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UNMANNED AIRCRAFT VEHICLE (UAV) SELECTION BASED ON MEASURE OF EFFECTIVENESS: NAVAL PURPOSES

Adi Nugroho[1], Victor Pardamean[2], M.B. Pandjaitan[3], Ardian Widjanarko D.S[4]
[1,2,3,4]Master Program of Naval Operations, Navy Staff and Command School, Jalan Cileduk Raya, Komplek Seskoal, Cipulir, Kebayoran Lama, Jakarta Selatan 12230
e-mail: adi.nugroho@tnial.mil.id

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Abstrak

Perkembangan teknologi selain membawa dampak positif juga membawa dampak negatif berupa ancaman faktual maupun ancaman potensial terhadap keamanan laut Indonesia. Kemampuan untuk melakukan deteksi dan cegah dini terhadap ancaman-ancaman tersebut mutlak harus dapat dikuasai oleh lembaga atau institusi keamanan maupun pertahanan di bidang kelautan. Salah satu upaya dalam pengumpulan data maritim adalah dengan memanfaatkan teknologi Pesawat Terbang Tanpa Awak (PTTA). Teknologi PTTA telah berkembang dengan pesat dan banyak dimanfaatkan di kalangan sipil maupun militer, seperti: deteksi dini, intelligence surveillance and reconnaissance (ISR), pengambilan gambar dan video, Search and Rescue (SAR), dan berbagai misi pengintauan serta pemantauan. TNI AL sebagai alat negara mengemban tugas pertahanan negara di laut memiliki kemampuan Operasi maritim yang harus terus dikembangkan. Penelitian ini menggunakan pendekatan kuantitatif deskriptif, dengan metode MoE untuk menilai efektifitas penggunaan PTTA di intelijen TNI AL dan metode AHP untuk memilih jenis PTTA terbaik. Hasil pengukuran efektifitas yang didapatkan PTTA dinyatakan efektif dalam mendukung operasi Keamanan TNI AL. Hasil pengolahan data pemilihan PTTA terbaik yang menjadi peringkat pertama direkomendasikan untuk diadakan adalah PTTA jenis High Altitude Long Endurance (HALE) yang memiliki kemampuan strategis. Diharapkan bahwa dengan memiliki PTTA jenis HALE pola operasi TNI Al menjadi lebih efektif dan keamanan dapat meningkat secatra optimal.

Kata kunci: *Teknologi, Pesawat Terbang Tanpa Awak (PTTA), Operasi Pertahanan*

Abstract

Technological developments in addition to bringing positive impacts also have negative impacts in the form of factual threats and potential threats to Indonesian marine security. The ability to detect and prevent early against these threats absolutely must be mastered by security and defense institutions or institutions in the marine sector. One of the efforts in collecting maritime data is to utilize Unmanned Aircraft Vehicle (UAV) technology. UAV technology has developed rapidly and is widely used in civilian and military circles, such as: early detection, intelligence surveillance and reconnaissance (ISR), image and video capture, Search and Rescue (SAR), and various reconnaissance and monitoring missions. The Indonesian Navy as a state instrument carrying out the task of state defense at sea has maritime operations capabilities that must continue to be developed. This study uses a descriptive quantitative approach, with the MoE method to assess the effectiveness of the use of UAV in Indonesian Navy intelligence and the AHP method to select the best type of UAV. The results of the effectiveness measurement obtained by UAV are declared effective in supporting the Navy's security operations. The results of data processing for the selection of the best UAV which is ranked first recommended to be held is the UAV type of High-Altitude Long Endurance (HALE) which has strategic capabilities. It is hoped that by having UAV type HALE the TNI Al's operational pattern will be more effective and security can be increased optimally.
Key words: *Technology, Unmanned Aircraft (UAV), Defense Operations*

INTRODUCTION

Indonesia as one of the largest archipelagic countries in the world which has a very strategic position, geographically located in a cross position between two continents and two oceans, namely the Asian continent and the Australian continent, as well as between the Indian Ocean and the Pacific Ocean, is a geostrategic condition that brings opportunities at the same time. challenge. The state of Indonesia itself borders ten countries, where this can lead to and can increase tensions, mutual claims that lead to conflicts between countries, especially in the North Natuna Sea area. Indonesia as an archipelagic country must continue to strive to increase jurisdictional boundaries in order to overcome this. Indonesia needs to secure the waters of national jurisdiction with the strength of the sea dimension by a fleet of warships (KRI) and aircraft owned by the Indonesian Navy through a well-planned and structured marine security operation.

