THE SELECTION ANALYSIS OF LOCATION FOR THE DEVELOPMENT OF THE HYDROGRAPHIC UNIT IN SUPPORTING THE HYDRO-OCEANOGRAPHY CENTRE'S TASKS

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ABSTRACT

The Hydro-Oceanography centre has the task of carrying out military and national Hydro-Oceanographic mapping survey operations which include surveys, research, marine mapping, nautical publications, application of the marine environment, and shipping navigation safety as well as preparing data and information in territorial waters and national jurisdictions in order to support the interests of the TNI and public for national defense and national development. This research was carried out because the current condition of Pushidrosal has one Survey Unit (Satsurvei) which is centralized in Jakarta. The Satsurvei is tasked with carrying out the development of the Hydrographic Auxiliary KRI (BHO) and the Coastal Survey Unit to carry out marine mapping surveys, faced with a spectrum of challenges and task demands, especially in accelerating the updating of Hydros data and information accurately and sustainably throughout Indonesian waters as well as to support national development, it is necessary to innovate organizational governance in the form of developing the degree of strength of a regional work unit, namely the Hydro-Oceanographic Unit (Sathidros). Determination of the development of the Sathidros location becomes a necessity as an extension of the Pushidrosal in order to be able to reach the implementation of the task of fostering hydros functions and carrying out mapping surveys throughout Indonesia more effectively and efficiently. In this study, the development site of Sathidos will be selected using a methodological approach, namely Fuzzy Multi-Criteria Decision Making (FMCDM). For the fuzzy criterion weighting problem (opacity/bias) in, this study a more intuitive technique in its application is used, which is AHP Fuzzy (Analysis Hierarchical Process).

Keywords: Sathidrosal, FMCDM, AHP

1. Introduction

Changes in nomenclature and organizational structure in the Indonesian navy had an impact on Pushidrosal. Hence Pushidrosal Some of the strategies for developing strengths and capabilities include: (1) Strengthening the organization through revitalizing the position and capability of the Pushidrosal, (2) Increasing the strength and capability of personnel as well as professional development, (3) Increasing the defense equipment system for surveying and mapping, (4) Development of building facilities and infrastructure. supporting infrastructure, (5) Increasing mapping survey equipment and technology as well as supporting non-defense equipment, (6) Increasing security, defense, and security capabilities, (7) Increasing the capability of empowering marine defense areas, (8) Increasing the capability of supporting marine mapping survey operations, logistics, budgeting, cartography, nautical and map production and distribution, (9) Increasing foreign cooperation, information and data analysis system, marine geospatial and formal national institutions.

Strength and capability development strategies in organizational development are based on the dynamics of the development of the strategic environment, the scope of the Pushidrosal work area is quite wide covering all Indonesian waters, the dynamics of organizational validation within the Indonesian navy has legal aspects.

The background of this research because the current condition of Pushidrosal has one Survey Unit which is centralized in Jakarta. The Satsurvei is tasked with carrying out the development of the Hydrographic Auxiliary warship (BHO) and the Coastal Survey Unit to carry out marine mapping surveys, faced with a spectrum of challenges and task demands, especially in accelerating the updating of Hydros data and information accurately and sustainably throughout Indonesian waters as

well as to support national development, Therefore, it is necessary to innovate organizational governance in the form of developing a regional unit of strength, namely the Hydro-Oceanographic Unit in three defense compartments, namely Regions I (West), II (Central), and III (East).

2. Literature review

2.1 Theory of organizational change

Mirrian Sofjan ((2005: 1.10)) (Yulianti & Meutia, 2020) states that modern theory views organization as a system of processes. A system is made up of parts of an organization that are related to each other as a whole. These divisions include external factors and internal factors of the organization. External factors are environmental factors that the organization finds itself, such as political, economic, social, and cultural factors, technology, legal, demographic, resource. nature, consumers, customers, etc. While the internal factors are working people, duties and responsibilities, working relationships, funds and tools, work regulations and procedures, etc.

