>
		(ST)7	<ul style="list-style-type: none"> <li>Build a strong foundation and infrastructure of information systems in the maritime territory to cope the cyber threats.</li> </ul>		

Based on table 4 upon, this paper is given four strategies for national maritime security. The strategies consist of seven points for strategy I Strength-opportunity (SO); seven points for strategy II Weakness-Opportunity (WO); six points for strategy III Weakness-Threat (WT); seven points for strategy IV Strength-Threat (ST).

**Analysis of Fuzzy MCDM**

The next step is to determine the choice strategy by the Fuzzy MCDM (F-MCDM). The choice of strategy that exists after SWOT

analysis is given weight in the ranking. Previously, a questionnaire was completed by 6 competent expert assessors (E1; E2; E3; E4; E5; E6) in the field of maritime security.

Scale questionnaire consists of two apart, linguistic scale and a numerical scale. The example of linguistic scale is "very weak", "weak", "moderate", "strong" and "very strong", while numerical scale interval of values take 1-10, as the table below

**Table 4.** Questionnaire Scale for Linguistic level

Aspect / Criteria	Very Weak		Weak		Moderate		Strong		Very Strong	
	1	2	3	4	5	6	7	8	9	10

After obtaining the data from the questionnaire, the next step is to recapitulate the results of the questionnaire and data processing.

The steps of data processing using MCDM fuzzy algorithm, are as follows:

The result of qualitative criteria assessment from Expert judgement (E1-E6).

**Table 5.** Result of Qualitative Criteria Assessment

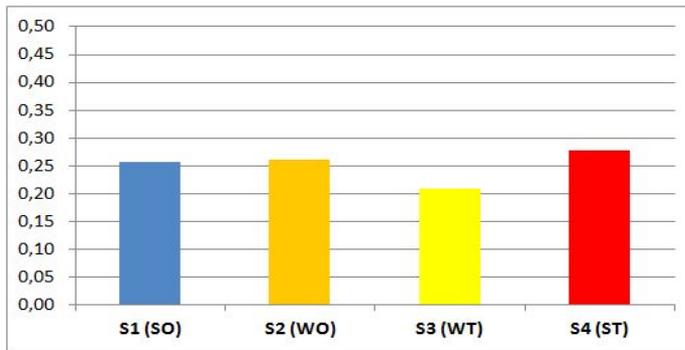
NO	Criteria of Good Strategies	E1	E2	E3	E4	E5	E6
1	Effective communication among stakeholders.	6	8	7	7	5	7
2	The Strategy has good information about security and intelligence.	9	7	8	8	6	9
3	There is continuous assessment of existing security processes, procedures and technologies.	6	6	9	7	7	8
4	Strategy is Supported by the ability and the number of personnel adequate.	4	9	8	8	7	9
5	The Strategy Supported by policies and funding from the Government	8	8	9	9	7	10
6	There is a good and effective interaction within the organization or between organizations.	6	7	8	5	7	6
7	There is consistency in the application of systems, processes and protocols.	5	7	6	8	7	7
8	Maritime security strategy shall synergize with risk management, quality, environment and other safety systems.	7	7	8	8	5	7
9	There are metric measurements, accurate monitoring and reporting procedures.	6	7	8	5	8	7
10	There is regular and ongoing training	4	7	8	8	6	7
11	There is an adequate control center.	7	6	9	8	8	5

The result of preference assessment for each alternative based on existing qualitative criteria.