To assist these maritime security tasks, it is important to enter data through good initial recognition, especially from information from perception by marine air surveillance aircraft with strategic surveillance capacity. In determining the need for strategic reconnaissance aircraft, various studies and developments in perception are expected to be able to choose the best type of aircraft that can be used by the Indonesian Navy to assist the main task. The capacity of sea perception that utilizes airplanes is a vital supporting tool to further develop the combat capabilities of warships as an important part of marine activities, particularly in terms of location, identity and agglomeration of focus groups. The guard exercise was completed in addition to the main task of the Indonesian Navy to maintain sea security by air as an augmentation of the eyes of warships (KRI).

Maritime situational awareness (MSA) as one of the concepts developed by NATO, is characterized as "a visible empowering ability to convey the expected prevalence of data in the marine climate in order to achieve a common understanding of the state of the sea, to increase feasibility in preparation and lead assignments". An important part of MSA is maritime surveillance, which is very important for defense and security reconnaissance tasks (Soldi, Gaglione, Forti, Simone, Daffin, Bottini, Quattrociocchi, et al., 2020), including early detection. , tracking, civilian applications (fishery control, port management) and military (intelligence, defense against asymmetric threats) both using active sensor devices (radar) (Soldi, Gaglione, Forti, Simone, Daffin, Bottini, & Quattrociocchi, 2020);(Singh et al., 2020) and optical sensors (Cameras with visible and infrared spectrum) (Oliveau, 2019). Maritime surveillance is also related to monitoring human activities in both legal and illegal sea uses (Melillos et al., 2020).

This research focuses on marine aspect surveillance (maritime surveillance) by utilizing optical system devices, in this case UAV (Unmanned aerial vehicle). Accurate and real-time detection of objects moving in the ocean is becoming an important component in maritime visual surveillance, leading to increased safety and security (Wen et al., 2021). With massive technological developments, UAVs are currently widely used in monitoring marine aspects that are prepared to deal with urgent and sudden situations (Jeon et al., 2019), which are able to operate independently from a distance (Custers, 2016);(Suteris et al., 2018);(Srinivasan et al., 2019);(West & Bowman, 2022). UAVs are becoming increasingly potential to be used in large frameworks of maritime surveillance units that are integrated with command centers on the mainland (Dimitriou, 2013).

The function of sea observation using aircraft is a very important supporting facility to improve the combat capability of warships as a major component in sea operations, especially in the detection, identification and classification of targets at sea. Patrol activities are carried out which are increasingly sophisticated and efficient over time. Until now, there have been many types and types of UAVs that can be used as surveillance instruments according to the needs required by an institution/state.

In this regard, research on the selection of the right UAV or PTTA in Bahasa Indonesia for implementation of marine operations can use the AHP and *Measurement of Effectiveness* (MoE) methods. The use of this method will generate profits by knowing the criteria and sub-criteria that have a very significant influence so that they will obtain the most appropriate main alternative.

RESEARCH METHODS

Researchers used quantitative descriptive research methods in carrying out research related to the analysis of UAV selection in supporting the operations of the Indonesian Navy. Data on the value of the relationship between criteria elements, both inner dependence and outer dependence and the relationship between criteria and alternatives by means of pairwise comparisons between criteria, sub-criteria and alternatives that will be used. Research related to the use of UAV by using influential criteria seen from internal factors and external factors UAV that will be used. These factors can be described by the criteria for general, tactical, and technical conditions for the UAV that will be used.

Data collection technique

Collecting data in this study using primary data and secondary data obtained through filling out questionnaires and interviewing experts, namely:

- Expert interviews.
- Questionnaire Creation
- Documentation

Data Processing Techniques

Referring to Saaty (2000), in solving problems with AHP there are several principles that must be understood. In general, decision making using the AHP method is based on the following steps:

