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INTELLIGENT DECISION SUPPORT SYSTEMS (IDSS) FOR MULTI-OBJECTIVE OPTIMIZATION PROBLEMS AT SEA SECURITY INDONESIA

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ABSTRACT

Indonesian maritime security issues is a complex problem therefore included in the multi-objective problems, it is necessary for the proper method to overcome these problems, one of them by developing intelligent decision support system using methods *Non dominated Sorting Genetic Algorithms* II (NSGA II) and Fuzzy C Means (FCM). NSGA-II method will produce a set of optimal solution candidates, while the FCM method serves to minimize the set of optimal solutions. His study aims to maximize the achievements of the *coverage area* and minimize operational costs by considering the type of vessel, speed, range radar, *endurance.* Optimization results using NSGA-II with the following parameters: population = 20, generation = 100, crossover probability = 75% and = 90% probability of mutations produced as many as 125 candidates for the optimal solution. Furthermore, the solution is in the cluster to minimize the prospective solutions based on a predetermined point cluster into four, resulting in four candidates for the best solution, that is: [1] Co = Rp. 4.741.205.798 and Ca = 1.915.083 Mil^2; [2] Co = Rp. 3.997.582.228 and Ca = 1.560.672 Mil^2; [3] Co = Rp. 4.802.314.832 and Ca = 1.962.895 Mil^2; [4] Co = Rp. 4.939.637.487 and Ca = 1.982.564 Mil^2. Results of Intelligent Decision Support System with consideration of increasing security in sea area of Indonesia and optimize the budget that has been set by the Government, the recommended solution is the solution to the cluster of four with a combined value of patrol boats [6477554756251363061531165O2] Cost = Rp. 4.939.637.487, Coverage = 1.982.564 Mil^2 and distance = 0.006724.

Keywords: *IDSS*, *Multi-Objective Optimization Problems, NSGA-II, FCM*

1. INTRODUCTION

Negara kesatuan Republik Indonesia (NKRI) is an archipelago of 17.504 islands and has a 81.290 kilometer long beach *(Dishidros TNI-AL, 2003).* As an island nation with 80% of marine areas and 20% of the land area, the percentage of the greatest threats to the sovereignty of Indonesia is in the sea area. This percentage becomes higher threat because of the geographical position of Indonesia are in the world trade traffic.

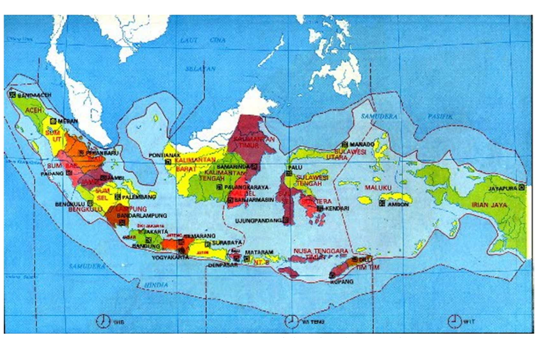

Figure 1. Map Indonesian archipelagic sea lanes (ALKI) *(Source: google maps)*

The high number of crimes and violations that occurred in Indonesian waters showed that the Indonesian sea is not safe. Violations were caught during the year 2005 - 2012 has increased. Supposed to be the quality and quantity of the Navy was able to secure Indonesian waters from various threats of *illegal logging*, *illegal fishing, illegal minning* and violations of the border region. This is due to several factors, that is:

[1]. Delimitation of the sea area of Indonesia is not yet clear;
[2]. Indonesian sea connected with Indonesian archipelagic sea lanes (ALKI I and II);
[3]. Weak coordination among government agencies that handle marine border security Indonesia;
[4]. The vast area of Indonesian waters are to be secured;
[5]. The limited number of Patrol Boats Republic of Indonesia (KRI);
[6]. The lack of the budget provided by the State for the cost of security operations Indonesian sea area;

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[7]. Less precisely the Navy's decision in determining the operational management of Indonesia's marine security;

[8]. he limited ability of a commander to resolve some of Indonesia's marine security issues quickly and accurately.

Based on the above factors the Government is seen to be more careful, quick and precise to decide what strategy will be taken in the Indonesian marine security operations.