**Table 6.** Result of Preference Assessment

NO	QUALITATIVE CRITERIA	Strategies	E 1	E 2	E 3	E 4	E 5	E 6
1	Effective communication among stakeholders.	S1 (SO)	6	6	9	8	7	9
		S2 (WO)	9	8	7	9	9	9
		S3 (WT)	8	7	9	9	9	8
		S4 (ST)	8	6	6	8	9	6
2	The Strategy has good information about security and intelligence.	S1 (SO)	6	6	7	6	8	7
		S2 (WO)	8	7	9	8	7	9
		S3 (WT)	6	7	4	7	6	6
		S4 (ST)	9	9	7	7	9	9
3	There is continuous assessment of existing security processes, procedures and technologies.	S1 (SO)	8	9	8	7	9	8
		S2 (WO)	6	7	7	6	8	9
		S3 (WT)	7	6	7	6	8	7
		S4 (ST)	7	5	7	8	8	7
4	Strategy is Supported by the ability and the number of personnel adequate.	S1 (SO)	8	8	9	9	7	8
		S2 (WO)	6	7	5	6	5	6
		S3 (WT)	6	7	8	6	8	7
		S4 (ST)	6	8	7	6	6	7
5	The Strategy Supported by policies and funding from the Government	S1 (SO)	8	8	9	8	9	9
		S2 (WO)	8	7	7	7	8	8
		S3 (WT)	6	8	7	6	8	7
		S4 (ST)	9	7	7	7	8	9
6	There is a good and effective interaction within the organization or between organizations.	S1 (SO)	6	8	8	6	7	7
		S2 (WO)	7	8	6	6	8	9
		S3 (WT)	7	9	8	8	6	6
		S4 (ST)	8	8	7	8	6	8
7	There is consistency in the application of systems, processes and protocols.	S1 (SO)	8	8	7	7	6	6
		S2 (WO)	6	5	5	6	9	6
		S3 (WT)	6	8	7	6	6	5
		S4 (ST)	6	6	7	8	7	7
8	Maritime security strategy shall synergize with risk management, quality, environment and other safety systems.	S1 (SO)	8	8	7	8	9	7
		S2 (WO)	6	7	7	6	8	9
		S3 (WT)	6	6	8	5	5	8
		S4 (ST)	8	8	7	8	9	8
9	There are metric measurements, accurate monitoring and reporting procedures.	S1 (SO)	6	6	8	5	7	6
		S2 (WO)	7	6	8	8	6	6
		S3 (WT)	6	8	7	7	6	6
		S4 (ST)	8	7	7	6	8	8
10	There is regular and ongoing training	S1 (SO)	6	8	7	8	6	7
		S2 (WO)	8	7	7	8	6	7
		S3 (WT)	8	6	7	9	8	6
		S4 (ST)	7	8	9	8	8	9
11	There is an adequate control center.	S1 (SO)	6	8	6	7	8	6
		S2 (WO)	8	7	9	8	6	8
		S3 (WT)	8	8	9	6	6	7
		S4 (ST)	7	8	8	6	8	8

S2 (WO)	0,260	II
S3 (WT)	0,208	IV
S4 (ST)	0,276	I



**Figure 4.** Questionnaire Scale for Linguistic level

*Step 12.* The result of the best alternative based on the value of the highest rank.

Based on Fuzzy MCDM Analysis, this paper generates the weighting of strategies available in maritime security control. Strategy 1 (SO) has a weight of 0.256 as a third rank; Strategy 2 (WO) has a weight of 0.26 as a second rank; Strategy 3 (WT) has a weight of 0.208 as a fourth rank; Strategy 4 (ST) has a weight of 0.276 as a first rank. Then, the strategy chosen is Strategy 4 (ST) as a priority to use in maritime security control.

### **Borda Method Analysis.**

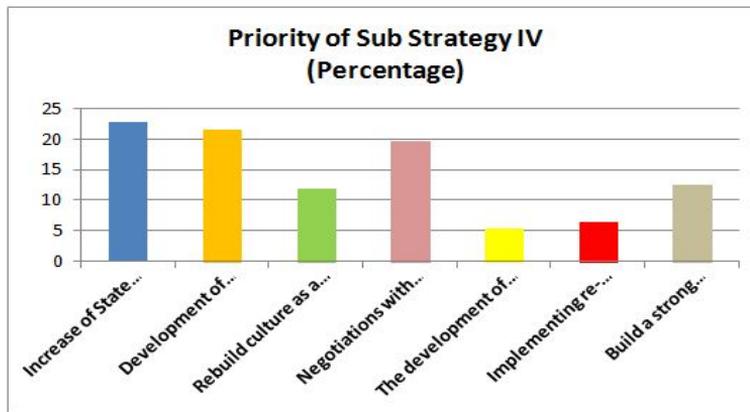
In this research, Borda method is used to provide priority allocation scale to existing sub-strategy and budget allocation in selected strategy of previous Fuzzy MCDM analysis.

