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INDONESIA NAVAL TECHNOLOGY COLLEGE

INTERNATIONAL CONFERENCE ON MARITIME SCIENCE AND TECHNOLOGY

The 6th ICMST - STTAL

FIELD :

1. Operation Research.
2. Logistics Management.
3. Policy and Strategy.

SURABAYA SEPTEMBER 28th , 2022

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POSTGRADUATE INTERNATIONAL CONFERENCE

"The 6th International Conference on Maritime Science and Technology"

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POSTGRADUATE STUDIES PROGRAM
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PREFACE

Dear Authors,
Congratulations on the acceptance of your paper, And thank you for your interest in Postgraduate International Conference, Indonesian Naval Technology College STTAL 2022.

On behalf of the Conference Committee, We would like to formally invite you to attend The STTAL Postgraduate International Conference on Maritime Science and Technology ICMST 2022 on Wednesday, September 28th 2022.

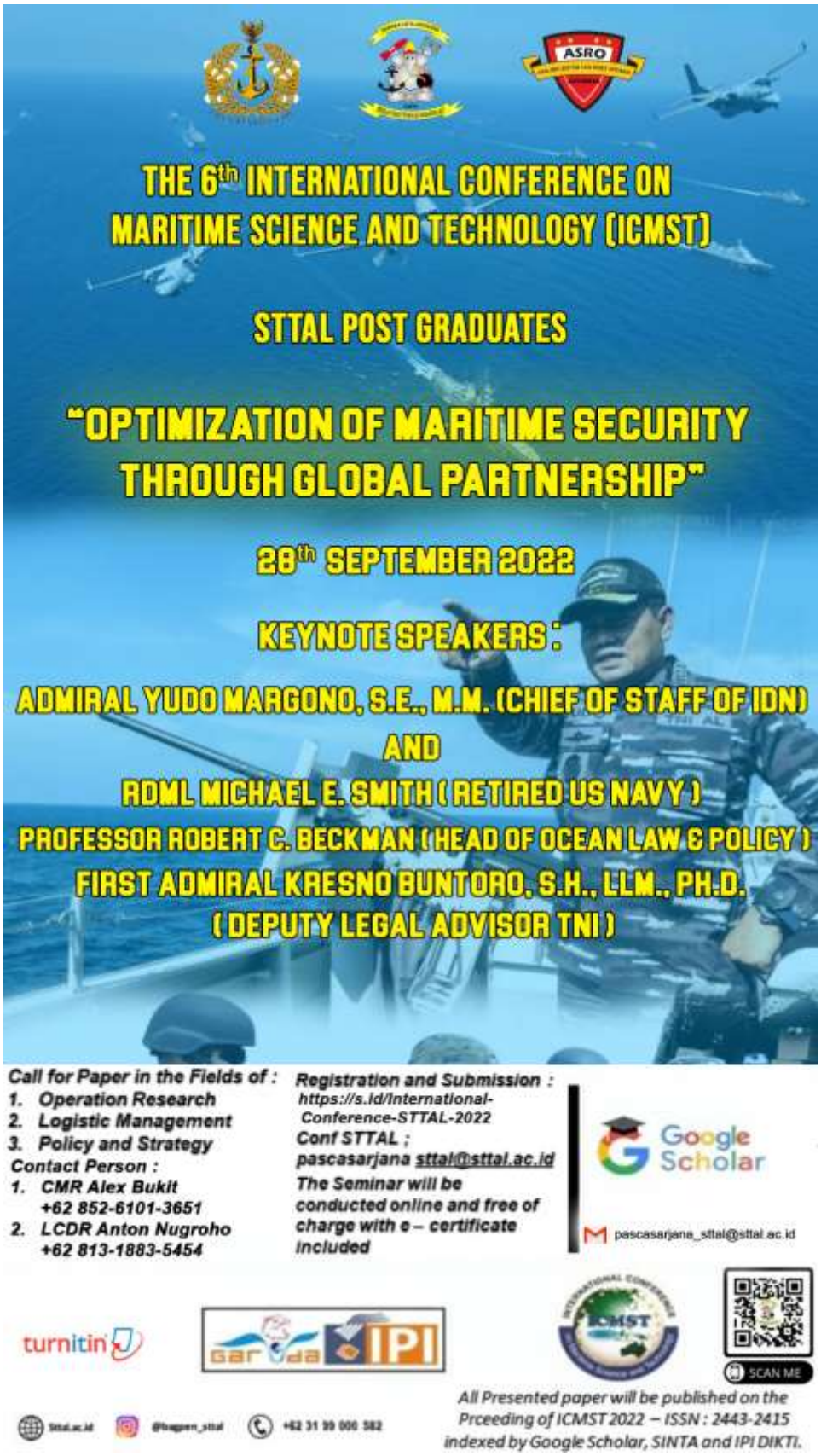
The aim of this international conference is to provide a platform to academics, scholars, researchers and practitioners to present and disseminate the latest innovative ideas, research results, and findings on various aspects of Maritime and Management Science. Presenters will be given the opportunity to have their submissions included in the on-line conference proceedings.

Attendees include educators, students, academic managers, quality assurance and educational system leaders, and researchers. We welcome as many attendees as possible.

We look forward to meeting you on Wednesday, September 28th 2022.

Surabaya, September 28th, 2022
Chairman of Committee,

Dr. Sutrisno, S.T., M.T.
Captain Navy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THROUGH GLOBAL PARTNERSHIP"
28th SEPTEMBER 2022
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SCEDHULE

International Conference on Maritime Science and Technology
ICMST 2022

Held in STTAL Surabaya, Bumimoro-Morokrembangan, On Wednesday, September 28th 2022

WEBSITE : http://www.seminarpasca-sttal.ac.id/

07.30 - 07.40	Opening Remarks
07.40 - 07.45	National Anthem “Indonesia Raya”
07.45 - 07.50	Opening Prayer
07.50 - 08.00	Executive Remarks by Commander of STTAL
08.00 - 08.30	Keynote Speaker by Chief of Staff on the Indonesian navy
08.30 - 11.30	**International Conference** / **Seminary**
	Speaker I : RDML Michael E. Smith (Retired US NAVY, USA) **Speaker** II : Professor Robert C, Beckman (Head of Ocean Low & Policy) **Speaker** III : Commodore Kresno Buntoro (Center For Law and Operation)
11.30 - 12.30	Break
12.30 - 17.00	**Per-Room Seminary,** Presentation by Lecturers & students who send papers, include: **Room I.** Operation Research Field **Room II.** Logistics Management Field **Room III.** Policy And Strategy Field
17.00 – 17.15	Symbolic Delivery of Certificates and Closing

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FIELD II : LOGISTICS MANAGEMENT

FIELD III : POLICY AND STRATEGY

SPEAKER 1

Indonesia's defense force management challenges associated with escalating tensions of the South China Sea

Rear Admiral Mike Smith, USN (Ret)
Institute for Security Governance Non-Resident Advisory Team Lead

Opening the material, the resource person conveyed that the challenge of the military to fight tensions in the South China Sea is to maximize military operational readiness within limited resources (people, equipment, funds). together. One of the advantages of defense management through a joint military operations approach is that it results in increased operational readiness within the same budget. Furthermore, it is explained that military effectiveness and operational efficiency require great leadership and reliable management. Military leadership comes in various forms as follows:

1. battlefield leadership (leading troops in battle)
2. operational leadership (run the unit)
3. strategic leadership (setting direction for the organization)
4. defense management

He further explained that defense management is about making choices that are faced with three big ideas when allocating resources, namely scarcity where the relationship between needs and resources is, then priority: what matters, and next is choice: invest resources where you want them. Then it is explained how to make choices in defense management, namely the first is to determine priorities, the second is to identify needs across the priority forces then the last is to make choices. The resource person explained that joint transformation is the key to making the TNI a world-class military, with several points of explanation as follows:

Joint command and control i.e. TNI establishes the powers, roles and responsibilities of permanent and temporary joint force organizations to successfully employ assigned troops in all areas of operations.

1. Joint planning in which joint military forces are trained to carry out joint planning to achieve objectives in the various military operations for which they are responsible.

2. Joint force management ie tni establishes and implements an efficient process that allocates joint forces to operational command and employs them at an acceptable level of risk.
3. Joint force sustainability i.e. tni provides operations commanders with predictable war capacity which facilitates improved joint force short-term planning
4. Shared doctrine ie where tni has developed the common doctrine needed to train its forces and guide operational planning across all areas of operations.

The conclusions that can be drawn are as follows:

1. To maximize military operational readiness, a capability-based defense management approach is needed, which includes: integrating & balancing people, equipment, and readiness.
2. Defense management is about prioritizing between needs and resources. To implement it, we can use joint concept planning through the army and air force, which makes a capability plan, jointly prioritized, resource constrained, and operationally effective.
3. Joint transformation is the key to making the TNI a world-class military.

SPEAKER 2

Maritime Security Challenges posed by Autonomous Ships and Unmanned Vehicles

Robert Beckman
Emeritus Professor, Faculty of Law
Head, Ocean Law & Policy Programme, CIL
National University of Singapore

The first section describes the impact of using unmanned surface vessels and considers reviewing the impact of using unmanned vessels on the rights and obligations of the state based on UNCLOS 1982. Furthermore, communication procedures between these unmanned vessels and staff on the coast (ports) are associated with regulations that apply.

In the second part it is explained based on the US Commander's Handbook of Naval Operations 2022 that the USV and UUV are unmanned underwater vehicles (UUV) are water vessels that are either autonomous or long-distance navigation that have many uses, including intelligence, surveillance, reconnaissance, mapping and surveying. This section also explains that warships have the right of passage in the territorial sea and archipelagic waters and have immunity from capture by the coastal state. A warship means a ship belonging to the armed forces of a country which bears an external marking distinguishing such ships by nationality under the command of an officer assigned by the government of that country and whose name is listed on the appropriate or equivalent service register and manned by a crew who is under the discipline of the regular armed forces

In the third section, it is explained that autonomous ships or vehicles can present opportunities as well as threats to coastal states. Coastal states and archipelagic states can use autonomous vessels to monitor foreign vessels in their waters. Autonomous ships or vehicles can assist Indonesia in monitoring foreign vessels exercising the right of passage in archipelagic waters and Indonesian territorial seas. The conclusions that can be drawn are as follows:

1. Autonomous ships are currently under development, while UNCLOS 1982 has not been modified to address this development, so the provisions in UNCLOS should be interpreted taking these developments into account.

2. Indonesia must pay close attention to following developments in imo and the use of the autonomous system by foreign navies.

3. Indonesia should monitor developments in the definition of ships and the rights and obligations of MASS, USV and UUV.

SPEAKER 3

Cooperation In Maritime Security

Commodore Kresno Buntoro, S.H., LL.M, Ph.D
Center for Law and Operation

In the Maritime Security Perspective, it is divided into two, namely traditional security where when it is associated with maritime disputes this means relating to territory and borders, while when it is associated with armed forces (Navy) it is associated with arms races. Then non-traditionally explained that maritime security includes maritime security itself, maritime governance, protection of maritime borders, military activities at sea and security regulations of the marine transportation system.

Furthermore, Maritime Security has an important role due to several factors, including:

1. High level of dependence on seaborne trade. Seaborne trade accounts for 80-90% of world trade.
2. The sea as an important food source, based on data, oceans in Asia account for 2/3 of global fish consumption.
3. Economic dependence on the sea by many coastal communities,
4. economic well-being
5. Environmentally vulnerable marine ecosystem
6. The sea as a source of political strife.

The speaker also explained several Maritime Security Issues such as lawlessness in the unregulated and unregulated part of the maritime area, Piracy; Drug Smuggling; arms transportation; Illegal exploitation of marine resources and organized crime such as terrorism. The conclusions that can be drawn are as follows:

1. There are two perspectives on maritime security, traditional and non-traditional. There are so many challenges behind it. For example: overfishing, pollution, global warming, marine natural disasters and others.
2. Maritime security must be addressed through cooperation between countries.
3. A new strategic mechanism is needed that enhances regional cooperation, as well as the involvement of maritime stakeholders between countries

FIELD I

OPERATION RESEARCH

SELECTION OF THE WARSHIP AS AN AUXILIARY SHIP FOR THE DISTRIBUTION OF AMMUNITION TO SUPPORT THE NAVY TASK

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ABSTRACT

Arsenal is a work unit that has the responsibility of storing, maintaining, and distributing weapons and ammunition supplies has not been able to support optimally because there is only one Arsenal, and must serve user units like the Indonesian Naval Base. spread throughout Indonesia and there is no special transportation of ammunition to distribute so the process of distributing ammunition depends on the element of the title. Distribution constraints faced with existing conditions will be planned for the selection of KRI in the assignment as an auxiliary ammunition ship. This study aims to determine the selection of the best ship for the assignment as an ammunition auxiliary ship using the Analytic Network Process (ANP) method. The use of the ANP method is based on the existence of data that has a relationship between criteria and a relationship between subcriteria. There are two main criteria used in conducting alternative selection, namely operational requirements criteria with five sub-criteria: Security, Geographical conditions, mobility, ship worthiness, sailing resistance, and technical requirements criteria with five sub-criteria: machining, navigation, platform safety equipment as well as sensors. The results of this study are an alternative priority for the selection of ships in the assignment as ammunition auxiliary ships to carry out the distribution of ammunition throughout the Indonesian Naval Base. The best alternative based on the main criteria and sub-criteria is the type of personnel transport auxiliary ship (BAP) with a score of 0.341260.

Keywords: Assignment, Analytic Network Process (ANP), and Auxiliary Ship for Ammunition.

1. INTRODUCTION

The Navy as an integral part of the Indonesian armed force must be able to support the main duties of the Indonesian armed force mandated in law no.34 of 2004. Based on Chief of Naval Staff Regulation number Perkasal/ 69/XI/ 2010 Navy logistics are all activities that aim to prepare and provide material and implementation of logistical support needed and used in the implementation of the entire Navy development system to realize a force capable of carrying out the duties of the Navy. One of the expected logistical support operation capabilities is to be able to provide sufficient provision support for the duration of the planned operation and can support basic provisions and re-provisions, one of the index norms is 5th class (ammunition) provisions.

The pattern of ammunition development that is oriented to facilitate the process of providing and supporting ammunition for TNI units, is essentially influenced by sources, facilities, and infrastructure as well as management procedures (Panglima TNI, 2011). The main ammunition distribution problem is that there is no special ship to transport ammunition so the distribution of ammunition is very dependent on the element of the title (KRI) that will operate.

Thus causing the problem of erratic distribution time. With the existing conditions and realities, the main problem that can be formulated in this study is how to determine the selection of the type of KRI that exists and is appropriate for assignment as an ammunition auxiliary ship and how to determine the criteria and critical subcriteria in the selection of ammunition auxiliary ships. The purpose of this study is to determine the priority of alternative types of existing ships and most appropriately for assignment as ammunition auxiliary vessels that meet operational requirements and technical requirements using the Analytic Network Process (ANP) method and

knowing the main subcriteria on the criteria for operational needs and technical requirements.

2. LITERATURE REVIEW

2.1 Distribution and Logistics Planning

a. Distribution

Distribution aimed at streamlining the supply of goods and services from producers to consumers and ensuring their use under what is needed (type, quantity, price, place, and needs) can be interpreted as marketing activities (Tjiptono, 2008). Distribution is the interdependent organizations that are covered in the process that makes a product or service available for use or consumption. They are the line devices that the product or service follows after production, which culminate in the buyer and use by the end user (Keller, 2007).

b. Logistics Planning

In the new concept, logistics problems are a very long process problem, starting from raw materials to finished products used by consumers. Logistics is the process of strategically procuring, moving, and storing materials, spare parts, and inventory of finished goods (and related information flows) through the organization and its marketing channels to generate current and future revenue through the fulfillment of coastal orders, so that efficiency is effectively maximized (Cristopher, 2005).

2.2 Decision Making

The essence of decision-making is that which lies in the formulation of various alternative actions according to what is being considered at the moment and in the selection of the right alternative after evaluating the effectiveness of the decision in achieving the goals that are intended. One of the most important elements of the decision-making process is to collect information to obtain an assessment of the decision-making situation. If enough information can be gathered to provide a complete specification of all alternatives and the degree of their effectiveness in a situation of concern the process of making or making relative decisions is absolutely easy. However, in practice, it is impossible to accumulate limited funds, time, and energy (Suprapto, 2006).

2.3 Analytic Network Process (ANP)

The Analytic Network Process (ANP) is a framework for addressing decision-making problems without considering assumptions about the independence between higher element levels and weaker elements, and the independence of elements within a level. This pairwise comparison process uses numbers/scales that reflect the decision's importance/priority towards other decisions at the same hierarchical level. It helps decision-makers compare all elements of the decision. as they only focus on two of them in pairwise comparison (Saaty, 1990). Table 1. the following shows the comparison scale in pairs.

Table 1. Pairwise Comparison

The scale of Importance Level	Definition
1	Both elements are equally important.
3	One element is slightly more important than the other.
5	One element is more important than another.
7	One element is more important than another.
9	One absolute element is more important than another.
2, 4, 6, 8	The middle grade is among the 2 side-by-side assessments.

(Source: The Analytic Hierarchy Process, Saaty,1990)

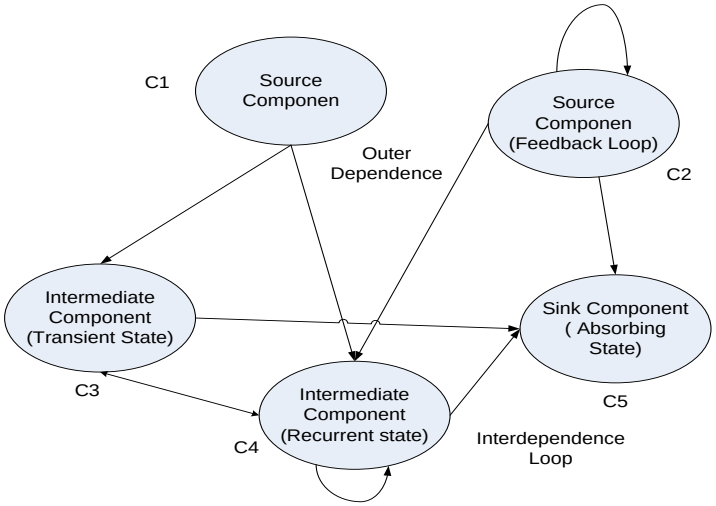

Figure 1. Structure feedback network

Some the decision problems cannot be arranged hierarchically because they involve the interaction and dependence of elements that are at a higher level with elements that are at a lower level. The level of alternative importance is not only determined based on the importance level of the criteria but also determined by the level of importance of the alternative itself. Feedback also makes it possible to factor the future into the present to determine what we should do to get the desired future.

This feedback structure does not have a straight shape from top to bottom as in the hierarchy but rather resembles a network with a cycle that connects the components in it to the components themselves. This structure also has sources and sinks. A source node is the origin of an influence path and is never the destination of that path. The sink node is the opposite of the source node i.e. the purpose of the influence path and will never be the source of the existing path. An example of a feedback network structure can be seen in Figure

this feedback structure does not have a straight shape from top to bottom as in the hierarchy but rather resembles a network with a cycle that connects the components in it to the components themselves. This structure also has sources and sinks. A source node is the origin of an influence path and is never the destination of that path. The sink node is the opposite of the source node i.e. the purpose of the influence path and will never be the source of the existing path. An example of a feedback network structure can be seen in Figure.

2.4 Criteria Determination.

The criteria used for the selection of ammunition auxiliary vessels are obtained from literature studies, interviews, and questionnaires with experts. From the results of literature studies, interviews, and questionnaires, criteria and subcriteria were obtained as in tables 3, 4, and 5. The table number is sub-criteria based on opsreq criteria, table number 4 is regarding the Techreq criteria and table 5 is the alternative ship.

Table 2. Criteria Used

No.	Criteria Raised	Definition / Assessment Parameters

1	Operational Requirements (Opsreq)	Operational requirements relating to the strategic value of Auxiliary Munitions Vessels
2	Technical Requirements (Techreq)	Technical requirements relating to the design and technical specifications of auxiliary ammunition vessels.

Table 3. Subcriteria on Operational Requirements Criteria

No.	Subcriteria Raised	Definition / Assessment Parameters
1	Security	The safety factor of the Ship becomes a high level for assignment as an Auxiliary Ship Ammunition in charge of distributing ammunition to the Naval Bases has a high level of risk due to transporting hazardous materials.
2	Geographical Conditions	It can operate in all Indonesian waters, especially in the waters around main bases, and can sail in sea state 6 conditions.
3	Mobility	The ship has high stability, and good speed and must be able to carry out coat effective sustainable operations to supporting-range operations
4	Sailing Endurance	Resilience at sea is not less than 20 (ten) days.
5	Shipworthiness	Stability meets international standards, has a room that can accommodate large loads, equipped with adequate safety equipment.

Table 4. Subcriteria on Technical Requirements Criteria

No.	Subcriteria Raised	Definition / Assessment Parameters
1	Machinery	Ship propulsion systems, both basic thrusters (MPK) and auxiliary engines.
2	Navigation	An adequate navigation system and integrated communication
3	Safety Equipment	Safety Equipment is good for ships and people in good condition and functioning normally
4	Platform	The shipbuilding system becomes an ammunition warehouse and other compartments that can be used as an ammunition warehouse from the bow to the stern and from top to bottom.
5	Sensor	Early detection tools are integrated with machining, navigation, and safety equipment.

2.5 Alternative Requirements.

Based on interviews, literature studies and questionnaire results from experts to determine the appropriate alternative type of ship to carry out the assignment as an auxiliary ammunition ship can be seen in table 5.

Table 5. Alternatives to Auxiliary Ship Type Selection

No.	Ship Type	Description
1	AT	Drive Tank
2	LST/M	Landing Ship Tank/Modified
3	MA	Markas
4	BAP	Bantu Angkut Personel
5	BRS	Bantu Rumah Sakit

3. RESULTS AND DISCUSSION

3.1 Questionnaire Data Retrieval.

Making questionnaires using a reference model network that has been formed. The questionnaire is made based on the relationship between the criteria elements of both interdependence and outer dependence and the preference relationship between criteria and goals (goal) using a pairwise comparison between clusters and between cluster elements. To make it easier in terms of data processing, a new notation is given for existing alternatives, criteria, and subcriteria. The list of notations is shown in Table 6 below.

Table 6. List of Notations

No.	Name	Code
1	Ammunition Auxiliary Ship Selection	G
2	Operational Requirements	O
3	Technical Requirements	T
4	Security	O1
5	Geographical Conditions	O2
6	Mobility	O3
7	Shipworthiness	O4
8	Sailing Endurance	O5
9	Machinery	T1
10	Navigation	T2
11	Safety Equipment	T3
12	Platform	T4
13	Sensor	T5
14	AT	A1
15	LST/M	A2
16	MA	A3
17	BAP	A4
18	BRS	A5
19	Respondent 1	R1
20	Respondent 2	R2
21	Respondent 3	R3
22	Respondent 4	R4

No.	Name	Code
23	Respondent 5	R5
24	Respondent 6	R6

3.2 Data Processing

The next stage of data collection is data processing activities. The method used in this study is the use of ANP method and the data processing process is carried out with the help of Super Decisions 2.10 software

a. Pairwise Comparison Matrix

After the network model is created, pairwise comparison values can then be determined between criteria and between subcriteria for each alternative. The pairwise comparison score was obtained using a questionnaire. The priority weight value of each category obtained based on the pairwise comparison value will be compared to get the final priority weight value.

The data that has been obtained from the distribution of questionnaires is in the form of pairwise comparison values between criteria and between alternatives for each subcriteria. The assessment of the respondents will be unified using the geometric mean formula as follows.

$$\sqrt[n]{\prod_{i=1}^{n} X_i}$$

Information:

X_i = Decision on the comparison of the 1st criterion

After obtaining one pairwise comparison value for each relationship, a local priority weight calculation is carried out. This calculation aims to find out the weight of each of the interconnected elements. Whenever a local priority weighting is carried out, the priority to be considered is the consistency value, the inconsistency value cannot exceed the value of 0.1. An example can be seen in Table 13 which shows the inconsistency value of the comparison of pairs between subcriteria on the Opsreq criterion. It turns out from Table 13. shows that the Inconsistency Index is 0.013440. The value is still below 10% or 0.1 which means that the answers given by the respondents in this questionnaire are consistent.

Table 7. Inconsistency Index of Paired Comparisons Between Subcriteia on Opsreq Criteria.

Inconsistency	0.01344	
Name	Normalized	Idealized
1. O1	0.46241386	1
2. O2	0.121982009	0.263794015
3. O3	0.071379225	0.154362209
4. O4	0.214627707	0.464146354
5. O5	0.129597199	0.280262359

3.3 Processing with Super Decisions 2.10

After entering all geometric mean into the questionnaire format in the Super Decisions software, the software worked through all the stages of the ANP method by running Synthesize, which contained, among other things, alternative

weight values as seen in the red-circled values in the picture below.

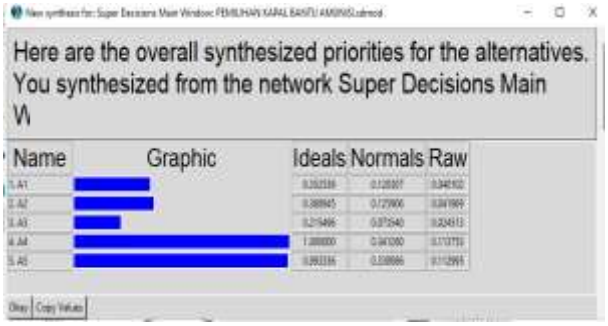

Figure 2. Alternative weight value

Meanwhile, to find out the overall priorities, both alternative priorities, and criteria, you can run Priorities in the Super Decisions software so that weight values from alternatives and criteria are obtained as shown in Figure 3.

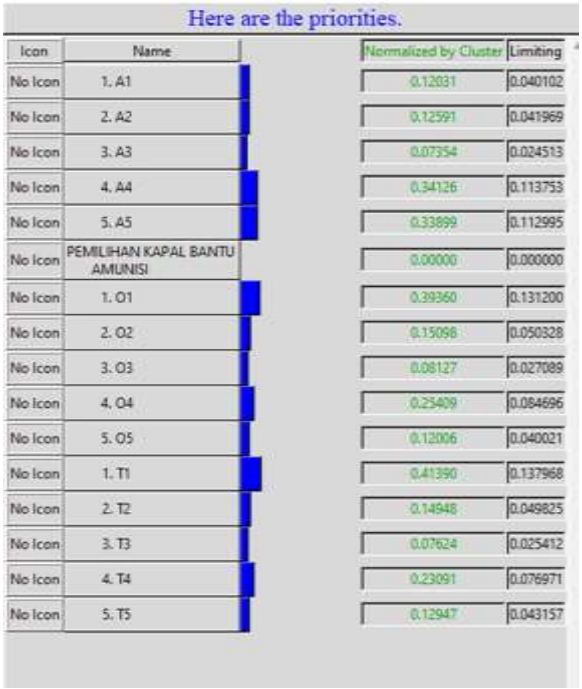

Figure 3. Criteria and Alternative Weight Value

3.3 Sensitivity Analysis

Sensitivity analysis carried out using Super Decisions software is to change the weight value in the alternative test. This test functions for searching the criteria that have bound with the alternative, so the researcher can compare between criteria.

In this test, it will be known that changing the weight value in the alternative test, it will affect the results of the original ranking or not. Whenever there is a point where there is a change in ranking/priority, the point is called the critical point of an alternative. An example can be seen in Figure 5 which shows a sensitivity test at alternative 1 (A1) which resulted in a critical weight value of 0.118660

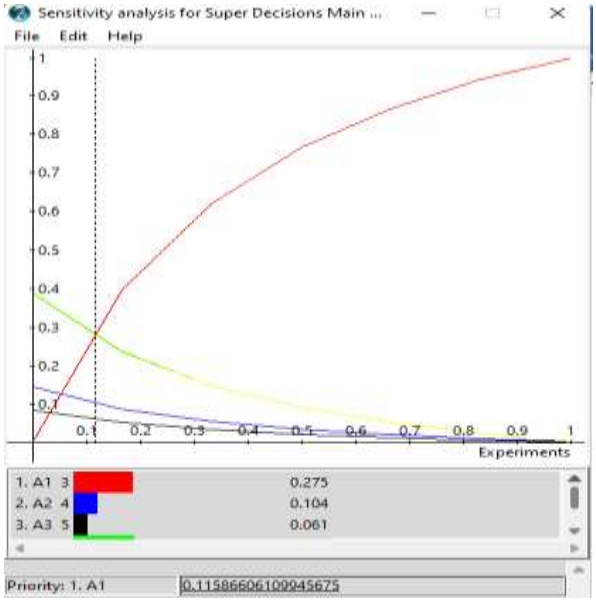

Figure 4. Alternative Sensitivity Analysis 1 (A1

4. CONCLUSION

From the results of data collection and processing, as well as the analysis and interpretation of the results of data processing that has been carried out, the conclusion that can be drawn in this final project is the alternative ammunition auxiliary ship selected is the one that gets the largest priority weight value, namely the type of BAP ship with a priority weight value of 0.34126 Sequentially the alternative priority in the selection of ships for assignment as auxiliary ammunition vessels is the ship type BAP, BRS, LST/M, AT and as the last priority of the five alternatives is the MA. The main/critical criterion that gets the largest priority weight in the selection of alternative ammunition auxiliary ships is the machining criterion with a priority weight value of 0.41390. Sequentially the criteria in the selection of

submarines are Machinery, security, ship worthiness, platforms, geographical conditions, navigation, sensors, sailing resistance, mobility, and furthermore as a priority the last criterion of the existing criteria is safety equipment.

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SYSTEM DYNAMIC MODELING OF COMMUNICATION PROTOCOL FOR INCREASING SECURITY AND CONFIDENTIALITY OF INFORMATION SYSTEM IN SECOND FLEET COMMAND

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ABSTRACT

The progress of information technology science is a current problem because, in addition to being able to contribute to improving welfare, progress, and the level of human civilization, it can also have a negative impact that causes unlawful actions and actions including criminal acts (crimes). Department of Information and Data Processing of Second Fleet Command has the main task of collecting, managing, and processing data as well as presenting information, research, and development in the Second Fleet Command and acting as an information technology service center. Telegraphic communication radio within the Indonesian navy is used for long-distance communication between ships, aircraft, and international coastal radio. Radio communication Telegraphy RTG uses international Morse signs, Q code, and Z code procedural signs to convey information or news. This research is planning a communication protocol scenario using the Mavlink and AX2.5 communication protocols. Each scenario will be run using simulation to get network performance. The results of the network performance measurement will be modeled using a dynamic system to get the best communication protocol as a proposal to improve the information security system at the Department of Information and Data Processing Second Fleet Command.

Keywords: RTG, Mavlink, AX2.5, Radio communication Telegraphy, Communication protocol, network performance.

1. INTRODUCTION

The development of information technology is currently a dilemmatic problem because it can contribute to improving welfare, progress, and human civilization, but on the other hand, it becomes an effective means for unlawful acts, namely a crime. Information security is how to prevent theft or detect theft in an information-based system, where the information itself has no physical meaning (Raharjo, 2002).

Network security in the journal "The principles of network security design", is the main network security as system protection against threats originating from outside the network. Information system security is used to control risks associated with the use of information and distribution of information (Stawowski, 2007). The application of Radio Telegraphy communication is very vulnerable to information theft. Important information that is conveyed from ship to ship, ship to aircraft, or to coastal radio or vice versa can be accessed publicly. This explains the weak point of information security using Radio Telegraphy RTG communication even though in general the information has been encoded in international Morse signs, Q code, and Z code procedure marks.

Information system security defense in the Department of Information and Data Processing Second Fleet Command has not shown a level of efficiency and effectiveness, due to the absence of a special section on the field of information system security issues related to data transactions in communication networks, which fully plays a role and has responsibility in handling the security of existing Information Technology resources. There is no Standard Operating Procedure (SOP) for defense from information system attacks and recovery from attacks or data theft. The need for the importance of network security in information or news transactions from ship to ship, ship to aircraft, or to coastal radio

or vice versa requires improvement or enhancement of information security that plays a role in maintaining the confidentiality of information. The Navy Information and Data Processing Service (Department of Information and Data Processing) is the Working Unit in Second Fleet Command which carries out special functions in the field of Information System Development and Naval Data Processing. The usage of information technology in Second Fleet Command is strategic support for operations in achieving the objectives stated in the vision and mission. The application of Radio Telegraphy communication is very vulnerable to information theft.

Important information that is conveyed from ship to ship, ship to aircraft, or to coastal radio or vice versa can be accessed publicly. This explains the weak point of information security using Radio Telegraphy RTG communication even though in general the information has been encoded in international Morse signs, Q code, and Z code procedure marks. Information system security defense in the Department of Information and Data Processing Second Fleet Command has not shown a level of efficiency and effectiveness, due to the absence of a special section on the field of information system security issues related to data transactions in communication networks, which fully plays a role and has responsibility in handling the security of existing Information Technology resources. There is no Standard Operating Procedure for defense against information system attacks and recovery from attacks or data theft. The need for the importance of network security in information or news transactions from ship to ship, ship to aircraft, or to coastal radio or vice versa requires improvement or enhancement of information security that plays a role in maintaining the confidentiality of information.

2. MATERIALS AND METHODS

2.1 Research Approach

The research to be carried out is a type of quantitative research carried out by developing using mathematical models, theories, and hypotheses related to empirical observations. Second Fleet Command is the largest Indonesian navy Fleet in the central region of Surabaya. The Navy Information and Data Processing Service are one of the Working Units in the Second Fleet Command which carries out special functions in the field of Information System Development and Naval Data Processing. The application of Radio Telegraphy communication is very vulnerable to information theft. Important information that is conveyed from ship to ship, ship to aircraft, or to coastal radio or vice versa can be accessed publicly. This explains the weak point of information security using RTG Telegraph Radio communication even though in general the information has been encoded.

2.2 Data Sources, Subjects, and Research Objects

The data sources, subjects, and objects of this research are devoted only to data that affect infrastructure, software, hardware, security, and information system network governance.

2.2.1 Data Source

The information collected was obtained from the essential information and auxiliary information. Essential information was obtained from informants, namely individuals or individuals, through interviews conducted by researchers. While secondary data means the source of research data obtained by researchers within the frame of studies, proving historical records or reports orchestrated in files.

2.2.2 Subjects

Research subjects are parties who are directly involved as resource persons or data providers. This research will be conducted at the

Department of Information and Data Processing Second Fleet Command Surabaya by examining the information system in its fabric in the distribution and exchange of data using a wireless communication system.

2.2.3 Objects

The object of this research is the Disinfolata Second Fleet Command Surabaya. It has tasks to manage, and secure all data in the Second Fleet Command. Moreover, disinfolahta second fleet command is the nearest place and can represent the research in the navy.

2.3 Research design

VmeS is a communication that uses radio intermediaries in the Very High Frequency (VHF) frequency to send messages or data from the sending station to the receiving station. The VMeS terminal is at the sending station and the VMeS gateway is at the base station or receiving station. The application of VmeS on the VHF frequency is very vulnerable to information theft. Important information submitted or otherwise can be accessed publicly. This is a weak point of information security using VmeS on VHF frequencies. Variable identification is done to find out the variables involved in modeling the system. In this step, historical patterns or hypothetical patterns are identified that describe the behavior of the problem. These patterns are integrated into an arrangement (fabrication) so that they can represent the internal tendencies that exist in the system. The variables were arranged based on the results of literature studies and in-depth interviews with the Department of Information and Data Processing Second Fleet Command Surabaya.

2.3.1 Model Design and Formulation

A dynamic system is basically a system where the modeler will take into account the value of the taste of the system, not just the logic of a system. In the Dynamic System method, the system concept refers to a closed system or a system that has feedback. The feedback system has the ability to control itself in achieving certain goals that it identifies itself.

2.3.2 Model Verification and Validation

Performed to test the accuracy of the logic of the model and there are no errors. The process of checking units or unit variables is carried out in this process. While the model validation is done to compare the behavior of the simulation model with the actual system behavior. If in the test there is a significant difference in behavior, then the system variables can be reviewed again or modified as necessary. However, if behavioral conformity is achieved, then the model can be accepted as a valid representation of the actual system.

2.3.3 Communication Protocol Scenario Design

The design and formulation of the simulation model were built based on the results of in-depth interviews with the Department of Information and Data Processing Second Fleet Command Surabaya. The interview results obtained an overview of the wireless communication system that is applied today. This stage is supported by some literature and data from the Department of Information and Data Processing Second Fleet Command Surabaya. The data is used as initial input when designing the model. Furthermore, a mathematical formulation of the model is made, so that the model can describe the state of the real system. Variable identification is carried out through in-depth interviews. Based on the comes about of the meeting, several variables were gotten that will be used in making the simulation model, such as:

a. Throughput. Throughput is communicated as the volume of information that's effectively sent in

unit time. It could be a degree of how quickly or moderately the arrangement is being measured.

b. Packet Loss Is a measurement of how many packets are lost in the process of sending data.

c. End-to-End Delay is a measurement of the time interval required to transmit data from the sender to the receiver.

2.3.4 Causal Loop Diagram

Causal Loop Diagram (CLD) (Ghafiqie, 2012), serves to describe the relationship between variables that have been defined previously. From the existing Network Security modeling references,a Causal Loop Diagram concept was made for planning the development of information technology security in implementing communication protocols. The four main behaviors in the clause loop:

a. Training strengthens awareness (loop R1).

b. Incidents of theft of information can increase the likelihood of another incident of theft of information (loop R2).

c. Management contributes to make strides in data security and versatility (loop B1).

d. Management contributes to specialized security to increase versatility and information security (loop B2).

2.3.5. Stock and Flow Diagram

The attack model is described as consisting of two stocks, namely, the success of information theft and the development of information security systems. The success of information theft arises due to the vulnerability of the security system, as the probability value of the information theft rate. Information security resilience capabilities arise as a result of efforts to increase information security resilience. Risk assessment efforts are also needed to be able to assess which parts of the system are vulnerable to information theft so that efforts to reduce vulnerability can be made according to the results of the risk assessment carried out.

2.3.6 Formula Determination

The model is built consistently in the use and measurement of its variables on system elements. The next step is to create equations to relate the variables and constants defined for each element of the system. Errors in the determination and use of units, variables, and constants will result in unnecessary confusion and complexity.

2.3.7 Testing Model

Model testing is carried out to determine the feasibility of the model that has been made. Model testing consists of :

a. Verify the model to avoid errors and,

b. The model resembles the actual system.

2.3.8 Analysis and Interpretation

Analysis and interpretation are done to compare with the actual system. How do the variables influence each communication parameter that has been made.

3. RESULT AND DISCUSSION.

This chapter will explain the analysis and discussion of the research "Procedures of Communications Network Information System Department of Information and Data Processing Second Fleet Command to Support the Main Duties of the Indonesian Armed Forces in Facing Cyber Threats and Information Crime". At the beginning of the discussion will be described the data transmission system model on radiotelegraphy communication which is used for long-distance communication between ships, aircraft, and international coastal radio.

Radio communication Telegraphy RTG uses international Morse signs, Q code, and Z code procedural signs to convey information or news. In the implementation process, radiotelegraphy can be

formed in a communication network consisting of two or more radios on the same frequency. In transmitting data, a modulation system model is used, namely FSK modulation. The Matlab simulation model with the configuration of messages sent through the FSK modulator and received and processed in the demodulator is shown in the waveform image Figure 1. The simulation model is set by sending the message 'Telegram message'.

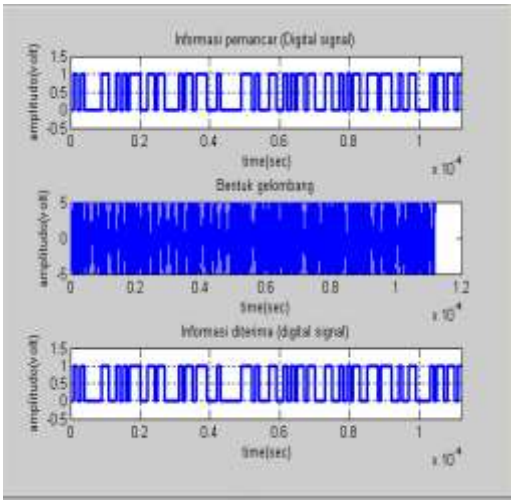

Figure 1. Transmitter Information and Receiver Information Wave

In the Figure 2 shows the data information that transmiting in binary form.

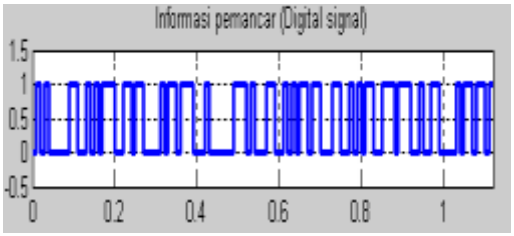

Figure 2. Transmitter Data Information in Binary

The network performance simulation test using the AX2.5 and Mavlink protocols will be explained in the following discussion. The initial number of nodes used as a test of the success of the configuration is 8 nodes. The source node is node number 0 in red and the destination node is node 4 in blue. Node 0 performs the process of sending data to node number 4 success be delivered.

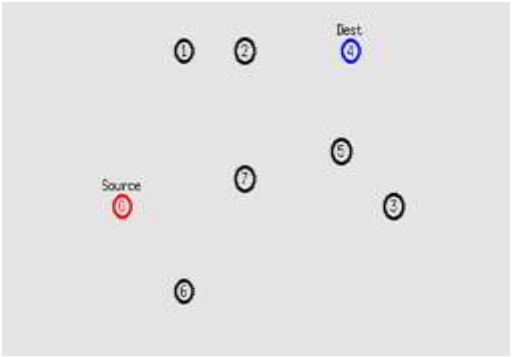

Figure 3. Simulation of The AX2.5 Protokol Protocol

The RREP process is given by all nodes other than node 0, which aims as a routing process to get the shortest route from node 0 to node 4. From the simulation process, the shortest routes are node 0, node 7 and node 4.

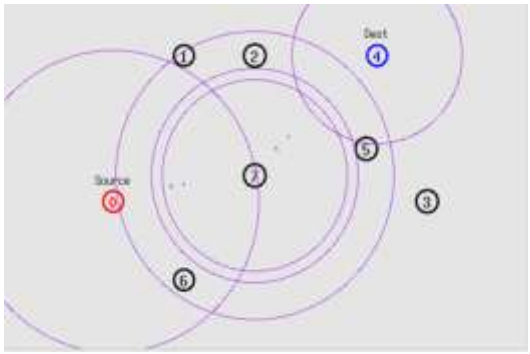

Figure 4. Route Search Process

The simulation shows the process of sending packets from node 0 to node 4 through node 7. The packet delivery process will be carried out until 100 packets are sent.

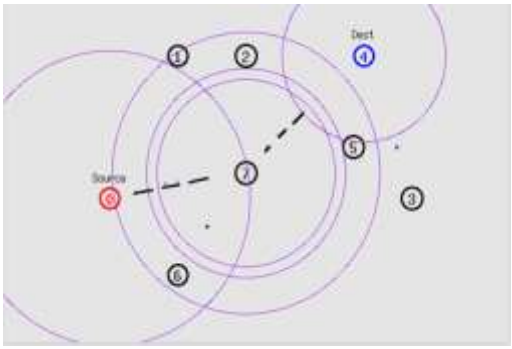

Figure 5. The Process of Sending Packets

The test results in figure number 6 was obtained Packet Delivery Ratio of 1.0 or in percentage is 100%. This proves the number of Packet Loss is 0 or there are no packets lost in the

transmitting process. In the large test, the packets sent were 8631 and received by node 4 was 8631 packets.