The decision is the process of choosing, that is a choice of two or more possibilities. Decision making is the process of choosing an alternative way of acting with an efficient method according to the situation. For that a commander of the Navy must be able to provide some alternative decision regarding the assignment and placement of Indonesian warship (KRI) in the area of operation so as to increase the intensity of Indonesian maritime security while considering operational costs prepared by the State. Therefore, the Indonesian maritime security issues not only in the form of single objective problem but has become a model of multi-objective problem.

For that we need a method to solve these problems, using the best methods of finding solutions. It is known for Multiobjective Optimization Problems (MOP), based on some previous studies that MOP included in Metaheuristic issues that have been extensively researched and developed by the researchers (Talbi, 2009) (Luke, 2012). So Multiobjective Optimization Problem is a problem that involves more than one objective function to be minimized or dimaksimasi. The answer will be obtained from these problems is a collection of solutions that describes best tradeoff among competing objective functions (Deb, 2001). The best solution in Multiobjective Optimization Problem is determined by the dominance / dominace test.

This study focused on solving the problems of Indonesia's marine security by means of simulating the placement of the Navy patrol boats to the respective bases. The purpose of this research is to develop an intelligent decision support system application by optimizing database available, the methods used to construct the intelligent decision support system is Nondominated Sorting Genetic Algorithm (NSGA) and Fuzzy C-Means (FCM).

The simulation results NSGA generate many combinations of solutions Navy patrol boat optimum form of optimal Pareto set. Therefore, it still needed further processing to minimize the many solutions that use clustering methods to reduce the Pareto optimal set into a number of more specific decisions so that decision-makers will be easier to determine the best decision of several alternative decisions.

2. RESEARCH METHODS

2.1. *Intelligent Decision Support Systems* (IDSS)

Intelligent Decision Support System (IDSS) is a development of the method of *Decision Support System* (DSS) and *Artificial Intelligent* (AI). This method was developed to help decision makers at various stages of decision-making by integrating modeling and human knowledge.

IDSS is a tool to help the decision-making process in which the uncertainty of the solution becomes a complex problem in which the decision must be made using human judgment and preference (Hozairi, 2011). IDSS as the concept of implied, are used to support decision-making and is not meant to replace the task of decision-makers. In addition, the IDSS work under the assumption that the decision makers are more familiar with the problem to be solved. In this case, the IDSS provides full control to the user regarding information acquisition, evaluation and make a final decision.

IDSS is an interactive *system, flexible,* adaptable and is specifically developed to support the management of unstructured problem solving to improve decision-making. A more cognitive than the IDSS technology systems, The fundamental difference is that the basic characteristics of intelligence can not be captured in a mechanistic (Malhotra et al, 2003). Most researchers agree that the aim of DSS is to support management solution and enables the processing of unstructured knowledge with better communication skills (Qian et al, 2004;. Quintero et al, 2005).

2.2. The Principle of Multi Objective Optimization

Indonesian maritime security issues is a complex issue because it deals with the placement of some of the Navy patrol boats at each base in each sector. So that marine safety problems Indonesia is a *multi-objective* problem. Problems multi objective is to minimize the operational costs of the Navy patrol boats and improve the achievement of coverage of the Navy patrol boats.

The goal of completion of the Multi *Objective Optimization Problems* is to find a solution for each of the objective which has been optimized. In

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mathematics usually indicates a conflict between the objective function. Therefor, optimization is used to find a solution that will provide value to optimize all functions that goal can be fully accepted by the decision maker.

So *Multiobjective Optimization Problems* is a problem that involves more than one objective function to be minimized or in the maximization. The answer will be obtained from these problems is a collection of solutions that illustrate best tradeoff among competing objective functions (Deb, 2001).