2.2 Development strategy

Etymologically, development strategy is a form derived from the Greek word Strategyos, which means "military commander". While the meaning of the term is the meaning derived from Experts suggest that strategy has different meanings depending on their point of view. In general, it has the same meaning and meaning, namely aimed at achieving goals efficiently and effectively.

According to (Afridhal, 2017), a development strategy is a means or action that becomes a requirement of decision-making for leadership leadership in an effort to achieve development. The development strategy will have an impact on the life and performance of the organization in the long term.Because the development strategy is forward-looking in nature, it will have an impact on the organization's life and performance in the long run. The development strategy functions to form by taking into account the external and internal factors in the organization's conditions. Formulation strategy activities include those aimed at developing the evolving business mission and vision,identifying aspects of opportunities and threats outside the organization, identifying aspects of strengths and weaknesses within the organization, determine the long-term goals of the organization, design alternative organizational strategies, and formulate the strategies selected for development (Fariyatul & Bandono, 2017).

2.3 The concept of fuzzy logic

Fuzzy logic is logic that has a fuzzy value between two values (Yusuf Anshori, 2012). Fuzzy set theory, this concept was first proposed by Professor Lotfi A. In 1965 Zadeh was Professor of Electrical Engineering and Computer Science at the University of California, Berkeley. The advantage of fuzzy logic is that it can express various uncertainties/ambiguities of human thought and subjectivity.

2.4 Fuzzy Set.

fuzzy set implements infinity logic whereas a clear set uses bi-valued logic. Previously, the principles of expert systems were formulated based on Boolean logic. But later human thinking doesn't always follow the "yes" / "no" that is shown in 0 and 1 logic and it can be vague, qualitative, uncertain, imprecise, or obscure. This gave the start of the development of fuzzy set theory to imitate human thinking.

2.5 Membership Features.

A Membership Function is a curve on the interval from 0 to 1 that associates data entry points with their membership values (also known as degrees of membership). One way to get

membership values is using a functional approach. (Kusmadewi et al., 2010).

2.6 Triangular Fuzzy Number.

A triangular fuzzy number is a subtype of fuzzy number defined by three symbolic real numbers (l, m, u). Where “l” is the lower limit, “m” is the most probable value, and “u” is the upper limit. limit. Scored. The fuzzy numbers are sharp when l=m= u. The triangular fuzzy number is represented as shown in the following figure 1:

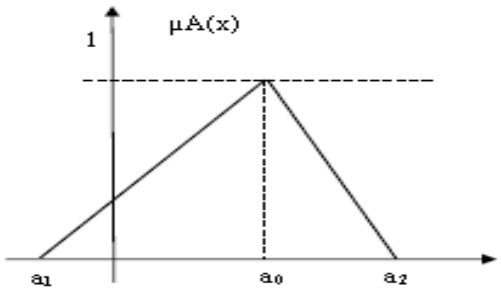

Figure 1. Triangular Fuzzy Number The triangular

3. Research Methodology

3.1 Multi-Criteria Decision Making (MCDM)

Multi-criteria decision making is a decision-making method that encompasses analytical decision-making theories, processes, and methods including aspects of uncertainty, dynamics, and multiple decision criteria. (Zavadskas & Turskis, 2010), MCDM methods are grouped as follows:

a. This method is based on a quantitative measurement. Methods based on Multi-Criteria Utility Theory (MAUT) are included in this group, e.g. TOPSIS, SAW , LINMAP (Linear Programming Technique for Multidimensional), Prioritized analysis, COPRAS), COPRAS-G and ARAS (Supplementary Report Assessment).

b. Methods based on qualitative initial measurements include two groups.

c. compared to the preferred comparison method based on surrogate pair comparison.This group includes ELECTRA, PROMETHEUS.

d. Methods are based on qualitative measures that are not converted into quantitative variables. This group includes methods of making decisions about linguistic data and the use of qualitative data with a high degree of uncertainty.