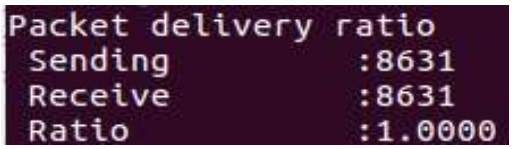

Figure 6. Packet Delivery Ratio

The throughput measurement results were obtained a value of 16580 Kbps, throughput is the data sent in units that represent how much bandwidth capacity is actually used.

Figure 7. Throughput Measurement

4. CONCLUSION.

Based on the comes about of the investigate recreation with the title "Modeling Communication Protocol Dynamic Systems in Improving the Security and Confidentiality of the Information Systems of the Second Fleet Command Surabaya" is as follows, namely, with no packet loss found in the AX2.5 protocol communication test, the AX2.5 protocol has the highest level of the best coefficient and become a proposal in an effort to improve security and confidentiality in the information system at Second Fleet Command Surabaya.

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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:

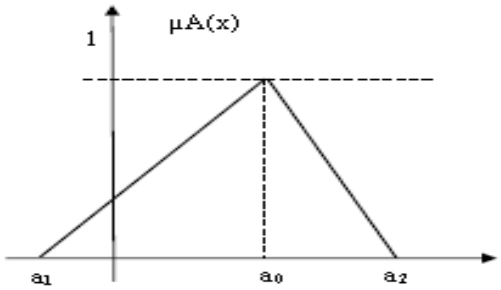

Figure 1. Triangular Fuzzy Number The triangular

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:

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

đt = 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 :

$$T_{i1} = \frac{\sum_{c=1}^{k}(a_{ic}-q_{ic})(a_c-c_c)}{k}$$
$$T_{i2} = \frac{\sum_{c=1}^{k}[q_{ic}(a_c-c_c)+c_c(a_{ic}-q_{ic})}{k}$$
$$U_{i1} = \frac{\sum_{c=1}^{k}(p_{ic}-a_{ic})(b_c-a_c)}{k}$$
$$U_{i2} = \frac{\sum_{c=1}^{k}[b_c(a_{ic}-p_{ic})+p_c(a_c-b_c)}{k} \quad \text{.....5)}$$
$$H_{i1} = \frac{T_{i2}}{2T_{i1}}$$
$$H_{i2} = -\frac{U_{i2}}{2U_{i1}}$$
$$Y_i = \frac{\sum_{c=1}^{k} q_{ic}a_c}{k}$$
$$Q_i = \frac{\sum_{c=1}^{k} a_{ic}a_c}{k}$$
$$Z_i = \frac{\sum_{c=1}^{k} p_{ic}b_c}{k}$$

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

$$T_{i1} = \frac{\sum_{c=1}^{k}(a_{ic}-q_{ic})(a_c-c_c)}{k}$$
$$T_{i2} = \frac{\sum_{c=1}^{k}[q_{ic}(a_c-c_c)+c_c(a_{ic}-q_{ic})}{k}$$
$$U_{i1} = \frac{\sum_{c=1}^{k}(p_{ic}-a_{ic})(b_c-a_c)}{k}$$
$$U_{i2} = \frac{\sum_{c=1}^{k}[b_c(a_{ic}-p_{ic})+p_c(a_c-b_c)}{k}$$

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

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

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

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:

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

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:

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

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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APPLICATION OF ANP AND TOPSIS TO SELECTION OF UNMANNED AERIAL VEHICLES (UAV) LAND-BASED LOCATIONS FOR SUPPORTING THE INDONESIAN NAVY MISSION

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ABSTRACT

The Indonesian archipelagic sea lane which connects the Indian Ocean with the Pacific Ocean and East Asia with Australia brings huge consequences to the efforts to implement security. Therefore, Indonesia needs facilities and infrastructure to carry out the enforcement of state sovereignty while maintaining security in all areas of national jurisdiction. The naval battle strategy using aircraft as an extended sensor system has shown the ability that naval battle tactics will be more effective in detecting the enemy. In carrying out the defense function, almost all defense equipment owned by the Indonesian navy currently need the radar as a remote sensing system or as an early warning system. The strategic location of land base is needed in optimizing the current detection system. The ability of UAVs for security and defense at sea needs to be developed as an Integrated Fleet Weapon System (SSAT) to fulfill the functions of tactical reconnaissance and sea surveillance (Surveillance). The use of the UAV can also increase strength and complement the need for maritime patrol aircraft (MPA), which so far has not been met quantitatively in covering all waters of Indonesia's national jurisdiction. The area of the Indonesian archipelagic sea lane is in the working area of the First Fleet Command (Koarmada I). Where there are some Lantamal and Lanal underneath. In order to optimize the placement of the ScanEagle UAV in the Indonesian archipelagic sea lane region, it is very important to create a UAV location determination model using the ANP and TOPSIS methods. The first step is to develop criteria and sub-criteria for the Landbase location of the Landbase (UAV) in the Indonesian archipelagic sea lane region using the Analytical Network Process (ANP) method. The next step is to compile the criteria and sub-criteria for the location of the Landbase (UAV) in the Indonesian archipelago sea lanes. The last step is to arrange the best priority location using the TOPSIS method. The results of determining the location of the ScanEagle UAV Landbase are expected to be used as input in formulating a strategy for projecting the future strength of the Indonesian navy.

Keywords: UAV, SSAT, Surveillance, ScanEagle, ANP, TOPSIS

1. INTRODUCTION.

The Indonesian archipelagic sea lane which connects the Indian Ocean with the Pacific Ocean and East Asia with Australia. Of course, this brings huge consequences to the efforts to implement the security so that the continuity of national development can be maintained. The naval battle strategy using aircraft as a warship weapon system has shown the ability that naval battle tactics will be more effective in destroying the enemy if carried out with aircraft power according to their function. In carrying out the defense function, almost all defense equipment owned by the Indonesian navy currently require a detection tool in the form of radar as a remote sensing system or as an early warning system, the use of Unmanned Aerial Vehicle (UAV) is an alternative. The use of the UAV can also increase strength and complement the need for maritime patrol aircraft (MPA), which so far have not been met quantitatively in covering all waters of Indonesia's national jurisdiction.

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2. MATERIALS AND METHOD

2.1 Research Approach

In this study the authors use a quantitative research approach where in the implementation the data is taken from the measurement results and based on existing variables. In addition, data collection was also carried out using instruments in the form of questionnaires and interviews.

2.2 Data Sources, Subjects and Research Objects

This research also aims to develop a new approach in solving problems by applying directly to the real world where the type of data collected is in the form of quantitative data consisting of primary data and secondary data.

2.2.1 Data Source

The data collected are:

a. Primary research data comes from data collected by the author himself from the first source or the place where the research object is carried out.

b. Secondary research data comes from data that has been previously collected by other researchers, agencies or other sources that have been tested/valid.

2.2.2 Subject

Research subjects are people who are directly involved as resource persons or data providers, for example being interviewees, filling out questionnaires, or being participants in experiments conducted and observed.

2.2.2 Object

The object of research is generally material, already available before the research is carried out. The shape of the object of research is very diverse, ranging from writing or pictures (for example: transcripts of data and field notes that already exist, results of previous research, minutes of meetings, speeches, thesis details, main tasks and functions, maps, floor plans, charts, organigrams to in the form of objects, buildings, or land (for example: weapons, war vehicles, bunkers, munitions storage, battlefield training fields, and others.

2.3 Research design

Research design is a guideline in carrying out research stages from obtaining or collecting data, processing data, analyzing data and evaluating the data, testing data sensitivity to the final stage of interpreting research results. In this consider, information collection procedures were carried out through perception, interviews and documentation /literature ponders. The literature study was carried out by means of a literature review of several literatures that were correlated with the research theme. Field studies were conducted to obtain the data needed in this research.

2.3.1 Design

The selection of the ANP network model analysis is based on the reason that the purpose of this study is to choose the priority for selecting the Landbase Unmanned Aerial Vehicles (UAV) location in Indonesian archipelagic sea lane region. ANP has the advantage of generalizing the existing alternative options based on the weight of the comparative importance of each factor. . By using ANP it is hoped that the highest priority and lowest priority of the Landbase Unmanned Aerial Vehicles (UAV) locations in the ALKI I Region will be identified. The existing criteria are grouped into 7 clusters, namely Geography, Weather, Violations and Regional Security, Facilities and Logistics Support, Strategic Values and Technology. The next stage is to rank priorities for alternative locations for determining the location of Landbase Unmanned Aerial Vehicles

(UAV) in the Indonesian archipelagic sea lane region which is considered the most suitable. This research, use the TOPSIS method to rank priorities.

2.3.2 Research procedure

The research procedure there are six steps that were written below:

a. Define and formulate the problem.
b. Conduct literature study.
c. Determine the research design.
d. Processing and presenting information.
e. Analyze and interpret.
f. Results and conclusions.

3. RESULT AND DISCUSSION.

The limited number of ScanEagle UAVs on Intelligence, Surveillance, and Reconnaissance (ISR) tasks at Indonesian navy bases in the Indonesian archipelagic sea lane region must be covered by UAVs, it is important to know the level of urgency and certain criteria in determining the location, so it is important to optimize . The optimization process is carried out based on the criteria for the ScanEagle UAV Landbase location. Most of the ALKI I area is in the working area of the Fleet Command I (Koarmada I) which consists of several Lantamal and Lanal under it. The ScanEagle UAV is tasked with carrying out location mapping activities in the Fleet I Command (Koarmada I) work area. In this study, to weight the criteria and sub-criteria used the ANP method. The criteria and sub-criteria that have been determined by the author are described as follows:

a. Geographical Location Criteria, Geographical location criteria are used as a basis for consideration of location selection, which includes mountains and land. The sub-criteria of the geographical location criteria are as follows in the table 1 below.

Table 1. Sub Criteria in Geographical Location Criteria

No	Sub Criteria	Parameter
1	Mountain	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is not constrained by the presence of mountainous areas which will interfere with the transmission of the data link to the Ground Control Station.
2	Tall Buildings	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is not constrained by the number of tall buildings that will interfere with the transmission of the data link to the Ground Control Station.
3	Land	Relates to the planned position of the Landbase Unmanned Aerial Vehicles (UAV) location. The UAV will be able to operate properly if the location is in the form of a lowland so as to minimize interference with sending data links to the Ground Control Station

b. Criteria for Weather Conditions Criteria for weather conditions are used as a basis for consideration of location selection, which includes sunny cloudy and rainy. The sub-criteria of the weather conditions criteria are as follows in the table 2 they are :

1) sunny cloudy
2) Rainfall

Table 2. Sub Criteria in Weather Condition Criteria

No	Sub Criteria	Parameter
1	Sunny cloudy	Cloudy sunny weather at the UAV Landbase location greatly affects flight operations to the maximum
2	Rainfall	When it rains, it has a big effect on the sensor sensitivity of the UAV

c. Criteria for Vulnerability and Security, Criteria for vulnerability and security are used as the basis for site selection considerations, which include territorial violations, crimes of piracy, smuggling and SAR Rescue. The sub-criteria of the vulnerability and safety criteria are:

Table 3. Vulnerability and Security Sub Criteria

No	Sub Criteria	Parameter
1	Territory violation	With the determination of the location plan that will be used as a UAV Landbase, all area violation activities will be monitored more quickly and action will be carried out faster
2	The crime of piracy	By determining the location plan that will be used as a UAV Landbase, the occurrence of piracy crimes at sea can be anticipated
3	Smuggling	By determining the location plan that will be used as a UAV Landbase, smuggling activities at sea can be anticipated
4	SAR Rescue	By determining the location plan that will be used as the UAV Landbase, it will make it easier to carry out SAR in the event of an accident in the area

d. Criteria for Facilities and Logistics Support, Criteria for Facilities and Logistics Support are used as the basis for site selection considerations, which include Airport, Port, Maintenance, Fuel and Electricity. The sub-criteria of the Facilities and Logistics Support criteria are as follows:

Table 4. Sub Criteria for Facilities and Logistics Support

No	Sub Criteria	Parameter
1	Airport	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have easy access to spare parts so as to ensure the continuity of the UAV's operation.
2	Harbor	The existence of a port close to the planned location for determining the Landbase Unmanned Aerial Vehicles (UAV) will make UAV delivery easier

3	Parts	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have easy access to spare parts so as to ensure the continuity of the UAV's operation.
4	Maintenance	The area around the Landbase Unmanned Aerial Vehicles (UAV) location must have the convenience of carrying out repairs so as to ensure the continuity of the UAV's operations.
5	Fuel	The ease of access to get fuel will greatly support the optimal operation of the UAV
6	Electric	The existence of electricity at the Landbase Unmanned Aerial Vehicles (UAV) location, the operation of the UAV is guaranteed starting from the UAV unit itself, the Ground Control Station and crew personnel from the UAV

The alternative choices that have been determined by the author are described as follows in the table 5. The alternatives consist of A Naval base, B Naval base, C naval base, and D Naval base.

Table 5. Alternative

No	Description	A Naval base	B Naval base	C Naval base	D Naval base
1	Location	A	B	C	C
2	Land area	765 M2	20.720 M2	612 M2	22.60 M2
3	Land owner	Indonesian navy	Indonesian navy	Indonesian navy	Indonesian navy

The pattern of interrelationships is useful for explaining the inner dependence of the elements. This relationship was obtained through the results of interviews and the results of filling out research questionnaires on the relationship between the elements involved in the selection of UAV placement locations filled out by related parties.

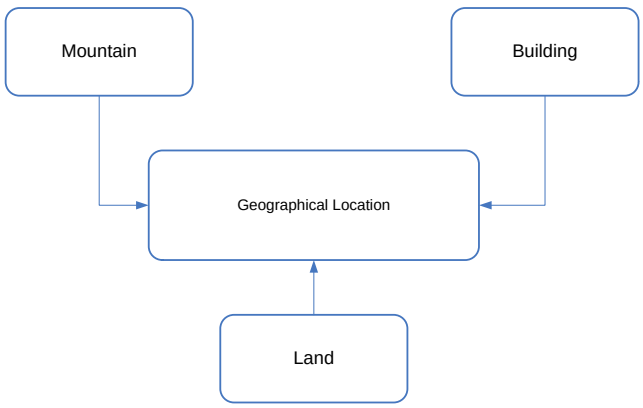

Figure 1. Inner Dependence Linkage Pattern on Cluster of Geographical Location criteria

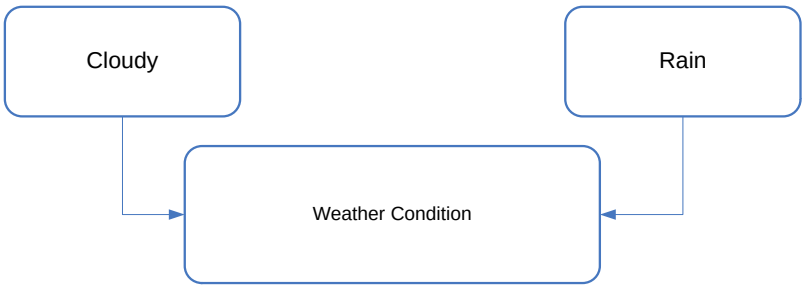

Figure 2. Pattern of Inner Dependence on Cluster of Weather Condition criteria

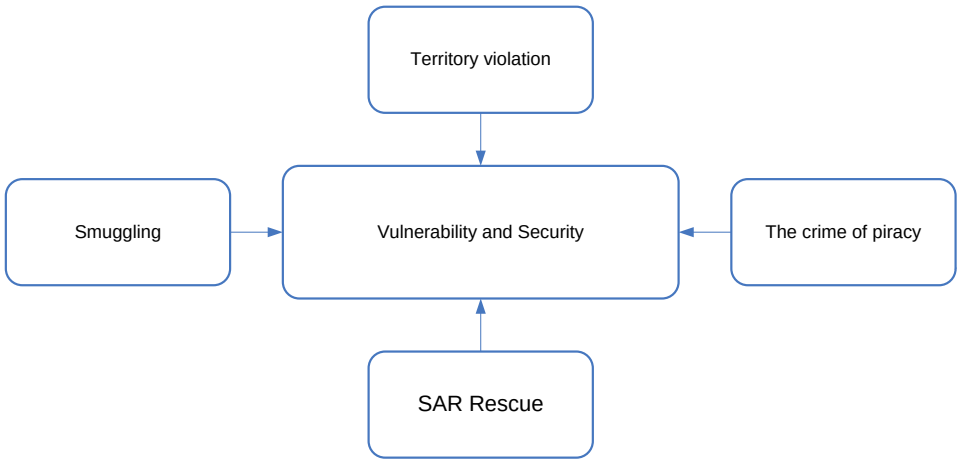

Figure 3. Inner Dependence Linkage Pattern on Cluster of Vulnerability and Security criteria

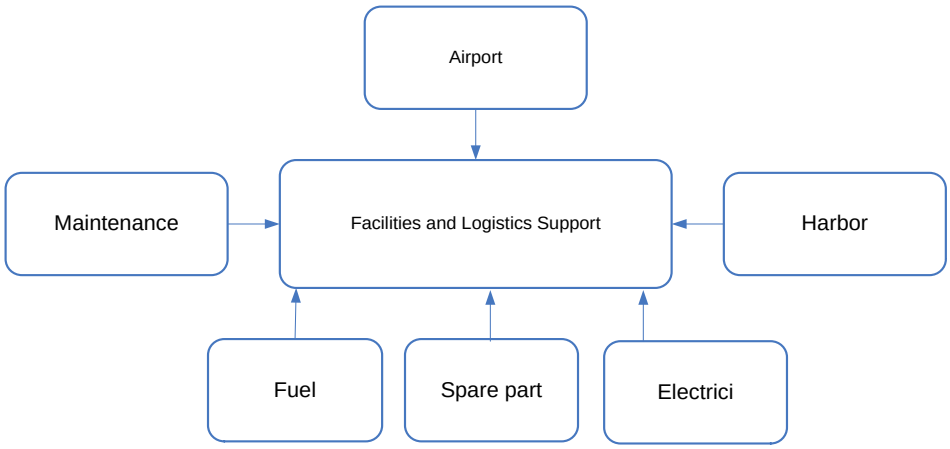

Figure 4. Patterns of Inner Dependence Linkages on Clusters of Facilities and Logistics Support criteria

The structure of the ANP relationship consists of criteria in which there are sub-criteria and alternatives. The structure of this ANP relationship has a relationship between criteria, sub-criteria and each alternative inner dependence. This ANP linkage structure is a summary of all identifications of all related elements. This linkage structure is used as the basic pattern in entering the linkage pattern using the Super Decisions software

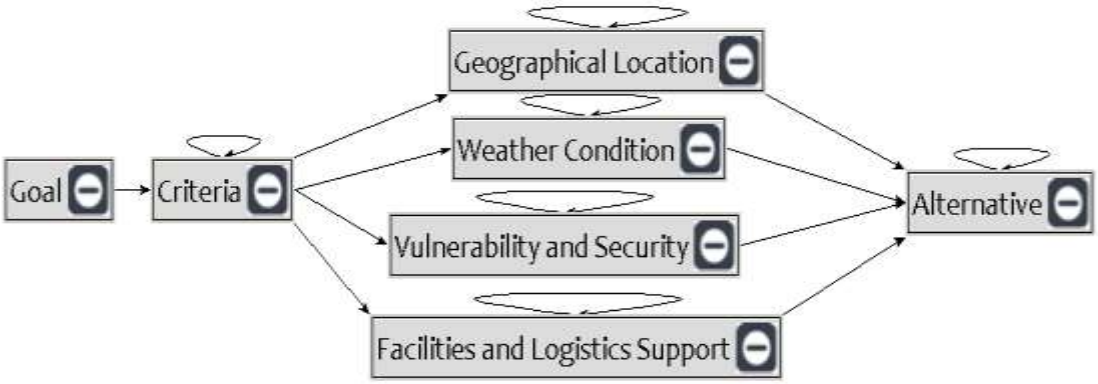

Figure 5. The ANP Relationship Structure

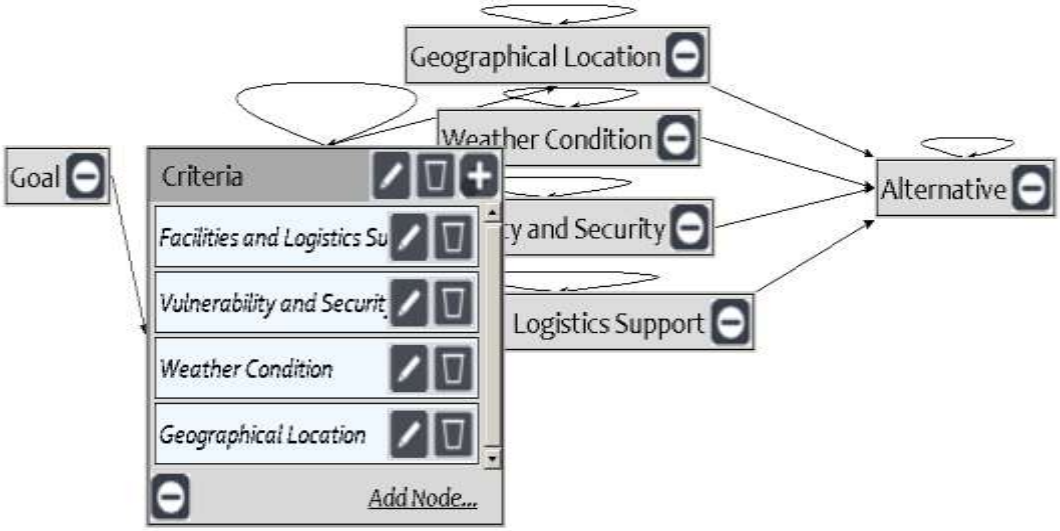

Figure 6. Criteria Structure

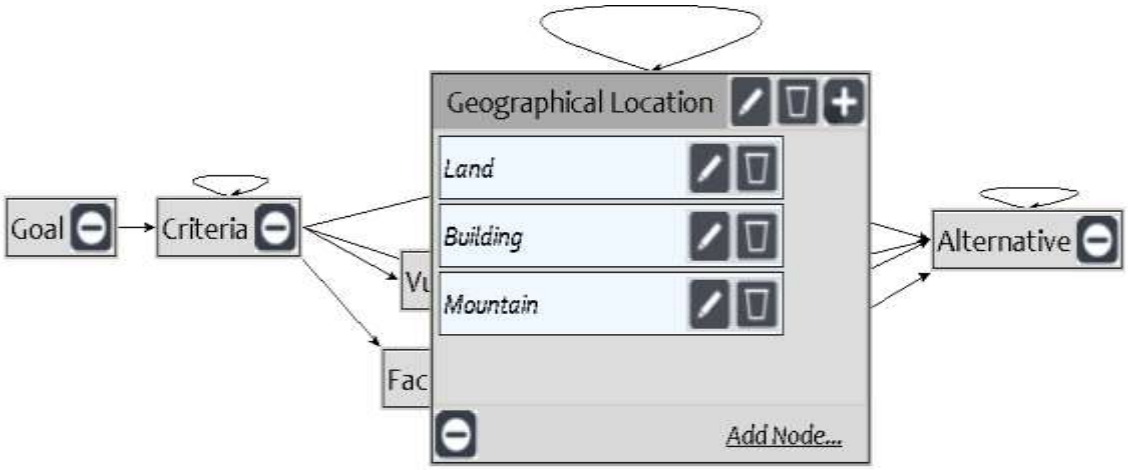

Figure 7. Structure of ANP Relationship Details of Geographical Location Criteria

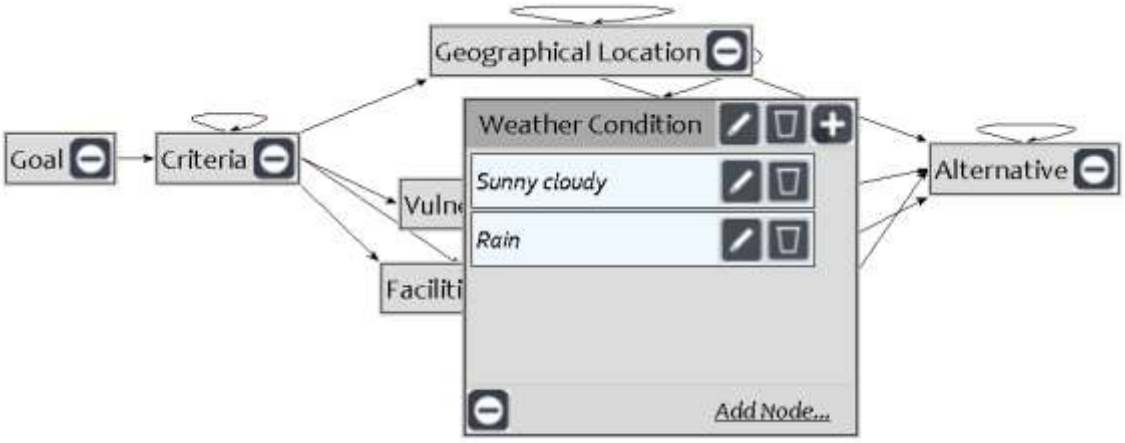

Figure 8. ANP Relationship Structure Details of Weather Condition Criteria

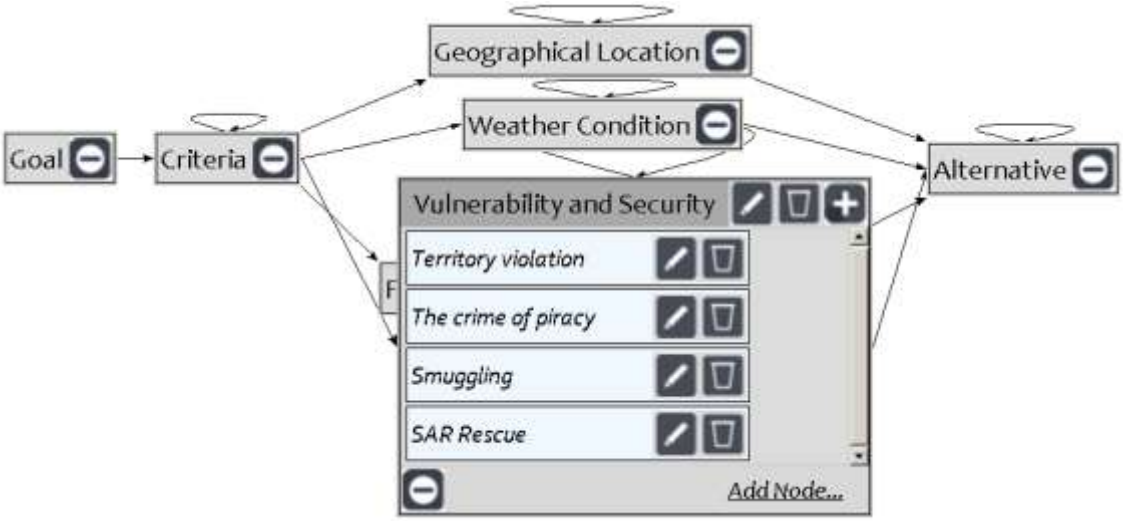

Figure 9. ANP Relationship Structure Details of Vulnerability and Security Criteria

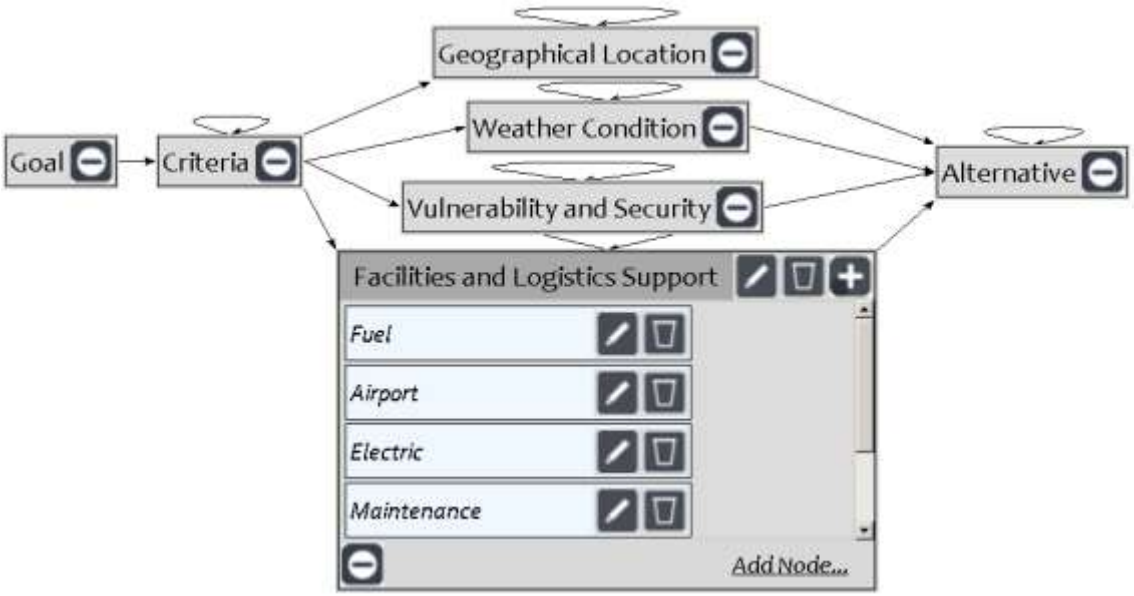

Figure 8. ANP Relationship Structure Detail Criteria for Facilities and Logistical Support

4. CONCLUSION.

The purpose of this research is for selecting location the best landbase for naval UAV and ANP has the advantage of generalizing the existing alternative choices based on the weight of the comparative importance of each factor. Topisis used for decision making that has multiple criteria. furthermore the selected landbase is D Naval base because it has highest value between all alternative.

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OPTIMIZATION OF THE AIRCRAFT ASSIGNMENT MODEL IN THE ALKI II REGION UNDERNEATH THE OPERATION OF SECOND FLEET COMMAND

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ABSTRACT

Assignment Marine security operation is an operation where the presence at sea has strategic value for the existence of national sovereignty and maritime security in Indonesia's national jurisdiction. The threat of security disturbances and violations at sea in the form of fishing theft, theft of timber and other natural resources as well as encroachment on territorial boundaries by foreign ships requires the presence of the Indonesian navy Patrol Elements (Ships and Aircraft) for security. The limited number of Indonesian navy Patrol Elements and the budget provided by the state as well as the need for securing the maritime territory of the Republic of Indonesia have resulted in the need for thinking about optimizing the assignment of Patrol Ships and Aircraft in the Kamla operation sector and placement to their supporting bases, so that the right type and amount and operational costs in security. Ships and aircraft carry out patrols in randomly determined sectors. This optimization model identifies the related decision variables through open interview discussions, then sets the objective and constraint functions as an optimization model to be developed. The application of the Goal Programming method which can be formulated by determining the decision variables related to the assignment of aircraft where the objective function is to calculate the maximum radar coverage area in the operating sector and minimize operating costs. Meanwhile, Mamdani's Fuzzy Logic method is used to determine the output of certain radar coverage areas. In this case, it requires the help of Matlab software on the Fuzzy Inference System (FIZ) toolbox to solve this problem.

Keywords: Maritime Patrol Aircraft, Coverage, Operating Costs, Goal Programming, Fuzzy Inference System, and Mamdani Fuzzy Logic .

1. INTRODUCTION

Indonesia is the largest archipelagic state in the world which has 17,504 islands and the area of archipelagic waters reaches 3.11 million km2 (Pushidrosal, January 2018). Geographically, Indonesia is at the crossroads between the Indian and Pacific Oceans, and is between the continents of Asia and Australia and has 4 choke points out of 9 choke points in the world which are located in the three Indonesian Archipelagic Sea Lanes (ALKI). In the vast sea, there is potential for marine resources that are very abundant and have strategic value for the sustainability of national development, but they are still not managed optimally. The Indonesian Naval force as the most component of state defence at sea is obliged to preserve the regional keenness of the Republic of Indonesia and keep up security solidness at the ocean and secure normal assets at the ocean from different forms of security unsettling influences and infringement of law within the regional waters of Indonesia's national locale, whereas taking into consideration the essential concept that the realization of Security at the ocean has two measurements, to be specific the authorization of sway and law authorization which is interrelated with one another.

This causes Indonesia's marine areas to be vulnerable to various security disturbances.

Crimes or violations in the Indonesian seas are broadly defined into 3 (three) parts as follows:

a. Violation of the territorial sea boundaries of the Republic of Indonesia by foreign ships.

b. Direct and indirect crimes that threaten to harm the interests of the Indonesian people and state include: piracy, piracy and theft of state assets at sea (mines, fish and other marine resources).

c. There are many criminal acts carried out through the media of the sea/Indonesian waters such as smuggling of fuel, wood and other goods (Asops, 2019).

In association with the usage of the requirement of sway and law at the ocean, the concept of security at the ocean is characterized to address each occasion of infringement of impact and law at the sea which has legitimate legitimateness both broadly and all-inclusive. The Indonesian Oceanic compel must be able to carry out the early range of infringement by conducting marine security watches with components of the Integrated Fleet Weapon System (SSAT) comprising of the Republic of Indonesia Warships, Aircraft, Marines, and Bases.

The maritime patrol pattern that has been used by KRI will carry out observations in arbitrarily chosen sections. This plan has various challenges, including

a. Operational organizing isn't extraordinary and requires a broad working budget

b. The number of ships that operating is small because just a few ships are ready so the operation is not optimal.

The speed of progression towards the target (time reaction) is a deterrent in giving advantage levels to requests, to be specific securing the working division. Taking into thought the issues over, it is vital to think and organize for the task of the Maritime Watch Carrier to support perfect ocean security operations interior the eastern district. In this paper, the producer tries to optimize the task of the 800th Squadron. Puspenerbal Ocean Observe Flying machine based on scope and working costs utilizing Objective Programming and Fluffy Deduction Framework (FIS) techniques. The optimization comes almost gotten can at that point be utilized as input in defining the Indonesian navy's control projection technique.

2. LITERATURE REVIEW

2.1 Linear Programming

Linear Programming is one of the Operations Research sciences that discusses the mathematical calculations of efforts to achieve optimum results with limited resources: Linear programming is a model consisting of linear relationships representing a firm's decision(s) given an objective and resource constraints .(Taylor III, 1999). Linear Programming is a form of planning that is used to illuminate optimization problems so that it has a maximum or minimal goal. The nature of Linear Programming is a function that expresses its objectives and constraints in the form of a linear function. For delimiters in the form of equations or inequalities.

2.2 Model Integer Linear Programming

There are three essential models of numbers direct programming: Add up to Numbers, 0-1 Numbers, and Mixed Numbers. The anticipated add-up to numbers of the choice variable is a non-negative integer. At 0-1 integer all decision variables are zero or one. For Mixed integers, the decision variable (not all) is required to have an integer value (Taylor III; 1999).

The problem formulation using Integer Linear Programming is built with the following components:

a. Decision Variables. This variable describes the decisions that must be taken, can be made in the form of X1, 1, X1, 2,...., Xn, m.

b. Purpose Function. This function is a decision variable that will be maximized or minimized. To express the objective function is denoted by Z.

c. Constraint. The constraint is a function that limits the determination of the decision variables. Called the technological coefficient, this limit is usually related to the available resources.

2.3 Goal Programming

The hallmark of the Goal Programming method is that there are many goals that must be accomplished by choice creators. Given the numerous objectives that must be accomplished, the accomplishment of objectives is diverse from one

another. Perhaps the accomplishment of an objective is more than what has been set as a victory measure and perhaps the accomplishment of an objective is less than what has been set (deviation). And bad habits versa for other purposes inside the system of the same issue. An objective in this case, in case the accomplishment is more prominent than the victory criteria, is alluded to as over accomplishment whereas in the event that if on the off chance that in the event that in case the objective accomplishment is littler than the victory criteria, it is alluded to as "beneath accomplishment". The issue of Objective Programming is said to be optimal in terms of achieving these goals if the total value of underachievement and overachievement is as small as possible and even zero if possible. Or in other words the deviations from the overall goal are as small as possible.

Deviations from one goal may be considered more important than other deviations in a given situation. Or a situation may arise where the deviation over achievement is considered more important than the deviation under achievement or vice versa. This situation requires a scale that reflects the relative importance of the various deviations from the goal. Deviations from one goal may be considered more important than other deviations in a given situation. Or a situation may arise where the deviation over achievement is considered more important than the deviation under achievement or vice versa. This situation requires a scale that reflects the relative importance of the various deviations from the goal. Deviations from one goal may be considered more important than other deviations in a given situation. Or a situation may arise where the deviation over achievement is considered more important than the deviation under achievement or vice versa. This situation requires a scale that reflects the relative importance of the various deviations from the goal.

Conceptions of various approaches in the formulation of Goal Programming can be summarized as follows:

a. Each goal constraint in addition to having a decision variable, namely Xi (X1, X2, X3, ... Xn) has a non-negative deviation variable, namely ui and ei. Variable ui states deviation under achievement and variable ei states deviation over achievement.

b. The objective function in Goal Programming is the minimization of deviations or the minimization of the deviation variables ui and ei. Xi's decision variable. not stated in the objective function.

c. To minimize deviation under achievement ui, the objective constraint formulation is :gi (X1, X2, X3,..... Xn) + ui < U > bi : ui > 0 with objective function to minimize ui.

d. Minimiz deviations over achievement ui, the formulation of the goal constraint is: g_i(X1, X2, X3,..... Xn) + ui - ei < U > bi : ei > 0 with the objective function minimizing ei.

e. Minimizing under achievement and over achievement deviations, the objective limiting formulation is as follows: gi (X1, X2, X3,..... Xn) + ui - e=b with the objective function of minimizing ui+ ei.

f. To express a preference for a deviation, a weighing factor is used within the detailing of the objective function. The weighted objective function in the Goal Programming model is represented as follows:

Minimization: $\sum_{i=1}^{n}$ w1 ui + wi - ei …….....1)

Because one or both deviation variables are equal to zero, the objective constraint that has a positive deviation variable is an active constraint.

2.4 Fuzzy Inference System (FIS)

Fuzzy Inference System (FIS) additionally called Fuzzy Induction Motor may be a framework that works on the preface of Fuzzy Basis (Fuzzy rationale) which can reason with comparable

guidelines as individuals do consider with their instinctual. There are a few sorts of FIS known, namely Mamdani, Sugeno and Tsukamoto . The FIS that's the most effortless to get it, since it is most in line with human instinctual is the FIS Mamdani . The Mamdani strategy is frequently known as the Min-Max Strategy. This strategy was presented by Ebrahim Mamdani in 1975. The FIS works based on linguistic rules and incorporates a fuzzy calculation that gives an estimation to enter into scientific investigation. The input given to FIS is inside the outline frame outline shape of a certain number and the coming approximately abdicate must additionally be a certain number. The fuzzy strategy that the author employments here is the Mamdani method Fuzzy with the assistance of Matlab R2014A instruments, where the input and yield factors are separated into one or more fuzzy sets. The steps for the solution are as follows:

a. Formation of fuzzy sets

Mamdani strategy, both input and yield factors are separated into one or more fuzzy sets.

b. Implication function app

Suggestion work app In the Mamdani strategy, the suggestion work utilized is Min.

c. Composition Rules

Unlike monotonic thinking, in the event that the strategies utilized in performing fuzzy system inference, to be specific: max, added substance and probabilistic OR (probor), as follows:

1) Max Method (Maximum)

In this method, the fuzzy set arrangement is gotten by taking the greatest esteem of the run the show, at that point utilizing it to adjust the fluffy locale, and applying it to the yield utilizing the OR (union) administrator. In the event that all recommendations have been assessed, then the output will contain a fuzzy set that reflects the commitment of each suggestion. In common it can be composed

μsf[xi] ← max(μsf[xi], μkf[xi]) with:

μsf[xi] = fuzzy solution membership value up to the i-th rule;-

μkf[xi] = fuzzy consequent membership value of the i-th rule;

2) Additive Method (Sum)

In this method, the fuzzy set solution is obtained by performing a bounded-sum on all fuzzy range outputs. Generally composed:

μsf[xi] ← min(1,μsf[xi]+ kf[xi]) with:

μsf[xi] = participation value of fuzzy arrangements up to the i-th rule;

kf[xi] = fuzzy consequent membership value of the i-th rule;

3) Probabilistic Method OR (probor)

In this strategy, the fuzzy set arrangement is gotten by doing the item of all fuzzy range outputs. In common, it is composed:

sf[xi] (μsf[xi]+ kf[xi]) - (μsf[xi] * kf[xi]) where:

sf[xi] = membership value of fuzzy solutions up to the i-th rule; kf[xi] = fuzzy consequent membership value of the i-th rule;

4) Affirmation (Defuzzy)

The input of the defuzzification preparation could be a fuzzy set gotten from the composition of fuzzy rules, whereas the resulting yield may be a number within the domain of the fuzzy set. So in the event that given a fuzzy set inside a certain extend, it must be able to take a certain crisp value as output.

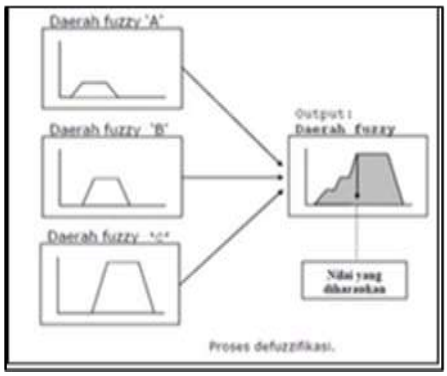

Figure 1. Defuzzification Process

There are a few methods of defuzzification within the composition of the Mamdani rules, counting

1) Centroid method (Composite Moment)

In this method, the crisp solution is obtained by taking the center point (z*) of the fuzzy area. Generally formulated:

$$z^* = \frac{\int_Z z\mu(z)dz}{\int_Z \mu(z)dz} \qquad z^* = \frac{\sum_{j=1}^{n} z_j\mu(z_j)}{\sum_{j=1}^{n} \mu(z_j)}$$

2) Bisector Method

In this strategy, the crisp course of action is gotten by taking esteem inside the fuzzy space which highlights cooperation esteem of half of the general support esteem within the fuzzy locale.

3) Method Mean of Maximum (MOM)

In this strategy, the crisp course of action is gotten by taking the normal esteem of the space that has the most extreme support esteem.

4) Method Largest of Maximum (LOM)

In this strategy, the fresh course of action is gotten by taking the biggest esteem of the space that has the most extreme cooperation esteem.

5) Method Smallest of Maximum (SOM)

In this strategy, the crisp arrangement is gotten by taking the esteem of the littlest of the spaces that have the most extreme interest esteem.

2.5 Lingo

Lingo is a tool which is a program used to solve linear and non-linear optimization problems into the formulation of complex problems, then processed and analyzed the results. There are several problems that can be solved with lingo such as transportation management, marketing, production, finance and personnel. Lingo is designed to process cases in linear and non-linear programs with a matrix that shows columns as decision variables. Writing the lingo formulation is an algebraic formulation (summing between variables).