**Table 8.** Result of sub strategy weighted

<b>Code</b>	<b>Strategy IV (ST)</b>	<b>Weight</b>	<b>Priority</b>
<b>(ST)1</b>	Increase the percentage of State Budget for maritime sector in the development of force of Navy and other stake holder to carry out the operation of sea crime action.	0,057	1
<b>(ST)2</b>	Development of maritime infrastructure and connectivity in coastal and border areas to open logistics channels.	0,071	2
<b>(ST)3</b>	Rebuild culture as a maritime nation.	0,168	5
<b>(ST)4</b>	Conducting negotiations with related neighboring countries in handling sea border country transfers agreement	0,089	3
<b>(ST)5</b>	The development of shipping academy infrastructure in every coastal area and the addition of teacher.	0,232	7
<b>(ST)6</b>	Carry out re-negotiations with foreign parties in the management of natural resources controlled by foreigners.	0,221	6
<b>(ST)7</b>	Build a strong foundation and infrastructure for information system in the maritime territory to cope with cyber threats.	0,161	4

**Table 9.** Percentage of State Budget Allocation

<b>Code</b>	<b>Strategy IV (ST)</b>	<b>%</b>
<b>(ST)1</b>	Increase the percentage of State Budget for maritime sector in the development of force of Navy and other stake holder to carry out the operation of sea crime action.	22,857
<b>(ST)2</b>	Development of maritime infrastructure and connectivity in coastal and border areas to open logistics channels.	21,429
<b>(ST)3</b>	Rebuild culture as a maritime nation.	11,786
<b>(ST)4</b>	Conducting negotiations with related neighboring countries in handling sea border country transfers agreement	19,643
<b>(ST)5</b>	The development of shipping academy infrastructure in every coastal area and the addition of teacher.	5,357
<b>(ST)6</b>	Carry out re-negotiations with foreign parties in the management of natural resources controlled by foreigners.	6,429
<b>(ST)7</b>	Build a strong foundation and infrastructure for information system in the maritime territory to cope with cyber threats.	12,500



Based on Borda method, the first priority of sub strategy from strategy 4 (ST) is increasing of State Budget percentage for the maritime sector in the development of Navy Capability and other stakeholders to carry out the operation of sea crime action with allocation of the budget is 22,587%.

#### 4. CONCLUSION

The economic development of Indonesia and regional areas gives an effect on national security, including maritime security sectors. Indonesia has encounters some challenges to in managing maritime security with various dimensions, including defense and security perspective.

Based on SWOT analysis, the paper gives four strategies for national maritime security. The strategies consists of seven points for strategy I Strength-opportunity (SO); seven points for strategy II

Weakness-Opportunity (WO); six points for strategy III Weakness-Threat (WT); seven points for strategy IV Strength-Threat (ST).

Based on FMCDM method, Strategy 1 (SO) has a weight of 0.256 as a third rank; Strategy 2 (WO) has a weight of 0.26 as a second rank; Strategy 3 (WT) has a weight of 0.208 as a fourth rank; Strategy 4 (ST) has a weight of 0.276 as a first rank. Then, the strategy chosen is Strategy 4 (ST). Based on Borda method, the first priority of sub strategy from strategy 4 (ST) is increasing of the State Budget percentage for the maritime sector in the development of Navy Capability and other stakeholder to carry out the operation of sea crime action with allocation is of 22,587%.

For the future work, the integrated method (SWOT-Fuzzy MCDM-Borda) can apply in any other sector of decision making.

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