- Define the problem and determine the desired solution, then establish a hierarchy of problems encountered.
- Determine the priority of elements or criteria:
  1. The first step in determining the priority of elements is to create a pair comparison matrix, comparing elements in pairs according to the given criteria.
  2. The pairwise comparison matrix is filled in using numbers to represent the relative importance of an element to other elements.
- Synthesis, Considerations for pairwise comparisons are synthesized to obtain overall priorities. The things that are done in this step are:
  1. Sum the values of each column in the matrix.
  2. Divide each value from the column by the corresponding column total to obtain a normalized matrix.
  3. Add up the values of each row and divide by the number of elements to get the average value
- Measuring consistency in decision making, it is important to know how good the consistency is. The things that are done in this step are as follows:
  1. Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element and so on.
  2. Sum each row
  3. The result of the row sum divided by the corresponding relative priority element
  4. Add the quotient above with the number of elements, the result is called max.
- Calculate the Consistency Index (CI) with the formula: CI = (λmax - n) /n (1) Where n = number of elements.
- Calculate the Consistency Ratio (CR) with the formula: CR= CI/IR (2)Where CR = Consistency Ratio CI = Consistency Index IR = Random Consistency Index.
- Check for hierarchical consistency. If the value is more than 10%, then the data judgment assessment must be corrected. However, if the Consistency Ratio (CI/CR) is less or equal to 0.1 then the calculation results can be declared correct, where the RI value or random index can be seen in the table below.

Table 2. Random Index Value

N	1	2	3	4	5	6	7	8
RI	0	0	0,58	0,90	1,12	1,24	1,32	1,41
n	9	10	11	12	13	14	15	
RI	1,45	1,49	1,51	1,53	1,56	1,57	1,58	

Source: (saaty, 2008)

The researcher uses the AHP method for selecting the appropriate UAV so that it can improve the intelligence operations of the Navy, with the criteria used are UAV operations, technical and UAV operational patterns.

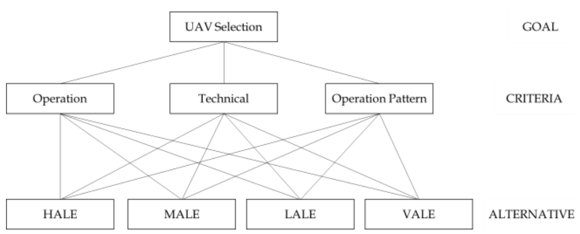

Figure 1. Application of AHP in the selection of UAV

Data Analysis Techniques

Data analysis aims to obtain answers to the problems raised. Then after the data has been collected from various sources and by using several data collection methods, the next step is to reduce the data by making abstractions. Abstraction is making a summary of the core business, processes and questions that need to be maintained so that they remain in it. The stages of data analysis carried out in quantitative research in this study used the AHP method to analyze the sensitivity value for each alternative related to the usage criteria. Furthermore, Microsoft Excel is used to identify and analyze the ratio coefficients and to accumulate the weighting of each expert in the research subject. The steps in this study for data analysis are:

- Define the problem and determine the desired solution. In this stage determine the problem to be solved in a clear, detailed and easy to understand manner. From the existing problems will be determined solutions that may be suitable for the problem. There may be more than one solution to a problem. The solution will then be further developed in the next stage. In this study the identification of the problem is how to analyze the selection of UAV.

- Define criteria for providing analysis on UAV alternatives.

- Create a hierarchical structure starting with the main objective. After arranging the main objectives as the top level, the hierarchy level below it will be arranged.

- Create a pairwise comparison matrix that describes the relative contribution or influence of each element on the objectives or criteria at the level above it. The matrix used is simple, has a strong position for the consistency framework, obtains other information that may be needed with all possible comparisons and is able to analyze the sensitivity of overall priorities for changes in considerations.

RESULTS AND DISCUSSION

Research Overview

The use of the unmanned aerial vehicle (UAV) system can essentially be the right alternative to overcome existing problems, as well as respond to the impact of rapid technological advances and In line with the implementation of the revolution in military affairs (RMA), therefore, the development of the capabilities of the Navy must able to keep up with technological advances in an effort to increase early warning military capabilities to support security operations in the Natuna Sea.

The ability of the UAV system to monitor national areas by air with its peculiarities and advantages, especially in terms of altitude, flexibility and range, minimizes operational risks and the ability to fly for a relatively long time in developed countries. as well as countries in the region such as Australia, Malaysia, India, Singapore and Thailand to increase K4IPP capacity. This technological capability has developed into a modern technology with precise, precise and integrated engineering and operation capabilities. With the development of military technology, it is hoped that the Indonesian Navy will also have modern and sophisticated UAV technology to optimally support the completion of the Navy's missions..