3. MATERIALS AND METHODS

3.2 Research Flowchart

The research begins with the identification of problems which are the activities that form the basis for carrying out the research. This activity is carried out to identify the main problems to be discussed and then proceed with the formulation of the problem. Identification of problems obtained with prior knowledge that the maritime territory of the State of Indonesia contains a tall potential for helplessness in terms of law and sway. Meanwhile, the pattern of sea area security operations carried out by the Indonesian Naval force have numerous challenges in the form of an unplanned operation pattern that requires an expansive budget, the number and response time of the KRI is limited so that the surveillance coverage is not optimal, and the supporting equipment for supervision such as IMSS is also limited in number and capabilities. . Meanwhile, the utilization of resources, in this case the elements of the SSAT, has not been maximized. Following up on some of these things, it is necessary to think about utilizing the Maritime Patrol Aircraft as an expansion of the KRI's eyes so that marine security operations run in a perfect world. For this reason, it is necessary to calculate the assignment model in order to maximize the radar coverage of the Maritime Patrol Aircraft, both ideal and real, which patrols the operating sectors optimally utilizing the least conceivable budget to be able to back the utilization of oceanic security operations inside the work zone of the command maritime drive.

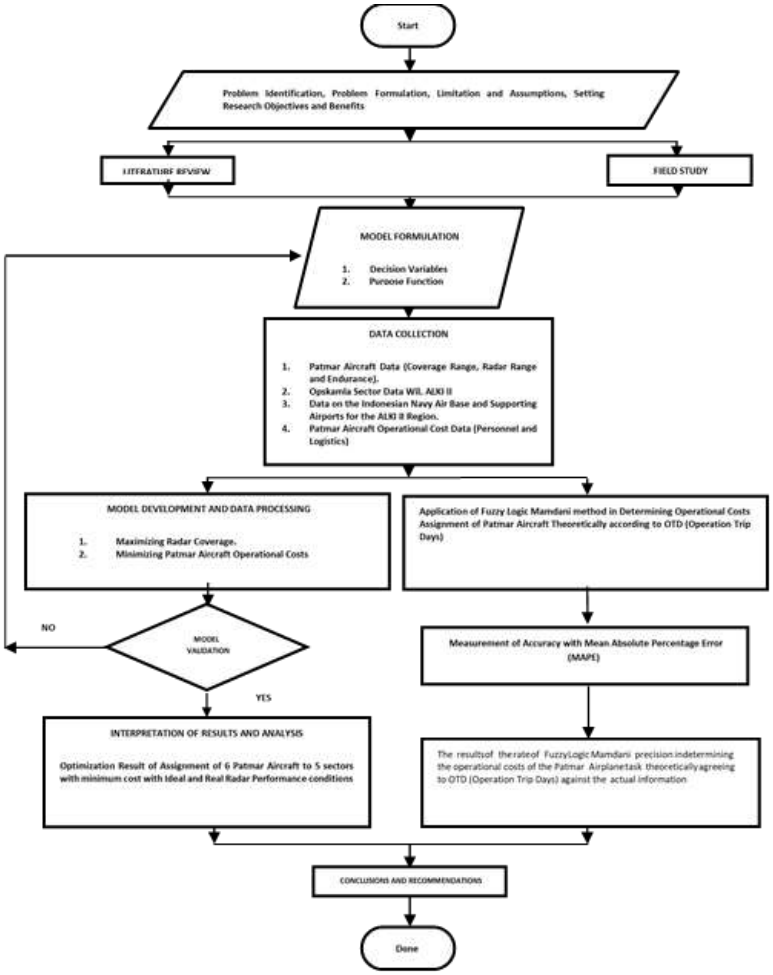

Figure 2. Flowchart The Reseach

3.1 Research Object

The object of research in this paper is the Lantamal Patrol Vessel and the Maritime Patrol Aircraft for the Koarmada II area. The object will be optimized by taking certain characteristics that have a value, score or measure which will later be processed at the data processing stage so thatThis research applies the principles of data analysis and variable analysis.

This study contains the collection and processing of data used for data analysis and interpretation. From the collection and processing of information can be seen the specified comes about of this study. The information gotten is within the frame of subjective and quantitative information comprising essential and secondary information obtained by conductingdirect interviews with officials in relevant agencies and data on the latest technical condition of the Maritime Patrol Aircraft according to the field.

4. RESULTS AND DISCUSSION

4.1 Maritime Patrol Aircraft Capability

Table 1. Aircraft Ability

No	AIRCRAFT	YEAR	Speed (Knots)	ABILITY AIRCRAFT	
				OPERATION HOURS (O'clock)	SURVEILLANCE (nm)

				ENDURANCE	REAL	IDEAL	REAL
1	A	200A	155	5	3	120	60
2	B	200B	155	5	3	120	72
3	C	200C	155	5	3	120	96
4	D	199D	155	5	3	120	50
5	E	199E	155	5	3	120	50
6	F	200F	155	5	3	120	96
7	G	200G	155	5	3	120	96
8	H	200H	155	5	3	120	96
9	I	202I	185	9	3	200	200
10	J	201J	185	9	3	200	200
11	K	201K	185	9	3	200	200
12	L	201L	185	9	3	200	200
13	M	201M	185	9	3	200	200

Source: Processed Author's Data

4.2 Maritime Patrol Aircraft Coverage Capability

Maritime Patrol Aircraft moving from one point to another in the midst of operation have variable speed capability and radar expand capability. Oceanic Observe Plane cruising run is the expanded capability of the Ocean Patrol Aircraft flying in the midst of working hours/trips. Scope range Oceanic Watch Airplane is the zone that can be secured by the Sea Observe Flying Machine within the working area during working hours/trips.

To calculate the cruising distance and coverage area of the Maritime Patrol Aircraft per trip during flight, it is described and formulated in Figure 4.1 as follows:

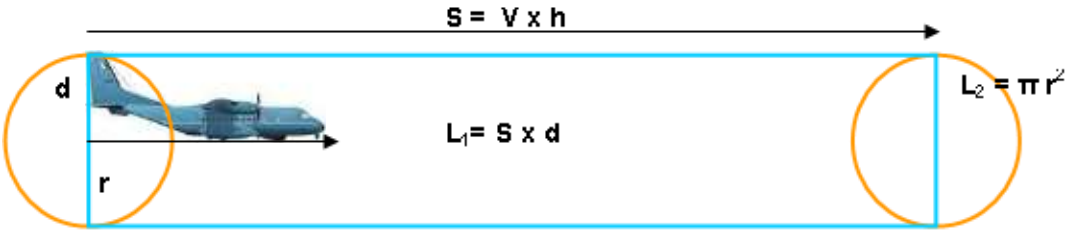

Figure 3. The wide coverage area of the Maritime Patrol Aircraft

S = V xh **……(4.1)**
L1 = S xd
L2 = r^2

Table 2. Maritime Patrol Aircraft Operation Capability per Trip

NO	AIRCRAFT	SPEED	ENDURANCE	O'CLOCK OPS	TRAVEL DISTANCE	SURVEILLANCE IDEAL RADAR (nm)	SURVEILLANCE REAL RADAR (nm)
1	A	155	5	3	465	120	60

2	B	155	5	3	465	120	72
3	C	155	5	3	465	120	96
4	D	155	5	3	465	120	50
5	E	155	5	3	465	120	50
6	F	155	5	3	465	120	96
7	G	155	5	3	465	120	96
8	H	155	5	3	465	120	96
9	I	185	9	3	555	200	200
10	J	185	9	3	555	200	200
11	K	185	9	3	555	200	200
12	L	185	9	3	555	200	200
13	M	185	9	3	555	200	200

Source: Processed Author's Data

Table 3. Coverage Maritime Patrol Aircraft per Trip

NO	AIRCRAFT	IDEAL			REAL		
		L1	L2	COVERAGE	L1	L2	COVERAGE
		S*D	3.14*r2	(L1 + L2)* 0.9	S*D	3.14*r2	(L1 + L2)* 0.9
1	A	111600	45216	141134.4	55800	11306.0	60393.6
2	B	111600	45216	141134.4	66960	16277.8	74914.0
3	C	111600	45216	141134.4	89280	28938.2	106396.4
4	D	111600	45216	141134.4	46500	7850	48915
5	E	111600	45216	141134.4	46500	7850	48915
6	F	111600	45216	141134.4	89280	28938.2	106396.4
7	G	111600	45216	141134.4	89280	28938.2	106396.4
8	H	111600	45216	141134.4	89280	28938.2	106396.4
9	I	222000	125600	312840	222000	1256000.0	312840.0
10	J	222000	125600	312840	222000	1256000.0	312840.0
11	K	222000	125600	312840	222000	1256000.0	312840.0
12	L	222000	125600	312840	222000	1256000.0	312840.0
13	M	222000	125600	312840	222000	1256000.0	312840.0

Source: Processed Author's Data

4.3 Maritime Patrol Aircraft Operation Cost

Operational cost is characterized as the fetched per perseverance of fluid coordination and flying machine faculty coordinations during operation.The use of liquid logistics includes:

a. Lubricant The use of personnel logistics include
b. Operation Consumtion Cost (UMO)
c. Avtur Jet A-1 Cost
d. Operational Allowance (USO)
e. Tactical Fund
f. Supplies and Health
g. Command and Control Intensive

Table 4. Cost Required per Operation

No		BBM	TRIP	∑BB/ month	∑OE/ month	∑H/ month	∑t/ month	∑TC/ Th
Aircraft	End	K(Ltr/Hour)	exK(Ltr)	ex Kx10 x Rp11,800	6x 20,500	H x 14,800	∑BB+∑OE +∑H(RP)	∑TOT/monthx12x (Rp)
A	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
B	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
C	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
D	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
E	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
F	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
G	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
H	3	400	1,200	141.600.000	123,000	88,200	141,811,200	1,701,734,400
I	3	450	1,350	159,300,000	123,000	88,200	159,511,200	1,914,134,400
J	3	450	1,350	159,300,000	123,000	88,200	159,511,200	1,914,134,400
K	3	450	1,350	159,300,000	123,000	88,200	159,511,200	1,914,134,400
L	3	450	1,350	159,300,000	123,000	88,200	159,511,200	1,914,134,400
M	3	450	1,350	159,300,000	123,000	88,200	159,511,200	1,914,134,400

Source: Processed Author's Data

4.4 Marine Security Operation Sector Data in Second Fleet Region

The territorial waters in the ALKI II Region as the Marine Security Operations sector of the second Fleet Command are divided into five Operational Sectors. This division aims to facilitate coordination in the division of operational work areas for KRI and Aircraft to carry out patrols as well as simplify the reporting system in patrols. The following is a picture of the five Operational Sectors.

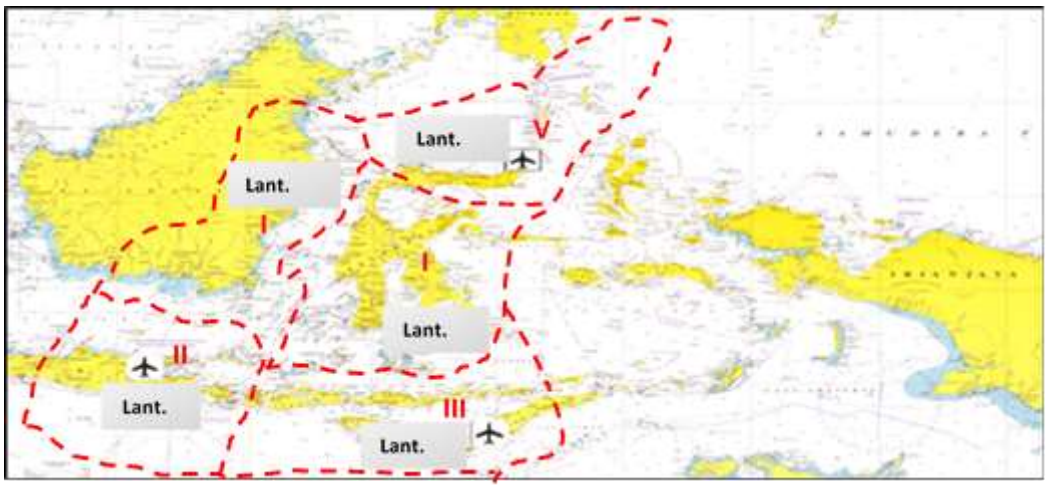

Figure 4. Sector Operation In ALKI II

4.5 Calculation of OTD (Operation Trip Days)

OTD (Operation Trip Days) is the number of days required for a Maritime Patrol Aircraft unit to fly one operation course interior the security sea Operations fragments. In the event that you do not intellect note that in one day the Maritime Patrol Aircraft flies for 3 hours of operation.

OTD = (Route Length / Speed) / 3

OTD = (L/V) / 3 (days), where L = Route length, V=Aircraft Speed

Table 5. Result of Calculation

NO	AIRCRAFT	OPERATION TRIPS DAYS				
		Fleet II REGIONAL PATROL SECTOR				
		Sector I	Sector II	Sector III	Sector IV	Sector V
		1650	1370	1610	1390	1000
1	A	3.54	2.94	3.46	2.98	2.15
2	B	3.54	2.94	3.46	2.98	2.15
3	C	3.54	2.94	3.46	2.98	2.15
4	D	3.54	2.94	3.46	2.98	2.15
5	E	3.54	2.94	3.46	2.98	2.15
6	F	3.54	2.94	3.46	2.98	2.15
7	G	3.54	2.94	3.46	2.98	2.15
8	H	3.54	2.94	3.46	2.98	2.15
9	I	2.97	2.46	2.90	2.51	1.80
10	J	2.97	2.46	2.90	2.51	1.80
11	K	2.97	2.46	2.90	2.51	1.80
12	L	2.97	2.46	2.90	2.51	1.80
13	M	2.97	2.46	2.90	2.51	1.80

Source: Processed Author's Data

4.6 Optimization of the Assignment of Maritime Patrol Aircraft to the Operations Division

The starting information collection and calculation have been carried out, at that point the other step is to optimize the task of Sea Watch Flying machine to the working division. This association incorporates the arranging of logical models and optimization arrangement. The arranging of logical models and optimization forms is carried out utilizing the speculation of Numbers Straight Programming, with the taking after stages:

a. Determination of Decision Variables
b. Determination of the Objective Function
c. Determination of System Constraints
d. Optimization Process

The optimization arrangement is carried out utilizing the program Lingo 8.0 which encompasses a boundless impediment shape with the point that all sorts of restrictions/constraints can be obliged so that it is expected that the comes almost gotten can be maximized. The sequence of steps is as follows:

a. Data Input and Compilation
    1) Data 5 Operational Sector (route length and operating division area).
    2) Capability of 13 aircraft (speed, perfect and genuine radar range and most extreme fuel tank capacity).
    3) Operating costs/day
b. Arrangement of Decision Variables
    1) Matrixzero-oneMaritime Patrol Aircraft assignment.
    2) ScoreDeviation
c. Preparation of Objective Functions

1) Minimize the value of deviation/deviation

2) Achievement of the greatest scope range of the radar (in Idealize and Genuine Execution conditions) 13 Sea Watch Air ship in 5 operating/patrol divisions by minimizing working costs.

5. CONCLUSION

The optimization handle in this ponder has not included insights information within the shape of territorial helplessness components, ocean conditions in neighbouring nations and calculated capabilities at each supporting base in each observed division. It endorsed a more complex multi-purpose range. The course of action of the Sea Watch Aircraft within the eastern sea, security operations are uncommonly able. The "Sea Saw" operation arrange that has been executed interior the KRI can be supplanted with the "Hold up Standby" arrange by prioritizing the Sea Observe Aircraft as a component of reconnaissance, so as to diminish the operational costs of the KRI.

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PLANNING MODEL OF TOTAL REQUIREMENTS OFFICER PERSONNEL IN SUPPORTING THE TASKS OF THE INDONESIAN NAVY

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ABSTRACT

As the main component of national defense and security in the marine dimension, the Indonesian navy must be able to carry out organizational tasks effectively and efficiently so that the successful achievement of organizational goals can be achieved. The main resources needed in supporting the implementation of the duties of the Indonesian navy are Human Resources or personnel. With an important role as a leader/supervisor in decision making and policy determination as well as organizational mobilization, it is very necessary for officer personnel planning in manning the entire spectrum of office space assignments in a timely manner, quality, quantity and place. The plan is a form of implementation in the Navy officer personnel development system with the characteristics of a complex and dynamic system. Given the characteristics of the system, the researcher uses a system thinking approach analysis with the aim of articulating the problem into a causal loop diagram model to then be integrated into a dynamic system simulation model with the aim of getting the best policy scenario formulation from the simulation results of the planning model for the number of officer personnel needs at the rank strata. "C" to "H", so that the behavioral conditions of a stable personnel development system are still achieved regarding the element of the number of personnel needs in supporting the sustainability of the implementation of the Indonesian navy's tasks effectively and efficiently in achieving the success of organizational goals.

Keywords: complex **,** dynamic **,** personnel coaching system, system thinking, dynamic system

1. INTRODUCTION

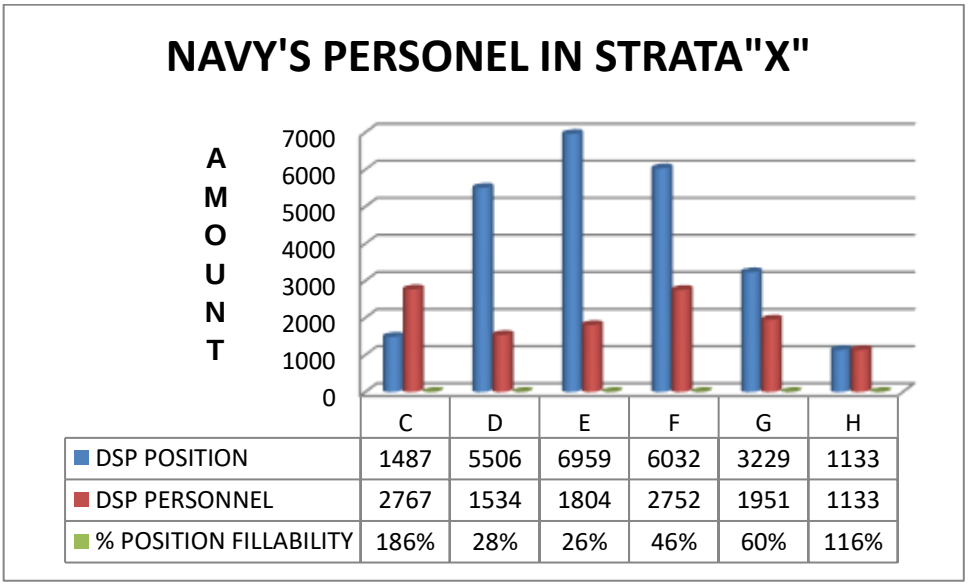
Along with globalization and technological advances, the development of the strategic environment today clearly provides an increasingly free space for threats to all areas of state life, including in terms of national defense at sea (Kusuma, AW, Prakoso, LY, & Sianturi, 2021) . As one part of the organization of the Indonesian National Armed Forces , the Indonesian navy is the main component of the defense and security of the sea-level state that carries out its duties based on state policies and political decisions in order to uphold state sovereignty, maintain the territorial integrity of the Unitary State of the Republic of Indonesia. The Republic of Indonesia is based on Pancasila and the 1945 Constitution. In carrying out these tasks, the Indonesian navy is guided by the basic policy of development towards the Minimum Essential Force/MEF. Minimum Essential Force (MEF) is a standard of basic and minimum strength, which is part of the overall and absolute posture of the Indonesian navy to be prepared as the main and fundamental prerequisite for the effective implementation of the tasks and functions of the Navy in dealing with threats and achieving high deterrent effect.

The principle in the MEF program is a form of optimization of the limited defense budget provided by the government to continue to be able to support the successful implementation of the development and development of a more realistic Indonesian navy force by focusing on the fields of organization, defense equipment, personnel and bases. In the development and development of strength in the field of organization and defense equipment, the Navy always carries out organizational validation activities and modernization of defense equipment on an ongoing basis, both within the organizational structure of the Navy and within the TNI Headquarters. These activities have an impact on

increasing the number of office spaces that must be manned by Indonesian navy personnel. Based on these conditions, it can be said that the planning in determining the number of navy personnel needs must be in line with the planning of the office space as a result of the validation of the organization and defense equipment.

In planning the number of personnel needs and positions in the Navy, it is carried out based on the strata of rank, where the officer group plays an important role as a leader/superior in decision making and determining policies for the advancement of the Navy organization. So with the important role of officer personnel in the Indonesian navy organization, it is very necessary for the sustainability of the Navy officer personnel to be able to oversee the entire spectrum of office space assignments in a timely manner, quality, quantity and place.

So far, in the implementation of planning the number of officer personnel needs within the Navy, it has not been able to determine precisely the condition of the number of personnel needs faced with the office space that must be manned. This is shown in the navy Personnel Composition List year "X" which is a description of the needs for personnel and positions of the Navy in detail as follows:



	C	D	E	F	G	H
DSP POSITION	1487	5506	6959	6032	3229	1133
DSP PERSONNEL	2767	1534	1804	2752	1951	1133
% POSITION FILLABILITY	186%	28%	26%	46%	60%	116%

Figure 1. Graph of Comparison of the Number of Officers with the Indonesian navy's Office Space

(Source: Z, X)

The picture above shows the conditions of shortage and excess in the number of navy officer personnel needs at certain rank strata which is a form of imbalance between the number of office spaces that must be manned with the real number of officer personnel currently available. In other words, the planning that causes an increase in the officer's office space, in this case the planning for the development of defense equipment and organizations, both within the Indonesian navy structure and within the Indonesian Armed force Headquarters which needs to be manned, is not in line with the planning for the needs of the Indonesian navy officer personnel (Kasal, 2019) . In planning the number of personnel needs, it is an implementation in the complex and dynamic system of personnel development for Indonesian navy officers, so that researchers use system thinking analysis which is integrated into the dynamic system approach method with the aim of obtaining the best policy scenario formulation from the simulation results of the planning model for the

number of personnel needs. officers at the "C" to "H" strata, so that a stable condition of behavior for the personnel development system is still achieved regarding the number of elements needed by the Indonesian navy personnel. With the condition of the behavior of the system is expected to support the sustainability of the implementation of the duties of the Navy effectively and efficiently in achieving the success of organizational goals.

2. MATERIAL/ METHODOLOGY

2.1 Research Flowchart

The systematic and structured stages used in conducting research so that existing problems can be resolved properly. The research method is a process consisting of stages that are interrelated with each other or interpreted as the result of a stage that will become input for the next stage. The stages in this research can be briefly described in the following flow chart:

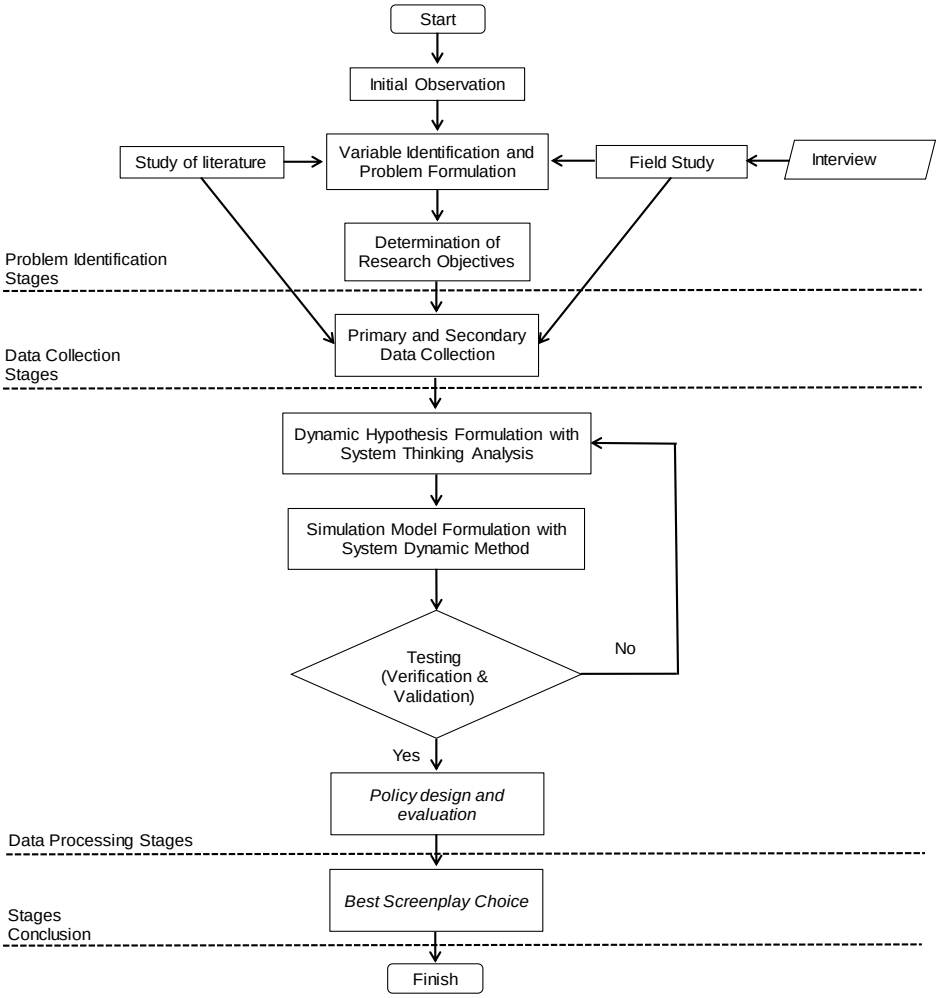


Figure 2. Research Flowchart

(Source: Research data processing, 2022)

2.2 System Thinking

System thinking analysis in this study was carried out based on brainstorming and depth interviews with experts in the field of Navy personnel planning as well as conducting a review and critical study of the existing literature with the aim of defining these problems and identifying variables that have an influence on the problems in the object of research. After identifying the variables that have an influence relationship in the

Indonesian navy officer personnel development system, the next step is to structure it into a causal loop diagram model that explains the interrelationships that influence each other (interact) in a causal form between the variables in the total planning system. the need for officer personnel starting from the rank of "C" to " H" . The system thinking approach in this study is used in the stages of the dynamic system modeling process.

2.3 Dynamic System

The development of increasingly complex system dynamics requires an effective approach method to produce the desired system behavior. One method that is effective in analyzing a complex system is system dynamics (Sterman, 2000a) . The dynamic system approach is part of the concept of systems thinking which can be interpreted by looking at the problem as a whole system and the relationship between each element of the system (Addin Aditya, S.Kom., 2018) . In the process of compiling a dynamic system model, there are the following stages (Sterman, 2000b) :

a. Articulation Problems
b. Formulation Dynamic Hypothesis
c. Formulating a Simulation Model
d. Testing (Verification & Validation) Model .
e. Policy planning and evaluation

2.3.1 Articulation Problems

On the articulation problem step is implemented based on brainstorm and depth interview with para expert in charge of planning Indonesian Navy personnel as well as do a review and study critical to existing literature with destination for define problem the as well as identify variables that have linkages influence to problem in the object research. Stages in the articulation problem can outlined as following :

a. Theme Problem

Problems that occur in the planning amount needs Indonesian navy officers are something phenomenon whose presence no wanted , where is output implementation system construction Navy personnel . Existence characteristics structure in the system construction Navy personnel who describe existence complexity dynamic system , and role strategic Commissioned Officer in the Indonesian Navy organization , as well as impact caused is in time period long , then make something very thing important for held a planning amount needs personnel Indonesian navy officer appropriate in support implementation Army duties sea by effective and efficient in the achievement success destination organization .

b. Identification Variable Aspect Main and Criteria .

The identification of variables that affect the complexity of planning the number Of Indonesian Navy officer personnel needs in this study is divided into several main aspect variables based on rank and each of the main aspect variables consists of several sub-variables or criteria. The main aspect variable is a variable that influences the planning of the number of needs of Indonesian navy officers, where these variables are interrelated and interact in a causal relationship. The identification of these variables can be shown in the following table

Table 1. Identification Main Variable Planning Amount Needs Commissioned Officer

NO	MAIN ASPECT	DESCRIPTION
1	Personnel "C"	Amount personnel on group rank the officer who was at the lowest strata _ based on level hierarchy rank in the structure Navy organization

2	Personnel "D"	Amount personnel on group rank the officer who was on the order strata one (1) level on "C" based on level hierarchy rank in the structure Navy organization
3	Personnel "E"	Amount personnel on group rank the officer who was on the order strata one (1) level on "D" based on level hierarchy rank in the structure Navy organization
4	Personnel "F"	Amount personnel on group rank the officer who was on the order strata one (1) level on “E” based on level hierarchy rank in the structure Navy organization
5	Personnel "G"	Amount personnel on group rank the officer who was on the order strata one (1) level on “F” based on level hierarchy rank in the structure Navy organization
6	Personnel "H"	Amount personnel on group rank the officer who was on the order strata one (1) level on “G” based on level hierarchy rank in the structure Navy organization

On Sub-variables or criteria that influence the main aspect variables have the same attributes with different values . So that the identification can be summarized and shown directly in the form of a stock and flow diagram model formulation .

c. Limitation Time design

In the design of this planning model, the determination of a time horizon of 40 years is used, which is the time of one (1) cycle of the personnel development system starting from the initial stage (acceptance / intake of personnel "C" with a minimum age limit of 18 years) to the final stage. (separation/retirement with a maximum age limit of 58 years). The time horizon in planning the number of Indonesian Navy officer personnel needs is an investment plan for Human Resources, which must be made in a far enough scope to be able to find out how a problem arises and what the symptoms are, and it is extended far enough into the future with the aim of being able to capture the indirect effect of a policy in planning the number of officers' needs.

d. Reference Mode

After the design time horizon has been determined, in this step the measurement of the relationship in the dynamic structure of the Indonesian Navy officer personnel development system is carried out which is identified as an assessment system that is influenced by the variables in the model. The identification of the variables in this study is categorized based on each of the main aspect variables that influence the planning of the number of Navy officers. In the relationship between entities, these variables have a positive and negative polarity.

2.3.2 Formulation Of Dynamic Hypothesis

After obtaining a variable entity that has a relationship with the planning of the number of Indonesian Navy officers, then it is connected into an interaction in each of the main aspects of the Planning for the Number of Needs of the Indonesian Navy officers as shown in the main aspect variable diagram as follows:

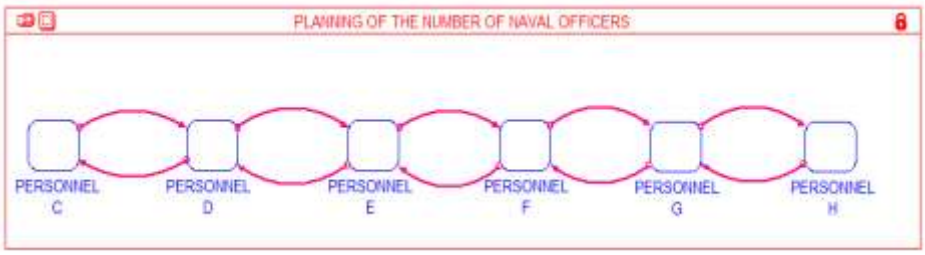


Figure 3. Diagram of the Main Aspects of Interaction Relationships on Planning the Number of Navy Officers Personnel Needs

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3 , 2022)

Then in each of the main aspects, it consists of sub-variables and criteria that influence the main aspect, where the sub-variables and criteria have the same attributes, so that if they are formulated briefly into the Causal Loop Diagrams (CLD) model, they will form a closed system as illustrated in the following figure:

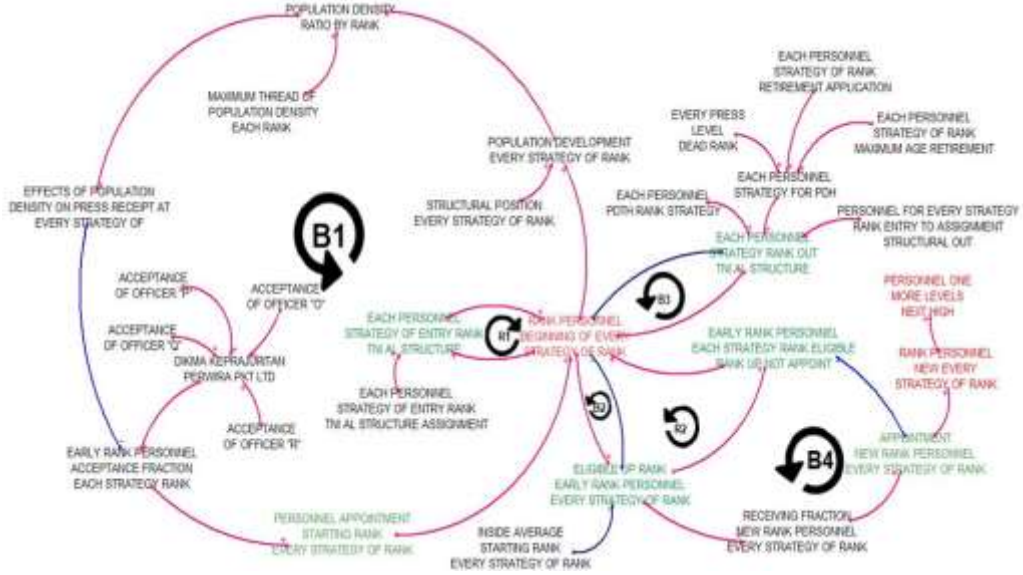


Figure 4. Causal Loop Diagram of Planning for the Number of Navy Officers' Personnel Needs

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

Figure 4 above is a conceptualization of the model of the Indonesian Navy officer personnel development system in the form of CLD which explains the interrelationships that influence each other (interact) in a causal form between the variables in the planning system for the number of officer personnel needs starting from the rank of "C" to "H". "In the main aspect variable, initial rank personnel are state personnel in initial conditions or one lower level which will lead to the new rank personnel state (one level higher), and the new rank personnel state will experience repetition of becoming personnel in the initial state towards the rank personnel state . new again until finally heading to the state personnel rank "H" .

2.3.3 Formulation Of A Simulation Model

The formulation of a simulation model step is the stage in formulating the conceptual model of the Causal Loop Diagram planning the number of Indonesian Navy officer personnel needs (Figure 4.2) into the basic structure of a specific dynamic system modeling (flow diagram / stock flow diagram), complete with equations , parameters and initial

conditions prior to the simulation. In structuring into a dynamic system model in this study using the help of a tool in the form of Stella software . The formulation of a dynamic system simulation model in the Causal Loop The planning diagram for the number of Navy officers needs is translated into each rank, starting from the rank of "C" to "H" which is shown in the following figure:

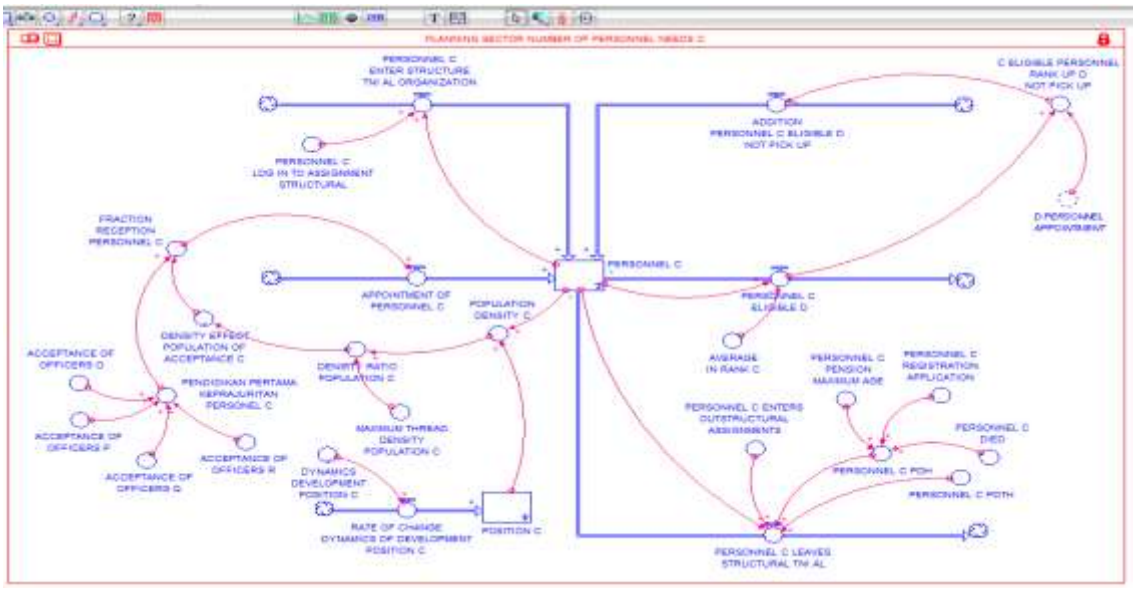


Figure 5. Stock Flow Diagram of the Number of Personnel Needs "C"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

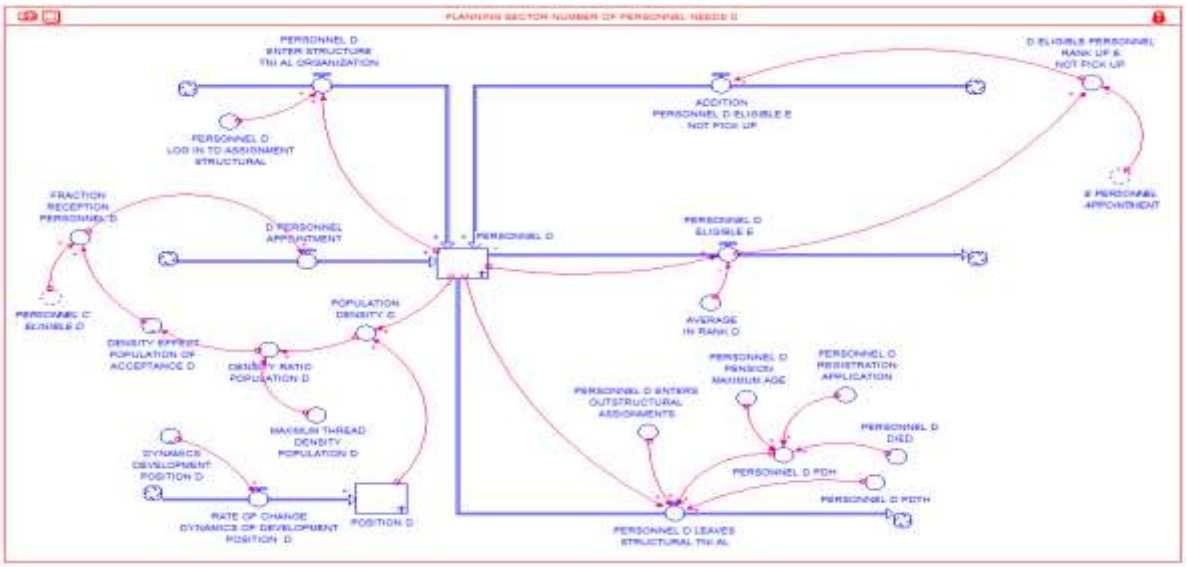


Figure 6. Stock Flow Diagram of the Number of Personnel Needs "D"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

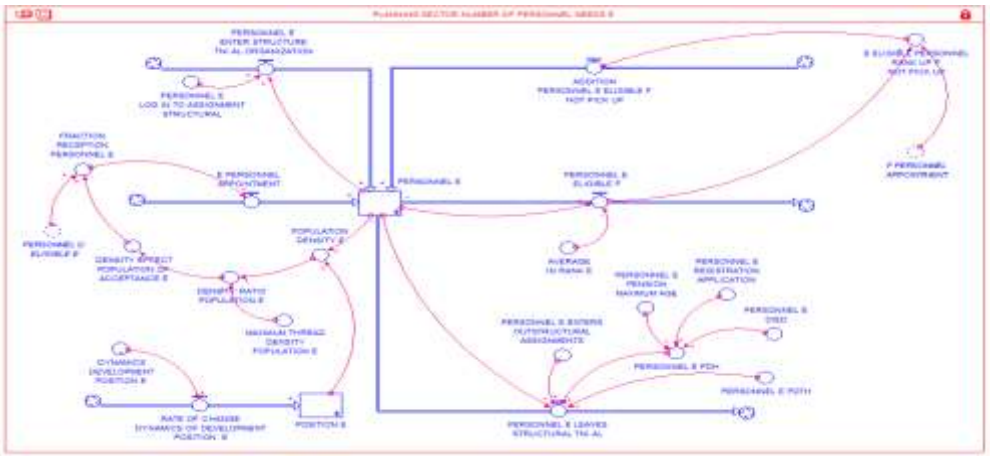


Figure 7. Stock Flow Diagram of the Number of Personnel Needs "E"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

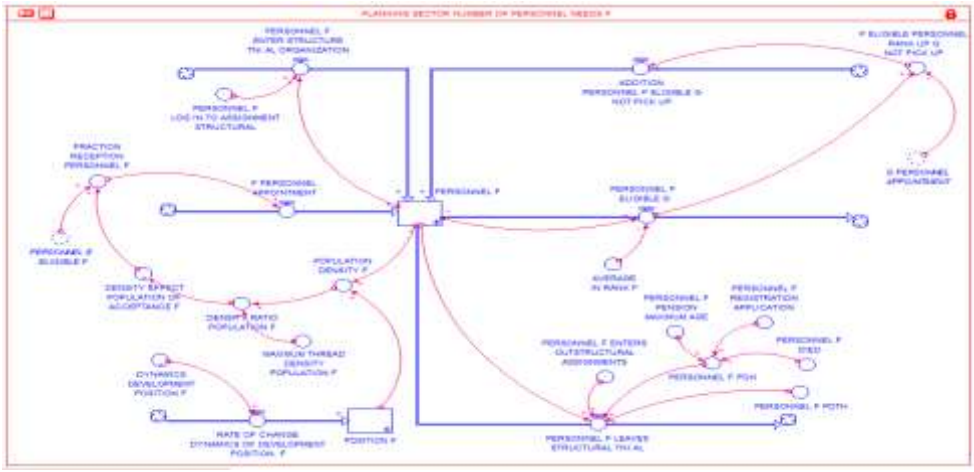


Figure 8. Stock Flow Diagram of the Number of Personnel Needs "F"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3 , 2022)

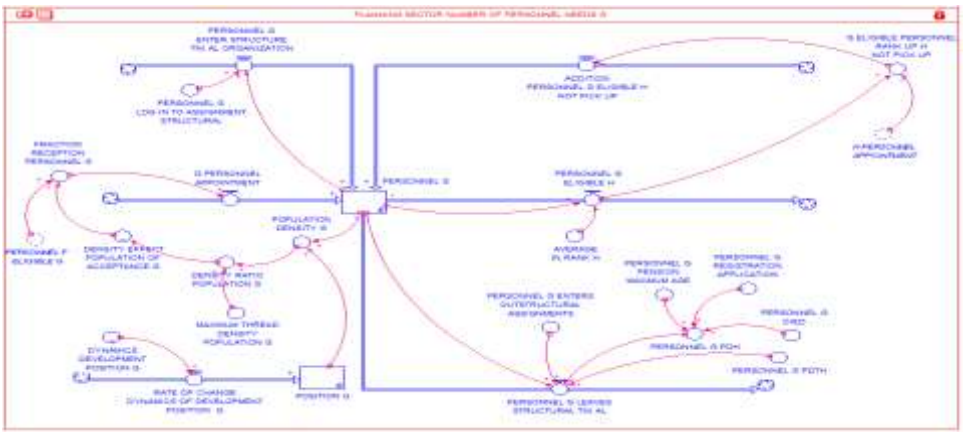


Figure 9. Stock Flow Diagram of the Number of Personnel Needs "G"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

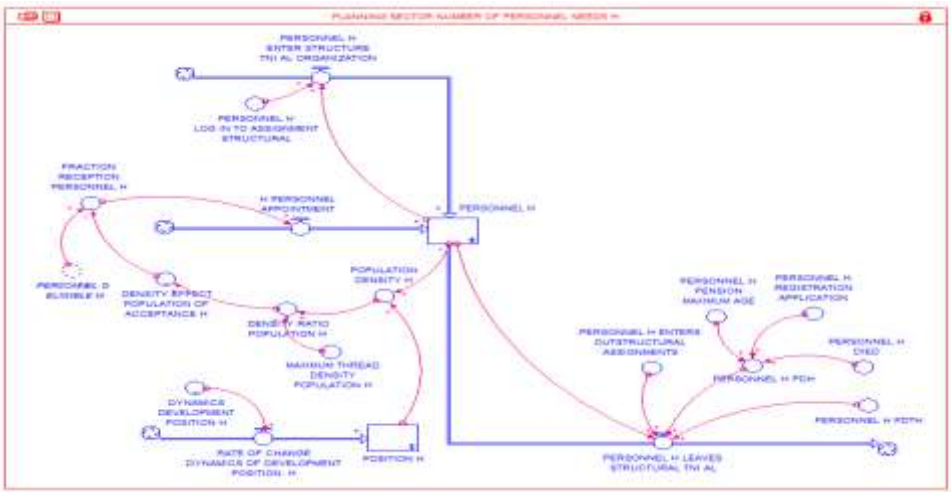


Figure 10. Stock Flow Diagram of the Number of Personnel Needs "H"

(Source: Processed data by researchers and Depth Interview Experts using Stella 9.1.3, 2022)

2.3.4 Simulation Model Testing

Testing is done as early as possible since we enter the first equation. Part of the test, which compares the simulated behavior of the model to the actual behavior of the system. The form of testing the dynamic system simulation model in this study is as follows:

a. Model verification

Is the process of determining whether the simulation model properly reflects the conceptual model. The model verification is carried out to check whether there are errors in the model and ensure that the model functions according to the logic of the observed system. In addition, verification also needs to be done by checking the formulations (equations), models and checking the unit variables of the model. If there is no error in the model, it can be said that the model has been verified. In this study, verification has been carried out in the Stella software with the results obtained that all formulations (equations), models and checking the variable units of the model are consistent as shown in the figure below:

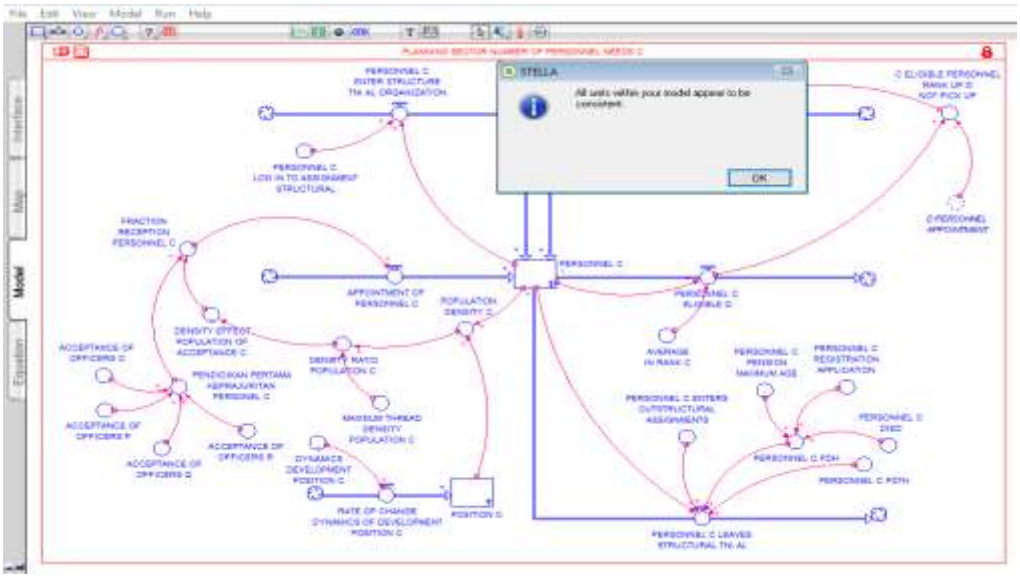


Figure 11. Verification of Planning Model Unit Number of Officer Personnel Requirements From Rank "C" to "H"

(Source: Processed data researcher and Depth Interview Expert using software stella 9.1.3, 2022)

b. Model validation

Model validation is the process of determining whether the conceptual model properly reflects the real system (Harrel, Ghosh and Bowden, 2002a) . In model validation, it is a stage in evaluating whether the model made is representative of the real situation. In this case, model validation is carried out to determine that the conceptual model has accurately reflected the real system and met the overall modeling objectives. Several validation tests that will be carried out in this study are as follows (Harrel, Ghosh and Bowden, 2002b) :

1) Limit Sufficiency Test

This test is done by testing the variables used in the simulation model. If a variable does not have a significant effect on the objectives of this research model, then that variable does not need to be included. So that the variables used in the design of the simulation model are in accordance with the objectives of the model. If the model is made for a certain scope, then the model cannot be used in a larger scope. Therefore, to create a new model, the limitations and objectives of the model must be developed so that it produces a different scope.