The general form of the mathematical model of this function is:

Min/Max f_m (x) m= 1,2,……m

Subject to:

$g_i(x) \geq$ $j = 1,2,\ldots\ldots,j$

$h_i(x) = 0$ $k = 1,2,\ldots\ldots,k$

$X_j^l \leq X_i \leq X_j^U$ $i = 1,2,\ldots..n;$

l = lower bound;

u = upper bound

In the *single-objective,* optimization problem, the best solution is easily determined by comparing the value of the objective function. While the problem of *multi-objective* optimization, the best solution is determined by *dominance. Dominace test* the intention is as follows:

- X_1 dominate X_2, if:
  - X_1 is a better solution than the X_2 in all the results of the objective function.
  - Solution X_2, X_1 is better than at least in the objective function
- X_1 dominate X_2 → if X_2 is controlled by X_1

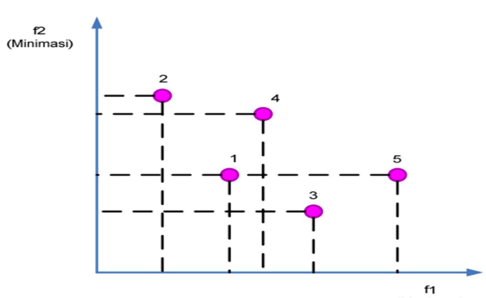

Figure 3. *Dominance test (Source: Deb, 2001)*

In figure 3 is described as follows:

- 1 Vs 2: 1 Dominating 2
- 1 Vs 5: 5 Dominating 1
- 1 Vs 4: no solution dominates

2.3. *Nondomination Sorting Genetic Algorithm* II (NSGA II)

One type of *Multi Objective Genetic Algorithm* (MOGA) is a *non-dominated Sorting Genetic Algorithm* (NSGA) developed by N. Kalyanmoy Srinivas and Deb [8] which is a modification of the ranking procedure. NSGA II algorithm based on multiple layers of classification of individuals. Before the selection is displayed, the population in the rankings on the basis of *non-domination*. Non dominated all individuals classified into one category.

In order to maintain the diversity of the population, This classified individually divided by the value of *dummy fitness.* Then a group of individuals classified is ignored and another layer of individual non-dominated considered. The process will continues until all individuals in the population classified. Since the individual on the first *front* have the maximum *fitness* value, they always get a copy which is more than the remaining population. This allows for a better search on the area *Pareto Front* and produce convergence of the population towards the area.

2.4. Fuzzy C – Means

Fuzzy clustering is one technique for determining the optimal *cluster* in a vector space based on the normal form for the Euclidean distance between the vectors. *Fuzzy clustering* very useful for modeling *fuzzy* especially in identifying rules *fuzzy.* Method *clustering* grouping of data and its parameters in groups - groups according to the tendency of the nature of each of these data (similarity properties).

Famous *fuzzy clustering* algorithm is Fuzzy C-Means (FCM) which was introduced by Jim Bezdek. he Introduced the idea of *fuzzyfication* parameter (m) in the range [1, n] the which determines the degree of all of the cluster's fuzzy. When the cluster *m = 1,* the effect is a *crisp* clustering of some point, but when *m> 1* degree to the fuzzy-an in between points on the decision space to be increased.

If X=$\{x_1,x_2,\ldots,x_n\}$ where $x_i \in R^n$ is a set of data features and objectives of the FCM algorithms is to minimize the cost function FCM the formulated as followed:

$$J(U,V) = \sum_{j=1}^{C}\sum_{i=1}^{N}(\mu_{ij})^m \left\|x_i - v_j\right\|^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

V=$\{v_1,v_2,\ldots,v_c\}$ is the center of the cluster. U=$(\mu_{ij})_{NxC}$ is a *fuzzy* partition matrix where each member μ_{ij} shows the degree of membership between data vectors x_i and cluster j. The value of the matrix U must meet the following conditions:

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$$\mu_{ij} \in [0,1] \quad \forall i = 1,\dots,N \quad \forall j - 1,\dots,C \qquad \text{........... (2)}$$

FCM *Clustering* involves two processes, namely counting center cluster and assignment of points to the center by using a form of the *Euclidean* distance. This process is repeated until the center *cluster* has stabilized. FCM executing a direct constraint on the *fuzzy* membership function connected with each point as follows:

$$\sum_{j=1}^{C} \mu_{ij} = 1, \quad \forall i = 1,\dots,N \qquad \text{......................... (3)}$$

The purpose of the FCM algorithm is the assignment of data points into *clusters* with varying degrees of membership. The membership reflects the degree to which point more representative of one of the other cluster.