3.2 Fuzzy Analytical Hierarchy Process (FAHP)

(Sari et al., 2019) Chang (1996) defines AHP intensity values on a triangular fuzzy scale by dividing each fuzzy set by 2, excluding intensity of importance 1. Triangular fuzzy used in Chang scale. The chang scale consists of intensity interest from 1 until 9, each number including the triangular fuzzy number. So there is a smooth gradation between the previous and new numbers. The scale of Fuzzy AHP can be seen in table 1:

Table 1. Fuzzy Triangle Value Scale Table

Intensity of Interest of AHP	Linguistic Set	Triangular Fuzzy Number (TFN)	Reciprocal (Inverse)
1	Comparison of the same elements (Just Equal)	(1, 1, 1)	(1, 1, 1)
2	Intermediate	(1/2, 1, 3/2)	(2/3, 1, 2)
3	Moderate importance	(1,3/2,2)	(1/2,2/3,1)
4	One intermediary is more important than the other	(3/2 2,5/2)	(2/5,1/2,2/3)

5	Elements of one is stronger than the other (Strongly Important)	(2, 5/2, 3)	(1/3, 2/5, 1/2)
6	Intermediate	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)
7	Elements one is more important than the other (Very Strong)	(7/2, 4, 9/2)	(1/4, 2/7, 1/3)
8	Intermediate	(7/2, 4, 9/2)	(2/9, 1/4, 2/7)
9	Elements of one is absolutely more important than the other (Extremely Strong)	(4, 9/2, 9/2)	(2/9, 2/9, 1/4)

According to Chang (1996), the steps to complete F-AHP are:

a. Create a hierarchy of problems to solve and determine pairwise matrix comparisons between criteria using the TFN scale

b. Determine the dominant fuzzy (Si) composite value using the following formula:

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \frac{1}{\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j}\right]} \quad .....1)$$

where:

M = Triangular fuzzy number

m = Number of Criteria

j = column

i = row

g = parameters

c. The results M2= (l2, m2, u2), M1= (l1, m1, u1) obtained for each fuzzy matrix can be defined as vector values.

d. The resulting fuzzy value is larger than fuzzy k, Mi =, 1, 2,…,k. can be determined as the value of the coordinate.

e. The normalized vector weight or the derived preference value for the criterion, W = (d(A1), d(A2),…d(An), “W” is a fuzzy number.

3.3 Determination of Criteria and Sub-criteria

Criteria are measures, rules and standards that become a reference for decision makers. Many different factors were considered in the decision-making process of selecting Sathidros sites for development. At this stage, criteria and sub-criteria were determined, preceded by consultation through discussions with experts at Pushidrosal headquarters. Before determining the priority of the alternative to be selected, the process considers criteria and sub-criteria. The criteria and sub-criteria to consider when selecting alternatives are:

a. Criteria for Sathidrosal Development Locations include:

1) Supporting Facilities for Sathidrosal
2) Environmental Condition
3) Strategic Condition of Location
4) Facilities Maintenance and Repair

b. The sub-criteria include:

1) The supporting facilities for the Sathidrosal mako are land availability facilities, port facilities, restocking facilities, material and personnel maintenance facilities, coaching and training facilities.

2) At the facility environmental conditions, namely geographical conditions, regional vulnerability, climate and weather.

3) In strategic location conditions, namely the availability of shopping centers, availability of transportation, health facilities.

4) In maintenance and repair facilities, namely docking facilities, workshop facilities, warehousing facilities, electricity and clean water facilities.

3.4 Data processing

FMCDM algorithm (Liang & Wang, 1994):

a. Weighted Results Table Qualitative criteria for evaluating aggregated weight values.

b. Present evaluation results or prioritize alternatives based on existing qualitative criteria versus.

c. Calculate the average fuzzy number by adding the values that occur at each level of the language scale and dividing the total by the number of criteria that fall within that level.. For math notation:

$$a_t = \frac{\sum_{i=1}^{k} \sum_{j} T_{ij}}{\sum_{i=1}^{k} n_{ij}} \quad \text{.....2)}$$

ðt = mean value of fuzzy number for level

T = extremely low, low, medium, high, and extremely high rating

n = number of scale coefficients of the language scale T for the first alternative of the i factor

Tij = numeric value of the T language scale for the first variant of the jth factor.