2) Model Structure Test

This test is carried out by conducting in-dept interviews with parties who know and master the system. The goal is to ensure the variables and structure of the model that has been built in accordance with the actual system. The model structure is declared valid when the formulation and units are appropriate and can describe the actual concept of the system.

3) Extreme Condition Test

This test is carried out to test the model's ability in extreme conditions so that it can show the model's structural errors. This test can be done by entering the smallest and largest extreme values on the measured or controlled variables in the model. If variable A is a controlled variable in the model, then the decrease in the value of A is followed by the decrease in the value of variable B.

4) Model/Replica Behavior Test

This test is done by comparing the data between the simulation results and real conditions, so that the model can represent the system being modeled. The real/actual conditions carried out by the model are then matched to the state of the real system at some time in the past. Furthermore, an assessment of how close the behavior of the model is to the past data. Quantitatively, the validation of the model is carried out using the Mean Error variance method. (Barlas, 1996) . This method is done by comparing the average value of the actual data with the average value of the simulation model results to find the average value of the error that occurs. The calculation method uses the following equation:

$$E = [(S - A)/A$$

With :

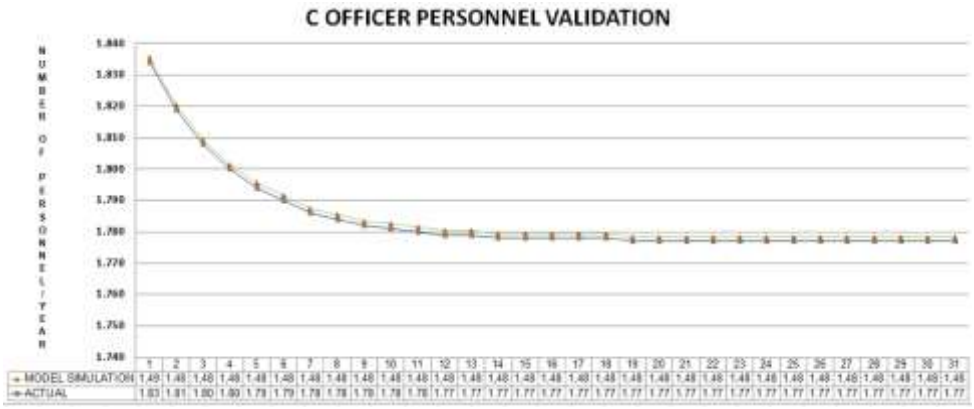
A= real data

S= Simulation result data

E= Error variance between actual data and simulated data Where if E < 0.1 then the model will be valid.

Based on the calculations in table 2, the average error value for each personnel variable C is less than 0.1. Therefore, the model is said to be quantitatively valid. In connection with the research objective to plan the number of needs of Indonesian navy officers for each strata starting from rank C to H in supporting the tasks of the Indonesian navy which is the output in this modeling, so that the model can be said to be quantitatively valid by testing the Mean variance method.

Table 2. Calculations Error Data C personnel current and Simulation



2.3.5 Policy Design And Evaluation

Models that have been made could used for evaluate and designing policy for enhancement future , including designing strategy new , structure , and orran decision with method analyze sensitivity the most influential variables (variable _ key) against results model simulation on planning amount needs personnel Commissioned Officer each rank so that obtained scenario best in the planning and evaluation simulation of the model . Based on run simulation _ on models that have created , then pattern results simulation from aspect main planning amount needs personnel Commissioned Officer the taken three (3) variables key on aspect planning amount personnel C and two (2) variables key on aspect planning amount personnel D arrived with G, as well as one (1) variable key on aspect planning amount H personnel .

From result analysis sensitivity variable key with testing simulation of the model by over and over again , then obtained form results scenario model simulation as following :

a. Scenario on aspect planning amount personnel C is with as following :

1) Reception R again value 95 personnel / year to 450 personnel / year.

2) Reception Q again value 39 personnel / year to 300 personnel / year.

3) O Reception of 220 personnel / year to 50 personnel / year.

4) Average in rank C back 4 years to be 2 years.

5) Average Personnel C who entered to assignment position outside structural original 0.0185 / year _ to 0/ year.

b. Scenario on aspect planning amount personnel D is with as following :

1) Average in rank D back 5 years to be 7 years

2) Average Personnel D who entered to assignment position outside structural back 0.0065 / year _ to 0/ year .

c. Scenario on aspect planning amount personnel E is with as following :

1) Average in rank E back 5 years to be 8 years

2) Average Personnel E who entered to assignment position outside structural back 0.031/ year to 0/ year

d. Scenario on aspect planning amount F personnel is with as following :

1) Average in rank F back 4 years to be 8 years

2) Average Personnel F who entered to assignment position outside structural back 0.050/ year to 0/ year

e. Scenario on aspect planning amount personnel G is with as following :

1) Average in rank G back 4 years to be 2 years

2) Average Personnel G who entered to assignment position outside structural back 0.071/ year to 0.24/ year

f. Average Personnel H who enter to assignment position outside structural back 0.081/ year to 0.019/ year.

3. RESULTS AND DISCUSSION

On results and discussion this , will explained simulation running results condition existing and condition scenario policy best on every variable response . Variable the response to be focus on study this is planning amount needs personnel and position each strata (starting from rank C to with H).

Table 3. Planning amount personnel C.

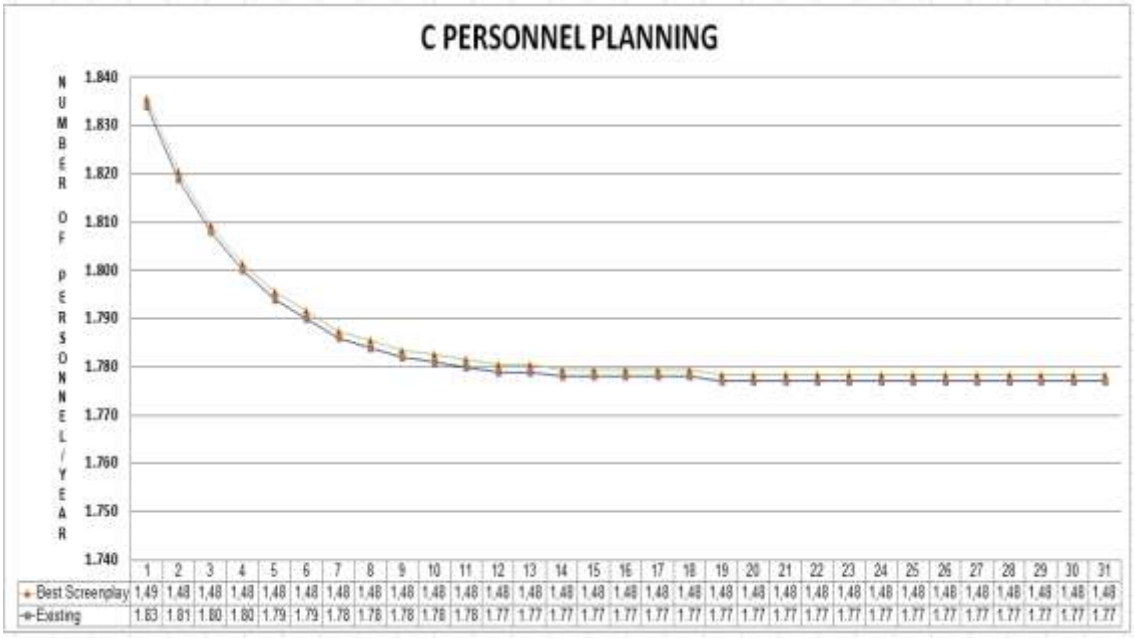


Table 4. Planning amount D personnel

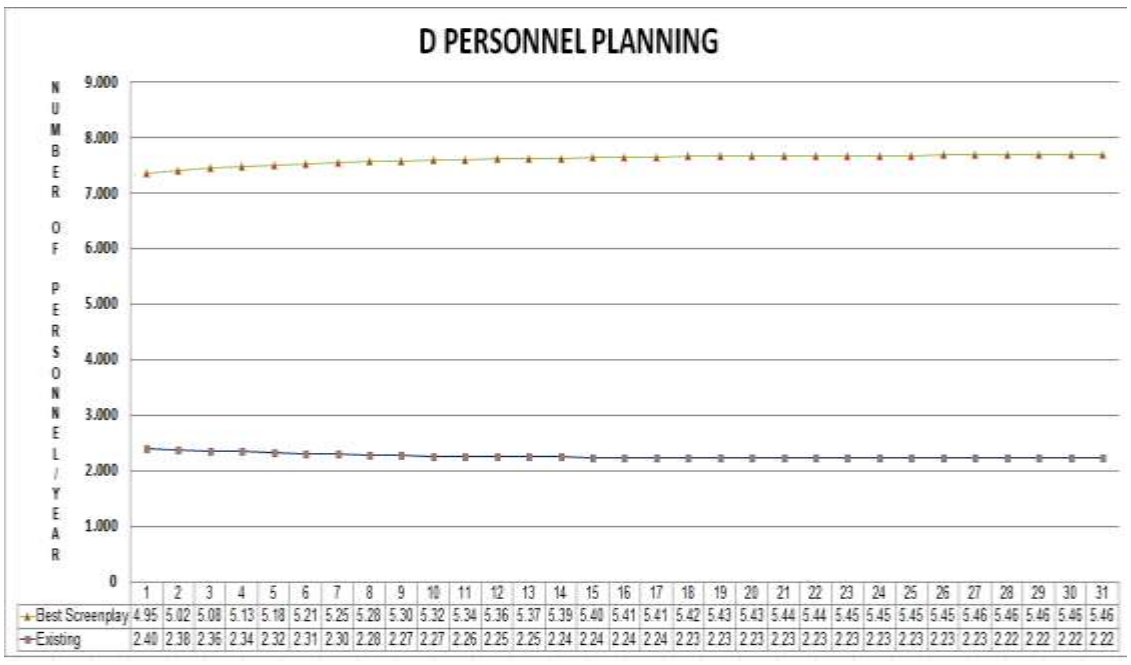


Table 5. Planning amount E personnel

Table 6. Planning amount F personnel

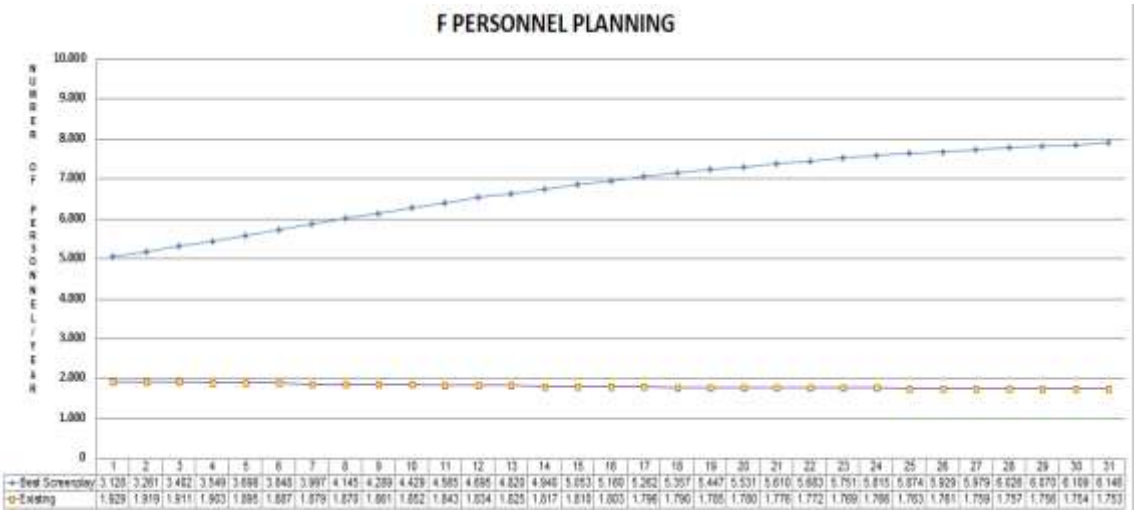
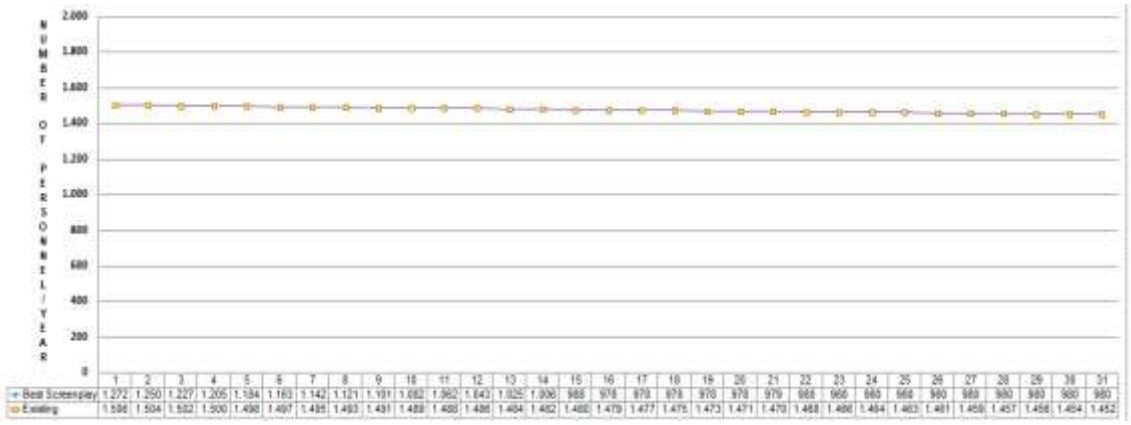


Table 7. Planning amount G personnel

Table 8. Planning amount H personnel



4. CONCLUSION

In the simulation model, the best policy scenario has been prepared in planning the number of personnel needs from rank C to H so that a stable behavior can be produced on the variable number of personnel for each rank strata faced with the number of positions that must be manned. In this scenario, the average variable in the rank of each rank has a very significant change effect in the dynamic behavior of the system.

ACKNOWLEDGEMENT

The authors express their gratitude for the support of the Indonesian navy, and also thank the STTAL Surabaya Indonesia Naval Technology College for providing the necessary resources to carry out this research work. The authors also thank the experts in the field of human resource planning for Indonesian navy officers who have assisted in the analysis in this study.

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MODEL OPTIMIZATION OF PATROL ASSIGNMENT AT NORTH NATUNA SEA TO SUPPORT OPERATION TASK OF INDONESIAN NAVY

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ABSTRACT

The South China Sea conflict is a regional security issue that has not yet reached the point of completion, and is prone to disrupting regional stability in the future. There are 3 (three) basic things that are the main reasons why countries are involved in the South China Sea conflict. First, it contains enormous natural resources, including oil and gas, biodiversity and fisheries and other marine resources. To operate patrol boats and logistics vessels so that the distribution of liquid logistics support is appropriate, timely, and in the right place, in solving the problem of liquid logistics distribution, the "Linear Programming" approach will be used to optimization the distribution of liquid logistics for patrol boats in the Security Operations sector sea. From the description of the formulation of the problem above, this research was carried out by aiming at the objectives to be achieved, including: formulating a logistic distribution optimization model and optimizing the ability of Naval Warship B9 in supporting the elements of the title at sea. Data processing in this research activity is data that has been obtained from data collection activities and processed using the help of an excel solver. the results of the running of the spreadsheet solver program, the running results stated that in order to carry out operations in the Natuna sea for one year it required 7 Naval Warship (1 K3; 5 K4; and 1 K5), then the central point of operation is sector A, the optimal refuel point is in R17 because it is closest to operating sector A.

Keywords: Distribution logistics, spreadsheet solver, Linear Programming.

1. INTRODUCTION

The Maritime Security Patrol is an operation at sea that has a strategic value for the existence of national sovereignty and maritime security in Indonesia's national jurisdiction. The Natuna Islands are one of the Indonesian archipelagos whose sovereignty has been violated by China. The Natuna Islands are located in the Riau Islands Province and are in the middle of the South China Sea. The Natuna Islands have been part of Indonesia since 1956, having previously been part of the territory of Malaysia. (Tampi, 2017) The Natuna Islands cover an area of 264,198.37 Km2, of which 2,001.30 Km^2 island while 262.197.07 Km^2 is water. The limited capabilities of the KRI, liquid logistics support,

Currently the Indonesian Navy has several elements of the Naval warship type of Auxiliary Liquid Oil (BCM) which have been assigned according to the existing Fleet Command. In relation to the North Natuna Sea sector, there is naval warship B9 which is assigned to carry out liquid logistics support in the waters of the North Natuna Sea. With the operation of naval warship B9 in Koarmada I, overall the Indonesian Navy Satban operates several tankers, such as naval warship T9, BL9, S9, A9, G9, and S9. Because the main task This KRI is in the distribution of fuel, then B9 will help to supply fuel. So that regional defense operations by Indonesian Navy ships in particular can last longer at sea.

2. MATERIALS AND METHODS

2.1 Maritime Security

Mahan in (Rath, 2007) said "Control/Security of the Sea is carried out by expelling enemy ships and pirates so that sea lanes can be used for commercial purposes". Mahan's opinion has become a universal understanding of the need for the deployment of military force in the efforts of a country to maintain its existence and protect its interests. Currently, various things appear to be a threat to the use of the sea in Indonesia. Conelley

sees that tensions in the South China Sea will pose a threat to Indonesia in the form of potential violations of territory and fisheries that are backed up by the government (Connelly, 2016).

2.2 Microsoft Excel Solver

With Solver, you can find the optimal (maximum or minimum) value for a formula in one cell called the objective cell that satisfies the constraint (boundary), or limit, value in another formula cell on the worksheet. Solver processes a group of cells called decision variable cells which are part of the calculation formula for the objective and constraint cells. Solver™ adjusts the values in the decision variable cells to meet the limits on the constraint cells and produce the results you want for the objective cells. The cells of the objective variables, constraints and interrelated decisions and formulas make up the Solver model; the final value found by Solver is the solution for this model. Solver uses a variety of methods, from linear programming and optimization nonlinear to genetic and evolutionary algorithms, to find solutions. Solver is part of a series of commands that are often called what-if analysis tools. This facility works with cells of a group that are connected, either directly or indirectly (directly-indirectly), for formulas on target cells. Solver consists of three parts:

a. Adjustable cells/regulator cell. Solver manages to change the value of a specific cell, to produce results it is necessary to specify the formula on the target.

b. Constrained cells/cell constraint Constraints are used to limit the solver values that can be used in a particular model and constraint refers to other cells that affect the formula in the target cell.

c. Target cells/target cell. Is part of the solver as a place where the final result of processing / execution of a formula is placed.

d. Solver is used to determine the maximum and minimum values in a cell by changing another cell.

2.3 Linear Programming

Linear programming (LP) is an analytical tool that supports the success of operations research in solving various problems so that the right decision can be taken. In general, the Linear Programming problem model can be formulated in the following example:

Maximize or Minimize Z = Cij Xij (2.1)

$\sum_{i=1}^{n}\sum_{j=1}^{n}$ description :

Zmin/max=The objective function (Z) of the results of Cij and Xij

Cij = Decision variables

Xij = Limit function

2.4 Optimization Model

Optimization Model is the activity of modeling problems with mathematical models to make it simpler and easier to understand with steps, namely identification of decision variables (*decision* variables), identification of barriers / constraints (*constrain*) and determination of objective functions.

2.4 Research methodology

The research begins with the identification of problems followed by goal setting and benefits which are all related to the subject matter of this study. Problem formulation and goal setting are the directions for the research to succeed as expected. The formulation of the problem and the setting of goals chosen by the author are in accordance with the conditions of urgency that occur in the title of Marine Security Operations, namely in planning the composition of the elements of ships and maritime patrol aircraft of the Navy that are optimal in the context of securing the seas of the eastern region of the Republic of Indonesia. It is hoped that this research will be useful for the Navy institution .

The outline of all research activities is depicted in a flowchart as shown in Figure 1 below:

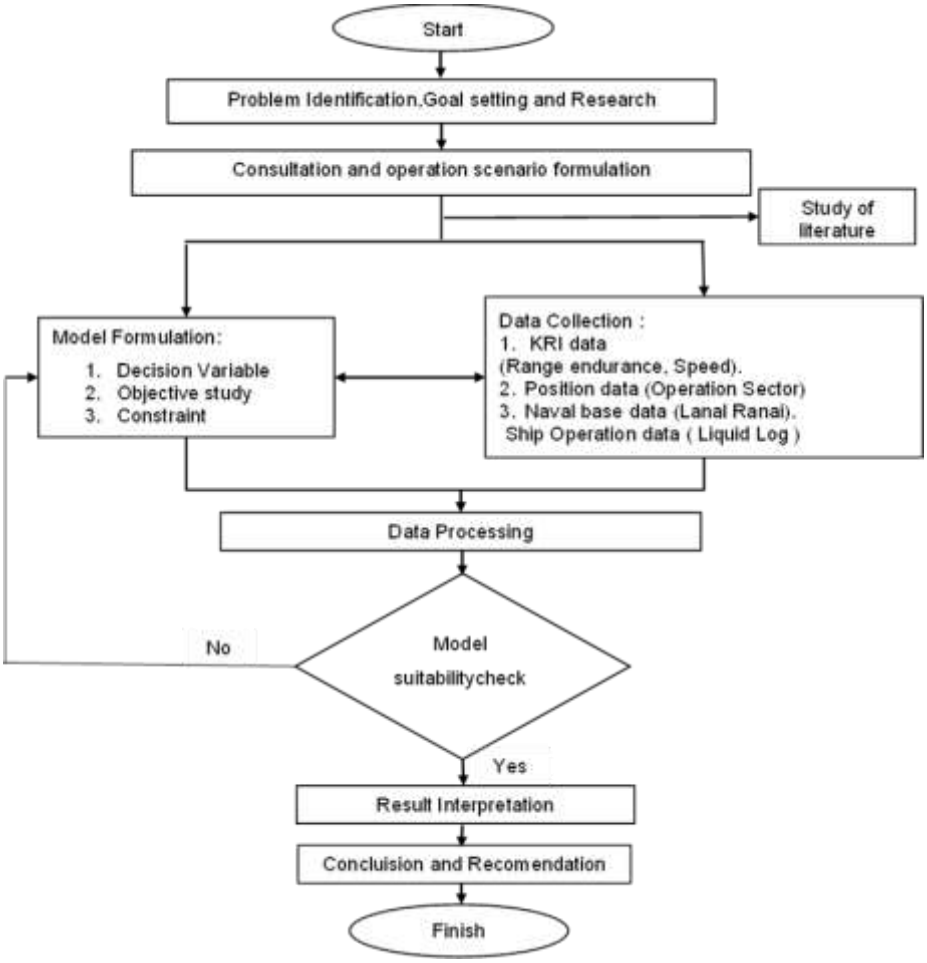

Figure 1. Research Method Flowchart
(Source: Research Data Processing, 2022)

3. RESULTS AND DISCUSSION

The optimization process in this ship class assignment uses a spreadsheet solver program from Microsoft Office Excel. The resolution steps are as follows:

a. Modeling (Developing)

Developing the model in the form of input for compiling all problem data, compiling decision variables, constraints, and objective functions is carried out by means of Spreadsheet Solver program operations. The sequence of steps is as follows:

1) Data Input and Compilation

a) Data for 7 operating sectors (route length, sector area and operation map).

b) Capability of 5 KRI Classes (speed, radar, cruising distance, coverage area, endurance and cost).

c) Compatibility 5 Class patrol boats in 7 operating sectors.

Table 1. Fuel Capacity at Base

PATROL FORCES	CAPACITY (Liters)
K1	500,000
K2	300,000
K3	150,000
K4	400,000
K5	100,000

Table 2. Distance from Operation Point to Base

REFUEL POINT	DISTANCE (Nautical Miles)						
	A	B	C	D	E	F	G
P17	317	308	163	79	16	110	114
B7	327	326	191	110	36	115	128
T4	151	182	166	182	160	64	71
R17	36	82	212	277	283	197	183
DS	368	340	167	75	94	181	173

(Source: Data Processing, 2022)

Table 3. Patrol Vessel Class Competitiveness in Operation Sector

Route	FROM	DESTINATION	DISTANCE (NM)	PKR	PK	FPB	KCR	PC
A1	A	P17	317	1	1	1	1	1
A2	A	B7	327	1	1	1	1	1
A3	A	T4	151	0	1	0	1	1
A4	A	R17	36	1	1	1	1	0
A5	A	DS	368	0	0	1	1	1
B1	B	P17	308	1	1	1	1	1
B2	B	B7	326	1	1	1	1	1
B3	B	T4	182	0	1	0	1	1
B4	B	R17	82	1	1	1	1	0
B5	B	DS	340	0	0	1	1	1
C1	C	P17	163	1	1	1	1	1
C2	C	B7	191	1	1	1	1	1
C3	C	T4	166	0	1	0	1	1
C4	C	R17	212	1	1	1	1	0
C5	C	DS	167	0	0	1	1	1
D1	D	P17	79	1	1	1	1	1
D2	D	B7	110	1	1	1	1	1
D3	D	T4	182	0	1	0	1	1
D4	D	R17	277	1	1	1	1	0
D5	D	DS	75	0	0	1	1	1
E1	E	P17	16	1	1	1	1	1
E2	E	B7	36	1	1	1	1	1
E3	E	T4	160	0	1	0	1	1
E4	E	R17	283	1	1	1	1	0
E5	E	DS	94	0	0	1	1	1
F1	F	P17	110	1	1	1	1	1
F2	F	B7	115	1	1	1	1	1
F3	F	T4	64	0	1	0	1	1
F4	F	R17	197	1	1	1	1	0
F5	F	DS	181	0	0	1	1	1
G1	G	P17	114	1	1	1	1	1
G2	G	B7	128	1	1	1	1	1

G3	G	T4	71	0	1	0	1	1
G4	G	R17	183	1	1	1	1	0
G5	G	DS	173	0	0	1	1	1

(Source: Data Processing, 2022)

2) Preparation of Decision Variables

a) Matrix zero-one patrol boat assignments.

b) Deviation Value

Table 4. Decision Variables

PATROL FORCES/KRI	SECTOR						
	SA	**SB**	**SC**	**SD**	**SE**	**SF**	**SG**
1	X 1.1	X 1.2	X 1.3	X 1.4	X 1.5	X 1.6	X 1.7
2	X 2.1	X 2.2	X 2.3	X 2.4	X 2.5	X 2.6	X 2.7
3	X 3.1	X 3.2	X 3.3	X 3.4	X 3.5	X 3.6	X 3.7
4	X 4.1	X 4.2	X 4.3	X 4.4	X 4.5	X 4.6	X 4.7
5	X 5.1	X 5.2	X 5.3	X 5.4	X 5.5	X 5.6	X 5.7

(Source: Data Processing, 2022)

3) Constraints

a) System boundary data.

b) Base capability to carry out fuel to operating ships.

c) Demand for fuel oil supplies, does not exceed the supply of fuel for the destination base.

d) Restocking must not exceed the ship's capacity.

e) For the value of the ship's utility operating less than 1.

f) The fuel consumption (endurance) of the ship does not exceed the capacity of the ship's fuel.

Table 5. Constraints

REFUEL POINT	CLASS				
	K1	**K2**	**K3**	**K4**	**K5**
P17	✓	✓	✓	✓	✓
B7	✓	✓	✓	✓	✓
T4	**-**	✓	**-**	✓	✓
R17	✓	✓	✓	✓	**-**
D5	**-**	**-**	✓	✓	✓

(Source: Data Processing, 2022)

Table 6. Demand

KRI	TOTAL	OPERATION	NEEDS
K1	230000	<=	230,000
K2	97500	<=	97,500
K3	97500	<=	97,500
K4	146000	<=	146,000

K5	68000	<=	68.000

(Source: Data Processing, 2022)

Table 7. Base Fuel Supply

KRI	TOTAL	OPERATION	CAPACITY
K1	230,000	>=	500,000
K2	97,500	>=	300,000
K3	97,500	>=	150,000
K4	146,000	>=	400,000
K5	68.000	>=	100,000

(Source: Data Processing, 2022)

b. Preparation of Objective Function

At this stage is the achievement of assignments in the operating sector in the Natuna area, minimizing the distance to the freezing point of fuel oil, then determining the number of KRI classes of at least 2 operating sectors and determining bases that can support the provision of fuel oil (BBM).

Min Z = (u-e)j

(minimize under and upper deviation coverage area of each operating sector -j)

Min Z =

(u - e)1,sector 1

(u - e)2,sector 2

.....

(u - e)5, sector 7

Information:

Min Z = Minimize operating costs

Min Z = (u - e)j (minimize under and upper deviation of each sector)

Cij = Value of coverage areaeach ship i (1-5) in sector j (1-7)

Bij=Operating costs per vessel i(1-5) in sector j (1-7)

Eij =Number of days carrying out operations per vessel (1-5) in sector (1-7)

Uij = Valueutility per vessel (1-5) in sector (1-7)

Pij : Valueprobability of each ship(1-5) in sector (1-7)

Xij =Ship type i (1-5) assigned to sector j (1-7)

Xi(1-17), j(1-4) = Ship i (1-5) assigned to sector j (1-7)

i = 1,...5 ; j = 1,...,7

c. Program Running (Running)

The program starts by entering the following data:

1) Set target cells / objective function
2) By changing cells / decision variable
3) Subject to the constraint / constraint function
4) Option select assume linear model, select non negative variable
5) Solve / program is executed.

Table 8. Optimization Results in assignments in the North Natuna Sea

Code	Number of Ships	quantity. Ship (rounding
K1	-	-
K2	-	-
K3	1.0	1
K4	4.4	5
K5	1.0	1
AMOUNT		**7**

(Source: Data Processing, 2022)

4. CONCLUSION

After carrying out the entire process of working on the thesis, conclusions can be made based on the results of data analysis and discussions that have been carried out. The result of running the solver program in this problem is the obtaining of a decision variable (zero-one decision variable) which indicates the optimization of the assignment of 5 (five) Class naval warship 7 (seven) operating sectors in the Natuna area, namely the optimization results show an illustration of the assignment of patrol boats in the sector. operations, that patrol boats on duty can cover all sectors and there is no buildup in any of the operating sectors. And all ships operate in accordance with their technical capabilities and compatibility in each sector of operation. It is stated that in order to carry out operations in the Natuna Sea for one year it requires 7 naval warships.

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FIELD II

LOGISTIC MANAGEMENT

ANALYSIS OF THE SUSTAINABILITY OF WARSHIP OPERATIONS IN SECOND FLEET COMMAND FOR SUPPORTING THE TASKS OF THE INDONESIAN NAVY

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ABSTRACT

Indonesian Warships are a representation of the strength and ability of the Navy in maintaining state sovereignty in the area of national jurisdiction. Second Fleet Command is one of the main cities of the Indonesian navy which oversees the central part of the Republic of Indonesia. This maritime area security activity is realized through the implementation of Marine Defense Operations and Marine Security Operations using the warship. In assessing aspects, criteria and alternatives that affect the sustainability of the warship operation degree in Second Fleet Command, the author uses the Analytical Hierarchy Process method (AHP) in assessing the weight of each intensity, in this processing the author uses super decision software 2.10 in processing the data. In the implementation of warship operations, there are many aspects that affect its implementation. The three main aspects are the Geopolhankam aspect, the naval warships technical/physical aspect and the Navy's financial/budgetary aspect. Of the three aspects, the technical aspect is the main aspect that affects the sustainability of the warships operation title with a weight value of 0.44343. Furthermore, the Financial aspect / Indonesian navy budget with a weight of 0.38737 and the Geopolhankam aspect is the aspect with the lowest priority with a weight of 0.1692. In the threat level criteria, regional conflicts have the highest value with a weight value of 0.16398, in the Indonesian Navy budget criteria the budget for carrying out the tasks of the Navy is the highest criterion with a weight value of 0.19437,

Keywords: warship operation, Operation Pattern, Analytical Hierarchy Process (AHP), Super Decision 2.10

1. INTRODUCTION

The dynamics of the development of the current strategic environmental situation and conditions have created an increasingly complex spectrum of threats and has very implications for national security and defense (Ministry of Defense, 2021). Indonesian Warships is a representation of the strength and ability of the Navy in maintaining state sovereignty in the area of national jurisdiction (Admiral TNI Dr. Marsetio, 2014). Second Fleet Command is one of the main cities of the Indonesian navy which oversees the central part of the Republic of Indonesia. This maritime area security activity is realized through the implementation of Marine Defense Operations and Marine Security Operations using the Naval Warship (Slamet soebjijanto, 2016).

The purpose of Opshanla/ Opskamla is to realize the stability of defense/security at sea by organizing a series of sea operations in order to prevent and take action against all forms of threats to defense/security at sea in accordance with the provisions of applicable laws and regulations, and protect national interests at sea, so that the sea with all its potential can be exploited to the fullest (Second Fleet Command Operations Staff Officer Handbook, 2019).

In carrying out its current duties, Second Fleet Command faces the reality of the increasing level of threat and vulnerability, the limited number of defense equipment (Naval Warship) and the limited defense budget, so a more comprehensive plan is needed to anticipate existing limitations. With the reality of the limitations and potentials as well as the existing contingency plans, the efforts carried out to deal with them are to assess the intensity of each aspect and variable that affects the implementation of Naval Warship operations (Ministry of Defense Number 12, 2012).

2. LITERATURE REVIEW

2.1 Second Fleet Command

Second Fleet Command (KoarmadaII) is one fleet that has position in Surabaya, It has coverage area from north of semarang until Sulawesi sea. It has the main task of fostering the ability of elements of fleet strength, fostering maritime potential to become a state defense and security force at sea, carrying out daily operations and sea combat operations for sea control and power projection ashore by sea in the context of enforcing sovereignty and law at sea (President of the Republic of Indonesia, 2019).

2.2 Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) has many advantages in explaining the decision-making process, this is in line with Kusrini's opinion in a book entitled Concepts and Applications of Decision Support Systems where it is stated that AHP has many advantages in explaining the decision-making process, one of which is that it can be described graphically so that it is easy to use. understood by all parties involved in decision making. Furthermore, in the Journal of Mhd. Sandi Rais entitled Decision Support System for Housing Site Selection Using the Analytical Hierarchy Process (AHP) stated that in solving problems with AHP there are several principles that must be understood (Siagian, 2017), among others are:

a. Create a hierarchy.

Complex systems can be understood by breaking them down into supporting elements, arranging the elements hierarchically, and combining them or synthesizing them.

b. Assessment criteria and alternatives

The assessment of criteria and alternatives was carried out by pairwise comparisons. The value and definition of qualitative opinion from the Saaty comparison scale can be measured using an analysis table as shown in the table below:

Table 1. Criteria and Alternative Assessment

Score	Information
1	The vertical factor is as important as the horizontal factor
3	The vertical factor is more important than the horizontal factor
5	The vertical factor is clearly more important than the horizontal factor
7	The vertical factor is clearly more important than the horizontal factor
9	The absolute vertical factor is more important than the horizontal factor
2,4,6,8	When in doubt between two adjacent element values
opposite	Opposite of indigo description 2-9

Source Hussain et al., 2015

c. Determining priority (synthesis of priority)

For each criterion and alternative, it is necessary to do a pairwise comparison. The relative comparison values of all alternative criteria can be adjusted according to a predetermined decision to produce weights and priorities. Weights and priorities are calculated by manipulating matrices or by solving mathematical equations.

d. Logical consistency

Consistency has two meanings: first, similar objects can be grouped according to uniformity and relevance. Second, it concerns the level of relationship between objects based on the criteria.

Table2. Ratio Index (RI)

n	1 ; 2	3	4	5	6	7	8	9	10	11	12	13	14
RI	0.0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57

Determination of Questionnaires According to Saaty, there are three principles in solving problems with AHP, namely the principle of compiling a hierarchy (decomposition), the principle of determining priorities (comparative judgment), and the principle of logical consistency (logical consistency). The hierarchy in question is a hierarchy of problems to be solved to consider the criteria or components that support the achievement of goals (Hussain et al., 2015). In the process of determining goals and the hierarchy of objectives, it is necessary to consider whether the set of objectives and the relevant criteria are appropriate for the problem at hand.

2.3 Research Methodology

This research was conducted in four stages, namely the preliminary stage, data collection, data processing, analysis and the last stage is the conclusion and suggestion stage. Shown in the flow chart as follows:

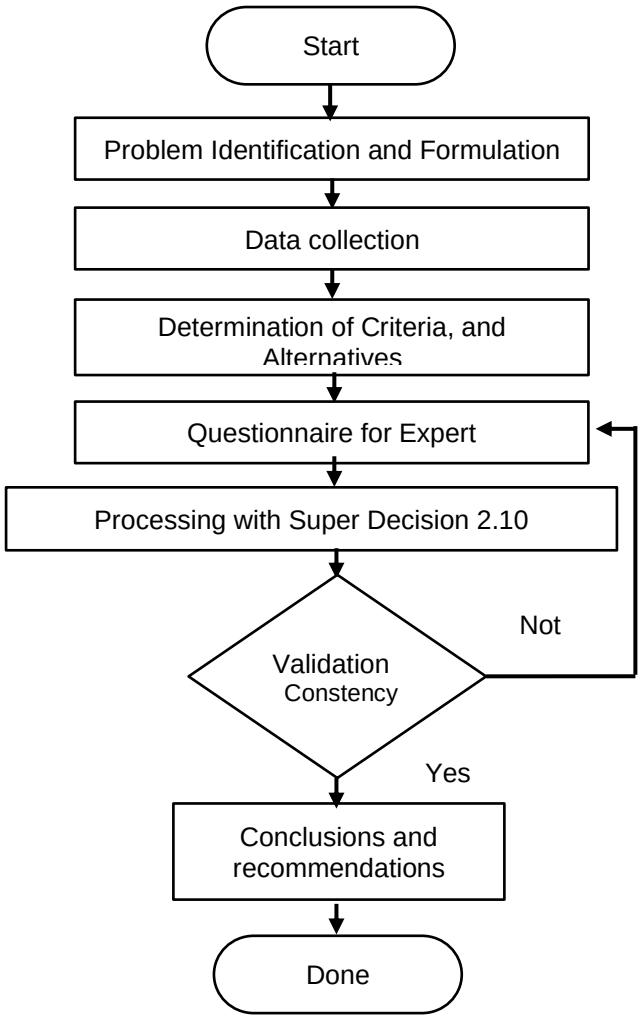

Figure 2. Research Method Flowchart

The preliminary stage consists of identifying problems, collecting data, determining criteria and determining alternatives. At the data collection stage, it was carried out through interviews and literature studies to find the criteria used in determining the strategic policies used. At the data processing stage, processing is carried out using the analytical hierarchy process (AHP) method using the Super Decision 2.10 tools. At stageanalysisThe data is analyzed from these calculations by considering the consistency value which will be used as a reference in making a decision. At the conclusion stage, conclusions are drawn from the calculations that have been made and suggestions are made to support the conclusions that have been drawn.