UAV Functions and Types

Nowadays, UAV technology is developing rapidly and has penetrated into the military field. Various uses can be applied with the use of this technology, namely directed at combat or combat functions, for example conducting control/observation operations/operations, tactical reconnaissance, especially in Natuna waters. UAV is growing and developing both in terms of form, propulsion system, weapon control system and sensor technology. Starting from drones that are only used to shoot targets or unmanned aerial vehicles, and then develop into remote surveillance vehicles or Intelligence, Surveillance and Reconnaissance (ISR) vehicles, to being able to fire missiles or rockets that are used automatically in modern electronic warfare. , and UAV is also developing in the fields of civil technology such as surveying, photography, cartography, search and rescue (SAR).

UAV is currently grouped into 3 (three), as follows:

- Based on the drive system UAV is divided into three types:
    1. Fixed wing
    2. Rotary
    3. UAV Combination of Fixed Wings and Rotary
- Based on the PERMENHAN RI No. 26 of 2016, the UAV System Classification consists of:
    1. Micro UAV systems weighing less than 2 kg and 200 feet in maximum operation, an example is Dragon Eye.
    2. Mini UAV weighing 2-20 Kg with an operating range altitude of 3000 feet, for example is Neptune.

3. Small UAV weighing 20-150 Kg with an altitude operating range of 5000 feet, for example is Chyper.
4. Medium UAV weighing 150-600 Kg with an altitude operating range of 20,000 feet, for example is the A-160.
5. UAV weighing more than 600 kg, for example is the global hawk.

- UAV based on altitude / altitude that can be reached, is divided into four, namely:
    1. High Altitude Long Endurance (HALE) capable of flying above 60,000 feet.
    2. Medium Altitude Long Endurance (MALE) capable of flying above an altitude of 20,000 - 60,000 feet.
    3. Low Altitude Long Endurance (LALE), which can reach an altitude of 3000 feet.
    4. Very Low Altitude Long Endurance (VALE) which is only capable of operating below 10,000 feet.

General Condition of North Natuna Waters

The area of Natuna waters reaches 262,197.07 km2, with 154 islands, of which 27 islands or to be precise 17.53% are inhabited. The Natuna Sea is part of the Asia-Pacific region (KKP, 2022). The Asia-Pacific region has become a strategic area in various aspects such as economic, political, and military. In the traditional security perspective, the Asia-Pacific region has very complex opportunities and challenges, as well as risk factors that can lead to conflicts between countries. Disputes in the South China Sea, East China Sea, the Korean Peninsula, and tensions in several border areas between countries are things that need to be handled wisely. Meanwhile, from a non-traditional security perspective, this region has a long history of drug smuggling, people smuggling, weapons smuggling, piracy at sea, theft of natural resources, and separatism. In addition, the issue of terrorism is getting stronger caused by various factors, including economic problems and radicalism.

Analysis of Measurement of Effectiveness (MoE)

To analyze the use of UAV to support the operations of the Indonesian Navy, the researchers assessed the effectiveness of UAV using the MoE method. Researchers used the MoE method using steps based on MP Economics Engineering teaching materials obtained during class lessons. The process of assessing the effectiveness of the MoE on the use of UAV to support the operations of the Indonesian Navy is as follows:

- Create a hierarchical diagram

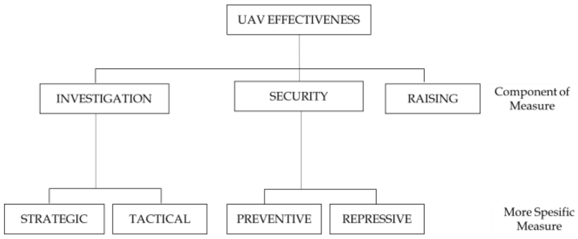

Figure 2. MoE . Hierarchical Diagram

If each component measure is separated according to more specific components, it will become two hierarchical diagrams, namely:

1. Research Effectiveness Score (A)

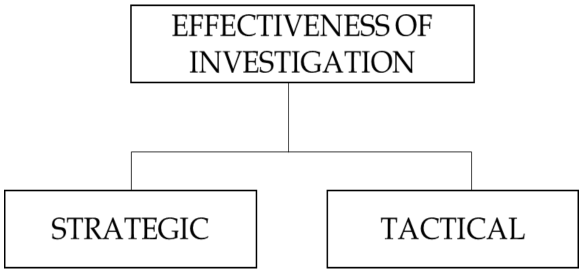

Figure 3. Component of Measure Diagram

2. Security Effectiveness Value (B)

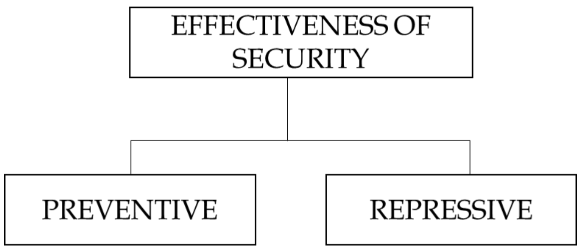

Figure 4. Component Of Measure Diagram Diagram

- Create a weighting for each level. The researcher determines the weight value of each level based on the results of a questionnaire with resource persons or experts. The weight value of each level is between 0 to 1 (0<=Wi<=1). The total weight value for each level is 1 (∑Wi=1). The weight values for each level are as follows:

Table 3. Weighting in MoE
Level 1 Component of measure

Value	Weight
Investigation function	0,6
Security Function	0,4
Raising Function	0
ΣWi	1

Level 2 More specific measur

Score	Investigation Function	Score	Security Function	Score	Raising Function
Strategic	0.4	Preventive	0.7	Goal	0
Tactical	0.6	Repressive	0.3		0
ΣWi	1				0

If the weight values that have been determined above are included in the hierarchical diagram, the diagram can be described as follows:

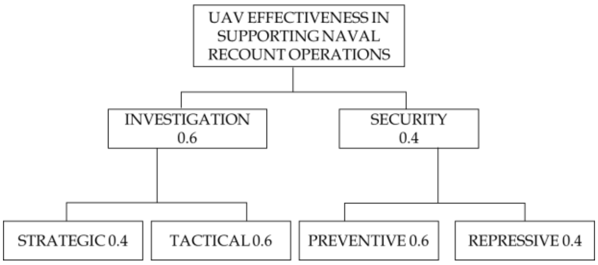

Figure 5. Weight Values in the MoE . Hierarchical Diagram

- Make a score based on the results of the questionnaire recapitulation to the respondents to determine the effectiveness of the components being measured. The effectiveness value that has been determined is as follows:

VI/Very Ineffective	: 0
IN/ Ineffective	: 0.25
D/ Doubtful	: 0.5
E/ Effective	: 0.75
VE/Very effective	: 1

For respondents who took the data amounted to 8 (eight) people with the results of the recapitulation as follows:

Table 4. Recapitulation of the value of each component

	VI	IN	D	E	VE	Source person	Score	Total Score
	0	0.25	0.5	0.75	1			
Investigation Function								
Strategic	0	0	0	3	5	8	7.25	0.906
Tactical	0	0	0	4	4	8	7	0.875
Security Function								
Preventive	0	0	0	5	3	8	6.75	0.843
Repressive	0	0	2	3	3	8	6.25	0.781
Raising Function								
-	8	0	0	0	0	8	0	0

The results of the recapitulation of the effectiveness value of the respondents when entered into a hierarchical diagram can be described as follows:

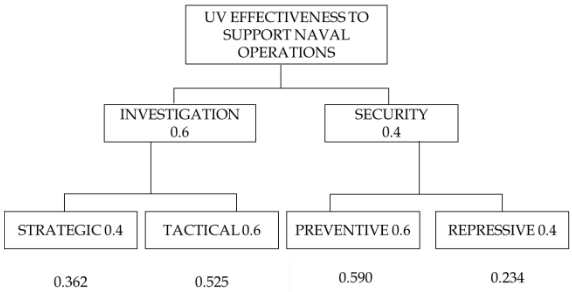

Figure 6. MoE Calculation Results

The weight value of each item is multiplied by the component value of each item down following the hierarchical line. So that the results obtained for the value of MoE/ Wi are:

Table 5. MoE value

	Weight			
	Component of Measure	More Spesific Measure	Score	Total Effectiveness Score
Investigation Function	0.6			
Strategic		0.4	0.906	0.362
Tactical		0.6	0.875	0.525
				0.887
Security Function	0.4			
Preventive		0.7	0.843	0.590
Repressive		0.3	0.781	0.234
				0.824
Raising Function				
-	8	0	0	**0**
MoE total score				**1.711**

After carrying out data processing the weight value of each item is multiplied by the component value of each item down following the hierarchical line above, the value is 0.887 based on the investigation function, for the security function the value is 0.824, and for the raising function it is 0.