Eksponen m ∈ [1, ∞] is a weighting factor that determines all of the *cluster's fuzzy*. The use of distance most frequently used is the *Euclidian* $d_{ij} = \| x_i - v_j \|$. Minimization of the cost function J (U, V) is a non-linear optimization problems can be minimized by following iterative algorithm:

1. Initialization U membership matrix with random values so that the condition (9) and (10) are met. Select exponent m with precise and termination criteria.
2. Calculate the cluster centers V according to the equation:

$$v_j = \frac{\sum_{i=1}^{N} (\mu_{ij})^m_{x_i}}{\sum_{i=1}^{N} (\mu_{ij})^m}, \quad \forall j = 1,\dots,C \qquad \text{......... (4)}$$

3. Calculate new distance:

$$d_{ij} = \| x_i - v_j \|, \forall i = 1,\dots,N; \forall j = 1,\dots,C \qquad \text{...... (5)}$$

4. Update fuzzy partition matrix U if $d_{ij}>0$ (indicating that $x_i \neq v_j$)

$$\mu_{ij} = \frac{1}{\sum_{k=1}^{C} \left(\frac{d_{ij}}{d_{ik}} \right) \frac{2}{m-1}} \qquad \text{.......... (6)}$$

5. If the termination criteria have been met, stop and if others go to step 2.

2.5. Operational Cost Navy

The operational costs of the Navy patrol boats is a collection of some of the costs involved in a single operation for the Indonesian maritime security. These costs include some things, That is:

a. **Logistics Cost Navy (B_{LK}):**
   - Fuel Oil (B_{BBM}) (Rp/ltr)
   - Lubricating Oil (B_{MP}) (Rp/ltr)
   - Fresh Water (B_{AT}) (Rp/ltr)

So the formula for calculating the cost of logistics ships as follows:

$$\mathbf{B_{LK} = \sum B_{BBM} + \sum B_{MP} + \sum B_{AT} \ (Rp)} \qquad \text{.......... (7)}$$

b. **Personnel cost (B_{OP}):**
   - Sailing allowances personnel (B_{TL}) (Rp/day)
   - Meal allowances personnel (B_{UMO}) (Rp/day)
   - Leaders allowances personnel (B_{TP}) (Rp/day)

So the formula for calculating the operational costs of personnel as follows:

$$\mathbf{B_{OP} = \sum B_{TL} + \sum B_{UMO} + \sum B_{TP} \ (Rp)} \qquad \text{.......... (8)}$$

So to minimize operational costs and personnel navy obtained by the following formula:

$$\text{Co} = \sum_{n=1}^{7} Co \ (Rp) \dots\dots Min$$

$$\text{Co} = \sum_{n=1}^{7} \sum B_{LK} + \sum B_{OP} \ (Rp) \dots . Min \qquad \text{..... (9)}$$

2.6. Coverage Area Navy

Navy patrol boats that move from one point to another during his endurance has several variables, namely: radar capability and speed. Coverage area of the Navy patrol boats is the ability of a vessel to conduct security operations in accordance with the sailing capabilities. For the calculation of broad range and coverage area of the patrol boat cruising distance as figure 3.

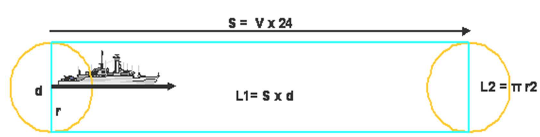

Figure 4. Coverage area range

Based on Figure 3 there are some similarities as follows:

S_{kri} = Navy speed x 24 Hours (Mil)

- $\mathbf{S_{kri}} = \sum V_{kri}$ * 24 Hours (Mil)
- d_{kri} = Radar range (Mil)
- $L1_{kri}$ = Wide Rectangle
  $L1_{\mathbf{kri}}$ = $S_{kri} * d_{kri}$ (Mil^2)
- $L2_{kri}$ = Area of a circle
  $L2_{\mathbf{kri}}$ = $\pi * r^2$ (Mil^2)

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Coverage Area wide range navy is a rectangular area (L1) plus the area of a circle (L2) and multiplied by the *probability* of detection radar.