3. RESULTS AND DISCUSSION

Analytical Hierarchy Process has many advantages in explaining the decision-making process, in solving problems with AHP there are several principles that must be understood, including:

a. Create a hierarchy.

Complex systems can be understood by breaking them down into supporting elements, arranging the elements hierarchically, and combining them or synthesizing them In the research carried out, the calculation of the value of the intensity of the aspect and criteria was calculated using Super Decision 2.10 software. In this use the hierarchy of aspects and criteria is illustrated in Figure 4.6 as follows:

b. Accumulating the assessment of the intensity level of the qualitative variable aspect to obtain the aggregate quantitative value.

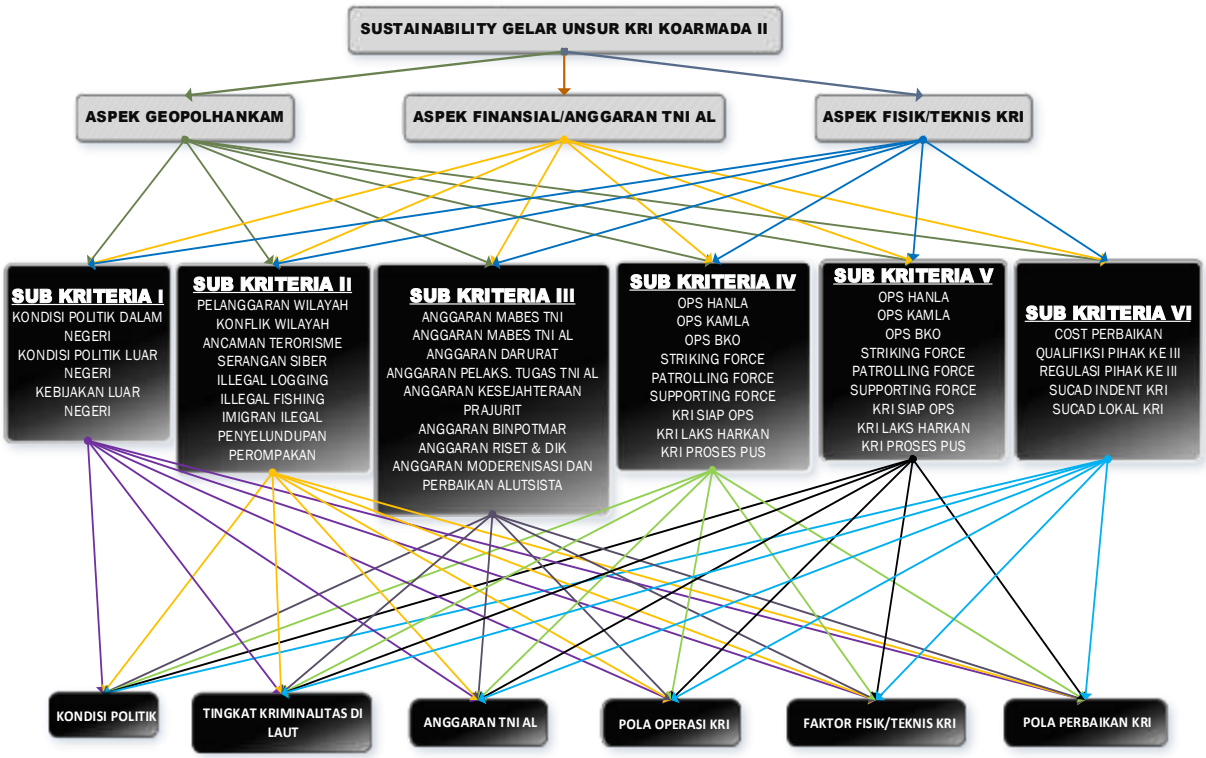

Figure 3. Picture of Sustainability Hierarchy Held Elements of NAVAL WARSHIP Second Fleet Command (Source: Research data processing, 2022)

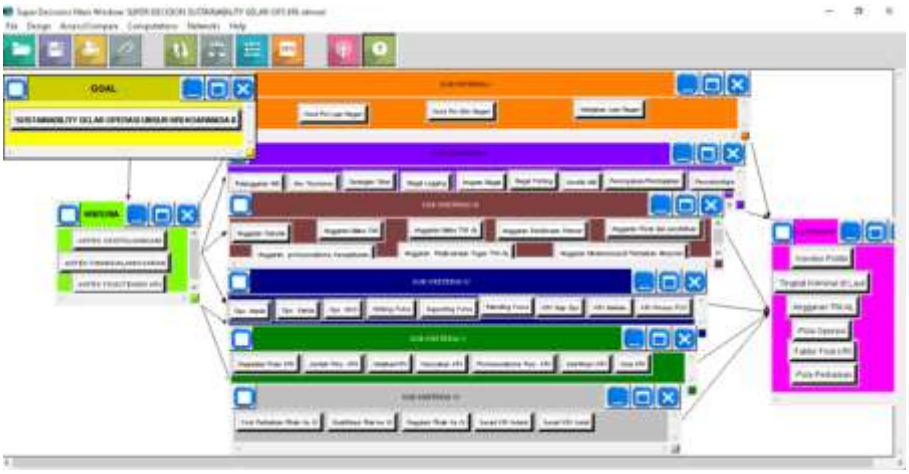

Figure 4. Hierarchical Diagram Using Super Decision Software 2.10
(Source: Research data processing, 2022)

Table 3. Aggregate Assessment of Main Aspects

NO	MAIN ASPECT	E1	E2	E3	E4	E5	E6	E7	E8	GEOMETRY VALUE
1	POLITICAL GEOGRAPHY ASPECT OF HANKAM	9	9	8	9	8	8	8	8	8.38
2	FINANCIAL ASPECTS/BUDGET OF THE Navy	8	9	8	9	8	7	8	7	8.00
3	ASPECTS OF KRI TECHNICAL CONDITIONS	9	8	9	9	9	8	9	8	8.63

Table 4. Geography, Defense, Defense and Security Assessment Aggregate

NO	ASPECT CRITERIA	E1	E2	E3	E4	E5	E6	E7	E8	GEOMETRY VALUE
1	Foreign Policy Conditions	7	8	7	7	7	8	8	7	7.4
2	Foreign policy	7	7	7	7	7	7	7	7	7.0
3	Crime at sea	9	8	9	9	9	8	9	8	8.6
	a. Territory Offense	8	8	8	9	9	8	8	9	8.4
	b. Threat of Terrorism at sea	7	8	8	8	8	8	9	7	7.9
	c. Illegal fishing	9	9	8	9	9	8	8	9	8.6
	d. Illegal logging	9	8	8	9	8	8	9	9	8.5
	e. Piracy and piracy	8	9	8	8	9	7	8	9	8.3
	f. Smuggling	9	9	8	9	9	8	7	8	8.4
	g. Territorial conflict	8	9	9	8	9	8	9	9	8.6
	h. Territory violation	9	8	9	9	9	8	9	9	8.8
	i. Illegal Immigrant	8	7	8	9	8	8	7	9	8.0
	j. Cyber Attack	8	7	9	8	8	8	7	8	7.9

Table 5. Aggregate Financial Assessment/Budget of the Indonesia

NO	ASPECT CRITERIA	E1	E2	E3	E4	E5	E6	E7	E8	GEOMETRY VALUE
1	Emergency budget	8	7	7	8	8	9	8	8	7.88
2	TNI Headquarters Budget	9	9	8	8	9	9	9	8	8.63

3	Indonesian navy Headquarters Budget	9	9	8	9	9	9	8	9	8.75
4	Research and education budget	8	8	8	9	9	8	8	9	8.38
5	Maritime potential development budget	8	8	8		9	9	8	8	7.25
6	Budget for increasing professionalism and welfare of soldiers	9	9	9	8	8	9	9	9	8.75
7	Budget for carrying out the duties of the Navy	9	9	9	9	8	9	9	9	8.88
8	Budget for the modernization and improvement of the Alutsista program	9	9	9	9	8	9	9	8	8.75

Table 6. Aggregate Physical/Technical Assessment of KRI

NO	ASPECT CRITERIA	E1	E2	E3	E4	E5	E6	E7	E8	GEOMETRY VALUE
1	KRI age	8	8	8	9	9	9	8	9	8.5
2	KRI Eligibility Level	8	8	9	9	9	8	9	9	8.6
3	KRI Soldier Professionalism	8	8	8	7	8	8	9	9	8.1
4	KRI Damage Level	9	9	9	8	8	8	9	9	8.6
5	KRI Capability Degradation	8	8	9	8	9	9	8	9	8.5
6	Crew personnel (ABK KRI)	8	8	9	9	9	8	9	9	8.6
7	KRI's crew professionalism	9	9	9	8	8	9	9	8	8.6
8	Government policy	8	8	7	8	8	9	9	8	8.1
9	KRI Operation Pattern	9	9	9	9	8	9	9	8	8.8
	a. Opshanla	9	9	9	9	9	9	8	8	8.8
	b. Opskamla	9	9	9	8	8	9	9	8	8.6
	c. BKO	8	8	9	9	8	8	9	7	8.3
10	KRI Repair Pattern	8	8	9	9	9	8	9	9	8.6
	a. Third party	8	8	9	9	9	8	9	8	8.5
	1) Third Party Regulation	8	8	7	8	8	8	9	9	8.1
	2) Repair Price	8	8	9	9	9	8	9	8	8.5
	3) Third Party Competence	8	8	9	9	9	8	9	9	8.6
	4) Third Party Qualification	8	8	9	9	8	9	8	8	8.4
	b. Parts	8	9	9	9	8	9	8	8	8.5
	1) Local spare parts	7	8	7	9	9	8	9	9	8.3
	2) Indent spare parts	8	8	8	9	9	8	9	8	8.4
11	KRI Intensity Supports Indonesian navy Operations	8	8	9	9	9	8	9	9	8.6
	a. KRI type	9	9	8	8	9	9	8	8	8.5
	1) Strike Force	8	9	9	9	9	8	8	9	8.6
	2) Patrol Force	8	8	9	9	9	8	9	8	8.5
	3) Supporting Force	8	8	8	8	9	9	8	9	8.4
	b. Number of KRI	8	9	9	8	8	9	8	9	8.5
	1) KRI Status Ready for Operation	8	8	8	9	9	9	9	8	8.5
	2) KRI Status Not Ready for Operation	8	9	9	9	8	8	9	9	8.6
	3) KRI Implements EFA Process	8	8	7	8	7	9	9	8	8

c. The assessment of criteria and alternative criteria and alternatives is done by pairwise comparison. The pairwise comparison assessment of aspects and criteria using Super Decision 2.10 software is as follows:

Figure 5. Pairwise Comparation Priority Aspects

Figure 6. Pairwise Comparison of the Indonesian navy's Budget Criteria

Figure 7. Data on the value of Inconsistency between Sub-Criteria is attached below

Table 7. Weighting Value of Main Aspects

NO	SUB CRITERIA	WEIGHT VALUE	DESCRIPTION
1	POLITICAL ASPECTS OF HANKAM	0.16920	
2	FINANCIAL ASPECTS/BUDGET OF THE Navy	0.38737	
3	PHYSICAL/TECHNICAL ASPECTS OF KRI	0.44343	

Table 8. The Weighting Value of the Geographical Aspects of Defense and Security Politics

NO	SUB CRITERIA	WEIGHT VALUE	DESCRIPTION
1	Foreign Policy Conditions	0.13575	
2	Foreign policy	0.13498	
3	Domestic Political Conditions	0.42390	
4	Crime at sea	0.30537	

Table 9. Weighted Value of Crime Criteria at Sea

NO	SUB CRITERIA	WEIGHT VALUE	DESCRIPTION
1	Territory Offense	0.15518	
2	Threat of Terrorism at sea	0.05809	
3	Illegal fishing	0.13691	
4	Illegal logging	0.13955	
5	Piracy and piracy	0.10471	
6	Smuggling	0.12587	
7	Territorial conflict	0.16398	
8	Illegal Immigrant	0.06208	
9	Cyber Attack	0.05364	

Table 10. Weighting Value

NO	SUB CRITERIA	WEIGHT VALUE	DESCRIPTION
1	Emergency budget	0.11576	
2	Navy HQ Budget	0.06946	
3	Indonesian navy Headquarters Budget	0.08190	
4	Research and education budget	0.12706	
5	Maritime potential development budget	0.09664	
6	Budget for increasing professionalism and welfare of soldiers	0.16325	
7	Budget for carrying out the duties of the Navy	0.19437	
8	Budget for the modernization and improvement of the Alutsista program	0.15156	

Table 11. Weighting Value of KRI Physical/Technical Aspects

NO	SUB CRITERIA	WEIGHT VALUE	DESCRIPTION
1.	KRI age	0.08165	
2.	KRI Eligibility Level	0.18292	
3.	KRI Soldier Professionalism	0.27580	

4.	KRI Damage Level	0.13988	
5.	KRI Capability Degradation	0.11877	
6.	Crew personnel (ABK KRI)	0.07277	
7.	KRI Certification	0.12822	
8.	KRI Operation Pattern		
	a. Opshanla	0.15221	
	b. Opskamla	0.13671	
	c. BKO	0.08138	
10.	KRI Intensity Supports Indonesian navy Operations		
	a. KRI type		
	1) Strike Force	0.15798	
	2) Patrol Force	0.11533	
	3) Supporting Force	0.10973	
	b. Number of KRI		
	1). KRI Ready for Ops	0.09146	
	2). KRI Harkan	0.10944	
	3). KRI PUS Process	0.04577	
11.	KRI Repair Pattern		
	a. Third party		
	1) Third Party Regulations	0.19703	
	2) Repair Price	0.31453	
	3) Third Party Qualification	0.19062	
	b. Parts		
	1) Local spare parts	0.14306	
	2) Indent spare parts	0.15476	

Source: Processed by researchers, 2022 With Super Decision Software 2.10)

4. CONCLUSION

In the implementation of KRI operations, there are many aspects that affect its implementation. The three main aspects are the Geopolhankam aspect, the KRI technical/physical aspect and the Navy's financial/budgetary aspect. Based on the analysis using super dicision, 2.10, it is known that of the three aspects, the technical aspect is the main aspect that affects the sustainability of the KRI operation degree with a weight value of 0.44343. Furthermore, the Financial aspect / TNI Al budget with a weight of 0.38737 and the Geopolhankam aspect is the aspect with the lowest priority with a weight of 0.1692. In the threat level criteria, regional conflicts have the highest criterion value with a weighted value of 0.16398, in the TNI AL budget criteria, the budget for carrying out the tasks of the Navy is the highest criterion with a weight value of 0.19437, for the technical/physical condition of the KRI, the KRI feasibility level is the highest criterion with a weight of 0.19437. 0.18292, For the condition of the KRI suction operation pattern, the striking force type has the highest weight with a weight value of 0. 15798 and for the condition of the repair pattern, the third party repair price criteria has the highest weight value with a weighted value of 0.31453. By looking at the intensity of the influence of the sustainability aspects and criteria for the degree of KRI operation, this can be used as input in taking further policies.

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FTA AND FMECA ANALYSIS FOR DETERMINE CRITICAL COMPONENTS OF DIESEL GENERATOR CUMMINS KTA 38D

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ABSTRACT

Diesel Generator is equipment have functions as a power generator and electricity supply. Tanker warship is one of navy warship applying diesel generator Cummins KTA 38D for electricity supply when going on mission area or at basecamp. On diesel generator system consists of 7 (sevent) sub-system that are coolant sub-system, sea water cooling sub-system, fuel oil sub-system, air intake and exhaust sub-system, Lub oil sub-system, Electric starter sub-system and controling sub-system. Due high operating hours, the potential for damage is increasing, because damage a component diesel generator. According ship damage report data, the percentage damage of diesel generator reach until 38.5% from total equipment damage occurred during 2016-2022 year. Based on that phenomena, this research will identifcation factors cause damage and determine the components have high criticality in the diesel generator using the FTA (Fault Tree Analysis) to systematically explain unexpected causal factors that lead to failure, and the FMECA (Failure Mode Effect And Criticality Analysis) method to identify critical components according factors have the highest critical point with calculation of the Risk Priority Number (RPN). The results of calculations and analysis using the FTA and FMECA methods, there are 6 (six) critical components with the highest RPN value in the diesel generator system, that is Tube sea water component (375,4) with the risk of leaking, Impeller components (377,1) with a risk of corrosion/crack, Body Cover SW (372,0) with a risk of corrosion, Mechanical Seals (369,8) with a risk of leaking/damage, strainer (369,1) component with a risk of corrosion, Rectanguler seal HE (367,9) a risk leakage and Battery (371,0) with a risk no power electric for start engine.

Keywords : Diesel generator, FTA, FMECA, Critical components

1. INTRODUCTION

A tanker type of warship is designed for fuel distribution and liquid logistics supplies at sea (fleet on replenishment at sea). To support the vital role carried out by the ship, the readiness of the ship's technical condition is an absolute requirement that must be properly maintained. One of the equipment has a vital role on the ship is a diesel generator. Due to the high age and operating hours of the diesel generator, the potential for damage will increase. Damage diesel generators caused by damage a component cannot be known with certainty because each component has a different reliability and rate of damage.

According ship damage report data, the percentage of damage for Cummins KTA 38D diesel generator is higest reached at 38.5% form total equipment damage occurred during 2016 – 2022. The graphic of equipment damage shown in figure 1.

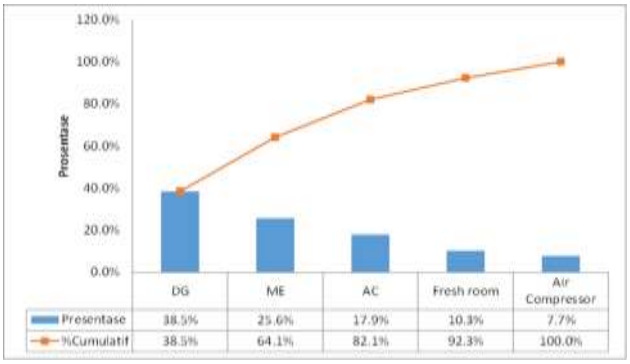


Figure 1. Graphics of equipment damage

There were several weaknesses in the maintenance of the diesel generator system carried out by ship personnel, these weaknesses is:

a. Incomplete equipment manual handbook.

b. Spare parts and tools maintenance equipment not available.

c. Lack understanding of maintenance by operators,

d. Operators are still having trouble to finding root cause of equipment damage,

e. The equipment operated continuously until breakdown occurs.

Based on these references, the purpose of this study is identify critical components based on the factors have the highest critical point on the diesel generator. So that it is expected to provide a solution for equipment maintenance along with the maintenance mechanism has been implemented until now.

2. MATERIAL AND METHODE

2.1 Diesel Genartor

The diesel generator is a ship's equipment useful for supply electricity needs of the ship. Diesel generator is a combination of diesel engine and generator. A diesel engine is a combustion engine with a combustion process that occurs within the engine itself (internal combustion engine) and combustion occurs because pure air is compressed (compressed) in a combustion chamber (cylinder) so that high pressure air and high heat are obtained, along with being sprayed. the fuel is atomized so that combustion occurs.

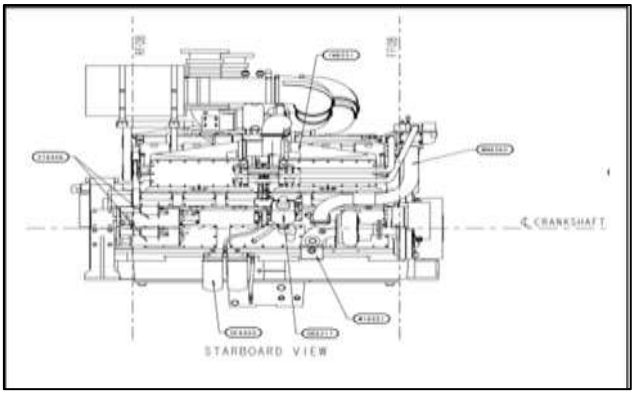


Figure 2. Engine Cummins KTA 38D

Specification engine data of the diesel generator Cummins KTA 38D can be seen in the description below:

Diesel		**Generator**	
Merk	: CUMMIN	Merk	: STAMFORD
Engine No	: 41183836	Type	: LVM634G1
Model	: KTA38-D(M)	AVR	: MX321
SO No	: S060179	Volt	: 400
Advert	: 880 kw	Phase	: 3
Max.	: 970kw	KVA	: 1100
Idle speed	: 650~750	Rpm	: 1500
Rpm	: 1500r/min	Ampere	: 1587.8
Produck	: 2013	Freq	: 50Hz
Manufacture	: Chongqing Cummins China	ID No	: X13A021703

2.2 Raliability Diagram Block

Evaluate for reliability of a component or system, the first is make model the component or system into a reliability block diagram. The composition of the reliability block diagram of the system consists of structural forms, namely:

a. Series Structure

Series structure is a system structure where the system is said to be damaged if one of its components is damaged.

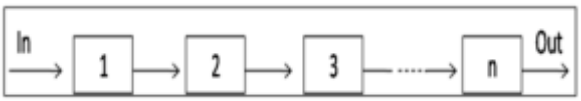


Figure 3. Series structure

b. Parallel structure

Parallel structure is a system structure where the system still functioning if at least one component functioning or it can be said that the system is damaged if all components are damaged.

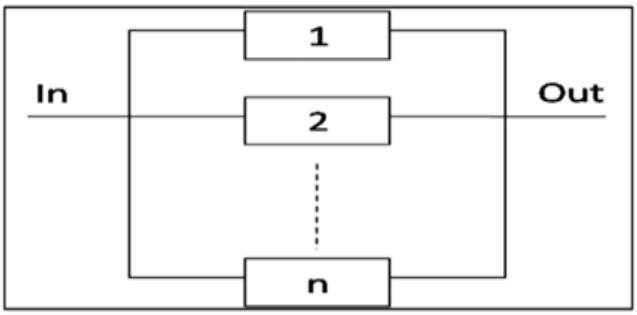


Figure 4. Parallel structure

2.3 Fault Tree Analysis (FTA)

Fault Tree Analysis (FTA) is a method of deductive analysis by describing numerical graphs and analyzing how damage can occur and what are the chances of damage (Blanchard, 2004). The FTA

steps in a system are as follows:

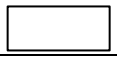
a. Identify the most important events in the system (top level events).

b. Create a fault tree (fault tree).

c. Analyze the fault tree (fault tree)

The symbols used in fault tree analysis are as follows:

Tabel 1. Symbol of Fault Tree Analysis

Symbols	Description
	Basic Event
	Intermediate Fault Event
	Undeveloped Event
	External Event
	Top Event
	Logic event End gate
	Logic event Or gate
	Exclusife Event

2.4 Failure Mode Effects and Criticality Analysis (FMECA)

FMECA is a development of FMEA by considering the level of criticality associated with the impact of the component failure mode. This criticality level is analyzed based on a combination severity and probability of occurrence The analysis may be performed according to the following scheme.

a. Definition and delimitation of the system (which components are within the boundaries of the system and which are outside).

b. Definition of the main functions (missions) of the system.

c. Description of the operational modes of the system.

d. System breakdown into subsystems that can be handled effectively.

e. Review of system functional diagrams and drawings to determine interrelation- ships between the various subsystems. These interrelations may be illustrated by drawing functional block diagrams where each block corresponds to a sub-system.

f. Preparation of a complete component list for each subsystem.

g. Description of the operational and environmental stresses that may affect the system and its operation. These are reviewed to determine the adverse effects that they could generate on the system and its components.

The Risk Priority Number (RPN) is the result of multiplying the weights of Severity, Occurance and Detection rating. These results will be able to determine the critical components of the system under study.

RPN = Severity(S) x Occurance(O)x Detection(D)

The Risk Priority Number is used to rank and identify failures or risks associated with operations due to design

Tabel 2. Severity, Occurance, and Detection rating

Rating	Description
High	The team must either identify an appropriate action to improve prevention.
Medium	The team should identify appropriate actions to improve prevention and / or detection controls,
Low	The team could identify actions to improve prevention or detection controls

Component criticality analysis based on failure mode/failure mode using a risk matrix according predetermined criteria. The final results obtained are items that are included in the critical components, namely components that are included in the "high" rating of risk based on the risk matrix. The overall results of the analysis of the FMECA method will be presented in the form of an FMECA Worksheet.

Tabel 3. Severity Level.

Severity Level		
Kategori	**Ranking**	**Definition**
Catastrophic	8,1-10	Cause system shutdown.
Critical	6,1-8	The system cannot function as specified.

Marginal	4,1-6	The system has decreased function performance.
Negligible	2,1-4	The system can function with little risk.
Minor	1-2	The system can function with negligible risk.

Tabel 4. Occurrence Level.

Occurrence Level		
Frekuensi Kejadian	***Occurrence Rating***	**Definition**
Frequent	8,1-10	Often occur
Probable	7,1-8	Very likely
Occasional	5,1-7	Commonly occurs
Remote	3,1-5	Rarely occurs
Improbable	1-3	Impossible to happen

2.4 Research Metodhology

In order to facilitate understanding achieve expected goals in the research process, a research design made which represented in a research flow chart

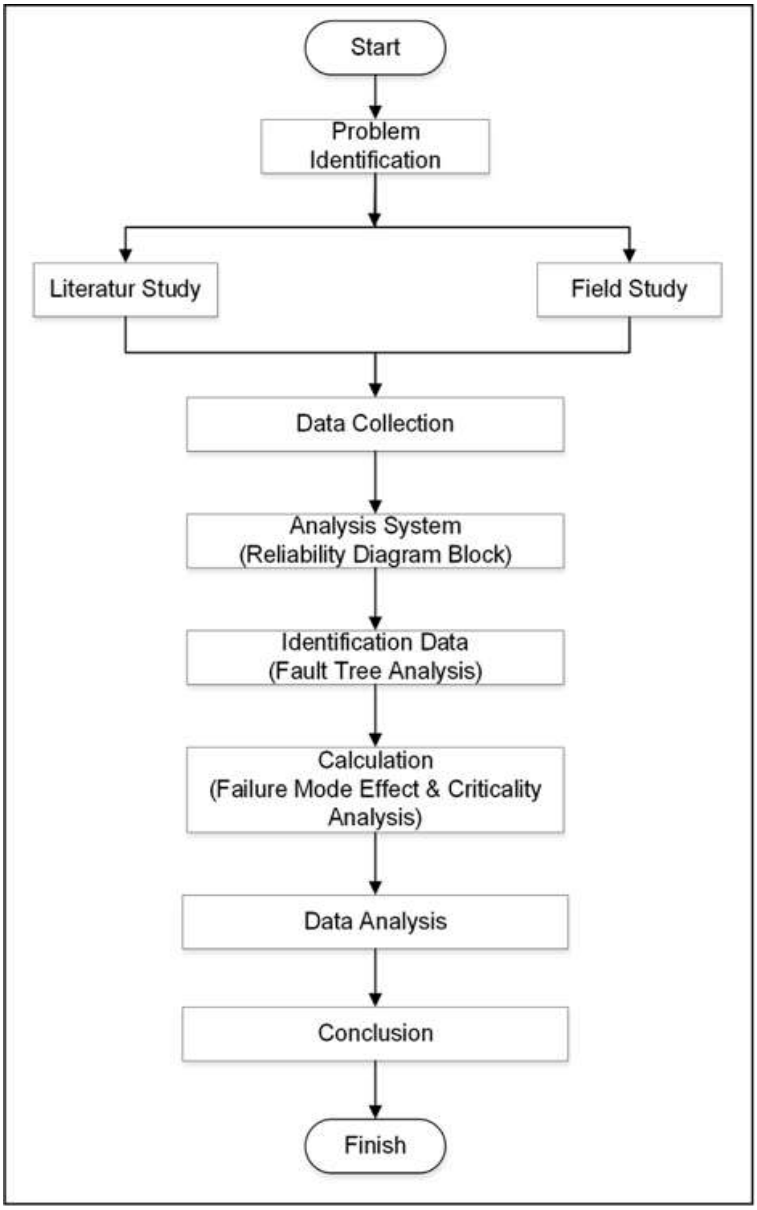


Figure 5. Flow Chart Diagram

3. RESULTS AND DISCUSSION

Based on direct observation, guidance from the Cummins KTA 38D engine manualbook and interviews with respondents and experts, there are 7 (seven) systems that support the operation of diesel generators arranged in series structure

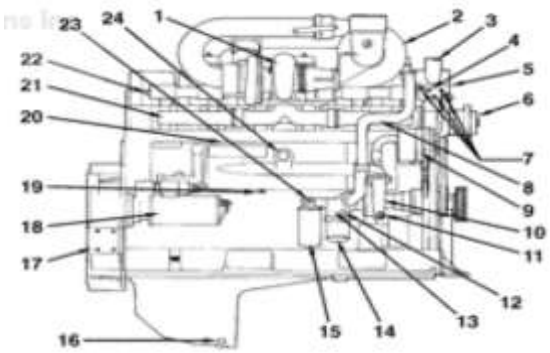


Figure 8. Layout of diesel generator

Generality of the supporting components of a diesel generator are as follows:

Table 5. Components of Diesel

1. High pressure Turbocahrger	13. Water Pump inlet housing
2. Low pressure Turbocahrger	14. Water inlet connection
3. Water outlet	15. Coolant Filter
4. Water Press. Pickup	16. Oil Drain
5. Thermostat housing	17. Flywheel housing
6. Gear Driven	18. Starter
7. Water press/temp	19. Petcock for water drain
8. Water bypass tube	20. oil cooler
9. Alternator	21. Exhaust manifold
10. Water pump	22. Heater supply
11. Petcock for water drain	23. Water shutoff valve
12. Heater retuen port	24. Coolant Heater

Acccording the block diagram of diesel generator system has a

series structure, where the system is said to be damaged if one of its components is damaged and the system is said to be good if all components are in good condition.

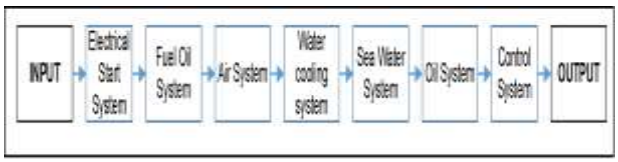


Figure 9. Block Diagram of Diesel Generator

3.1 Fault Tree Analysis of Diesel Generator

In the FTA method, the failure of the diesel generator is a top event, the diesel generator operational support systems are developed into a fault tree to find the factors that cause the diesel generator to fail. Factor analysis diesel generator failure can be caused by one of the existing systems. The relationship/logic event of the diesel generator failure factors is to use an OR gate. This shows that the failure of the diesel generator can be caused by one of the failure factors. For detail of factor cause diesel generator fail on figure 10.

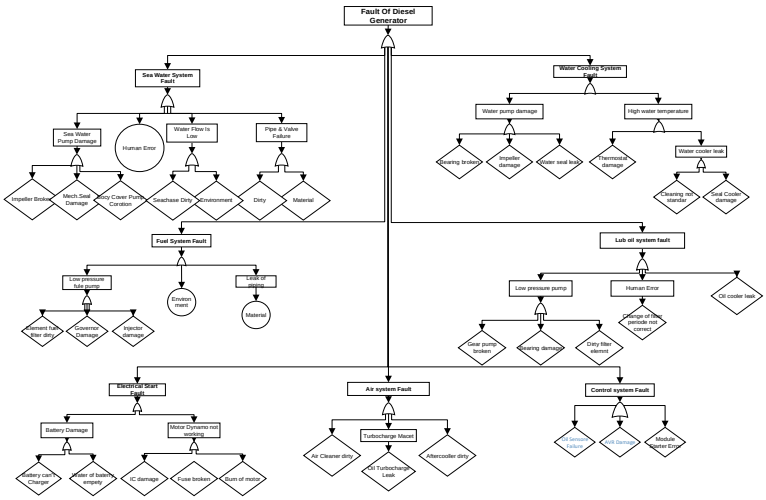


Figure 10. Fault Tree Diagram of Diesel Generator

3.2 FMECA of Diesel Generator

The diagram in figure 3.1 shows which components are the cause of the sub-system on the diesel generator that affects engine performance. To find out the failure in detail using the Failure Mode Effect and Citical analysis which is applied to the diesel genartor system. The diesel generator system is divided into 7 (seven) sub-systems, namely fresh

water sub-system, seawater sub-system, air sub-system, fuel sub-system, lubricant sub-system, electric start sub-system and control sub-system.

a. Sea water sub-system, function each component are of tube coole for heat absorber coolant, impeller for make faster in and out fluid, gasket pump for body casing insulator, Casing cover for protective rotary component pump, Mechanical seal for obratction fluid leakage, strainer for filtering sea water waste, shaft SW pump for pass on rotary moment from driver, and bearing SW pump for keep friction between shaft rotary and body casing.

b. Coolant water sub-system, function each component are, bearing for keep friction between shaft rotary and body casing, seal oil and water for prohibit oil and water get involved, thermostate for keep stability water temperature, rectanguler seal HE for obstauction fluid leakage, and heat excahanger tube for heat absorber coolant.

c. Fuel oil sub-system, function each component are, element fuel filter for filtering fuel sludge, main shaft fuel pump for pass on rotary moment from driver, o-seal drive shaft and seal wire for obstuction fuel leakage, and injector for fuel spraying to combution chamber.

d. Lub oil sub-system, function each component are bushing oil pump for vibration muffle, element oil filter for filtering oil sludge, and seal oil heat exchanger for leakage oil inhibitor.

e. Air intake and exhaust Sub-system, funtion each component are air cleaner for filtering air waste, aftercooler for absorb heat of air intake, seal rectanguler ring for air leakage inhibitor and bushing turbocharger for vibration muffle and oil leak inhibitor

f. Elelctricaly starter sub-system, function each component are, battery for electric power storage, and modul starter for regulating starting engine process

g. Control sub-system, function ecah component are, AVR for electrically controlling fuel and Engine oil sensor for read oil temperature.

For detail cause and effect each component in the sub system diesel generator show on FMECA worksheet tabel 7.

The FMECA process included components failure mode, failure cause, effects of the failure on the transformer/network and recommendations were formulated to curb future failure. The criticality analysis of each failure mode was performed by assigning to each failure mode a Risk Priority Numbers (RPN), and the results of the entire FMECA process is represented in table 7. Table 7, summarizes the failure modes of diesel geneator components each sub system, failure causes, effects of component failure of the diesel genator units or the entire grid and the Risk Priority Numbers based on how severe the effects of a failure are, how frequent a fault occurs and how easy is it to detect the failure before it occurs. Risk Priority Numbers assignments to failure modes are referred to as criticality analysis and specify the critical nature of each component failure. Sample calculation RPN on Tube cooler sea water is ; ***RPN = S*** (8) x O (8) x D (6) = 375

The highest RPN shows the components on which much attention should be tilted. From table 7, any seven component have the highest RPN values their are impeller, tube cooler sea water, casing cover, battery accu, mechanical seal, strainer and seal rectanguler heat excahanger.

Tabel 7. Causes and Effect failure worksheet

No	Item	Function	Failure Mode	Failure Causes	Failure Effect	Detection Method
W1	Tube Cooler Sea Water	Heat absorber coolant	Mechanical	Tube cooler corrosion	Coolant and sea water mixed	Visual inspection

No	Item	Function	Failure Mode	Failure Causes	Failure Effect	Detection Method
W2	Impeller	Make Faster in/0ut fluid from pump	Mechanical	Impeller corrosion and crack	Suction and press pump can"t work perfection	No detection equipment
W3	Gasket pump	Body casing insulator	Mechanical, thermal	Gasket damage	Permeate water from pump	Visual inspection
W4	Casing Cover	Protective rotary componen pump	Material, Mechanical	Material corrosion	Pump can't vaccum	Visual inspection
W5	Mechanical Seal	Obstruction fluid leakage	Mechanical	Mech.Seal damage	Pump suction not perfection	Visual inspection
W6	Strainer	Filtering sea water waste	Mechanical, material	Material corrosion	Sludge go into cooling water	Visual inspection
W7	Shaft SW Pump	Pass on rotary moment from driver	Mechanical	Wear out and corrosion of shaft	impeller not balance occure of vibration	No detection equipment
W8	Bearing SW pump	Fiction keeping between shaft rotary and body casing	Mechanical	Bearing broken and worn out	Pump suction not perfection	No detection equipment
W9	Bearing Coolant Pump	Fiction keeping between shaft rotary and body casing	Mechanical	Bearing broken and worn out	Pump suction not perfection	No detection equipment
W10	Seal Water Coolant Pump	Prohibit oil and water get involved	Mechanical, thermal	Solidify of seal or damage	less of pump suction	Visual inspection
W11	Seal oil Coolant Pump	Prohibit oil and water get involved	Mechanical, thermal	Solidify of seal or damage	Pump suction not perfection	Visual inspection
W12	Thermostat	Keep Stability water temperature	Mechanical, thermal	Termostate can"t work	Coolant temperature Overheating	Visual inspection
W13	Rectanguler Seal HE	Obstruction fluid leakage	Mechanical, thermal	Solidify of seal or damage	Leakage coolant	Visual inspection
W14	Heat Exchanger Tube	Heat absorber coolant	Mechanical, thermal	Tube HE corrosion	Coolant and sea water mixed	Visual inspection
W15	Element Fuel Filter	Filtering Fuel Sludge	Mechanical	Element filter clogged	Less of fuel pressure	Pressure sensor
W16	Main Shaft Fuel Pump	Pass on rotary moment from driver	Mechanical	Shaft worn out	Gear pump can"t rotatri occure vibration	No detection equipment
W17	O-Seal Drive Shaft	Obstruction fuel leakage	Mechanical, thermal	Solidify of seal or damage	Pump suction not perfection	Visual inspection
W18	Seal Wire	Obstruction fuel leakage	Mechanical, thermal	Solidify of seal or damage	Pump suction not perfection	Visual inspection
W19	Injector	Fuel spraying to chamber	Mechanical	Injector Shim worn out	High of exhaust temperatur	Visual inspection
W20	Bushing Oil pump	Vibration muffle	Mechanical	Bushing worn out	Crude noise and oil leak	No detection equipment
W21	Element oil Filter	Filtering oil Sludge	Mechanical	Element filter clogged	Less of oil pressure	Pressure sensor
W22	Seal oil Heat Exchanger	Leakage oil inhibitor	Mechanical, thermal	Solidify of seal or damage	Oil Leakage	Visual inspection
W23	Battery Accu	Electric Power Storage	Mechanical, thermal, Electrical	Less of accu water or element damage	No electrik power to starting engin	Voltage indicator
W24	Gear pinion motor	Pass on rotary power of starter	Mechanical	Knocked gear or fault	Flywheel can<t turning	No detection equipment
W25	Air Cleaner	Filtering air waste	Mechanical	Element filter clogged	Decreasing volume of air	Pressure sensor

No	Item	Function	Failure Mode	Failure Causes	Failure Effect	Detection Method
W26	Aftercooler	Absorb heat of air intake	Mechanical, thermal	Aftercooler corrosion	Air intake temperatur high	Visual inspection
W27	Seal Rectanguler ring	Air Leakage inhibitor	Mechanical, thermal	Solidify of seal or damage	Air leakage	Visual inspection
W28	Bushing TC	Vibration muffle and oil leakage inhibitor	Mechanical	Bhusing worn out	Crude noise and oil leak	No detection equipment
W29	AVR	Electricaly Controlling fuel	Thermal, Electrical	Short Circuit	Engine rotation unstable	Rpm engine Indicator
W30	Engine oil sensor Temperatur	Read oil temperature	Thermal, Electrical	Short Circuit	Engine can"t start	Alarm sensor
W31	Modul Starter	Regulating starting engine process	Thermal, Electrical	Short Circuit	Engine can"t start	Alarm monitoring

Tabel 8. RPN value of components

No	Item	Severity (S)	Occurrence (O)	Detection (D)	RPN
W1	Tube Cooler Sea Water	7.8	7.8	6.3	375.4
W2	Impeller	8.1	6.8	6.9	377.1
W3	Gasket pump	3.9	7.1	3.8	103.5
W4	Casing Cover	7.5	8.6	5.8	372.0
W5	Mechanical Seal	7.3	8.0	6.4	369.8
W6	Strainer	6.8	8.8	6.3	369.1
W7	Shaft SW Pump	7.9	2.1	5.6	94.1
W8	Bearing SW pump	3.8	4.5	3.8	63.3
W9	Bearing Coolant Pump	5.3	4.1	4.3	92.0
W10	Seal Water Coolant Pump	4.0	7.8	6.3	45.1
W11	Seal oil Coolant Pump	6.9	6.8	6.9	95.7
W12	Thermostat	5.3	2.4	4.8	67.3
W13	Rectanguler Seal HE	7.9	3.4	4.1	367.9
W14	Heat Exchanger Tube	7.9	2.5	5.1	103.4
W15	Element Fuel Filter	6.4	8.1	5.8	94.8
W16	Main Shaft Fuel Pump	7.9	2.5	5.3	98.4
W17	O-Seal Drive Shaft	3.3	7.0	2.1	76.0
W18	Seal Wire	4.0	2.5	5.0	97.5
W19	Injector	7.5	4.3	5.5	88.6
W20	Bushing Oil pump	7.8	4.9	5.0	80.4
W21	Element oil Filter	8.1	3.4	3.5	99.9
W22	Seal oil Heat Exchanger	7.0	2.5	6.1	101.5
W23	Battery Accu	7.9	7.3	2.3	371.0
W24	Gear pinion motor	7.3	4.0	3.6	73.4
W25	Air Cleaner	3.3	8.4	5.6	51.8
W26	Aftercooler	3.6	3.0	3.4	21.4
W27	Seal Rectanguler ring	3.5	6.4	2.5	82.7
W28	Bushing TC	8.1	2.3	2.6	75.2
W29	AVR	8.0	3.5	6.8	36.8
W30	Engine oil sensor Temperatur	3.6	2.0	4.6	15.0
W31	Modul Starter	7.8	2.6	1.8	38.8
		RPN Value : 366,6			

Tabel 9. Risk Matriks Component

No	Item	Consequency		Risk Level
		Severity	Occurrence	
W1	Tube Cooler Sea Water	Critical	Probable	High
W2	Impeller	Catastrophic	Probable	High
W3	Water Seal	Negligible	Probable	Medium
W4	Casing Cover	Critical	Frequent	High
W5	Mechanical Seal	Critical	Probable	High

No	Item	Consequency		Risk Level
		Severity	Occurrence	
W6	Strainer	Critical	Frequent	High
W7	Shaft SW Pump	Critical	Improbable	Low
W8	Bearing SW Pump	Negligible	Remote	Medium
W9	Bearing Coolant Pump	Marginal	Remote	Medium
W10	Seal Water Coolant Pump	Negligible	Improbable	Low
W11	Seal oil Coolant Pump	Critical	Remote	Medium
W12	Thermostat	Marginal	Improbable	Low
W13	Rectanguler Seal HE	Critical	Frequent	High
W14	Heat Exchanger Tube	Critical	Improbable	Low
W15	Element Fuel Filter	Critical	Occasional	Medium
W16	Main Shaft Fuel Pump	Critical	Improbable	Low
W17	O-Seal Drive Shaft	Negligible	Remote	Medium
W18	Seal Wire	Negligible	Remote	Medium
W19	Injector	Critical	Remote	Medium
W20	Bushing Oil pump	Marginal	Improbable	Low
W21	Element oil Filter	Marginal	Probable	Medium
W22	Seal oil Heat Exchanger	Critical	Remote	Low
W23	Battery Accu	Critical	Frequent	High
W24	Gear pinion motor	Critical	Remote	Medium
W25	Air Cleaner	Negligible	Occasional	Medium
W26	Aftercooler	Negligible	Improbable	Low
W27	Seal Rectanguler ring	Negligible	Remote	Medium
W28	Bushing TC	Catastrophic	Improbable	Low
W29	AVR	Critical	Improbable	Low
W30	Engine oil sensor Temperatur	Negligible	Improbable	Low
W31	Modul Starter	Critical	Improbable	Low

Tabel 10. Risk matriks mapping

	Minor	Negligible	Marginal	Critical	Catastrophic
Frequent				4,13,23	
Probable		3	21	1,5,6	2
Occasional		25		15	
Remote		8,14,17,18,27	9	11,19,22,24	
Improbable		10,26,30	12,20	7,14,16,29,31	28

Tabel 11. Critical Components

No	Item	Function	Failure Mode	Failure Causes	Failure Effect	Risk Level	RPN
W1	Tube Cooler Sea Water	Heat absorber coolant	Mechanical	Tube cooler corrosion	Coolant and sea water mixed	High	**375,4**
W2	Impeller	Make Faster in/0ut fluid from pump	Mechanical	Impeller corrosion and crack	Suction and press pump can"t work perfection	High	**377,1**
W4	Casing Cover	Protective rotary componen pump	Material, Mechanical	Material corrosion	Pump suction not perfection	High	**372,0**
W5	Mechanical Seal	Obstruction fluid leakage	Mechanical	Mech.Seal damage	Pump suction not perfection	High	**369,8**
W6	Strainer	Filtering sea water waste	Mechanical, material	Material corrosion	Sludge go into cooling water	High	**369,1**
W13	Rectanguler Seal HE	Obstruction fluid leakage	Mechanical, thermal	Solidify of seal or damage	Leakage coolant	High	**367,9**
W23	Battery Accu	Electric Power Storage	Mechanical, thermal, Electrical	Less of accu water or element damage	No electrik power to starting engin	High	**371,0**

RPN calculations and risk mapping for critical components of diesel generators are have effect of engine running is shutdown, which have an RPN value above the average and have a risk with a "High" rating. So that the components that can be categorized as critical components of diesel generators.