So that when added up as a whole, the total value of MoE/ΣWi from the effectiveness of using UAV to support the operations of the Indonesian Navy using the MoE method is 1,711. In accordance with the effectiveness formula, Wi is declared effective when the output versus input is greater than 1 or equal to 1 (ΣWi=Out/In>=1), so based on these results the use of UAV to support the Navy's operations is effective.

Results of Analytical Hierrchy Process (AHP)

Researchers carried out data processing using the AHP method to determine the priorities of the three analyzed aspects to support the operations of the Indonesian Navy, namely UAV operations, UAV technical and UAV title patterns. After the priority ranking is obtained, the researcher provides alternative priorities that will be carried out as a follow-up to the analysis of the use of UAV to support the operation of the Indonesian Navy which is declared effective. The alternatives or types of UAV that have been determined by the researchers are UAV types HALE, MALE, LALE, and VALE.

Pairwise comparisons were carried out on three criteria, namely: operational UAV, technical UAV and UAV degree patterns. The researcher carried out the distribution of this pairwise comparison questionnaire to eight Indonesian Navy personnel who served as experts, users and operators who were directly related to the UAV 's ability to support the Navy's operations. Next, look for the eigenvalues by doing the square of the matrix. After that, the researcher checked the consistency based on the obtained RK value (RK <0.1). The results of the calculation of RK are <0.1, which is worth 0.0556.

Based on the results of measurements using the AHP method for selecting the best UAV to support Natuna Marine Security operations based on the opinions of experts on the criteria and alternatives that have been determined, the results obtained are:

- Rank 1 is UAV type HALE with a final rank of 0.5442,
- Rank 2 is UAV type MALE with a final rank of 0.2027,
- Rank 3 is UAV LALE type with a final rank of 0.1964,
- Rank 4 is UAV type VALE with a final rank of 0.0847.

James L. Gibson (1997) in his theory of effectiveness said that the process of implementing activities is the most difficult element to implement, because it will be influenced by the current situation and conditions and the existence of linkages with other activities. UAV Hale type currently has mission system capabilities which include: maritime domain awareness, data link components, automatic identification system, multi sensors, high magnification optical telescope, maritime interception operations, presence and search. The American UAV Global Hawk is able to provide situational awareness in real time and has been battle proven by being placed on a US Navy warship as an effective Target Reporting Unit.

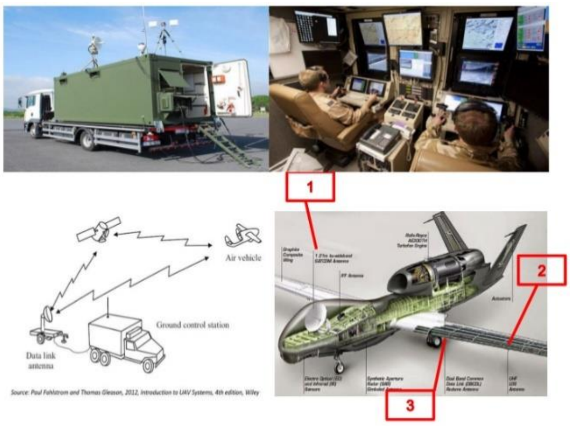

Figure 8. The communication network connects the UAV with the ground segment directly via line-of-sight or indirectly via satellite (Source: Defense World.net).

The RQ-4 Global Hawk HALE UAV is equipped with a large SATCOM antenna (1); datalinks (2); and a line-of-sight UHF antenna (3) to connect to the ground segment and its carriers. The installation of the system can be on warships or on land so that it can be used to carry out missions throughout the day. The functions of the operation and combat use of the RQ-4 Global Hawk include silent operation because it is difficult to detect visually or on radar from an altitude of 65,000 feet.

The effectiveness of the UAV Operational Pattern compared to aircraft in the Natuna Sea.

Related to the need for UAV and Pesud in carrying out security operations in the sea area, especially in the Natuna Sea area, UAV or Pesud is needed in the form of maritime patrol aircraft such as the CN 235 which is able to carry out aerial observations as well as a form of the presence of an elemental title of the Indonesian Navy in the Natuna Sea. Then the number of UAV or Pesud needed is as follows:

- Aircraft

$$N = \frac{A}{2.S.V.T}$$

Where:
A = The area covered.
S = Track Spacing.
V = Speed.
N = Number of aircraft needed.
T = Endurance.