Coverage Area Range (CA):

$CA_{kri} = \sum(L1+L2)$ * Probability radar (Mil^2)

$CA_{kri} = \sum(L1_{kri}+L2)*0.9\ (Mil^2)$ …………… (10)

So to maximize the achievement of the coverage area of the Navy patrol boats with the following formula:

$$\text{Ca} = \sum_{n=1}^{7} Ca \ldots Max$$

$$\text{Ca} = \sum_{n=1}^{7} \sum(\text{L1}_{kri} + \text{L2}) * 0.9Mil^2 \ldots Max$$

$$\text{Ca} = \sum_{n=1}^{7} (\sum((v_{kri} * 24\,Jam) + d_{kri}) + \sum\pi * r^2) * 0.9Mil^2 \ldots Max$$

2.7. Constraint Functions

- Class PARCHIM = All sector
- Class FPB and PC ≠ sector IV and VII
- Operational cost ≤ Rp. 5.000.000.000
- Coverage Area ≥ 1.868.000 Mil^2
- Used of Navy ≤ 27 Kapal

So to get a combination of the Navy patrol boats are optimal in each sector, constraint functions used are fitness value of genetic algorithms operator:

- ***Cost*** **(C_o):**

$$\text{Cost} = \sum_{n=1} \sum(B_{bbm} + B_{at} + B_{mp}) + \sum(B_{tl} + B_{umo} + B_{tp})\ (Rp) \ldots\ldots Min$$

$$\textit{Fitness 1} = \frac{1}{Cost} * 0.01 \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

- ***Coverage Area*** **(C_a)**

$$\text{Ca} = \sum_{n=1}^{7} (\sum((v_{kri} * 24\,Jam) + d_{kri}) + \sum\pi * r^2) * 0.9Mil^2 \ldots Max$$

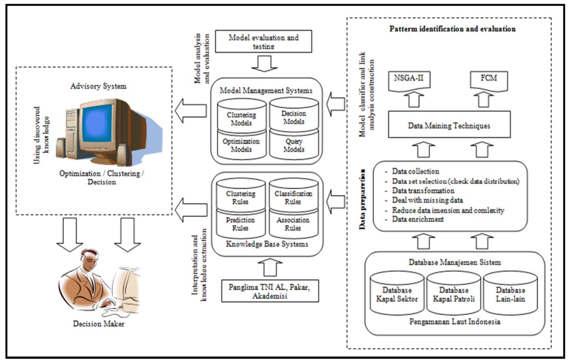
$$\textit{Fitness 2} = Ca * 0.01 \quad \ldots\ldots\ldots\ldots (12)$$

3. RESULT AND DISCUSSION

In Figure 4 shows the determination of design combinations, where at the beginning of the scenario of a commander will choose commissioned navy in accordance with the classification to each base represented by sector.

The selected scenario will be influenced by several factors: vessel specifications (speed, endurance radar capability, weaponry, the number of personnel), geographical conditions bases (level of vulnerability, wind velocity, an area, support facilities, etc).

The government demands is how to improve the achievement of the *coverage area* of the navy so the condition of Indonesia's marine area is guaranteed security. but what about the cost to a minimum by looking at the terms set by the Government budget. This problem will be solved by using NSGA-II to select optimal solutions of some combination of ships assigned to the 7 (seven) sectors of the fleet in the eastern region of Indonesia.



Fiqure 5. Model IDSS For Maritime Security

The first stage of the optimization assignment Navy patrol boats to every sector of operation, by using the algorithm NSGA-II obtained many optimal combination in accordance with the value of fitness is to maximize coverage area and minimize operational costs.

KODE KAPAL PATROLI TNI AL	COST	COVERAGE	ON	OFF	Fitnes
6477554756253510311263315O2	4869420525.00	1954784.00	25	2	2.131
647755475625136306153116502	4939637487.00	1982564.00	25	2	2.162
422755475625351031126333502	4741205798.00	1915083.00	25	2	2.082
647755475625136301153116502	4925224343.00	1976429.00	25	2	2.155
647755475625136301153116502	4925224343.00	1976429.00	25	2	2.155
647755475625136301153116502	4925224343.00	1976429.00	25	2	2.155
640755475650500631126311502	4249321785.00	1737294.00	22	5	1.879
647755475625136301153116502	4925224343.00	1976429.00	25	2	2.155
647755475625136056356532315	5032920449.00	2062297.00	26	1	2.228
647755475625136301103116502	4817888365.00	1897459.00	24	3	2.087
640755475650500631126311502	4249321785.00	1737294.00	22	5	1.879

Fiqure 6. Results Of The Optimization NSGA-II
(P_c < 50%, P_m = 10%, 20 Generation)

Results of a multi-objective optimization stage produced an optimal solution that is pretty much the constraint as follows:

- Coverage Area ≥ 1.688.765 Mil^2
- Operational Cost ≤ Rp. 5.000.000.000

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Based on the results of running the model NSGA-II with 20 generations showed 125 solution with various models of optimal combination of navy. Based on Figure 6 on the first line, describes the composition of 27 navy seven sectors.