4. CONCLUSION

System of Diesel generator Cummins KTA 38D have 7 (sevent) sub-systems that support the operation of diesel generators arranged in series structure. Fault tree to find the factors that cause the diesel generator to fail. Factor analysis diesel generator failure can be caused by one of the existing systems.

RPN calculations and risk mapping for critical components of diesel generators are have effect of engine running is shutdown, which have an RPN value above the average and have a risk with a "High" rating. The critical components are, tube cooler sea water (375,4) with failure causes tube cooler corrosion and failure effect is coolant mixed with sea water, impeller (377,1) with failure causes corrosion/crack and failure effect is suction and pressure can't work, casing cover (372,0) failure causes material corrosion failure effect pump suction not perfection, battery accu (371,0) failure causes is less of water battery failure effect no electric power , mechanical seal (369,8) failure causes damage failure effect pump suction no perfection, strainer (369,1) failure causes carrion failure effect sludge go into cooling water and seal rectanguler heat excahanger (367,9) failure causes solidify or damage failure effect is coolant leakage.

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HYBRID METHOD OF THE HOUSE OF RISK AND MONTE CARLO FOR PLANNING MODELS ON THE NEW CONSTRUCTION OF PROJECT X

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ABSTRACT

The series of activities which include preparation and selection of various alternatives, as well as its implementation, are carried out in a way and logically so that the consequences that may occur can be predicted and anticipated. In an activity, especially projects, risks is an inseparable part. HOR method is used identify and measure impact risks on project X. Monte Carlo simulation is used as a simulator in estimating the completion of a project. The simulation results on project X are known that there are 30 potential events that occur due to 29 risk agents in the project. Trajectory critical of the project the occurs in activity A-B-C-D-E-F-G-H-M-V-W-AG-AH-AI-AJ-AK. Based on results simulation montecarlo with crystal ball software known that with under risk so that the solution project becomes pessimistic with time completion 1.074 days or 351 late from time already planned.

Keyword : Risk Management, Project Management, Forecasting, House of Risk, Monte Carlo

1. INTRODUCTION

According to Coleman Woodbury in (Setiadi, 2014) defines planning as a process to prepare in a fairly systematic way, recommendations related to policies and actions as well as attention to be given to the impact or "spillover effect". Planning is a series of activities that include preparation, selection of alternatives in which the implementation is carried out logically and systematically so that various consequences that may occur can be predicted and anticipated. Every planner must be able to anticipate the consequences that will result from a plan that will be made between different factors, proper scheduling is one of the important elements for the success of a management project (Habibi et al., 2018). The most difficult aspect is scheduling because it estimates the duration of the activity which is highly correlated with the estimated cost, available resources, construction methods to be used in project work, how much is involved and what level of production (Farr, J., & Dow, Benjamin L. , 2010). In an activity, especially projects, risk is an inseparable part. Evaluation and assesment to something risk need to use implementation mitigation. Risks that occur in a project can have a direct impact on the project completion time, so that mitigation can be carried out as a form of anticipation. Delay in completion will not only have an impact on costs, but many factors will be affected, both tangible and intangible, so that a risky development planning framework is needed.

2. LITERATURE REVIEW

2.1 Risk Management

The possibility of an event that has an impact on the company's objectives is often interpreted and understood as a risk. Meanwhile, the culture, processes and structures that are geared towards realizing goals and managing side effects are project management. Risk management aims to prepare for all possible risks that may occur during the project (AS/NZS 4360:2004).

2.1.1 Management Project

The application of knowledge, the use of equipment, skills and techniques from project activities to meet the requirements that exist in a

project is also called project management (PMBOK, 2017). Where in management includes :

a. Identify various requirements in project implementation.

b. Meeting the needs and resolving various concerns and expectations of stakeholder interests as planned and implemented into the project.

c. Balancing the various constraints that cover the project but are not limited to the project. These constraints are:

1) Scope (work scope)
2) quality (quality)
3) Schedule (Schedule)
4) Budget (budget)
5) Resources (Source Power), and
6) Risk (Risk)

2.1.2 House Of Risk (HOR)

House Of Risk is a framework of combining FMEA and HOQ methods (Pujawan & Geraldine, 2009). Two stages have been shown in the House Of Risk framework, namely HOR1 and HOR2. HOR1 is used to determine the risk rating of each agent based on the potential risk aggregate (ARP). After knowing the priority of risk through ARP, then to prioritize the actions that must be taken by the company/organization in dealing with the selected risk agent, it can be done in HOR 2.

2.1.3 Monte Carlo Simulation

The Monte Carlo method is class algorithm calculations that rely on taking sample by random for count the result . Advantages from Monte Carlo simulation that is more flexible than PERT (Farr, J., &Dow, Benjamin L., 2010). Existence Monte Carlo dependence on numbers / numbers random , method this often run with help device soft . (Hubbard, 2014).

2.2 Flowchart Of Research

In order to facilitate understanding to achieve the goals expected in the proposed framework, a design is made which is represented in the research flow diagram.

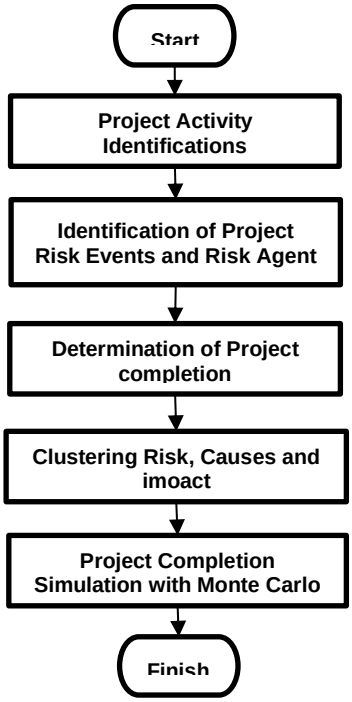

Figure 8. Project Risk Assessment Flow Chart.

2.3 Step Of Simulation

2.3.1 Project Activity Identification

Planning is the determination of the requirements for project resources in the order of use in various activities that must be carried out to achieve the goals achieved. However, a plan is incomplete if it is not accompanied by a time factor, but time must be flexible to financial, social and other factors in planning. The results of the dependency logic in table 4.1 are then processed into POM QOM V.4 software using the CPM method or single estimate time, resulting in the current project time duration, and knowing the project's critical trajectory in the form of a Gant Chart. An activity is said to be critical if its initial delay will cause a delay in the completion time of the entire project. The critical path (path) of a

project is the path in a network such that activities on this path have a slack of 0 (zero).

2.3.2. Identification of Project Risk Events and Causes

At the risk assessment stage, the House of Risk (HOR) method is needed to determine the factors that have the potential to cause project delays on the project's critical path with SCOR rules. The stages in compiling HOR 1:

a. Identify risk events that may occur on the critical path that has been identified from the project duration.

b. calculate the severity of each risk event. In this process, a scale is used to identify categories of risk impacts.

c. Identify risk agents and measure the occurrence value of each risk agent.

The emergence of opportunities / probability and consequences/impacts that arise can be used as a basis for risk assessment. An index scale is needed to provide a guideline for assessing the probability of each risk and its impact. The use of index scale guidelines refers *to the index as shown in table 1.*

Table 3. Index scale risk assessment.

Scale	Probability	impact	
		Cost	Time
Very High	>70%	>€250K	>4 months
High	51-70%	€101K-€250K	2-4 months
Medium	21-50%	€51K-€100K	1-2 months
Low	5-20%	€10K-€100K	1-4 weeks
Very Low	<5%	< € 10K	<1 weeks

2.3.3 Determination of Project completion

In compiling the determination of project completion, it is necessary to know the duration of each activity to be carried out. The goal is to determine the critical path of the project being worked on. Planning the duration of this project can be done by collecting data about the duration of each activity. Critical Path Method (CPM) is used in determining project completion.

2.3.4 Clustering Risk, Causes and Impact In Critical Path

At this stage, risk clustering is carried out on the critical path that can cause delays in a project. Risk clustering consists of risk events, risk causes and risk impact on the completion time of activities on the project.

2.3.5 Project Completion Simulation with Monte Carlo

One method by which uncertainty analysis can be carried out in different models is the Monte Carlo method. The Monte Carlo method is a class of calculation algorithms that rely on random sampling to calculate the results. This simulation begins by generating a random number obtained from the impact of risk on each activity on the critical path.

3. RESULTS AND DISCUSSION

3. 1 Project Activity Identifications

Based on the activity description data and the estimated duration of activity from the planning and control department as well as the network diagram, a logic of dependence between activities in the construction of ship X is drawn up which is shown in table 2.

Table 4. The Dependency logic Project X .

Activity	Predececors					Duration
A						2
B	A					110
C	B					92
D	C					80
E	D	C				62
F	E	K	P			2
G	F					150
H	G					8

I	A					130
J	I					88
K	J					82
L	K	J				80
M	L	G	H			48
N	A					100
O	N					88
P	O	C				70
Q	P	O	F			80
R	Q	H				30
S	A	I				120
T	S	P				88

3 .2 Identification of Project Risk Event (*Ei*) and Risk Agent (*Aj*)

At the stage of identifying risk events and causes of risk, the SCOR model is used, where the SCOR model is an approach model to identify risk from a supply chain management perspective. SCOR . Based on results Interview depth that has been validated with the experts/risk owners in project could identified risk events and potential risk agents Becomes reason lateness project . Risk events and risk agents shown in table 3 and 4.

Table 5. Identification Risk Event (Ei) Project X.

SCOR Model	Code	SCOR Model	Code	SCOR Model	Code	SCOR Model	Code	SCOR Model	Code
Plan	E1	***Source***	E11	***Make***	E18	***Deliver***	E24	***Return***	E29
	E2		E12		E19		E25		E30
	E3		E13		E20		E26		
	E4		E14		E21		E27		
	E5		E15		E22		E28		
	E6		E16		E23				
	E7		E17						
	E8								
	E9								
	E10								

Table 6. Identification of Project X 's Risk Agents (Ai).

Risk Agent (*Ai*)		
A1	A11	A21
A2	A12	A22
A3	A13	A23
A4	A14	A24
A5	A15	A25
A6	A16	A26
A7	A17	A27
A8	A18	A28
A9	A19	A29
A10	A20	

3.3 Determination of Project completion

From the results of the dependency logic in table 2 , it is then processed into POM QOM V.4 software with the CPM or single estimate time method, resulting in the current project time duration, as well as the project's critical trajectory in the form of Gant Charts and Precedence diagrams. An activity can be categorized as a critical activity if its initial delay causes a delay in the completion time of the entire project.

Project Management (PERT/CPM) Results

Activity	Activity time	Early Start	Early Finish	Late Start	Late Finish	Slack
Project	723					
A	2	0	2	0	2	0
B	110	2	112	2	112	0
C	92	112	204	112	204	0
D	80	204	284	204	284	0
E	62	284	346	284	346	0
F	2	346	348	346	348	0
G	150	348	498	348	498	0
H	8	498	506	498	506	0
I	130	2	132	46	176	44
J	88	132	220	176	264	44
K	82	220	302	264	346	44
L	80	302	382	396	476	94
M	48	506	554	506	554	0
N	100	2	102	88	188	86
O	88	102	190	188	276	86
P	70	204	274	276	346	72
Q	80	348	428	500	580	152
R	30	506	536	580	610	74
S	120	132	252	218	338	86
T	88	274	362	388	476	114
U	78	382	460	476	554	94
V	60	554	614	554	614	0
W	48	614	662	614	662	0
X	90	252	342	338	428	86
Y	68	342	410	428	496	86
Z	56	410	466	496	552	86
AA	50	466	516	552	602	86
AB	52	536	588	610	662	74
AC	56	342	398	434	490	92
AD	50	398	448	490	540	92
AE	62	448	510	540	602	92
AF	60	516	576	602	662	86
AG	40	662	702	662	702	0
AH	10	702	712	702	712	0
AI	6	712	718	712	718	0
AJ	4	718	722	718	722	0
AK	1	722	723	722	723	0

Figure 9. Current Duration project X Calculation Results with CPM.

Based on the results of the dependency logic in table 4.1, it is then processed into POM QOM V.4 software with the CPM or single estimate time method, resulting in the current project time duration, as well as the project's critical trajectory in the form of Gant Charts and Precedence diagrams. An activity is said to be critical if its initial delay will cause a delay in the completion time of the entire project. Data processing using POM QM V.4 software shows that the project's critical path is in the A-B-C-D-E-F-G-H-M-V-W-AG-AH-AI-AJ-AK activity, it can be seen from the absence of lag or the slack value = 0 (zero). Furthermore, from processing the duration of the initial conditions using POM QM V.4 obtained a Gantt Chart that describes information about the scope of the initial task that must be completed as a condition for completing the next task, as shown in Figure 3.

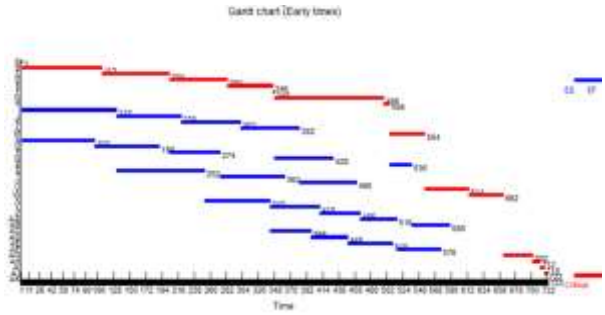

Figure 10. Gantchart project X.

3.4 Clustering Risk, Causes And Impact Critical Path.

The identified potential risks can be mapped on the project's critical path. Measurement of Severity Level states how much disturbance/impact caused by a risk event that can disrupt the project completion process. The value of the level of impact is seen from the size of the impact on the system/customer, the potential for property damage and the potential for danger to arise

Table 5 shows the impact on time caused by the risk agent. So it can be suggested mitigation or prevention so that the impact can be kept to a minimum. Impact on time will be used as forecasting data in the Monte Carlo simulation. The Impact data is a reference in generating random numbers.

Table 7. Risk and impact clusters.

Critical Path	Risk Agent	Scale	Impact (days)
A	A1, A3, A4	Very Low	< 7
B	A1, A3, A4	Medium	30-60
C	A8	Very Low	<7
D	A3,A8	Very Low	<7
E	A21, A23	Medium	30-60
F	A1,A4,A8	High	60-120
G	A1,A43,A21	Very Low	<7
H	A21,A23,A25	Very Low	<7
M	A25,A26,A27	High	60-120
V	A8,A26,A27	High	60-120
W	A1,A4,A8	Medium	30-60
AG	A8,A21,A23	Very Low	<7
AH	A1,A3,A8	Medium	30-60
AI	A3,A8,A27	Very Low	<7
AJ	A1,A4,A8	Very Low	< 1 week
AK	A3,A4,A8	Very Low	< 1 week

3.5 Simulation Project Completion with Monte Carlo

Existence impact on the project make solution project is at in uncertainty because presence risk. Make estimation to influential impact to very important project, for knowing estimation in solution time as well as the steps and strategies that will taken for prevent risk happen . In Monte Carlo simulation, each input is varied in the range that has been determined hundreds of times for produce shared output range with frequency its appearance. Frequency this then translated to in probability occurrence of each output. With use Monte Carlo simulation, can produce distribution mathematical in the form of curve bell indicating range possible results. Data used use PERT Beta distribution and processed using Crystal Ball software with simulation 10,000 times. Based on Figure 4.

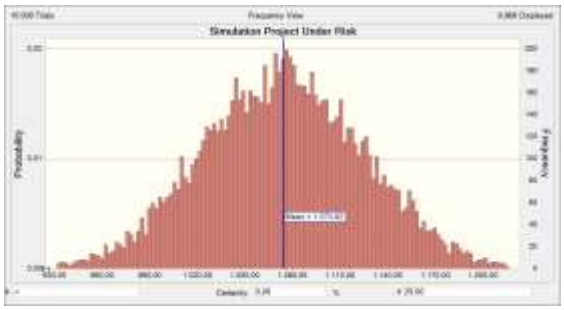

Figure 4. Simulation Project X Under Risk

In this figure is known that with existence potency risk on project X, known average time solution project is around 1,073.9 days or 1,074 days. The average time for making estimates is pessimistic from the return plans that can be made for 723 days or 351 days late from the plan returns.

4. CONCLUSION

Based on results simulation on project X is known that :

a. There are 30 potential events occurs caused by 29 agents risk inside solution project .

b. trajectory critical of the project the occurs in activity A-B-C-D-E-F-G-H-M-V-W-AG-AH-AI-AJ-AK.

c. Based on results simulation montecarlo with crystal ball software known that with under risk so that solution project Becomes pessimistic with time completion 1,074 days or 351 late from time already planned.

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. IMPLEMENTATION OF THE CPM METHOD IN THE CONSTRUCTION PROJECT OF THE SURABAYA "X" HOSPITAL HEALTH CHECKUP

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ABSTRACT

The process of planning to project control during the execution of construction work is an important activity of a project. A project can be said to be a success or a failure caused by ineffective planning and control, so project activities fail. so there will be a delays, decreased quality, and increased implementation costs. A project is limited by a predetermined time and cost so management in the project must be able to anticipate changing conditions that occur. The Critical Path Method abbreviated CPM method can be applied to manage project completion time more efficiently and effectively. To be able to reduce the impact of project delays and cost overruns through a crash calculation mechanism with three alternative controls; additional labor or overtime work. Duration acceleration is carried out on jobs that are on the critical path and with the cheapest costs. In this study, the total project age was 277 calendar days, while the project deadline was 284 calendar days, thus the project was delayed for 7 calendar days with a total fine of Rp 25.242.944.400 and penalty cost is 1/1.000 for sum of contract. In this study the CPM method is intended to shorten the life of the project so that it can be completed in accordance with the predetermined time limit and determine the age of project in accordance with the existing contract, using CPM the project life can be shortened to 257 working days with an budget efficiency Rp. 176,700,611

Keywords: Scheduling, CPM, Critical Path, Crashing, Time Acceleration

1. INTRODUCTION

A project activity can be said to be successful if all the scope of work is met with good quality, conformity between the realization of the schedule, the costs incurred, and the agreed time limit according to the contract. Therefore, it is necessary to control time efficiently and effectively. Sufficient knowledge and skills in using tools commonly used in project management such as Microsoft project, excel, primavera, etc. A project manager especially beginners. This capability will be more complete if a project manager is assisted with project management support applications. This capability makes it easier for project managers to manage and document, be it small or large-scale projects, it can also cut monitoring time because it is enough to see from the system.

So far, companies in determining time are only based on experience so several problems often arise in project planning and control, namely the lack of project managers in mapping the critical path of activity. The critical path is critical to project implementation. At PT. XYZ projects often occur due to delays in the completion of critical activities and the impact on project costs is getting bigger. Sometimes found more than one critical path in project work activities.

XYZ Corporate is a company working in the construction of the Indonesian National Construction Implementing Association (GAPENSI) so PT XYZ has standardization and classification to provide national construction services. In addition, PT XYZ's qualifications and classifications have been registered nationally based on the National Business Entity Certification Agency (LSBU) (Ministry of Public Works and Public Housing, 2022). Problems that often arise in there is a difference between the target time and the implementation of building construction by XYZ corporate and the realization of completion so that the impact on the costs incurred is increasing, affecting the company's profits, even the company can suffer losses due to penalties that must be met

if the building construction project does not comply with the agreed time.

Inadequate production equipment, procurement of required materials, procurement and quality of human resources, as well as costs are some of the factors that can affect project completion time, delays will impact not only costs but also consumer views on the credibility of the company itself which will have an impact on the survival of the company. In project planning and control, one of the methods used is the CPM method. This method is quite widely used in planning and controlling building construction projects. This method has the advantage of analyzing projects in terms of estimating the project finishing time by finding the critical path, identify the start and end times of each activity to determine the project schedule, and calculating the amount of slack time for each activity so as to minimize project delays.

The shortcoming that exists in previous studies, including those stated in the references review, is that the calculation of the CPM method is not detiled and has not been applied to health care a building construction project especially medical chekup building. In the CPM (Critical Path Method) method there are stages of determining the critical path, where the critical path is the activity in the project that has the longest total execution time and shows the fastest project completion time span compared to other activity paths..

Applying the CPM method to applications, especially in health care building projects, can help and facilitate project managers in mapping problems in project work so that the time and costs needed in project work can be estimated properly and critical paths in project work can be mapped properly. Project managers also easy to find out critical activities in project work so these activities need to be controlled so that related activities do there is no delay in project completion and the project can be completed on time.

2. LITERATURE REVIEW

2.1. Project Schedule

Schedule is elaboration of planning project into a sequence of steps for implementing work to achieve goals. The time factor has been included in the schedule. A well-known method of compiling a schedule is network analysis, which depicts in a graph the relationship sequences of project work. Network Planning Notations and Symbols include:

a. ⟶ : Arrows/arrows indicate an activity/activity, namely an activity or work whose completion requires a duration (a certain period of time) and a resort (labor, tools, materials, and costs). The arrows guide the direction of each activity, where length and slope have no effect.

b.  Node / Event, which is a round circle which means if an event or event is a meeting of the beginning and end of the activity.

c. ⟶ Dummy / discontinuous arrows that represent pseudo activities, namely activities that do not require duration and resources.

d. ⟷ Double Arrow / Arrow model that shows the critical path activities (critical path).

The factors that influence Network Planning according to (Siswojo, 2000) include (1) the plan that will be used by the company in implementing the project, determining the activities that must be carried out, and the logic of dependence on each other; (2) The length of time used in the project is usually measured in standard time units: days, hours, minutes, that time.

Jobs that must precede or be preceded by other jobs are identified in terms of time. This network is very useful for project planning and control. Scheduling is an activity to determine the time required and arrange the sequence of activities while determining when the project can be completed. Project scheduling is something more specific and becomes part of project planning. Project scheduling includes

timing and stages of implementing activities as originally planned.

2.2. Network Planning

Network planning is literally an interrelated dependency relationship between the parts of the work as outlined in the network diagram so that it is known which parts of the work must take precedence and which jobs must wait for the completion of other work (Soeharto, 1997). Overall (Gray and Erik, 2007). The following are some of the terms used to build a project network:

a. Activities are activities within the project that take time to be implemented according to the project plan.

b. A combined activity is an activity or activities that have more than one activity that precedes it (more than one dependency arrow).

c. A path is a sequence of related activities.

d. Predecessor is a predecessor activity.

e. A successor is a substitute activity or activity that follows another activity.

f. The Critical Path is the longest path on the network of a project, if the activity on that path is delayed, the project will experience delays due to the delay at the same time.

2.3. Critical Path Method (CPM)

CPM known as the critical path, was created by (Kelley, Walker, & Sayer, 1989) of the company Remington Rand and M.R Walker of Du Pont in order to develop a management control systemThis system is intended to plan and control a large number of activities that have complex dependencies on a project activity in terms of design and construction. Through the critical path method, implementers can find out which jobs are vulnerable and influential in the overall work process.

If there is a delay and by knowing the location of the delay, in its implementation, anticipatory actions can be taken for the time inefficiency that occurred previously, so that delays in one part do not propagate to other jobs. In the analyzes of identifying the critical path there are several terms or definitions, namely as follows:

a. Earliest Start Time (ES) is the earliest time (fastest) a project activity can start, taking into account the time to be achieved from the activity and the requirements that must be met according to the sequence of work.

b. Latest Start Time (LS) is the longest time to be able to start a project activity without experiencing a delay in the entire project.

c. Early Finish Time (EF) is the earliest time an activity in the project can be completed, or equal to ES + Desired activity time.

d. Latest Finish Time (LF) is the slowest time to be able to complete an activity in a development project without delaying the completion of the entire project, or equal for LS + expected time activity.

2.4. ES, EF, LS, dan LF

According to Heizer and Render (2014: 105-109) in conducting critical path analysis, the use of a two-pass process consisting of a forward pass and a backward pass to determine the time schedule of activities in the project. ES and EF are determined during the feed-forward activity. LS and LF are determined during the back pass activity. ES (earliest start) is the earliest time a project activity can start assuming all its predecessors have been completed. EF (earliest finish) is the earliest time a project activity can be completed. LS (late start) is the last time an activity can be started so as not to delay the completion of the entire project. LF (late finish) is the last time an activity can be completed so as not to delay the completion time of the entire development project.

a. Forward Pass is an Early Start Time rule. Before an activity project could start, all of its predecessors must be completed after any activities. The earliest finish time (EF) of an activity is the

calculate of the earliest start time (ES) and the time of the activity itself, that is EF = ES + Activity time.

1) If an activity have only one direct predecessor, ES is the same as the EF of the predecessor activity.

2) If an activity have more than one of direct predecessors, it's ES is the maximum value of all predecessor EFs, i.e.: ES = Maximum {EF all direct predecessors }.

b. Backward Pass is the Slowest Finish Time Rule activity project. Again, This rule is based on the fact that before a project activity can be started, all its predecessors must be completed within the given activity time. The rule for the slowest start time or also known as the slowest start time (LS) of a project activity is the difference between the latest completion time (LF) and the existing project activity time, namely: LS = LF - Activity time.

After calculating the earliest time and the slowest time of all activities, it becomes easy to find the amount of float time each activity project has. Slack is the free time that activity has so that its implementation can be postponed without causing delays in the overall project.

1) If an activity is a direct predecessor of only one activity, its LF equals the LS of the activity project that has immediately follows it.

2) If an activity project has a directing predecessor of more than one activity, then LF is the min of all LS values of the activity. activities that directly follow it, namely: LF = Min {LS of all activity that immediately follow it}.

3) Slack or Float is a critical activity with an activity value of zero which is on the critical path, namely Float = LS – ES or Float = LF – EF.

2.5. Research Methodology

The methodology used in this research is to do the work in a directed and systematic way so that there are clear sequences in the implementation of this research, by using a clear method, the research plan is carried out until the completion of the final stage of the research. The stages of work are made with a diagram according to Figure 1.

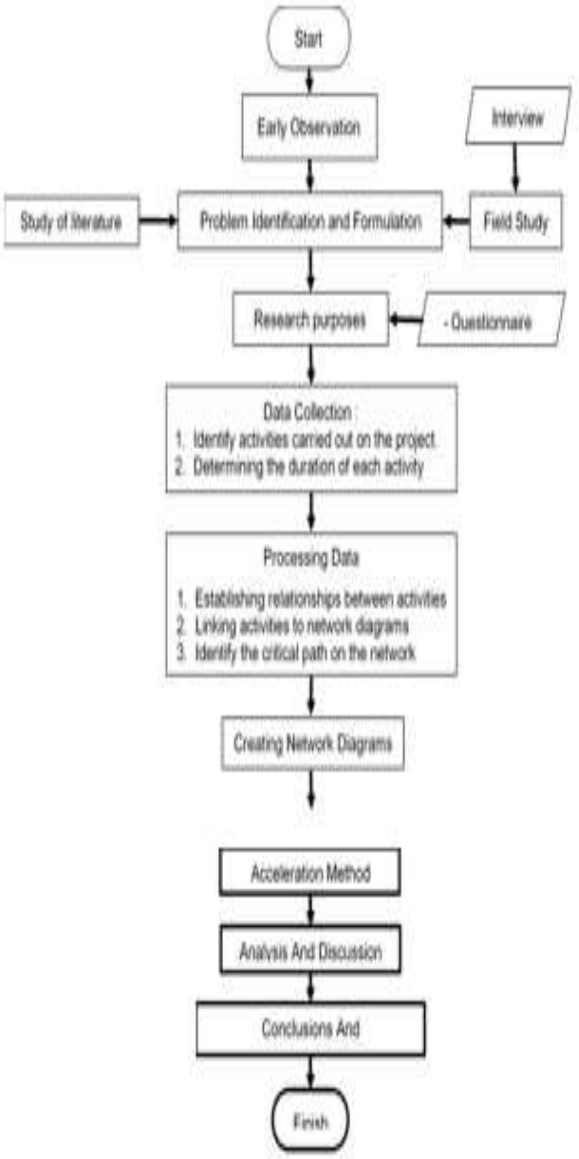

Figure 1. Research Flow Chart

The stages in this research begin with initial observation of the problem, identification and problem formulation through literature review and direct field observation through interviews, determining research objectives, collecting data through project identification and determining project duration, data processing through preparing

activities, and linking activities and determining critical path, compiling a Gantt Chart, calculating the time and cost of acceleration, Analysis of Results, and ending with the Final Stage, while the explanation of these stages includes the preparation stage, modeling stage, data processing stage, data processing stage, results from the analysis stage and the end.

3. Result and Discussion

This research initially describes the activities, namely the assessment and identification of the project scope by describing and breaking it down into activities or groups of activities that are project components. This preparation is based on experience and/or data in past projects. Each activity has an estimated time in the process or duration which is arranged in the master schedule.

Determine the relationship between activities, that is, activities are rearranged into a chain, where the sequence of activities is in accordance with the logic of dependency in network planning so that the sequence of activities can be known from the beginning of the development process of a project until the completion of the project as a whole.

a. Input Activities Project

Activity determination begins by defining project activities and entering the duration of each activity followed by defining its predecessor. That each activity on the project has a predecessor activity as the basis for implementing and calculating the completion time of activities in Table 1 and create network planning Figure 1 according to project data.

Table 1. Description of Activities, Duration, and Predecessors Activities

NO	Activity	Description of activities	Duration (Day)	Predecessor
1.	A	Mobilization	4	-
2.	B	Worker Barracks Loading	7	A
3.	C	Land Clearing	7	A
4.	D	Backfill and Compaction	14	C
5.	E	Stake Fabrication and Mobilization	11	A
6.	F	Erection	20	E
7.	G	Stake Head Cutting	7	F
8.	H	Reinforcing	17	G
9.	I	Formwork	19	H
10.	J	Casting	14	I
11.	K	Roof Frame Work	7	J
12.	L	Roof Closure	3	K
13.	M	Water Installation Sparring	7	F
14.	N	Genset Room	30	D
15.	O	Septic Tank Fabrication	14	A
16.	P	Making infiltration and septic tanks	2	O
17.	Q	Mobilization	3	P, N, B, L, M
18.	R	Making Keet Directors, Work Barracks, Work Losses During the Implementation Period	3	Q
19.	S	Practical Column Work	21	R
20.	T	Lightweight Brick Wall Pair	14	R
21.	U	Plaster and Acian	30	AP, S
22.	V	Install GRC Partition wall	30	Z
23.	W	Travertine and Conwood wall mount	20	U
24.	X	Ceiling Work	20	U
25.	Y	Door and Window Works	15	Z
26.	Z	Floor job	45	X
27.	AA	Painting Job	20	U
28.	AB	Glass Canopy Roof Work	7	X

NO	Activity	Description of activities	Duration (Day)	Predecessor
29.	AC	Storage Works	1	T
30.	AD	Submission of New Electrical Installation	45	R
31.	AE	Incoming and Outgoing Cubicle Jobs	14	AM
32.	AF	Transformer Work	4	AM
33.	AG	Bed Lift Jobs	120	R
34.	AH	Electrical Installation Installation	30	T
35.	AI	Internal telephone jobs	7	T
36.	AJ	Sound System Jobs	7	T
37.	AK	CCTV Jobs	7	T
38.	AL	AC jobs	14	AH
39.	AM	Feeder Cable Work	7	T
40.	AN	Electrical Panel Work	5	AH
41.	AO	Lightning Protection Job	2	AF, AE
42.	AP	Plumbing Job	21	R
43.	AQ	Sanitary Work	7	AP
44.	AR	Hydrant Job	14	U

Source: Processed Author's Data

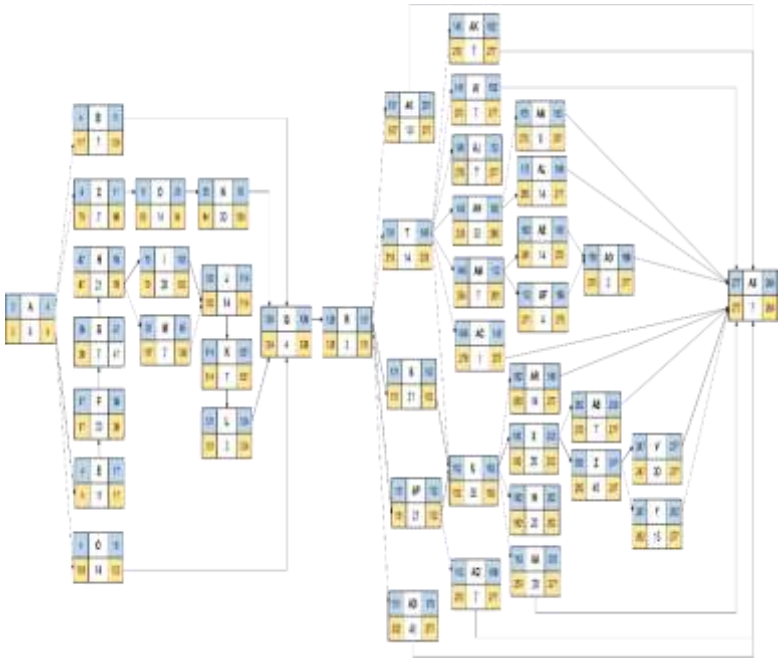

Figure 2. Network Planning

Table 2. CPM Calculation

No	Activity	Predessor	Durasi	Early Start	Early Finish	Late Start	Late Finish	Slack
1	A	-	4	0	4	0	4	0
2	B	A	7	4	11	117	124	113
3	C	A	7	4	11	73	80	69
4	D	C	14	11	25	80	94	69
5	E	A	13	4	17	4	17	0
6	F	E	21	17	38	17	38	0

No	Activity	Predessor	Durasi	Early Start	Early Finish	Late Start	Late Finish	Slack
7	G	F	9	38	47	38	47	0
8	H	G	23	47	70	47	70	0
9	I	H	30	70	100	70	100	0
10	J	I	14	100	114	100	114	0
11	K	J	7	114	121	114	121	0
12	L	K	3	121	124	121	124	0
13	M	F	7	38	45	117	124	79
14	N	D	30	25	55	94	124	69
15	O	A	14	4	18	108	122	104
16	P	O	2	18	20	122	124	104
17	Q	P, N, B, L, M	4	124	128	124	128	0
18	R	Q	3	128	131	128	131	0
19	S	R	21	131	152	131	152	0
20	T	R	14	131	145	219	233	88
21	U	AP, S	30	152	182	152	182	0
22	V	Z	30	247	277	247	277	0
23	W	U	20	182	202	257	277	75
24	X	U	20	182	202	182	202	0
25	Y	Z	15	247	262	262	277	15
26	Z	X	45	202	247	202	247	0
27	AA	U	20	182	202	257	277	75
28	AB	X	7	202	209	270	277	68
29	AC	T	1	145	146	276	277	131
30	AD	R	45	131	176	232	277	101
31	AE	AM	14	152	166	261	275	109
32	AF	AM	4	152	156	271	275	119
33	AG	R	120	131	251	157	277	26
34	AH	T	30	145	175	233	263	88
35	AI	T	7	145	152	270	277	125
36	AJ	T	7	145	152	270	277	125
37	AK	T	7	145	152	270	277	125
38	AL	AH	14	175	189	263	277	88
39	AM	T	7	145	152	254	261	109
40	AN	AH	5	175	180	272	277	97
41	AO	AF, AE	2	166	168	275	277	109
42	AP	R	21	131	152	131	152	0
43	AQ	AP	7	152	159	270	277	118

No	Activity	Predessor	Durasi	Early Start	Early Finish	Late Start	Late Finish	Slack
44	AR	U	14	182	196	263	277	81
45	AS	AN, AG, Y, AA, W, AD, AB AR,	7	277	284	277	284	0

Description : Critical Path

Source: Processed Author's Data

Based on the results of the CPM calculation in Table 2, then it is described in the form of a network diagram that has been adjusted to the results obtained. The following can be seen in Figure 3 network diagram using the CPM method. A series of activities that fall into the critical of path using the CPM method is a critical of path that is on the path A, E, F, G, H, I, J, K, L, Q, R, S, U, V, X, Z, AP, and AS.

Based on Figure 3, the project of completion time by using the CPM method is 101 days. With the analysis that Paths A, E, F, G, H, I, J, K, L, Q, R, S, U, V, X, Z, AP, and AS are paths that do not have work time between the completion of one activity stage with other activities with the start stage of the next activity.

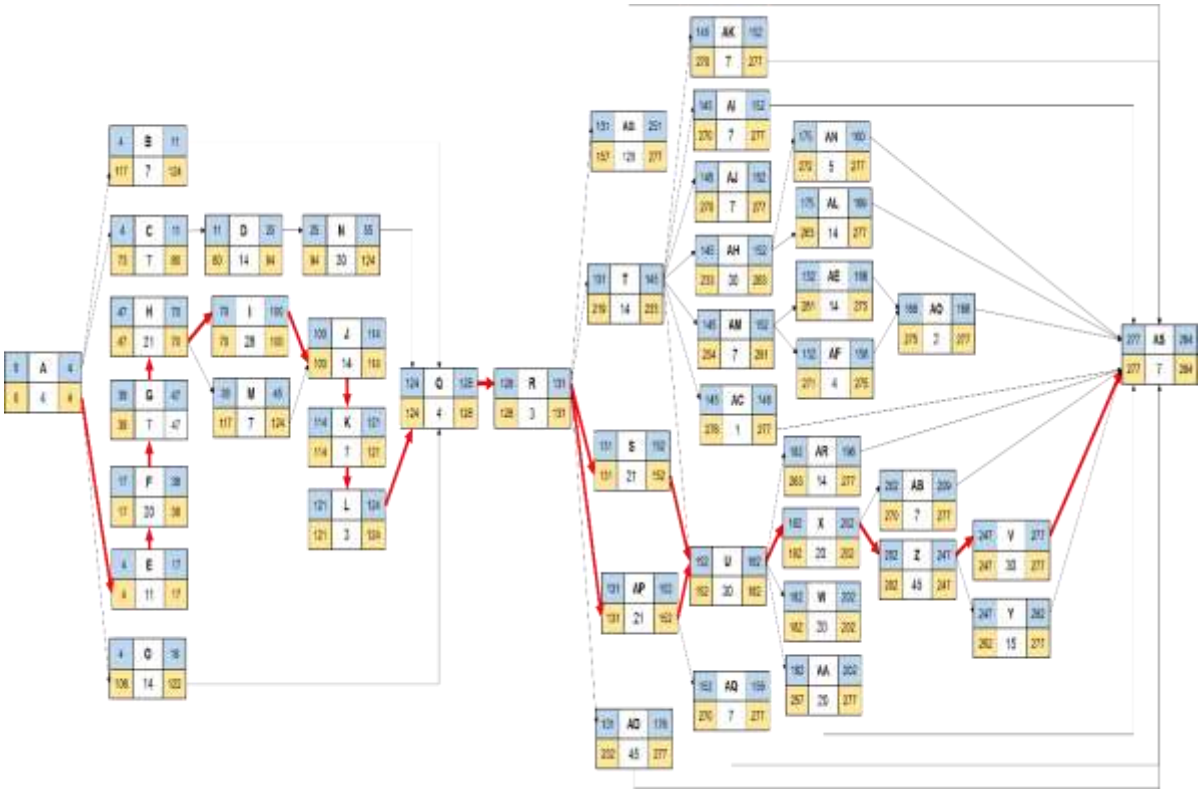

Figure 3. Critical Path

b. Acceleration Time

Calculating crash duration look in Table 3 :

$$\text{Crash Duration} = \frac{\text{Working hours}}{\text{Working hours} + (a \times b)} \times \text{Initial Duration}$$

Working hours + (a x b)

Where :

a = Number of overtime hours

b = Coefficient of decrease in work productivity

= 0.9 for 1 hour overtime

= 0.8 for 2 hours of overtime

= 0.7 for 3 hours of overtime

Initial Duration of Activity A = 4 days

$$\text{Crash Duration} = \frac{8 \text{ Hours}}{8 \text{ hours} + (1 \times 0.9)} \times 4 \text{ days} = 3.59 \text{ rounded to } 4 \text{ days}$$

Table 3. Acceleration Time

No	Activity	Predessor	Durasi	Accelerate	No	Activity	Predessor	Durasi	Accelerate
1	A	-	4	0	24	X	U	20	182
2	B	A	7	4	25	Y	Z	15	247
3	C	A	7	4	26	Z	X	45	202
4	D	C	14	11	27	AA	U	20	182
5	E	A	13	4	28	AB	X	7	202
6	F	E	21	17	29	AC	T	1	145
7	G	F	9	38	30	AD	R	45	131
8	H	G	23	47	31	AE	AM	14	152
9	I	H	30	70	32	AF	AM	4	152
10	J	I	14	100	33	AG	R	120	131
11	K	J	7	114	34	AH	T	30	145
12	L	K	3	121	35	AI	T	7	145
13	M	F	7	38	36	AJ	T	7	145
14	N	D	30	25	37	AK	T	7	145
15	O	A	14	4	38	AL	AH	14	175
16	P	O	2	18	39	AM	T	7	145
17	Q	P, N, B, L, M	4	124	40	AN	AH	5	175
18	R	Q	3	128	41	AO	AF, AE	2	166
19	S	R	21	131	42	AP	R	21	131
20	T	R	14	131	43	AQ	AP	7	152
21	U	AP, S	30	152	44	AR	U	14	182
22	V	Z	30	247	45	AS	AN, AG, Y, AA, W, AD, AB AR,	7	277
23	W	U	20	182					

c. Cost

The calculation of project costs in terms of workers' wages is divided into 2, namely the wages of workers in normal conditions and accelerated conditions, in normal conditions workers are paid according to normal wages while in accelerated conditions they are paid 1.5 times the normal wage so that the details of wages can be seen from the table 4.