d. Calculate the lower and upper bounds of fuzzy numbers. where the lower limit (ct = b I - 1)) equals the lower limit's mean and the upper limit (bt = b I - 1)) equals the upper limit's mean

e. Determine the aggregate weight for each qualitative criterion. In this study, we have defined the triangular fuzzy number, which is a form of linguistic evaluation, so the next synthesis is done to find the composite values for each lower bound (c), mean (a) and over constraint (b) and can be modeled as

$$c_t = \frac{\sum_{j=1}^{n} c_{tj}}{n} a_t = \frac{\sum_{j=1}^{n} a_{tj}}{n} \quad b_t = \frac{\sum_{j=1}^{n} b_{tj}}{n} \quad \text{.....3)}$$

where:

ct = limit value according to the t qualitative criterion of the j decision maker

at = mean of the tth qualitative criterion of the j decision maker

bt = upper limit value of the decision maker's tth qualitative criterion j

n = number of reviewers (decision makers)

N = value of composite weights for criteria t.

f. Calculation of individual option preference values by qualitative criteria. If you want to calculate the weight of each alternative aggregated by criteria, you can use the following model to find the fuzzy aggregation values.

$$q_t = \frac{\sum_{j=1}^{n} q_{tj}}{n} \quad o_t = \frac{\sum_{j=1}^{n} o_{tj}}{n} \quad p_t = \frac{\sum_{j=1}^{n} p_{tj}}{n} \quad \text{.....4)}$$

Where:

qt = alternative lower limit value for criteria t qualitative by j-th kep maker.

ot = alternative mean for criteria qualitative.tth by the jth decision maker.

pt = alternative upper limit value for criteria qualitative t by the maker of p to j.

n = number of raters (decision makers).

The aggregate value is Mtj = (qt,ot,pt)

Where :

Mtj = aggregation weight value for alternative i for the t qualitative criteria.

g. Computing fuzzy index values from results Evaluation of each alternative against the criteria Qualitative, denoted by Gi. First, the Mt and Nt values are obtained. Gi match index value for each subjective criteria. where Gi is a fuzzy number, not a fuzzy triangular number.

Gi = (Yi,Qi,Zi,Hi1,Ti1,Hi2,Ui1), i= 1,2,...m

The fuzzy index value is obtained by concatenating each triangular fuzzy number element of resulting numbers 2 and 4 with the following notation :

$$T_{i1} = \frac{\sum_{t=1}^{k}(a_{it}-q_{it})(a_t-c_t)}{k}$$
$$T_{i2} = \frac{\sum_{t=1}^{k}[q_{it}(a_t-c_t)+c_t(a_{it}-q_{it})}{k}$$
$$U_{i1} = \frac{\sum_{t=1}^{k}(p_{it}-a_{it})(b_t-a_t)}{k}$$
$$U_{i2} = \frac{\sum_{t=1}^{k}[b_t(a_{it}-p_{it})+p_t(a_t-b_t)}{k} \quad \text{.....5)}$$

$$H_{i1} = \frac{T_{i2}}{2T_{i1}}$$
$$H_{i2} = -\frac{U_{i2}}{2U_{i1}}$$
$$Y_i = \frac{\sum_{t=1}^{k} q_{it}a_t}{k}$$
$$Q_i = \frac{\sum_{t=1}^{k} a_{it}a_t}{k}$$
$$Z_i = \frac{\sum_{t=1}^{k} p_{it}b_t}{k}$$

h. Calculate the profit of each option according to qualitative criteria.

$$T_{i1} = \frac{\sum_{t=1}^{k}(a_{it}-q_{it})(a_t-c_t)}{k}$$
$$T_{i2} = \frac{\sum_{t=1}^{k}[q_{it}(a_t-c_t)+c_t(a_{it}-q_{it})}{k}$$
$$U_{i1} = \frac{\sum_{t=1}^{k}(p_{it}-a_{it})(b_t-a_t)}{k}$$
$$U_{i2} = \frac{\sum_{t=1}^{k}[b_t(a_{it}-p_{it})+p_t(a_t-b_t)}{k}$$