647755475625351031126331502

Figure 7. Solution NSGA-II In The First Row

Based on the figure 6, the composition of the navy in some sectors can be explained in table 1.

Table1. Composition Of The Navy In Some Sectors

Navy	Sector	Navy	Sector	Navy	Sector
1	6	11	2	21	6
2	4	12	5	22	3
3	7	13	3	23	3
4	7	14	5	24	1
5	5	15	1	25	5
6	5	16	0	26	0
7	4	17	3	27	2
8	7	18	1		
9	5	19	1		
10	6	20	2		

Model multi-objective optimization problem, the data input for the NSGA-II using a population of 20 and many 20 generations. Results of multi-objective optimization problem shown in Figure 7. There is an optimal solution produced as many as 125 solution.

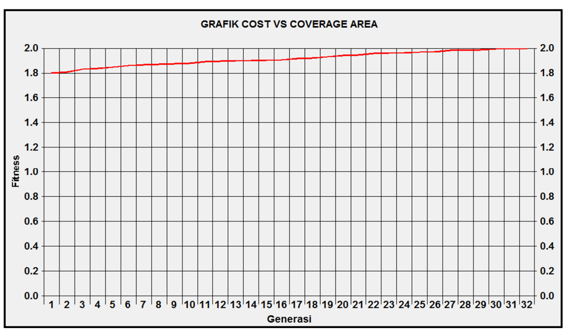

Figure 8. Results Of Optimization With NSGA-II

At the next stage will be stage *clustering,* FCM would be to *cluster* the optimal solution of the NSGA-II into any decisions. Stage *clustering* using FCM will reduce the solution became several decisions alone. Input parameters used FCM *clustering* is determined from the beginning as follows:

- Number of cluster (c) = 4;
- Rank (w) = 2;
- Maximum iteration (MaxIter) = 100;
- Error smallest (ζ) = 10^{-12}
- Initial objective function (P_o) = 0;
- Initial iteration (t) = 1;

FCM basic concepts, the first time is to determine the center of the cluster, which will mark the average location for each *cluster*. In the initial condition, the center of the *cluster* is still not accurate. Each data point has a degree of membership for each *cluster*. By improving the center of the *cluster* and the degree of membership of each data point repeatedly, it will be seen that the center *cluster* will move towards the right location. This iteration is based on minimization of the objective function that describes the distance from the given data point to the *cluster* center weighted by the degree of membership of the data points.

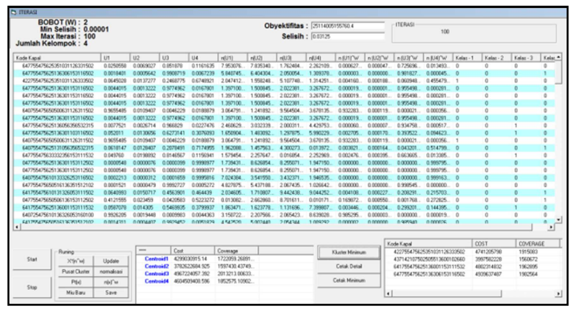

Figure 9. Results Cluster With FCM

Output of FCM is not *fuzzy* inference system, but a row of center cluster and some degree of membership for each of data points. The information can be Obtained from the four *clusters* are grouped into four classes as follows:

Class1 : Medium cost & medium coverage
Class 2 : Low cost & low coverage
Class 3 : High cost & medium coverage
Class 4 : High cost & high coverage

Four class cluster point of the final scores obtained by the closest distance to the point cluster. In detail can be seen in table 2.