Table 4. Comparison of Normal Cost and Accelerate Cost

Aktivity	Duration	Foreman	Craftsman	Labourer	Accelerate Cost		Normal Cost	
A	4	1	1	4	Rp	3.322.992	Rp	2.798.000
B	7	1	2	4	Rp	6.833.512	Rp	5.754.000
C	7	1	6	6	Rp	12.693.800	Rp	10.689.000

Aktivity	Duration	Foreman	Craftsman	Labourer	Accelerate Cost	Normal Cost
D	14	1	1	1	Rp 6.268.920	Rp 5.278.000
E	11	1	3	4	Rp 12.338.524	Rp 10.389.500
F	20	1	2	4	Rp 19.524.320	Rp 16.440.000
G	7	1	4	4	Rp 8.870.064	Rp 7.469.000
H	17	1	2	4	Rp 16.595.672	Rp 13.974.000
I	19	1	6	6	Rp 34.454.600	Rp 29.013.000
J	14	1	1	4	Rp 11.630.472	Rp 9.793.000
K	7	1	4	3	Rp 7.976.472	Rp 6.716.500
L	3	1	2	2	Rp 2.162.712	Rp 1.821.000
M	7	1	2	1	Rp 4.152.736	Rp 3.496.500
N	30	1	4	6	Rp 45.673.920	Rp 38.460.000
O	14	1	2	4	Rp 13.667.024	Rp 11.508.000
P	2	1	2	4	Rp 1.952.432	Rp 1.644.000
Q	3	1	1	4	Rp 2.492.244	Rp 2.098.500
R	3	1	2	2	Rp 2.162.712	Rp 1.821.000
S	21	1	2	1	Rp 12.458.208	Rp 10.489.500
T	14	1	2	1	Rp 8.305.472	Rp 6.993.000
U	30	1	2	1	Rp 17.797.440	Rp 14.985.000
V	30	1	9	6	Rp 67.494.120	Rp 56.835.000
W	20	1	9	6	Rp 44.996.080	Rp 37.890.000
X	20	1	2	2	Rp 14.418.080	Rp 12.140.000
Y	15	1	6	6	Rp 27.201.000	Rp 22.905.000
Z	45	1	6	6	Rp 81.603.000	Rp 68.715.000
AA	20	1	4	24	Rp 76.405.440	Rp 64.340.000
AB	7	1	6	3	Rp 10.013.024	Rp 8.431.500
AC	1	1	1	2	Rp 575.436	Rp 484.500
AD	45		1		Rp 6.546.060	Rp 5.512.500
AE	14	1	4		Rp 10.591.392	Rp 8.918.000
AF	4	1	4		Rp 3.026.112	Rp 2.548.000
AG	120	1	6		Rp 125.695.680	Rp 105.840.000
AH	30	1	3	3	Rp 29.820.840	Rp 25.110.000
AI	7	1	4	2	Rp 7.082.880	Rp 5.964.000
AJ	7	1	4	2	Rp 7.082.880	Rp 5.964.000
AK	7	1	3		Rp 4.277.420	Rp 3.601.500
AL	14	1	6		Rp 14.664.496	Rp 12.348.000
AM	7	1	2	2	Rp 5.046.328	Rp 4.249.000
AN	5	1	2		Rp 2.327.960	Rp 1.960.000
AO	2	1	2		Rp 931.184	Rp 784.000
AP	21	1	3	3	Rp 20.874.588	Rp 17.577.000
AQ	7	1	1	1	Rp 3.134.460	Rp 2.639.000
AR	14	1	6	2	Rp 18.238.864	Rp 15.358.000
AS	4	1	1	4	Rp 3.322.992	Rp 2.798.000
		Total			**Rp 807.738.337**	**Rp.733.914.500**

d. Equipment Cost

Namely the cost of equipment to carry out construction work. In calculating this cost, It is also necessary to pay attention to several things in calculating project costs such as direct and indirect costs of the warehouse, operating labor costs, and operating costs if the equipment is leased as well as investment, depreciation, repair, maintenance, and mobilization costs if the equipment is not leased.

The calculation of equipment costs is adjusted to the activities carried out by acceleration, namely project activities E (1 Day), F (2 Days), G (1 Day), H (2 Days), I (3 Days), J (1 Day), K (1 Day), S, (2 Days), U (3 Days), V (3 days), X (2 Days), Z (5 Days), AP (2 Days) and AS (1 Day) namely the cost of equipment to carry out construction work. In calculating this cost, In addition, it is necessary to pay attention to several factors and regarding the costs of entering and leaving the warehouse, operational labor costs, and operational costs if the equipment is leased as well as investment, depreciation, repair, and maintenance, and mobilization costs if the equipment is not leased, including table :

Table 5. Additional Activity Cost without Accelerate Time

Activity	Accelerate (Day)	Equipment	Cost (Per Day)	Total Cost
E	1	Rent Truck Trailer	Rp. 42.000.000	Rp. 42.000.000
F	2	Rent Mobile Crane	Rp. 390.000	Rp. 780.000
G	1	Rent Mobile Crane	Rp. 145.000	Rp. 145.000
H	2	Rent Scafolding	Rp. 1.440.000	Rp. 2.880.000
I	3	Rent Scafolding	Rp. 1.440.000	Rp. 4.320.000
J	1	Rent Scafolding	Rp. 1.440.000	Rp. 1.440.000
K	1	Rent Mobile Crane	Rp. 390.000	Rp. 390.000
S	2	Rent Mobile Crane	Rp. 390.000	Rp. 780.000
U	3	Rent Scafolding	Rp. 1.440.000	Rp. 4.320.000
V	3	Rent Scafolding	Rp. 1.440.000	Rp. 4.320.000
X	2	Rent Scafolding	Rp. 1.440.000	Rp. 2.880.000
AP	2	Rent Scafolding	Rp. 1.440.000	Rp. 2.880.000
AS	1	Rent Truck Trailer	Rp. 42.000.000	Rp. 42.000.000
Electricity	27	PLN	Rp. 120.000	Rp. 3.240.000
Water	27	PDAM	Rp. 90.000	Rp. 2.430.000
		Total		**Rp.114.805.000**

Comparison of the total cost of normal time with acceleration time:

a. Normal Time in 284 days :
   1) Workers' Wages : Rp. 733.914.500
   2) Equipment Cost : Rp. 114.805.000
   3) Penalty Cost 7 days : Rp. 176.700.611
   4) Total : Rp.1.025.420.111

b. Accelerate Time in 257 days :
   1) Workers' Wages : Rp. 848.719.000
   2) Equipment Cost : Rp. 0
   3) Penalty Cost : Rp. 0
   4) Total : Rp. 848.719.500

4. Conclusion

Based on the data analysis and discussion that has been carried out in this study, the conclusion that can be drawn in this study is the number of days that can be completed in this project using the CPM scheduling method is 257 days. However, without using this method, the project completion time would take 284 days. In addition, the company can save

costs of Rp. 176,700,611 while avoiding penalty fees due to project delays.

So that by applying the calculation to the CPM method, the company can perform project efficiency for 7 days while simultaneously being able to streamline the budget by using network planning. By using Network Planning using the CPM (Critical Path Method) method as a tool, companies can find out which activities need to be prioritized so as not to experience project completion delays. Initial planning in scheduling techniques must be more mature in order to facilitate the implementation of the project schedule.

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WORK SAFETY RISK MANAGEMENT TOWARDS ZERO ACCIDENT IN FASHARKAN SURABAYA

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ABSTRACT

Occupational health is an element of health related to the work environment and work, which can directly or indirectly affect work efficiency and productivity. Meanwhile, work safety is the main means to prevent work accidents that can cause harm in the form of injury or injury, disability or death, property loss, damage to equipment or machinery and environmental damage widely. In essence, Occupational Safety and Health (K3) is an effort to create protection and security from various risks of accidents and hazards, both physical, mental and emotional to workers, companies, communities and the environment. In addition, occupational safety and health is expected to create work comfort and high work safety as stated in PerKasal Number 26 of 2018 concerning Occupational Safety and Health in the Indonesian navy. This study aims to find out what types of accidents have a high risk in Fasharkan Surabaya, find out what impacts can be caused by high risk accidents and obtain steps that can be taken to reduce work accidents at Fasharkan Surabaya by using the Formal Safety Assessment (FSA) Method. There are four types of accidents that occur in Fasharkan Surabaya with the highest starting risk ranking, namely human accidents with work equipment, human accidents with property, human accidents with work systems and human accidents with the environment. The impact of the four accidents caused substantial material losses. To reduce the risk of the three types of accidents, the lowest Implied Cost of Averting a Risk (ICAR) measurement is carried out for each risk reduction option. The risk mitigation carried out is providing training for General K3 Experts, Electricity & Generators who have an ICAR of 92 million rupiahs, training of Fire K3 Officers who have an ICAR of 15.75 million rupiahs, Implementation of Work SOPs and Tightening of Supervision which has an ICAR of 12.5 million rupiah, and Procurement of Work Safety Equipment in the work area of workshops and ships as well as Personal Protective Equipment for each worker who has an ICAR of 53.5 million rupiah.

Keywords: Formal Safety Assessment (FSA), Risk Assessment, Work Accident.

1. INTRODUCTION.

The number of work accidents in Fasharkan Surabaya is very worrying. In the preliminary survey, in the last 10 years from 2010 to 2021, 20 incidents have been identified. This figure is still minimal when compared to actual events which are almost entirely not properly recorded through the workshop activity journal at Fasharkan Surabaya. Starting from scratching work accidents, falling materials, electrocuted, slipping, inhaling toxic gases, to the dangers of radiation of radioactive substances. So, based on these data, all are required to be more serious in implementing the OHS (Occupational Health and Safety) culture. Accidents not only cause death, material loss, and damage to the environment but also affect the productivity and welfare of the crew members of Fasharkan Surabaya. With a good K3 culture, the number of work accidents can be reduced, which in turn will increase work productivity. Work accidents also affect the human development index and the employment development index. (Menakertrans, Ida Fauziayah 2020).

Fasharkan Surabaya as one of The Work Unit in The Fifth Naval Main Base in particular and in the Navy in general which is loaded with high-risk construction work so there is a high potential for work accidents. Until now there is no SOP that specifically discusses Occupational Safety and Health as a derivative of Perkasal number 34 of 2020 concerning Guidelines for the Implementation of Occupational Health and Safety Management Systems (SMK3). Apart from the Jukker as an elaboration of the DSP,

there are only ways to deal with fire hazards in the event of a fire disaster. The research that has been carried out at Fasharkan Surabaya, especially regarding Risk Management, is to discuss global risks regarding the operations of Fasharkan Surabaya, both onshore and onboard operations. In this study, it will be discussed about risk management on work safety which is devoted to discussing the incidence of work accidents at Fasharkan Surabaya. What are the causes and how are risk mitigation efforts to overcome them. It is hoped that the final goal of this research is to be able to formulate a draft SOP regarding work safety standardization and minimize the occurrence of work accidents so that the goal of zero accident according to the Kasal Telegram Number 147/Basegram/0308 twu.0311.1538 can also be realized.

2. LITERATURE REVIEW

Risk management in this paper is using the FSA (Formal Safety Assessment) method. The steps carried out in implementing risk management are to identify the risks that may be experienced by the work unit, in this case Fasharkan Surabaya, after identifying them, an evaluation is carried out on each -each risk is reviewed from the risk value (severity) and frequency (IMO, 2002). The last stage is risk control. In the risk control stage, it is divided into 2, namely physical control (risk is eliminated, risk is minimized) and financial control (risk is retained, risk is transferred). Risk management consists of three components, namely:

a. Risk Identification & Analysis
b. Risk evaluation
c. Risk reduction & risk control (Risk Treatment)

2.1. Step 1 Hazard Identification:

Problem Definition. The purpose of the problem definition is to describe the problem correctly based on the analysis related to the regulation being reviewed or being developed. Problem definition must be in accordance with operational experience and applicable requirements by considering all relevant aspects.

Risk distinguishing proof, within the shape of a list of all important mishap scenarios with potential causes and results, as a reply to the address of what blunders might happen (IMO, 2002). The point is to distinguish a risk list and a set of scenarios whose need is decided by the level of hazard of the issue beneath the talk. This objective can be accomplished by utilizing standard strategies to distinguish dangers that contribute to mishaps, by screening these risks through a combination of existing information and conclusions, and by checking on the common show that was created amid the issue definition. The approach utilized for danger-distinguishing proof, for the most part, a combination of inventive and explanatory strategies, points to determining all significant risks. A harsh examination of the causes and impacts of each mischance category utilizing specific procedures, such as blame tree investigation, occasion tree examination, disappointment mode and impact investigation (FMEA), risk and operability thinks about (HAZOP), what on the off chance that investigation strategy, and chance commitment tree (RCT), which was chosen concurring to the issue being talked about.

2.2. Step 2 Risk Assessment:

This objective can be accomplished by utilizing methods that are fitting to the hazard show made and consideration is centred on the dangers that are surveyed as tall. The esteem in address is the level of hazard, which can be isolated into:

a. Risks that cannot be justified or accepted, except in exceptional circumstances (intolerable).
b. The dangers that have been made are so little that there's no requirement for advanced (insignificant) safeguards.
c. A hazard whose level is between an unfortunate and an irrelevant level (as low as reasonably practicable = ALARP).

2.3. Step 3 Selection of Risk Controls:

The point of step 3 is to propose successful and down-to-earth RCOs, by taking after four rule steps:

a. Centering on the dangers that require control, to channel the yield of the 2nd step, so that the centre is as it were on the zones that most require change control.

b. Distinguish activities to control potential dangers (risk control measures = RCMs).

c. Assess the adequacy of RCMs in decreasing chance by re-evaluating step 2.

d. Grouping RCMs into basic options.

2.4. Step 4 (Cost and Benefit Assessment):

The objective of step 4 is to recognize and compare the benefits and costs of actualizing each of the RCOs recognized in step 3. Costs must be expressed in life cycle costs, which incorporate a beginning, working, preparing, assessment, certification, decommissioning, etc. In the meantime, benefits may include diminishments in terms of passings (fatalities), injuries/losses (wounds), mischances (casualties), natural harm and cleaning (natural harm & clean-up), and reimbursements by third parties who are mindful. The yield of step 4 comprises of:

a. Costs and benefits for each RCO recognized in step 3.

b. The costs and benefits for the RCO of concern (which are most influenced by the issue).

c. Financial utility communicated within the suitable file.

d. The equation used to solve this problem is the Cost of Averting a Risk Index (ICAR) as given in Equation 2.1 below:

$$\text{ICAR} = \frac{(\Delta C - \Delta B)}{\text{Risk Reduction}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

ICAR = *Implied cost of averting a risk* (Risk reduction cost index)

ΔC = Risk control costs

ΔB = economic benefits of implementing risk control

Risk Reduction = Reducing risk after controlling

2.4. Step 5 (Recommendations for Decision Making):

The purpose of step 5 is to define the recommendations that should be provided to the decision-maker, in an auditable and traceable manner. Recommendations are based on:

a. Comparison and ranking of all hazards and their causes.

b. Comparison and ranking of risk control options as a function of combined costs and benefits.

c. Identification of risk control options that keep risk as low as possible so that it makes sense to implement.

Proposals ought to be given in an organization that can be caught on by all parties, not withstanding involvement. Accommodation of suggestions as a result of an FSA handle must be given instantly and get to pertinent supporting archives by a component that incorporates comments. The yield of step 5 comprises:

a. An objective comparison of alternative options, based on potential risk reduction and cost-effectiveness, according to legislation or regulations that are being reviewed or developed.

b. Feedback information to review the results given in the previous steps.

Table 1. Severity Index

Skala	Human	Property	Environment	Stakeholder
C0	Not significant (very small chance of injury) (0-1 million)	Not significant (0 - 10 million)	Insignificant (meaningless damage) (0 - 10 million)	Not significant (0 - 10 million)
C1	Minor (One minor injury) (1 million – 5 million)	Small (10 - 100 million)	Minor (Controlled short term damage) (10 – 50 million)	Small (Temporary project stop or work restrictions) (10 – 100 million)
C2	Medium (a lot minor injuries or one serious injury) (5 Million-10 million)	Currently / Middle (100 - 200 million)	Moderate (Major Damage) (50 - 100 million)	Medium (National scope, the project is temporarily closed for a few days. There are no KRI maintenance and repair activities) (100 - 200 million)
C3	Severe (Many serious injuries or one death) (10 million – 25 million)	Big (200 - 500 million)	Major (widespread damage with potential environmental damage) (100 - 200 million)	Large (National scope, Fasharkan temporarily closed from maintenance and repair projects for a few days) (200 - 500 million)
C4	Catastrophic / major disaster (Many cause death (25 Million and more)	Big disaster (500million+)	Disaster (Damage is extensive to neighboring countries) (200million+)	Disaster (international scope, Fasharkan closed, work was interrupted and maintenance and repair activities did not occur for a long period of time) (500million+)

(Table's Legend : *Port & Harbour Risk Assessment & Safety Management System*)

Table 2. Risk Possibility Assessment

Scale	**Concecuency**	**Definition**
F1	*Almost Certain*	Can happen any time Happens almost every day
F2	*Likely*	Happens once a week
F3	*Possible*	Can happen every now and then Happens 1 time in 1 month
F4	*Unlikely*	Can happen 1 time in 1 year
F5	*Rare*	Almost never, very rarely Happened once in more than 1 year

(Table's Legend: Australian Standard / New Zealand Standard 4360, 2004)

Table 3. Risk Matrix

Consequence	C4	5	6	7	8	10
	C3	4	5	6	7	9
	C2	3	3	4	6	8
	C1	1	2	2	3	6
	C0	0	0	0	0	0
Frequency		F5	F4	F3	F2	F1

Information:

0 & 1 = Negligible risk

2 & 3 = Low risk

4 & 5 = Area of As low as Reasonably Practicable Area (ALARP)

6 = The risk is getting higher

7 & 8 = Significant risk

9 & 10 = Risiko tinggi

2.5. Formal Safety Assessment

Formal Safety Assessment (FSA) could be a judicious, organized, and orderly technique or process for evaluating dangers related to exercises within the oceanic division (shipping) and assessing the costs and benefits of a few hazard control alternatives, utilizing chance investigation and cost-benefit appraisal (International Maritime Organization, 2002). FSA points to diminishing existing dangers, as well as moving forward with shipping security (marine security), which incorporates assurance of life, well-being, marine environment, and property rights.

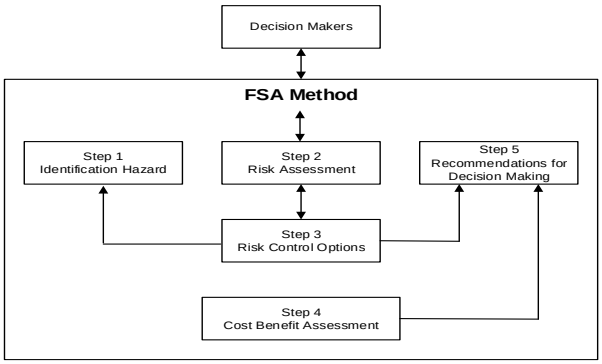

Figure 1. *Framework Formal Safety Assessment* (FSA)

2.6. Zero Accident

The Indonesian navy has a zero accident program as outlined in the Kasal Telegram Number 147/Basegram/0308 twu.0311.1538 which states that zero accidents means that there are no more accidents at work sites that can cause temporary or permanent injury, even fatal or death, as well as material loss. . Creating a zero accident work environment is not easy. This requires a long process even years and requires a continuous process. The zero accident campaign is one method to reduce the potential for work accidents caused by human error. The zero accident campaign is a campaign that supports the trinity of principles, methods and practices. If one of them is removed, the zero-accident campaign will not be achieved. The zero accident campaign consists of 3 (three) main principles, namely zero, anticipation and participation. These three are called 3 (three) basic image principles, namely:

a. Zero principle

It is a principle to eliminate all accidents to zero, including occupational accidents, occupational diseases and traffic accidents, by finding, understanding and solving hazards or problems that are hidden in everyone's daily life or hidden in the workplace and work.

b. Anticipation principle

Preventing the emergence of accidents before activities, by discovering, understanding and solving the hidden dangers and problems in their daily lives and of course the hidden dangers in the workplace and work, and to create a happier workplace, zero accidents and illnesses.

c. Prinsip partisipasi

Practicing problem solving activities in the spirit of self-initiative in their respective positions and workplaces with the integration and cooperation of leaders, managers, staff, and employees, to find,

understand and solve hidden hazards or problems in the workplace and work.

3. RESULT AND DISCUSSION.

At the beginning of data collection, one thing that is needed is how many work orders there are in Fasharkan Surabaya in the period 2010 to 2021 including Hardepo and Harmen / Hardar. The Fasharkan Surabaya 2010-2021 Job Data Table provides an overview of this.

Table 4. Fasharkan Surabaya Job Data (SPK unit)

No.	Year	Type of work	
		Hardepo	Harmen / Hardar
1	2010	156 SPK	157 SPK
2	2011	179 SPK	217 SPK
3	2012	102 SPK	127 SPK
4	2013	141 SPK	165 SPK
5	2014	139 SPK	203 SPK
6	2015	113 SPK	177 SPK
7	2016	99 SPK	182 SPK
8	2017	77 SPK	166 SPK
9	2018	121 SPK	154 SPK
10	2019	135 SPK	133 SPK
11	2020	165 SPK	199 SPK
12	2021	125 SPK	145 SPK

After knowing the common depiction of the conditions at Fasharkan Surabaya, the other most vital thing is to display information on mishaps that have happened. The Work Mishap Information table underneath appears mishap information that happened at Fasharkan Surabaya which appears the number of episodes recorded from 2010 to 2021.

Table. 5 Work Accident Frequency at Fasharkan Surabaya Year 2010 – 2021

No	Type of Accident	Number of Frequency												Jumlah
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
1	Human with Work System												1	1
2	Human with Environment		1		1		1							3
3	Human with Property			1					1	1	1	2		6
4	Humans with Work Tools	1				2	2	1		1	3			10
	Summary	1	1	1	1	2	3	1	1	2	4	2	1	20

(Table's Legend : Production Dept. of Fasharkan Surabaya and Author's processed results)

3.1. Determining Consequence Criteria Value

In determining a consequence criterion, an interview with an expert on work accidents that occurred at Fasharkan Surabaya was carried out, which later on the results of the interview will be assessed based on existing criteria standards, such as AS/NZS Standard 4360:2004, IMO, and others.

a. Humans: incidents on work safety that are the recipient of the direct impact of workplace accidents. The risks accepted by humans from mild to death.

b. Property: any work accident can cause property loss. For example, a fire in a workshop or other facility that causes damage to the asset.

c. Environment: work accidents can cause environmental damage, for example fires in the work area due to plate welding and others. The environmental damage includes those that have an impact on plants around the work area.

Fasharkan Surabaya stakeholders will also accept the risks caused by work accidents. For example, if there is a work accident at Fasharkan Surabaya, it will automatically concentrate on completing the work on time according to the schedule and production targets will be late and also production costs will swell due to the completion of the accident. The following table shows the initial risk level for this type of accident.

Table. 7 Hazard List with Frequency Scores and Consequences and Score Scores for Each Event

Danger Number	Hazard Type	Workshop Type	Danger Details	Possible Cause	The Most Likely Consequences						Worst Possible Consequence					
					Hazard Type	Hazard Impact Assessment				Frequency	Hazard Type	Hazard Impact Assessment				Frequency
						Human	Property	Environment	Stakeholer			Human	Property	Environment	Stakeholer	
1	(A) Human Accident with Work System	All Workshop	Accidents that occur when there is missed communication between 1 work team and another work team, including not complying with Standard Operating Procedures	- Communication tools that don't work normally - Errors in reading & understanding the SOP of a job - There is no backup communication (messenger) who is in charge of conveying messages when the communication tool is constrained	- Electrocution weak current - Bruises on the body - Irritation to the skin - Shock & fall - Sprained / slipped / bruised ankle	C1 2	C0 0	C0 0	C1 2	F3	- Electrocuted strong current - Severe bruises and even broken bones - Severe irritation to the skin - Shocked & Fallen even died	C2 6	C1 3	C1 3	C2 6	F2
2	(B) Human Accident with Property	All Workshop	Accidents that occur between humans and property that cause damage to property and humans	- The physical condition of the property / infrastructure is fragile due to the age factor - Lots of electric current leakage in buildings / ships - Lots of oil spills on the ship/workshop - Limited working space conditions	- Electrocution weak current - Bruises on the body - Shock & fall - Sprained / slipped / bruised ankle - Minor damage to buildings	C2 4	C1 2	C0 0	C1 2	F3	- Electrocuted strong current - Severe bruises and even broken bones - Shocked & Fallen even died - Severe damage to buildings	C3 7	C2 6	C1 3	C2 6	F2
3	(C) Human Accident with Environment	All Workshop	Accidents that occur between humans and the environment that cause damage to the environment and humans	- Unhealthy / stuffy work environment - Insufficient/excessive lighting in the workspace - The condition of a messy workspace with used materials & equipment that are not used / haven't been cleaned up	- Minor visual disturbances - Mild respiratory distress - Mild irritation to the body - Light pollution to the environment	C0 0	C0 0	C0 0	C0 0	F5	- Severe visual impairment - Severe respiratory distress - Severe irritation to the body - Severe pollution to the environment	C1 2	C1 2	C1 2	C1 2	F4
4	(D) Human Accident with Work Equipment	All Workshop	Accidents that occur between humans and work equipment that cause damage to work equipment and humans	- Only 50% ready-to-use work equipment - Lack of operator knowledge about work equipment - Operators do not understand the SOP for the use of work tools used - Unstable electrical voltage & imperfect lubrication on work tools	- Minor injuries to the body - Electrocution weak current - Shocked & fell - Minor damage to work tools	C2 6	C1 3	C0 0	C1 3	F2	- Severe injuries to the body - Electrocuted by a strong current - Shocked & fell - Severe damage to work tools	C3 9	C2 8	C1 6	C2 8	F1

(Source: Result of interview with expert and crew of Fasharkan)

Table 9. Results Obtained After Giving Weight

Incident	Most Likely Consequences				Worst Possible Consequence				**Summary**	**Order**
	Human	Property	Environment	Stakeholder	Human	Property	Environment	Stakeholder		
Human Accident with Work System	0,8	0	0	0,6	2,4	0,6	0,3	1,8	6,5	**3**
Human Accident with Property	1,6	0,4	0	0,6	2,8	1,2	0,3	1,8	8,7	**2**
Human Accident with Environment	0	0	0	0	0,8	0,4	0,2	0,6	2	**4**
Human Accident with Work Equipment	2,4	0,6	0	0,9	2,7	1,6	0,6	2,4	11,2	**1**

From the calculation the table above shows that human accidents with work equipment are the events that have the highest risk then the second is human accidents with property, the third is human accidents with the environment and the last is human accidents with work systems.

3.2. Weighting Sensitivity

On this occasion it will be shown how the sensitivity of this weighting value if it is varied to values that are considered realistic. In this study, the weighting values for humans varied,
namely 0.3, 0.4, 0.5, 0.6, 0.7 with the weighting values for Meteri given in the table below:

Table 10. Weight Variation

No	Human	Property	Environment	Stakeholders
1	0,7	0,1	0,1	0,1
2	0,6	0,1	0,1	0,2
3	0,5	0,15	0,05	0,3
4	0,4	0,2	0,1	0,3
5	0,3	0,2	0,2	0,3

Table 11. Variations in Weighting of Human Victims

Type of Accident	Risk Rating Per Weighted				
	0,7	0,6	0,5	0,4	0,3
Human Accident with Work Equipment	1	1	1	1	1
Human Accident with Property	2	2	2	2	2
Human Accident with Work System	3	3	3	3	3
Human Accident with Environment	4	4	4	4	4

The table above shows that by giving weighting variations, it does not provide a significant risk rating change from the types of accidents that exist. What is more important in risk mitigation here is how we reduce the high risk value that occurs to an acceptable risk value

Table 12. Risk Reduction

Incident	Initial Risk				General, Electrical & GenSet OHS Expert Training				Fire K3 Officer Training				Enforcement of Standard Operational Work Procedures & Tighter Supervision				Procurement of Personal Protective Equipment (PPE) in accordance with The List of Personnel Composition (DSP)			
	Human	Property	Environment	Stakeholder	Human	Property	Environment	Stakeholder	Human	Property	Environment	Stakeholder	Human	Property	Environment	Stakeholder	Human	Property	Environment	Stakeholder
Human Accident with Work Equipment	9	8	6	8	6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Human Accident with Property	7	6	3	6	6	4	2	4	6	4	2	4	5	3	2	3	6	4	2	4
Human Accident with Work System	6	3	3	6	4	2	2	4	-	-	-	-	3	2	2	3	-	-	-	-
Human Accident with Environment	2	2	2	2	1	1	1	1	-	-	-	-	0	0	0	0	-	-	-	-

Table 13. Risk Reduction Cost (in Rupiah)

Countermeasures	Countermeasures Cost (ΔC)	Benefit (ΔB)			
		Human Accident with Work Equipment	Human Accident with Property	Human Accident with Work System	Human Accident with Environment
General, Electrical & GenSet OHS Expert Training	242 million	150 million	100 million	50 million	10 million
Fire K3 Officer Training	81,5 million	50 million	25 million	-	-
Enforcement of Standard Operational Work Procedures & Tighter Supervision	105 million	80 million	50 million	25 million	10 million
Procurement of Personal Protective Equipment (PPE) in accordance with The List of Personnel Composition (DSP) (238)	607 million	500 million	350 million	-	-

Table 14. ICAR Calculation (in Rupiah)

Countermeasures	Risk Reduction				ICAR			
	A	B	C	D	A	B	C	D
General, Electrical & GenSet OHS Expert Training	2	2	2	1	92 million	142 million	192 million	232 million
Fire K3 Officer Training	2	1			15,75 million	56,5 million		
Enforcement of Standard Operational Work Procedures & Tighter Supervision	2	2	2	2	12,5 million	27,5 million	40 million	47,5 million
Procurement of Personal Protective Equipment (PPE) in accordance with The List of Personnel Composition (DSP) (238)	2	1			53,5 million	257 million		

Information: A = Human Accident with Work Equipment
B = Human Accident with Property
C = Human Accident with Work System
D = Human Accident with Environment

4. CONCLUSION.

From the results of the analysis carried out, the following conclusions are obtained:

a. The number of work mischances in Fasharkan Surabaya is very stressful. This may be seen from the overall rate of work mischances for 11 a long time (2010 to 2021) as numerous as 20 cases that can be recorded, not counting work mischances that are not well recorded within the everyday movement diary and work unit minutes. After the calculations are carried out, they can be positioned consecutively beginning from the most noteworthy hazard esteem, specifically:

1) Human Accident with Work Equipment, with risk value 9

2) Human Accident with Property, with risk value 7

3) Human Accident with Work System, with risk value 6

4) Human Accident with Environment, with risk value 2

For these four types of accidents, risk reduction measures are carried out by knowing in advance the main causes of the four types of accidents.

b. The main cause of the four types of work accidents with high risk is due to a very minimal understanding of K3 (Occupational Health and Safety) by Fasharkan Surabaya crew members. The most likely damage is injuries to the workers' bodies, damage to property buildings (infrastructure) and environmental pollution around the Fasharkan Surabaya workshop. Human Accidents with Work Equipment, Property, Work Systems, and Environment, are often motivated by work equipment that is not ready to use or only 50% of its technical condition and also the work space and work atmosphere that is not conducive so that there is a chance for work accidents to occur in humans and also result in accidents. damage to the physical building (infrastructure) of Fasharkan Surabaya.

c. The actions to reduce the risk of the four types of work accidents at Fasharkan Surabaya are as follows:

1) Human Accidents with Work Equipment, namely by holding training for General K3 Experts, Electricians & Generators who have an ICAR of 92 million rupiah so that workers understand K3 culture and avoid the risk of work accidents, as well as training for Fire K3 Officers who have an ICAR of 15.75 million rupiah so that workers are ready and alert within the occasion of a fire in the workshop or ship work area. Next is the implementation of work SOPs and tightening supervision which has an ICAR of 12.5 million rupiah so that workers understand and comply with all good and safe work procedures. Then the last one is the Procurement of Work Safety Equipment in the work area of workshops and ships as well as Personal Protective Equipment for each worker who has an ICAR of 53.5 million rupiah so that workers feel safe while working..

2) Human Work Accidents with Property, namely by holding training for General K3 Experts, Electricians & Generators who have an ICAR of 142 million rupiah so that workers understand K3 culture and avoid the risk of work accidents, as well as training for Fire K3 Officers who have an ICAR of 56.5 million rupiah so that workers are ready and alert within the occasion of a fire in the workshop or ship work area. Next is the implementation of work SOPs and tightening supervision which has an ICAR of 27.5 million rupiah so that workers understand and comply with all good and safe work procedures. Then the last one is the Procurement of Work Safety Equipment in the work area of workshops and ships as well as Personal Protective Equipment for each worker who has an ICAR of 257 million rupiah so that workers feel safe while working.

3) Human Accidents with Work Systems, namely by holding training for General K3 Experts, Electricians & Generators who have an ICAR of 192 million rupiah so that workers understand K3 culture and avoid the risk of work accidents and the application of work SOPs and tighten supervision which has an ICAR of 40 million rupiah so that workers understand and comply with all good and safe work procedures.

4) Human Accidents with the Environment, namely by holding training for General K3, Electricity & Genzet Experts who have an ICAR of 232 million rupiah so that workers understand K3 culture and avoid the risk of work accidents and the application of work SOPs and tighten supervision which has an ICAR of 47.5 million rupiah so that workers understand and comply with all good and safe work procedures.

From the results of this final project, we suggest reducing the occurrence of work accidents that can have a major impact on both human and material casualties, namely risk mitigation to reduce

the occurrence of work accidents between humans and work equipment, property, work systems and the environment in Fasharkan Surabaya is to provide an understanding maximum about Occupational Safety and Health (K3) through training of General K3, Electricity and Genzet Experts as well as fire prevention training. Then enforce professional and safe work SOPs and tighten supervision in the field. The next step is to equip work safety equipment both in the Fasharkan workshop and on the ship and equip workers with personal protective equipment that is comfortable to wear while working and provides security for the wearer.

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FIELD III

POLICY AND STRATEGY

ANALYSIS OF HEALTH SERVICE QUALITY IN IMPROVING XYZ HOSPITAL SERVICES

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ABSTRACT

XYZ Hospital is a type c military hospital located in Surabaya and has the function of support and optimal health services for military personnel, military families, and the general public. In its implementation, there are several problems related to health services including a decrease in the number of patient visits, lack of human resources, and long patient service times. Therefore, it is necessary to analyze the quality of health services in improving XYZ hospital services. Service quality (Servqual) and Importance Performance Analysis (IPA) methods are used to measure the level of quality of health services provided to patient satisfaction. Based on the results of research from 99 respondents, it shows that from the 5 dimensions of Servqual, there are positive performance gaps, namely 3 attributes E1-X7, E4-X10, A3-X27, and negative values, namely 27 attributes R2-X20, R4-X22, RE1-X12, RE3 -X14, R5-X23, A5-X60, A1-25, T4-X4, A2-X26, T1-X1, RE5-X16, R3-X21, RE7-X18, T5-X5, RE2-X13, T3-X3, E5-X11, R1-X19, R6-X24, T2-X2, A4-X28, T6-X6, RE6-X17, A6-X30, RE4-X15, E3-X9, and E2-X8. In IPA, Quadrant I has 10 attributes, namely T5-X5, RE1-X12, RE3-14, RE5-X16, RE7-X18, R4-X22, R5-X23, R2-X20, A1-X25, A5-X29 which are priority improvements health services, quadrant II 6 attributes that show maintain achievement, quadrant III 8 attributes are considered less important for patients and the services obtained are considered normal and quadrant IV 6 attributes. considered less important for patients but the services provided are too excessive.

Keywords: Quality of Health Services, SERVQUAL, IPA, XYZ Hospital.

1. INTRODUCTION

The hospital is one of the health service providers that continues to grow and the number is increasing every year. Based on data from the National Statistics Office (BPS), the number of hospitals in 2021 is 3112 units increasing by 5.17% from the previous year as many as 2,959 units. The number consists of 2514 general hospitals and 598 units are special hospitals. (Mahdi, 2022) . The tendency of the number of hospitals to increase from year to year shows that hospitals must be able to compete and win the competition. In addition, with the emergence of economic globalization and the era of change, it becomes a serious challenge for managers in hospital management. In this time of change, it is necessary to be careful with leaders so that they can adapt to developments while maintaining the continuity of the organization to survive.

In the era of opening up geographical boundaries, the obstacle is the emergence of new competitors, namely the creation of hospitals that are not only at the local or national level but also at the international level. Therefore, at this time hospitals that have been established and operating are expected to prepare themselves to advance their organizations, especially their resources and management systems, to be able to create quality hospital health services for their customers. The function of health services within the hospital itself has changed from what was once a social organization to a corporate organization that seeks profit (profitability) from the business it runs. This is because the hospital is complex. dense, capital-intensive, and technological organization, requires a fairly high cost to maintain this health effort.

The human resources that must be owned by hospitals are regulated by hospital accreditation,

especially in determining the number and specifications of staff and service support facilities that hospitals must have. Standardization of resources such as human resources, management standards, and technology is an important component to face competition and create hospitals with quality health services, which are indicators of improving the image and profitability of hospitals.

XYZ Hospital is a type c military hospital that has the function of carrying out optimal health support and services for military personnel, families, and the general public so that quality health services are needed. For this reason, it is necessary to involve patients as customers who feel the direct impact of the health services provided. The quality of health services is closely related to patient satisfaction which is a measure of the success of the quality of health services. (Pasalli' and Patattan, 2021) . Efforts to improve the quality of health services can be carried out in different ways or methods. Among them are by using the Service Quality (Servqual) and Importance Performance Analysis (IPA) methods.

Previous research regarding the measurement of service quality mostly uses the Servqual method, including the effect of service quality on customer satisfaction by using internet banking services in Jambi. This study examines the elements that affect the quality of internet banking services for customers, and finds that the quality of internet-based services significantly affects customer satisfaction (Assegaff, 2017), Next research uses the Servqual method and simple addictive weighting (SAW) on the implementation of the Servqual and SAW methods to analyze patient satisfaction based on the quality of outpatient poly services. The gap used is customer satisfaction. (Putro, 2017) , Further research was conducted on measuring patient satisfaction, and health care services in the UAE (United Arab Emirates) hospitals using Servqual. This study evaluates the quality of health services by investigating the factors that influence patient satisfaction in private and public hospitals in the UAE based on the five dimensions of service quality from Servqual (Al-Neyadi, Abdallah, and Malik, 2018). Next is service quality and satisfaction in the healthcare sector . of Pakistan-The patient's expectations examine the expectations of patients' satisfaction with health facilities in public hospitals which are higher than in private hospitals in Pakistan. (Al-Neyadi, Abdallah and Malik, 2018).

2. MATERIALS AND METHODS

Service Quality is generally grouped into five dimensions according to Parasuraman (Sinollah and Masruro, 2019). namely

a. Tangible (physical evidence) Direct evidence includes appearance and facilities, buildings, equipment, and appearance of company employees. The company's physical appearance will affect the customer's evaluation of the quality of service provided by the company,

b. Reliability (reliability), which shows how far the company provides the same service as promised accurately and precisely. This reliability is not only important for big problems because small problems are also important for customers in evaluating the company,

c. Responsiveness shows the willingness and commitment of the company in providing timely services. Responsiveness is not only about the speed of service provided, but also the willingness of the company or employees to help customers. ,

d. Assurance (belief) The ability to generate trust and confidence from customers which includes knowledge, courtesy, and the ability of employees to foster customer trust in the company, e. Empathy (empathy) The communication ability of employees to explain well about the services provided by the company will have a good impact on customer

evaluations. Service Quality can be defined as the difference between customer expectations of service before and after the service is provided (A. Parasuraman, Valarie A. Zeithaml, 1988). Service quality (Servqual) is a tool to measure service quality, which can be used to analyze the causes of service problems and understand how service quality can be improved. Measuring the quality of service is almost the same as measuring customer satisfaction, which is determined through the perceived performance variable by consumers.

Importance Performance Analysis is an analytical technique to identify performance factors. An organization must demonstrate the satisfaction of its service users (consumers). This method was originally used by Martilla and James in the field of market research and consumers. behavior. But in later developments, its use has been expanded to include research on hospital services, tourism, schools, and even analysis of public bureaucracy (government) performance. The IPA method (Importance Performance Analysis) is a framework for understanding customer satisfaction as a function of expectations (Importance or degree of importance) concerning an attribute and a customer rating of organizational performance (performance) as perceived by customers (Supranto, 2006).

The IPA method can provide managers in the service industry with important information in the form of measurement of customer satisfaction and efficient resource allocation. Both are in an easy-to-use format. There are two approaches to this method, namely: 1) assessing the performance gap by calculating the difference between the performance score and the importance score; 2) identifying service attributes that arena priority to be improved and have an impact on increasing customer satisfaction by using a Cartesian diagram which is divided into four quadrants. The method (IPA) can categorize the attributes of products or services based on how well a product or service can measure the satisfaction performance that is considered important by the patient and the satisfaction performance received by the patient (Hidayat, Wibowo and Wardana, 2021a). The steps in this research include.

2.1 Literature and Field Studies

At the library study stage and field study, researchers collect information and existing literature in the form of books, journals, laws or hospital websites, and profiles of XYZ Hospital that have a relationship with the topic problem to be raised in the research.

2.2 Problem Identification

The research begins with the identification of problems which are the activities that form the basis for carrying out the research. This activity is carried out to identify the main problems to be discussed and then proceed with the formulation of the problem. Identification of problems that occur in services in outpatient units, emergency units, and inpatient units to the expected patient satisfaction.

2. 3 Determination of Variables and Indicators

Determination of variables and indicators is carried out before making the questionnaire, to find out which factors must be studied. Determination of variables and indicators also makes it easier to analyze in a study. Where the operational definition of research variables and the measurement scale of expectations is the desire of the respondents about hospital services which can be known by a structured questionnaire. Meanwhile, the operational definition of the research variable and the scale of measurement of reality is the actual condition of the hospital services received by the respondent, which can be determined using a structured questionnaire.

2.4 Determination of Population and Sampling Techniques

At this stage, the determination sample is to be selected from the population of patients who seek treatment or receive services at XYZ Hospital in all service units to represent the population. for the selected sample to be representative, the number of samples is determined according to the solving formula.

$$n = \frac{N}{1+ Ne^2} \quad \text{.....1)}$$

Information:
n = sample size

N = population size

e = margin of error or maximum error tolerated (0.05)

To determine the number of samples in the population, the researchers took data from the last 4 years on the number of patient visits per day at the hospital from 2018 to 2021.

$n = \frac{123}{1+ 123.(0.05)^2}$ = 123/1.30755 = 94.07 rounded up by 94 samples. To anticipate the occurrence of errors in the research questionnaire, the target respondent was raised to 99 people.

2.5 Preparation and Distribution of Questionnaires

The preparation and distribution of questionnaires concerning the 5 dimensions in the servqual method, namely Tangible, Reliability, Responsiveness, Assurance, and Empathy are also used as variables determining indicators to be studied. Respondents were directed to answer all questions well through an assessment of the answers.