If the area of the North Natuna Sea (A) is 262,198 sq. NM. Track Spacing (S) is: 15 NM. Pesud Speed (V) is: 180 Knots. Pesud endurance is: 6 hours, then:

N = 262.198/ 2.S.V.T = 8.09 8 Pesud.

Based on the above calculation, at least 8 (eight) Pesud Fix Wings are needed to cover the Natuna Sea in 1 (one) operation, which are stationed in Jakarta and Tanjung Pinang. Given the distance that is quite far and the speed it has. This Pesud can carry out scheduled air patrols across each sector and stop at the nearest air base to carry out supplies.

- UAV

$$N = \frac{A}{2.S.V.T}$$

Where:
A = The area covered.
S = Track Spacing.
V = Speed.
N = Number of aircraft needed.
T = Endurance.

If the area of the North Natuna Sea (A) is 262,198 sq. NM. Track Spacing (S) is: 15 NM. UAV speed (V) is: 343 Knots. UAV endurance is: 35 hours, then:

N = 262.198/ 2.S.V.T = 0.72 1 UAV.

Based on the calculation above, at least 1 (one) UAV is needed to cover the Natuna Sea in one operation. So, if we compare the use of UAV and Pesud, it can be concluded that the use of UAV is more effective and more efficient where in implementing a Coverage area with an area of 262,198 Nm it takes 8 (eight) Pesud compared to UAV which only requires 1 (one) UAV type RQ- 4 Global Hawk to cover the area. This is in line with the Maritime Security Theory, which is related to maritime security operations, which are operations regarding the presence at sea carried out by ships and aircraft of the Indonesian Navy's maritime patrols that have strategic value for the existence of national sovereignty and security stability at sea in Indonesia's national jurisdiction. Where by using UAV the presence at sea can further optimize the pattern of operations and the pattern of degree of elements in the field, namely by placing 1 (one) Axis from the KRI which is placed followed by UAV which carries out patrols from north to south, continuing from east to west in the Natuna Sea area. , the operation pattern is:

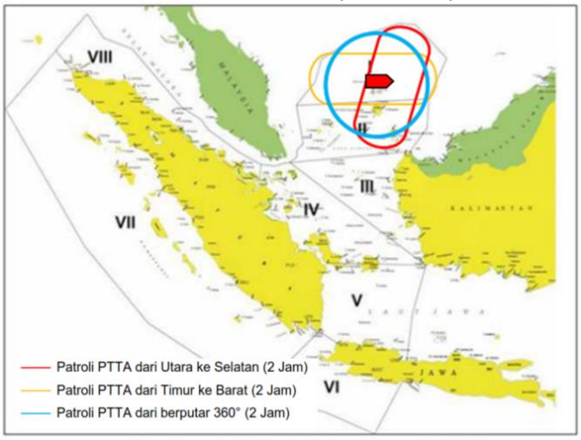

Figure 9. UAV Operation Pattern Map, (Red) UAV Patrol from North to South in 2 hours, (yellow) UAV Patrol from East to West in 2 hours, (Blue) UAV Patrol 360°

The overall effectiveness value with the formula Wi=Out/In>=1, the result is 1,711 which is greater than 1, it can be stated that the investigation and security function of the use of UAV is effective, but in the function of raising the use of UAV it is declared ineffective. The magnitude of the value of the effectiveness of the use of UAV in the investigation and security function indicates that the use of UAV will affect the successful implementation of the Indonesian Navy's operations. The results of research data processing are also in line with previous research conducted by Hyunkyung M, Hoyoung J which have similarities in measuring the effectiveness of the use of UAV in the military, where Hyunkyung's research also obtained effective results that UAV is needed to support military tasks and operations.

CONCLUSION

The ability of UAV with operational criteria, technical and degree patterns based on the results of data processing using the AHP method, the results obtained in the first rank are UAV type HALE with a value of 0.5442. The HALE type UAV has the function to carry out strategic missions such as reconnaissance, surveillance, surveys over a wide area and over a long period of time. The HALE type UAV is also used by developed country navies such as the US Navy which has used the Global Hawk because of its operational capability which is capable of flying high, lasts a long time and can cover a wide coverage area. Based on data processing using the AHP method to determine the best suitable UAV to support the Indonesian Navy's operations where it is needed for long-range strategic reconnaissance missions and is difficult to detect, the result is that it is necessary to procure HALE type UAV which is expected to strengthen Indonesia's maritime defense capabilities through the Indonesian Armed Forces. Sea using the latest, modern and sophisticated UAV technology.

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