Table 2. Solution 4 Classes Based On The Shortest Distance

Class	Navy Code	Cost (Rp)	Coverage (Mil2)
1	422755475625351031126333502	4,741,205,798.00	1,915,083.00
2	437142107502505513600102660	3,997,582,228.00	1,560,672.00
3	641755475625136001153111532	4,802,314,832.00	1,962,895.00
4	647755475625136306153116502	4,939,637,487.00	1,982,564.00

4 classes based approach or the cluster point, then the solution decision will be searched based on the normal form for the Euclidian distance between vectors such as figure 9. Based on figure 9 is already clearly the best solution, but commanders must consider several approaches in accordance with the conditions of Indonesian maritime security.

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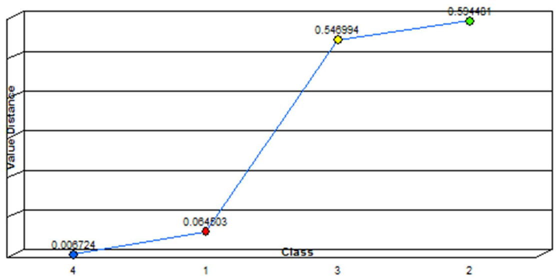

Figure 10. Graph Distances Between Classes

Figure 9 is explained that the IDSS provides convenience for the commander of the TNI AL some decisions, namely:

- If the commander wants moderate operating costs and achieving coverage were then combined in a class-1 ship should be chosen;
- If you want low operational costs and the achievement of low coverage, the combination of class-2 ship should be chosen;
- If you want high operating costs and achieving coverage were then combined in a class-3 ships to be selected;
- If you want high operating costs and achieving high leverage, the combination vessel in the 4th grade should be selected.

Every cluster has its disadvantages and advantages that the commander of the Navy will be easier to determine the most ideal decision.

Results of the above cluster process to produce 4 pieces of solutions that is central cluster of each cluster, as shown in Figure 9. The resulting distance between grades 1 to 4 are:

- Class 1 = 0.064503,
- Class 2 = 0.594481,
- Class 3 = 0.546994,
- Class 4 = 0.006724.

Based on the above, the application range IDSS will sort some of these decisions a priority decision. After posting by the IDSS system solutions presented recommendations to the commander of the Navy as table 3.

Table 3. IDSS Solution For Assignment Combination Navy In Indonesian

No	Class	Navy Code	Cost (Rp)	Coverage (Mil2)
1	4	647755475625136306153116502	4,939,637,487.00	1,982,564.00
2	1	422755475625351031126333502	4,741,205,798.00	1,915,083.00
3	3	641755475625136001153111532	4,802,314,832.00	1,962,895.00
4	2	437142107502505513600102660	3,997,582,228.00	1,560,672.00

Solution decisions total 4 pieces above were taken from the value of the smallest Euclidian. This means that the value of the smallest distance from the center of decision solutions centroid has represented the best combination of several other combinations. Solution of IDSS suggest selection decisions on class 4 with operational costs Rp. 4.939.637.487 and achievements covarega 1,982,564 Mil^2 area.

4. CONCLUSION

- Methods NSGA-II is able to provide 125 prospective solution for the combination of the placement of the Navy patrol boat in the respective sectors.
- FCM method is used to minimize the collection of solutions provided by NSGA-II by dot clusters that have been determined to be four, that is: [1] Cost medium and Coverage medium, [2] Low Cost and Low Coverage, [3] The High Cost and Coverage medium, [4] Cost high and Coverage high.
- IDSS has been able to provide a choice of solutions based approach to maritime security Indonesia, So the decision was elected priorities, namely: [1] Class 4 = 0.006724, [2] Class 1 = 0.064503, [3] Class 3 = 0.546994 and [4] Class 2 = (0.594481).
- IDSS Solution for a combination of patrol boats selecting clusters to 4 (high Cost and Coverage high).
- The combination of the selected navy is [647755475625136306153116502] by resting boats 17 and 26 and commissioned the entire navy to each sector.
- Achievement coverage area of 1,982,564 Mi^{l2} navy and implications for the cost needed to secure the eastern region of the sea Indonesia Rp. 4.939.637.487.
- From the achievements of area coverage decision is able to enhance maritime security Indonesia for 6:13% ≈ 94 895 Mil^2 and cost savings in terms of maritime security budget is able to save by 1.21% ≈ Rp. 60,362,513.

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