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

$$X_R = \frac{1}{2}\left\{2x_1 + 2H_{i2}(x_2 - x_1) + \frac{(x_2-x_1)^2}{U_{i1}} - (x_2 - x_1)\left[(2H_{i2} + \frac{(x_2-x_1)^2}{U_{i1}} + 4\frac{x_1 - z_{i_1}}{U_{i1}})\right]^{\frac{1}{2}}\right\}$$

$$X_L = \frac{1}{2}\left\{2x_2 + 2H_{i1}(x_2 - x_1) + \frac{(x_2-x_1)^2}{T_{i1}} - (x_2 - x_1)\left[(2H_{i2} + \frac{(x_2-x_1)^2}{T_{i1}} + 4\frac{x_1 - z_{i_1}}{T_{i1}})\right]^{\frac{1}{2}}\right\} \quad \text{.6)}$$

The first step is to find the value of the defuzzification criterion and its alternative setting. the defuzzification method used is the central one. The defuzzification formula of the criteria is:

$$\text{Defuzzifikasi}N_{it} = \frac{\left[\left[\int_{c_t}^{a_t}\frac{(x-c_t)}{(a_t-c_t)}x\,dx + \int_{a_t}^{b_t}\frac{(x-b_t)}{(a_t-b_t)}x\,dx\right]\right]}{\left[\left[\int_{c_t}^{a_t}\frac{(x-c_t)}{(a_t-c_t)}dx + \int_{a_t}^{b_t}\frac{(x-b_t)}{(a_t-b_t)}dx\right]\right]} \quad \text{.....7)}$$

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

The formula qualitative criteria to determine the intervention value of alternative preferences is:

$$\text{Defuzzifikasi}M_{it} = \frac{\left[\left[\int_{q_{it}}^{p_{it}}\frac{(x-q_{it})}{(p_{it}-q_{it})}x\,dx + \int_{p_{it}}^{y_{it}}\frac{(x-y_{it})}{(a_t-y_{it})}x\,dx\right]\right]}{\left[\left[\int_{q_{it}}^{p_{it}}\frac{(x-q_{it})}{(p_{it}-q_{it})}dx + \int_{p_{it}}^{y_{it}}\frac{(x-y_{it})}{(a_t-y_{it})}dx\right]\right]} \quad \text{.....8)}$$

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

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

i. Calculate the score value of each alternative based on the qualitative criteria :

$$ST_i = \frac{U_T(G_i)}{\sum_{i=1}^{m} U_T(G_i)|} \quad \text{.....9)}$$

Where :

STi = i alternative ranking of value based on qualitative criteria.

j. Calculate the score value of each alternative based on quantitative criteria according to the following formula:

$$OT_i = \frac{\sum_{j=1}^{p}\left[T_{ij}/\left(\sum_{i=1}^{m} T_{ij}\right)\right]}{p} \quad \text{.....10)}$$

Where :

đTi = value (score) of the i-th alternative for criteria j quantitative

M = number of alternatives

p = number of quantitative criteria

OT = i alternative ranking value based on quantitative criteria

k. Calculate the total/ final score of each alternative for the qualitative and quantitative criteria according to the following formula:

$$FT_i = \frac{ST_i + OT_i}{\sum Vk} \qquad ,0 \le x \le 1 \quad \text{.....11)}$$

Where :

STi = i alternative rating value based on qualitative criteria.

đTi = i alternative rating of value based on quantitative criteria

Vk = number of variables.

FTi = total rating values for i

l. Choose the best alternative based on highest rating value.

4. Conclusions and Suggestions

Based on data processing and analysis, conclusions and recommendations can then be presented to decision makers and other researchers. The important criteria in selecting the development location of Sathidrosal are the criteria of importance and based on the results of processing weight priority values. based on the selected weight values will be able to make recommendations to the decision makers in determining the policy.

The suggestion for further research is to solve the problem of choosing the preferred location for the development of higrograpy unit by using the MCDM AHP fuzzy matching approach. It would be perfect if it had software designed to solve this problem so it's easier to apply and dynamic problems are easier to fix.

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