2.6 Data Collection and Processing Phase.

The stages of data collection and processing include:

2.6.1 Validity Test

A validity test is used to determine whether a questionnaire is valid or not. A questionnaire is considered valid if the questions in the questionnaire can say something that is measured by the questionnaire. The questionnaire test (validity and reliability) was carried out in two stages. Stage 1 for 30 respondents is a preliminary survey that has similar characteristics to the research subject. Sampling to test the validity of this research instrument is based on the opinion (Singarimbun, M., & Shofian, 1995) that the minimum number of test samples is 30 respondents and the questionnaire can be said to be valid if r count > r table. To determine the r table based on the number of respondents, in this case, 30 respondents, look at the critical number in line N-2, which is 30-2 = 28 with a significant level of 5%, the critical number obtained in the two-way r table is 0.361. Stage 2 is an advanced stage in the validity and reliability test for 99 respondents to be studied. To test the validity of the extended questionnaire with the number of respondents 99 people, the critical number r table is obtained by looking at rows N-2. With 99 respondents, the line seen is line 99-2 = 97 . with a significant level of 5%, the critical number obtained in the two-way r table is 0.1975, so it is said to be valid if the r count ≥is 0.1975. This study used Bivariate Pearson (Product Correlation Pearson Moment). This analysis is done by correlating each item's score with the total score. The total score is the sum of all items. Question items that have a significant correlation with the total score. Data processing using IBM SPSS Statistics 25 software.

The correlation formula is as follows:

$$r_{xy} = \frac{N\Sigma xy - (\sum x)(\sum y)}{\sqrt{(N\Sigma x^2 - (\sum x)^2)(N\Sigma y^2 - (\Sigma y)^2}} \quad \text{.....2)}$$

Information:

r_{xy} = Correlation coefficient between variable X and variable Y

Σxy = The number of multiplications between the variables x and Y

$\sum x^2$ = The sum of the squares of the X . values

$\sum y^2$ = The sum of the squares of Y . values

$(\sum x)^2$ =

The sum of the values of X is then squared

$(\sum y)^2$ = The sum of the Y values is then squared

Statistically, the correlation number obtained must be compared with the critical number of the correlation table value of r.

2.6.2 Reliability Test

The instrument reliability test was conducted to determine the reliability of the measuring instrument used. In quantitative terms, data is declared reliable if two or more researchers in the same object produce the same data, or a group of data when split into two shows data that are not different. (Sugiyono, 2014) . The reliability test in this study used Cronbach's Alpha Coefficient method. This coefficient is the reliability coefficient that is most often used because this coefficient describes the variation of the item, either for true or false or not format, such as formal on a Likert scale. The formula is as follows:

$$rtt = \left[\frac{k}{k-1}\right]\left[\frac{1-\sum \sigma b^2}{\sigma t^2}\right] \quad \text{.....3)}$$

Information :

rtt = instrument reliability coefficient (total test)

k = number of questions

$\sum \sigma b2$ = number of item variants

$\sigma t2$ = total variance

Cronbach alpha scale 0 to 1, has the following meaning:

a. Cronbach's alpha value is 0.00 to 0.20, meaning less reliable

b. Cronbach's alpha value of 0.21 to 0.40, meaning somewhat reliable

c. Cronbach's alpha value is 0.41 to 0.60, meaning it is quite reliable

d. Cronbach's alpha value 0.61 to 0.80, means reliable

e. Cronbach's alpha value is 0.81 to 1.00, which means very reliable

From the scale above it can be concluded that where the results of Cronbach's Alpha calculations are then consulted with the provision that a variable is said to be reliable if it gives Cronbach's Alpha value > 0.60.

2.7 Processing Method Servqual.

After obtaining the necessary research data and passing the validity and reliability tests based on five dimensions, data analysis of the gap between expectations and perceptions was carried out by looking for the gap value. By calculating the Servqual score, the calculation results obtained can be used as a reference for the occurrence of gaps between gaps. In analyzing the servqual method, the following steps can be carried out (Irawan et al., 2020) :

Finding the reality score of each Xi variable and the expected score of the Yi variable. Summing up the score of expectation (Yi) and reality (Yi), from each variable of all respondents, then calculate the average $\overline{X}$ and $\overline{Y}$

$$\overline{X} = \frac{\sum Xi}{n} \quad \text{.....4)}$$

$$\overline{Y} = \frac{\sum Yi}{n} \quad \text{.....5)}$$

Where :

$\overline{X}$= Average score of reality level

$\overline{Y}$= Average score of expectation level

n= Number of respondents

Calculating the gap (gap) between the average score of reality with the average score of expectations.

$$Nsi = \overline{X}i - \overline{Y}i \quad \text{.....6)}$$

Where :

Nsi = The average score of the variable gap to -i

Calculate the average gap of each variable

$$\overline{NSi} = \frac{\sum NSi}{Ai} \quad \text{.....7)}$$

Where

$\overline{NSi}$ = The average value of the i variable gap

Ai = Number of attributes for each variable i

The conclusion of the calculation of the satisfaction score for each dimension with the following conditions:

a. A negative servqual score (<0) indicates a gap between reality and customer expectations, it is said to be "Unsatisfied".

b. A servqual score greater than or equal to zero (>=0), indicating the fact that it has met or exceeded customer expectations, is said to be "Satisfied".

2.8 Processing Method IPA

Importance-Performance Analysis (IPA) is used to determine the level of service provided by the hospital and the improvements that the hospital needs to make to improve the quality of its services. The analysis consists of two components, namely the level of conformity analysis and quadrant analysis. The calculation of the level of conformity between the level of expectation and the level of performance is by the formula (Wibisono, 2019) :

$$\overline{X} = \frac{\sum_{i=1}^{n} x\,i}{n} : \overline{y} = \frac{\sum_{i=1}^{n} y\,i}{n} \quad \text{: .....8)}$$

For information:

$\overline{X}$, $\overline{y}$ = The average score of the level of satisfaction (X) and the level of importance (Y) for an attribute

$\sum Xi$, $\sum Yi$: Total score of satisfaction level assessment (X) and importance level (Y) for attribute i

n: Number of respondents

3. RESULTS AND DISCUSSION

3.1 Questionnaire Creation

The making of the questionnaire is based on previous studies on measuring service quality using the servqual method and the results of consultations with the management of the hospital as well as the results of interviews with patients as respondents so that 30 measurement indicators are obtained in servqual Servqual Five Dimensions Questionnaire

Table 1. Variable Dimensions of Servqual

Servqual Dimension	Attribute	Questions in the Questionnaire
Tangibles (physical evidence)	T1-X1	The Attractive appearance of medical/non-medical staff
	T2-X2	The patient waiting room in the hospital is comfortable and clean
	T3-X3	The hospital has facilities for washing hands, water with soap, and hand sanitizer in every room
	T4-X4	The hospital has enough health experts
	T5-X5	There is a suggestion box and stationery to accommodate suggestions from patients and families
	T6-X6	Bathroom cleanliness and toilets are well maintained
Empathy (empathy)	E1-X7	patient's an illness and can provide a way out
	E2-X8	Nurses in serving are polite and friendly
	E3-X9	The comfort of the patient during the examination is very much considered by doctors and nurses
	E4-X10	Doctors and nurses provide encouragement and motivation to patients
	E5-X11	certain social status/class of patients
Reliability (Reliability)	RE1-X12	Doctor arrival and medical action according to schedule
	RE2-X13	Fast and appropriate nurse response for patients
	RE3-X14	Experienced medical personnel in providing health services
	RE4-X15	Provide visiting time for the patient's family according to the schedule
	RE5-X16	Doctors can diagnose diseases accurately
	RE6-X17	Issuance of billing receipts accurately and professionally

Servqual Dimension	Attribute	Questions in the Questionnaire
	RE7-X18	Easy service procedures and referral system.
Responsiveness (Responsiveness)	R1-X19	The counter clerk answers the patient when it is difficult to understand the treatment procedure
	R2-X20	Patient registration can be done online
	R3-X21	Hospital staff notify about when services will be provided
	R4-X22	Patient waiting time for outpatient services is less than 60 minutes.
	R5-X23	There is a complaint center or customer service that is always ready to serve which can be contacted by the complaints department or via telephone.
	R6-X24	The hospital pharmacy staff explained the dosage and the rules for taking medication.
Assurance	A1-X25	Medical treatment by doctors according to patient complaints
	A2-X26	The hospital always maintains the sterilization of health service facilities (Cleanliness of medical equipment)
	A3-X27	Guarantee that the confidentiality of patient information (social identity and condition) patient) can be well awake
	A4-X28	Medical staff can foster a sense of trust in patients
	A5-X29	Hospital pharmacies have a stock of drugs that patients need.
	A6-X30	Parking attendants have responsibility for vehicles that are guarded by leaving the parking area.

(Source : Research data processing, 2022)

3.2 Stage 1. Test the Validity and Reliability of the Questionnaire for 30 respondents

Carry out instrument testing in the form of questionnaires to 30 people for validity and reliability testing and ensure respondents understand the intent of the questions in the questionnaire. questions, while for the reliable level, if the questionnaire is found to be unreliable, it is done by adding or subtracting respondents and it can also be done to replace respondents because it is possible that respondents do not understand the questions in the questionnaire. Furthermore, if all the variables in the questionnaire are declared valid and reliable, the questionnaire will be distributed to 99 respondents who are the research sample, in this case, patients who receive treatment at the hospital. Questionnaires were distributed to 33 outpatients, 33 ER patients, and 33 inpatients. The selection of respondents to fill out the questionnaire was based on various considerations ranging from education level, occupation, having been treated in other hospitals which were benchmarks, and seeking treatment at XYZ Hospital so that they could compare the quality of the types of health services provided, other considerations regarding the selection of respondents including patients who had already been treated. aged 17 years and over who understand and understand the mastery of research themes and so on.

servqual validity and reliability test for 30 respondents at the level of expectation and level of perception.

Table 2. Validity Test Processing Results

Variable	Expectancy Level	Perception Level	r table	Interpretation
	r Count	r Count		
T1-X1	0.369	0.642	0.361	“Valid”
T2-X2	.662	.567	.361	“Valid”
T3-X3	.499	.722	.361	“Valid”

Variable	Expectancy Level	Perception Level	r table	Interpretation
	r Count	r Count		
T4-X4	.510	.683	.361	"Valid"
T5-X5	.600	.595	.361	"Valid"
T6-X6	.422	.667	.361	"Valid"
E1-X7	.715	.591	.361	"Valid"
E2-X8	.381	.691	.361	"Valid"
E3-X9	.464	.493	.361	"Valid"
E4-X10	.690	.725	.361	"Valid"
E5-X11	.565	.698	.361	"Valid"
RE1-X12	.395	.524	.361	"Valid"
RE2-X13	.703	.592	.361	"Valid"
RE3-X14	.467	.602	.361	"Valid"
RE4-X15	.532	.673	.361	"Valid"
RE5-X16	.571	.492	.361	"Valid"
RE6-X17	.406	.616	.361	"Valid"
RE7-X18	.622	.674	.361	"Valid"
R1-X19	.647	.599	.361	"Valid"
R2-X20	.478	.643	.361	"Valid"
R3-X21	.475	.539	.361	"Valid"
R4-X22	.525	.608	.361	"Valid"
R5-X23	.415	.515	.361	"Valid"
R6-X24	.596	.578	.361	"Valid"
A1-X25	.859	.595	.361	"Valid"
A2-X26	.565	.594	.361	"Valid"
A3-X27	.680	.713	.361	"Valid"
A4-X28	.586	.567	.361	"Valid"
A5-X29	.477	.482	.361	"Valid"
A6-X30	.556	.606	.361	"Valid"

(Source : Research data processing, 2022)

The test results using IBM SPSS statistics 25 show the level of expectation and perception level table for the value of r count $\geq$ r table so that the variables of the questionnaire can be validated. Furthermore, a reliable check was carried out for the questionnaire variables for 30 respondents at the level of expectation and level of perception. Cronbach's Alpha results show that the expectation level is 0.915 $\geq$ 0.60 and the perception level is 0.940 $\geq$ 0.60. This means that the variables on the questionnaire are very reliable

Table 3. Reliability Statistics Expectation Level

Reliability Statistics	
Cronbach's Alpha	N of Items
.915	30

Table 4. Reliability Statistics Perception Level

Reliability Statistics	
Cronbach's Alpha	N of Items
.940	30

3.3 Stage 2 Validity and Reliability Test for 99 respondents

Phase 2 was carried out after the validity and reliability tests for 30 respondents were completed. Furthermore, validity and reliability tests were carried out for 99 respondents. The results of the validity and reliability of the questionnaire on the expectation and perception level for 99 respondents were obtained as follows:

Table 5. Results of Validity Test Processing

Variable	Perception	Hope	r table	Interpretation
	r Count	r Count		
T1-X1	0.609	0.368	0.1755	Valid
T2-X2	0.440	0.346	0.1755	Valid
T3-X3	0.374	0.619	0.1755	Valid
T4-X4	0.625	0.203	0.1755	Valid
T5-X5	0.383	0.267	0.1755	Valid
T6-X6	0.387	0.417	0.1755	Valid
E1-X7	0.424	0.388	0.1755	Valid
E2-X8	0.649	0.296	0.1755	Valid
E3-X9	0.523	0.204	0.1755	Valid
E4-X10	0.276	0.233	0.1755	Valid
E5-X11	0.325	0.604	0.1755	Valid
RE1-X12	0.597	0.320	0.1755	Valid
RE2-X13	0.253	0.410	0.1755	Valid
RE3-X14	0.564	0.250	0.1755	Valid
RE4-X15	0.396	0.362	0.1755	Valid
RE5-X16	0.557	0.239	0.1755	Valid
RE6-X17	0.507	0.329	0.1755	Valid
RE7-X18	0.488	0.614	0.1755	Valid
R1-X19	0.558	0.679	0.1755	Valid
R2-X20	0.560	0.263	0.1755	Valid
R3-X21	0.435	0.498	0.1755	Valid
R4-X22	0.380	0.258	0.1755	Valid
R5-X23	0.518	0.261	0.1755	Valid
R6-X24	0.339	0.551	0.1755	Valid
A1-X25	0.637	0.288	0.1755	Valid
A2-X26	0.565	0.381	0.1755	Valid
A3-X27	0.357	0.584	0.1755	Valid
A4-X28	0.581	0.602	0.1755	Valid
A5-X29	0.490	0.262	0.1755	Valid
A6-X30	0.387	0.307	0.1755	Valid

(Source : Research data processing, 2022)

Table 6. Reliability Statistics Perception

Reliability Statistics	
ronbach's Alpha	N of Items
.802	30

The table above shows the calculated r-value at the level of perception and expectation shows the calculated r-value ≥ r table so that these variables are declared valid. Furthermore, for reliable variables at the level of perception, Cronbach's alpha value is 0.877 ≥ 0.60, and Cronbach's alpha value for the Expectancy level was 0.802 ≥ 0.60 so the variables at the level of perception and expectation could be assessed as very reliable.

Table 7. Expected Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.877	30

3.4. Distribution of Respondent's Characteristics

The characteristics of respondents who receive health services at hospitals are divided into several sections, namely based on age group, gender, type of work, level of education, income, treatment, reasons for choosing, and length of stay in the hospital. Distribution of Research Respondents Characteristics as follows:

Table 8. Distribution of Respondent's Characteristics

No	Patient Characteristics	Amount	Percentage
1	Age	99	100%
	17- 24 years old	12	12%
	25-34 years old	31	31%
	35-49 years old	47	47%
	50-64 years old	7	7%
	65 years and over	2	2%
2	Gender	99	100%
	Man	61	62%
	Woman	38	38%
3	Type of work	99	100%
	Student/Student	2	2%
	Government employees	19	19%
	Private employees	8	8%
	Housewife	28	28%
	Military	35	35%
	Etc	7	7%
4	Level of education	99	100%
	JUNIOR HIGH SCHOOL	3	3%
	SENIOR HIGH SCHOOL	65	66%
	College	31	31%

(Source : Research data processing, 2022)

3.5 Processing Method Servqual

Research data that comes from questionnaires that have been distributed to 99 respondents and have been tested for validity and reliability using the help of IBM SPSS 25 software, then data processing is carried out using the

Servqual method, namely processing gap data, to find the value of the gap between expectations and customer perceptions. or patients about services that have been felt and have also received health services at other hospitals as a benchmark. The comparison between expectations and the reality of service quality, according to the 5 dimensions/ variables in the Service Quality method that has been distributed through the questions in the questionnaire is as follows:

Table 9. Gap performance Servqual

Variable		Health services	Perception	Hope	gap	Rating
Tangible	T1-X1	The attractive appearance of medical/non-medical staff	2.63	4.37	-1.75	10
	T2-X2	The patient waiting room in the hospital is comfortable and clean	1.89	2.68	-0.79	20
	T3-X3	The hospital has facilities for washing hands, water with soap, and hand sanitizer in every room	2.40	3.60	-1.19	16
	T4-X4	The hospital has enough health experts	2.66	4.51	-1.85	8
	T5-X5	There is a suggestion box and stationery to accommodate suggestions from patients and families	2.32	3.75	-1.42	14
	T6-X6	The cleanliness of the bathroom and toilet are well maintained	2.67	3.43	-0.77	22
Empathy	E1-X7	The doctor listens to complaints about the patient's illness and can provide a way out	4.03	3.40	0.63	29
	E2-X8	Nurses in serving are polite and friendly	2.68	2.91	-0.23	27
	E3-X9	The comfort of the patient during the examination is very concern to doctors and nurses	2.31	2.70	-0.38	26
	E4-X10	Doctors and nurses give encouragement and motivation to patients	3.54	2.66	0.88	30
	E5-X11	There is no discrimination of certain social status/class of patients	2.22	3.41	-1.19	17

Variable		Health services	Perception	Hope	gap	Rating
Reliability	RE1-X12	Doctor arrival and medical action according to schedule	2.08	4.64	-2.56	3
	RE2-X13	Fast and appropriate nurse response for patients	2.26	3.54	-1.27	15
	RE3-X14	Experienced medical personnel in providing health services	2.30	4.62	-2.31	4
	RE4-X15	Provide visiting time for the patient's family according to the schedule	3.97	4.52	-0.55	25
	RE5-X16	Doctors can diagnose diseases accurately	2.26	3.90	-1.64	11
	RE6-X17	Issuance of billing receipts accurately and professionally	1.96	2.64	-0.68	23
	RE7-X18	Easy service procedures and referral system.	2.19	3.73	-1.54	13
Responsiveness	R1-X19	The counter clerk answers the patient when it is difficult to understand the treatment procedure	2.58	3.69	-1.11	18
	R2-X20	Patient registration can be done online	2.11	4.83	-2.72	1
	R3-X21	Hospital staff notify about when services will be provided	1.97	3.58	-1.61	12
	R4-X22	Patient waiting time for outpatient services is less than 60 minutes.	2.07	4.65	-2.58	2
	R5-X23	There is a complaint center or customer service that is always ready to serve which can be contacted by the complaints department or via telephone.	1.99	3.89	-1.90	5
	R6-X24	The hospital pharmacy staff explained the dosage and the rules for taking medication.	2.28	3.28	-1.00	19
Assurance	A1-25	Medical treatment by doctors according to patient complaints	2.23	4.10	-1.87	7

Variable		Health services	Perception	Hope	gap	Rating
	A2-X26	The hospital always maintains the sterilization of health service facilities (Cleanliness of medical equipment)	2.68	4.53	-1.85	9
	A3-X27	Guarantee that the confidentiality of patient information (social identity and patient condition) can be maintained properly	3.89	3.53	0.36	28
	A4-X28	Medical staff can foster a sense of trust in patients	2.61	3.39	-0.79	21
	A5-X29	Hospital pharmacies have a stock of drugs that patients need.	2.15	4.03	-1.88	6
	A6-X30	Parking attendants have responsibility for vehicles that are guarded by leaving the parking area.	3.87	4.47	-0.61	24

(Source : Research data processing, 2022)

In Table 9. it can be seen that of the 30 variables 3 variables have positive values, namely the Empathy E1-X7 attribute (Doctors listen to complaints about the patient's illness and can provide solutions), E4-x10 attributes (Doctors and nurses provide enthusiasm and motivation to the patient) and the Assurance attribute A3-x27 (Assurance that the confidentiality of patient information / social identity and patient's condition can be maintained properly) this indicates that the reality has met or exceeded customer expectations, is said to be "Satisfied". While the other 27 attributes are negative, this indicates that XYZ Hospital has not been able to fulfill the wishes of consumers/patients because consumers are still dissatisfied with these health services including attributes R2-X20, R4-X22, RE1-X12, RE3-X14, R5-X23, A5-X60, A1-25, T4-X4, A2-X26, T1-X1, Re5-X16, R3-X21, RE7-X18, T5-X5, RE2-X13, T3-X3, E5- X11, R1-X19, R6-X24, T2-X2, A4-X28, T6-X6, RE6-X17, A6-X30, RE4-X15, E3-X9, and E2-X8. The three biggest negative gaps, namely the responsiveness dimension R2-X20 (patient registration can be done online). R4-X22 (Patient waiting time to get outpatient services is less than 60 minutes) and RE1-X12 (Doctor arrival and medical action according to schedule)

3.6. Processing Method IPA (Importance Performance Analysis)

Data processing using the IPA method is carried out by analyzing the level of suitability and quadrant analysis. The Compliance analysis level is the result of the comparison of perceived satisfaction or reality score with the expectation or interest score so that the results of the calculation of conformity are obtained

Table 10. Conformity Level of Satisfaction and Reality

Service Variables	Satisfaction Rating (perception) (x)	Interest Assessment (Hope) (y)	Average Satisfaction (perception) x	Average Interest (Expectation) y	Conformity Level (Tki)
T1-X1	260	433	4.37	2.63	60%
T2-X2	188	265	2.68	1.89	71%
T3-X3	240	356	3.60	2.40	67%
T4-X4	263	446	4.51	2.66	59%
T5-X5	229	371	3.75	2.32	62%
T6-X6	266	340	3.43	2.67	78%
E1-X7	398	337	3.40	4.03	118%
E2-X8	265	288	2.91	2.68	92%
E3-X9	231	267	2.70	2.31	87%
E4-X10	351	263	2.66	3.54	133%
E5-X11	222	338	3.41	2.22	66%
RE1-X12	208	459	4.64	2.08	45%
RE2-X13	226	350	3.54	2.26	65%
RE3-X14	228	457	4.62	2.30	50%
RE4-X15	393	447	4.52	3.97	88%
RE5-X16	225	386	3.90	2.26	58%
RE6-X17	196	261	2.64	1.96	75%
RE7-X18	216	369	3.73	2.19	59%
R1-X19	256	365	3.69	2.58	70%
R2-X20	210	478	4.83	2.11	44%
R3-X21	195	354	3.58	1.97	55%
R4-X22	207	460	4.65	2.07	45%
R5-X23	199	385	3.89	1.99	52%
R6-X24	226	325	3.28	2.28	70%
A1-25	220	406	4.10	2.23	54%
A2-X26	265	448	4.53	2.68	59%
A3-X27	386	349	3.53	3.89	111%
A4-X28	259	336	3.39	2.61	77%
A5-X29	213	399	4.03	2.15	53%
A6-X30	382	443	4.47	3.87	86%
□	7623	11181			68%

(Source : Research data processing, 2022)

Based on table 3.10 above, it is obtained for the Total Conformity Level (Total TKI) between reality and expectations

$\text{TKi}= \frac{7623}{11181} \text{X}100\%= 68\%$

Overall Assessment Criteria:

0.81 – 1.00 (Very Good)

0.66 – 0.80 (Good)

0.51 – 0.65 (Pretty Good)

0.35 – 0.50 (Not Good)

0.00 – 0.34 (Very Bad)

So for the level of suitability Based on the results of calculations between the level of reality and the level of expectation of the quality of the attributes studied through a comparison of the

actual score to the expected score, the overall performance of service quality is in a Good category, namely 68%

The results of the average score of the reality level (satisfaction) with expectation level (interest) obtained a value that becomes the level of satisfaction and level of expectation on the importance matrix Performance. The point of intersection results from the mean value of the plane of expectation (y) and reality (x) so that it can be seen the relative importance or perception of various attributes on the satisfaction or expectations of hospital customers/patients. Making a Cartesian diagram using the help of IBM Spss Statistics 25 software. The following shows a Cartesian diagram for each servqual dimension.

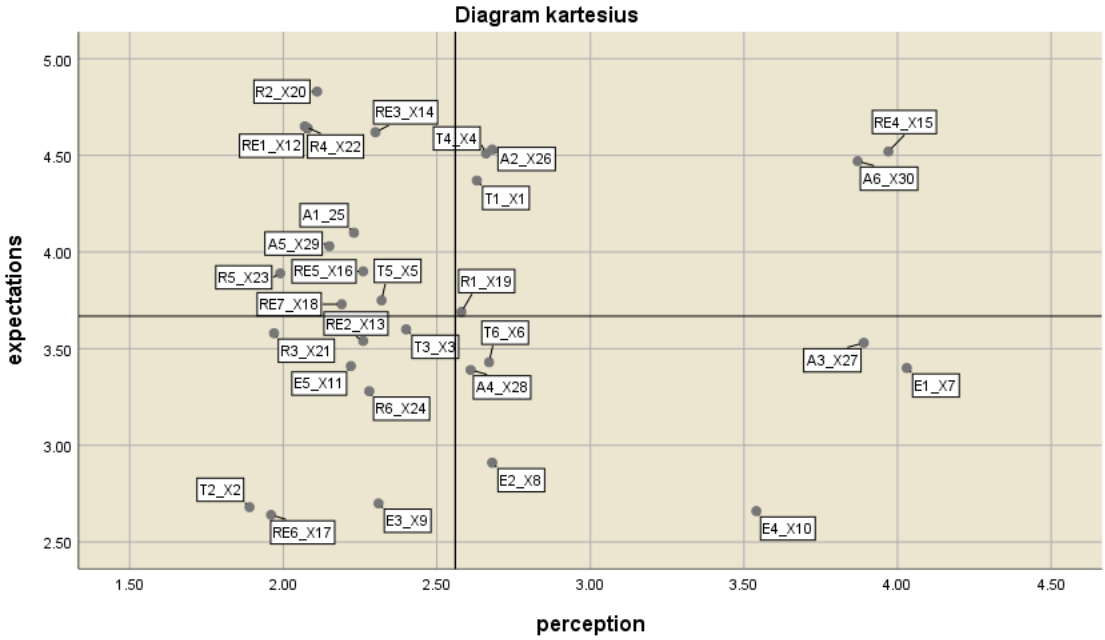

Figure 1. Cartesian diagram

(Source : Research data processing, 2022)

Based on the result visualization of the Cartesian diagram, quadrant I is obtained, namely 10 attributes including T5-X5, RE1-X12, RE3-14, RE5-X16, RE7-X18, R4-X22, R5-X23, R2-X20, A1-X25, A5- X29. This means that these attributes according to the patient are considered very important but in reality or reality, they are not in line with expectations. For this reason, the quality of this attribute needs to be improved. While the attributes T1-X1, T4-X4, RE4-X15, R1-X19, A2-X26, and A6-X30, are in quadrant II (6 attributes), this indicates that these attributes are following the expectations of the patient so they need to be maintained. In quadrant III there are 8 Attributes, namely T2-X2, T3-X3, E3-X9, E5-X11, RE2-X13, RE6-X17, R3-X21, R6-X17, R3-X21, R6-X24 which indicate the item considered less important to the patient and the services provided are considered ordinary. For the attributes in quadrant IV, there are 6 attributes, namely T6-V6, E1-X7, E2-X8, E4-X10, A3-X27, and A4-X28. this means the item is considered less important to the patient but the services provided are too excessive.

4. Conclusion

Based on the results of data processing that has been carried out by researchers, it can be concluded that The quality of the health services of Hospital XYZ is rated as good, but there are some things to consider, including:

a. The results of the Servqual Method analysis were obtained from 30 attributes that were judged to have 3 positive values, namely the Dimension Assurance attribute A3-X27 (Guarantee that the confidentiality of patient information (social identity and patient condition) can be maintained properly), Empathy attributes E1-X7 (Doctors listen to complaints about the disease suffered by the patient and can provide a way out) and E4-X10 (Doctors and nurses provide enthusiasm and motivation to patients) while the other 27 attributes are negative. The three attributes with the highest negative value are: the dimensions of responsiveness R1-X20 (patient registration can be done online), R4-X22 (patient waiting time to get outpatient services is less than 60 minutes), and Reliability on the RE1-X12 attribute (Doctor arrival and medical action according to schedule)

b. The results of the analysis using the IPA method obtained 10 attributes that exist in quadrant I which are priorities that must be repaired immediately on the Tangible dimensions T5-X5, Reliability RE1-X12, RE3-14, RE5-X16, RE7-X18, Responsiveness R4-X22, R5-X23, R2-X20, and Assurance A1-X25, A5-X29.

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DEVELOPMENT STRATEGY FOR KODIKLATAL ADMINISTRATIVE ASSISTANCE EDUCATION CENTERS TO IMPROVE THE QUALITY OF EDUCATIONAL RESULTS

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ABSTRACT

The Indonesian National Armed Forces as the front line of national defense must implement policies that are in line with those conveyed by emphasizing on the ranks in order to carry out appropriate budgetary activities, especially those that are right on target for predetermined uses. The use of the budget must optimize the control side of activities, the fulfillment of the procurement of goods and services as well as the maintenance of defense equipment and the fulfillment of targeted supplies, as well as personnel management and updating of educational institutions. The Center for Administrative Assistance Education, Kodiklatal is an instructive institution for the Naval force which is the center for authoritative help instruction and has an imperative part in regulatory help instruction. The reason of this consider was to decide elective techniques for creating authoritative help instruction centers in arrange to move forward the quality of prepared warriors utilizing the SWOT strategy. The comes about of the distinguishing proof are 15 (fifteen) inner variables with 8 (eight) quality variables and 7 (seven) shortcoming variables, and 15 (fifteen) outside components with 8 (eight) opportunity components and 7 (seven) risk components. By weighting all factors, the chosen methodology may be a strength-threat procedure which suggests maximizing the change of debilitating variables by utilizing qualities within the frame of concentric expansion, with 5 (five) ST methodologies produced.

Keywords **:** SWOT, education, administrative assistance

1. INTRODUCTION

The Navy is a system formed from sub-systems that must be maintained in readiness with the right coaching method so that it can be used in various operations (Marsetio, 2014). Various threats that occur in the world today require the TNI, especially the Navy, to be ready in all parts, to administrative and logistical assistance in various conditions, to carry out all forms of operations, to protracted war situations such as the example currently happening in various countries. countries in the world. In addition, the Covid-19 virus pandemic, which has even developed in various variants and has been felt by all countries in the world, has become a scourge for all elements of society, including the TNI, which is actually required to participate actively in supporting the government to prevent the transmission of the epidemic. the. The competence of all TNI soldiers at all strata is very much needed, to master and be ready from the start to enter the field of duty, according to their respective expertise in all units. This is largely determined by the education process and intense training undertaken by each TNI personnel in their respective fields from all educational strata.

In the Navy Leadership Meeting held in March 2022, the Chief of Staff of the Navy conveyed the importance of evaluating the work program of the previous years as a joint evaluation and introspection to improve the performance of the Navy. As the front line, the TNI as the front line of national defense must implement policies that are in line with those conveyed by the President, the Minister of Defense, and the Commander of the TNI, with emphasis on the ranks in order to carry out appropriate budgetary activities, especially on target for predetermined uses. . The use of the budget must optimize the control side of activities,

the fulfillment of the procurement of goods and services as well as the maintenance of defense equipment and the fulfillment of targeted supplies, as well as personnel management and updating of educational institutions.

Referring to the policy points of the leadership above, Command for Education and Training Doctrine of the Navy as a place of education for Indonesian navy soldiers, has one educational center, Administrative Assistance Education Center, which is located directly under the General Support Education Command, as an institutional unit. education that carries out the educational function of administrative assistance, with the task of coordinating, supervising, and controlling the schools under it, as well as fostering strength including its organic supporting facilities and infrastructure. As it were so distant, the concept of considering that has been connected until presently is still restricted to the application of financial variables and the viability of how in carrying out each operation one can get ready each movement at the least taken a toll as required, solid, and with adequate supplies, as well as with upkeep and other needs. as characterized prerequisites, how and when to move assets to where they are required, as well as supply chain administration amid operations managing with certain factors to anticipate costs, quality debasement, utilization, and ensuing request. However, the things mentioned above have not been followed by the development of the developing situation, for example, where the development of various software for the latest financial administration and supply administration activities in the government environment, where the TNI as one of the implementing elements of the State Revenue and Expenditure Budget must be able to follow and implement it. Then, the development of treasury science to internal supervision of institutions, Administrative Assistance Education Center still does not have certified educators and fully masters the field, causing the knowledge provided is still not in accordance with current developments, which results in many being found in the field of soldiers resulting from Administrative Assistance Education Center students who have just been assigned, must learn from the beginning again to be able to understand, follow and carry out their duties and responsibilities in financial and supply administration properly in their respective units.

From the three schools, each school has a different duration of time for each educational program. And the current conditions of Administrative Assistance Education Center related to the 10 components of education in accordance with the 2021 Administrative Assistance Education Center Development Report include :

a. The current education curriculum in the Administrative Assistance Education Center ranks, for example in the lessons of the treasury management system which still does not refer to current developments, so it is necessary to improve the curriculum according to the demands of the posture and criteria for the latest treasury administration system personnel.

b. Instruction packages to support students in teaching and learning activities are still lacking and there are still instruction packages that are invalid/not in accordance with the latest developments, for example in the development of the latest treasury system.

c. There is still a lack of qualified educators to educate students in Administrative Assistance Education Center, especially to teach material on financial administration and supply management.

d. There are still many Education Personnel in the ranks of Administrative Assistance Education Center, especially for several positions in organizational staff and schools, as well as the lack of qualified personnel to guide students in the

Administrative Assistance Education Center environment.

e. There are still students who do not master the required field of work when they are involved in the assignment.

f. Shortage of instructional instruments and instructional assists including computers that support the latest treasury system.

g. Teaching methods at Administrative Assistance Education Center have not utilized E-Learning technology which is one of the needs that must be mastered well by personnel involved in educational institutions faced with current technological advances.

h. Evaluation of learning outcomes that still have indications that are not balanced and real with the reality on the ground.

i. Some classroom buildings and accommodation mess buildings are old buildings and need renovation.

j. The budget for needs is not in accordance with the operational needs of education.

Given the importance of the Navy's readiness to carry out tasks according to the constitution and the development of the situation above, faced with various problems with the conditions of the Administrative Assistance Education Center, it is deemed necessary to carry out research on the strategy for developing the Administrative Assistance Education Center (Administrative Assistance Education Center) in the provision of education which refers to 10 (ten) components of education, in order to improve the quality of students who are superior and professional, in dealing with the problems above, as well as the challenges and threats faced today. The target of this research is to find a development strategy in the implementation of education in Administrative Assistance Education Center which still refers to the parameters of the 10 (ten) components of education, in dealing with the various problems above, as well as to improve the quality of the trained soldiers who are ready to face the challenges and threats that will be faced. since entering the field of their respective assignments. With the priority of research that everything that will be carried out in this study aims to make Administrative Assistance Education Center able to fix all parts of the process of providing education in a proportional and sustainable manner, so that it is hoped that Administrative Assistance Education Center will be able to improve the quality of its students in their respective fields, especially in facing the current developments.

There are several steps used in formulating a development strategy to improve the quality, capability and effectiveness of the implementation of the main tasks of Administrative Assistance Education Center in improving the quality of the trained soldiers. It begins with system thinking to analyze in general all stakeholders involved in the education implementation process at Administrative Assistance Education Center from the highest level to the lowest level, so that it can be clearly illustrated how to determine the steps to be taken in responding to the problems that occur. After analyzing the relevant stakeholder system, then determining the right strategy using the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis method, where the priority of this method is to obtain conceptual policy strategies that best.

The objectives to be achieved in this study are to identify external and internal factors to find the development strategy of Administrative Assistance Education Center to answer the problems that occur referring to 10 (ten) education components, then determine the priority of the Administrative Assistance Education Center development strategy in order to determine the best preferential strategy.

2. MATERIALS AND METHODOLOGY

2.1. Systems Analysis Theory

Concurring to Satzinger (2012), frameworks examination is an action that permits one to recognize and indicate what the unused framework ought to accomplish. Frameworks investigation is more than fair a brief explanation of the issue. For illustration, the administration must be able to track clients, enroll items, screen guarantee, and track levels of benefit and other capacities. System analysis explains in detail what the system must achieve according to the needs and how to solve a problem. There are 5 activities in conducting system analysis:

a. Gather detailed information, system analysis obtains information from people who will use the system, information is obtained either through interviews or seeing how it works.

b. Define requirements, analysts use the combination of information from implementing activities and documents to determine the latest system requirements.

c. Prioritize requirements, after all needs are met, it is important to determine which needs are the most important for implementing activities.

d. Develop user interface dialogs, by developing a new system to replace the old system, it is important to make the implementer of activities responsive to the new appearance of a system.

e. Evaluate requirements with users, it is important to evaluate the new system with the implementing activities and document everything for the sake of developing a good system in the future. In this study, the author will conduct a system analysis of stakeholders involved in the implementation of education at Administrative Assistance Education Center, Kodiklatal Surabaya, in order to clearly determine strategies to answer the problems that exist in this study.

2.2. Stakeholder Theory

Stakeholders or also called stakeholders are parties who can influence or receive the impact of the decisions taken (Freeman, 1984). Another meaning of partners is as a community, both exclusively and in bunches, who have authenticity, control, and intrigued within the victory of the company (Chandra, Indarto, Wiguna, & Kaming, 2011). In other words, partners have an enormous part and impact on the maintainability of the company. In this study, referring to various references to work instructions and rules as well as the results of interviews with officials and staff at Administrative Assistance Education Center, a scheme for the stakeholders/stakeholders from the implementation of the entire education program at Administrative Assistance Education Center can be made, as follows

a. The top command in this case the Navy Education Service

All related departments in the Naval Education Office, which are directly under the leadership of the Navy, formulate policies for all education within the Navy organization education in the field of Administrative Assistance in the Navy.

b. Command for Education and Training Doctrine of the Navy.

All relevant Directorates and staff who are indirectly responsible for the entire implementation of education at the Kodiklatal in this case education in the field of Administrative Assistance in the Navy.

c. General Support Education Command

The entire Department and related staff are indirectly responsible for the entire implementation of education at General Support Education Command in this case education in the field of Administrative Assistance under General Support Education.

d. Administrative Assistance Education Center

All Administrative Assistance Education Center officials and staff who are directly responsible for the

implementation of all educational programs at Administrative Assistance Education Center.

e. Instructor. All instructors of all educational programs at Administrative Assistance Education Center that have been prepared.

f. Student All students from all strata and groups who are studying at Administrative Assistance Education Center.

g. Users. In this case, work units directly receive students trained by Administrative Assistance Education Center and feel how capable the soldiers trained at Administrative Assistance Education Center are after entering service.

2.3 Stakeholder Analysis

According to Satzinger (2012) activity diagrams describe the various user activities in a system, the people who perform each activity, and the sequential flow of activities. Activity Diagrams use many symbols such as :

a. Oval, symbolizing individual activities in the work flow.

b. Connecting arrow, represents the sequence between workflow activities.

c. The black circle, symbolizing the beginning and the beginning of a workflow.

d. Diamond, symbolizing decision-making points in the workflow.

e. Heavy solid line, is a synchronization bar which separates one line into many lines or combines many lines into one.

f. Swimlane heading, symbolizing the main agent.

From the explanations of the three theories above, an analysis of the stakeholder system is described in the process of providing education at the Administrative Assistance Education Center :

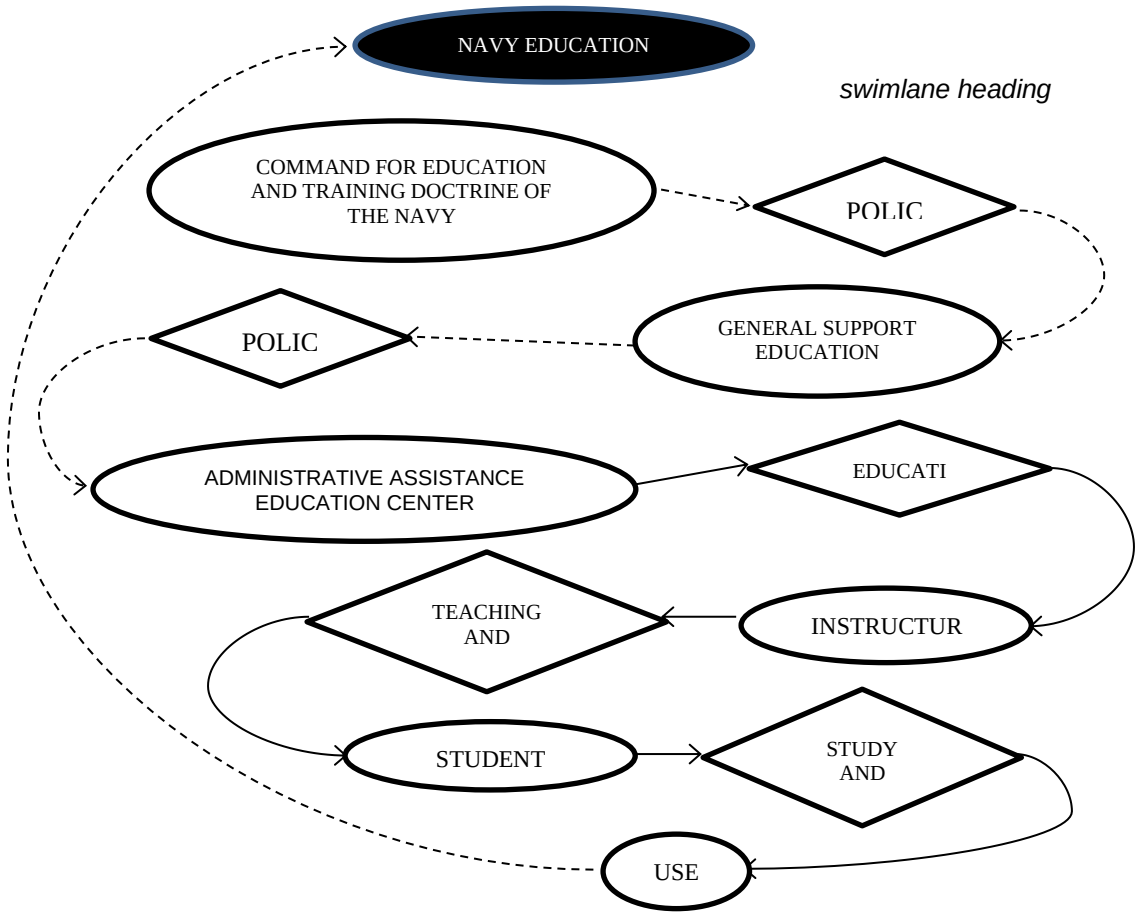

Figure. 1 Activity Diagram of Stakeholder System Analysis

2.4 Strategy Theory

The procedure may be a word with numerous implications that are pertinent and valuable to those entrusted with setting techniques for companies, businesses, or organizations (Özleblebici, et al., 2015). Strategy comes from the Greek word strategy which implies an arrangement to destroy the adversary by utilizing assets viably (Athapaththu, 2016). The advancement technique incorporates a detailing work in considering outside and inside variables in organizational conditions. Methodology detailing incorporates exercises to create an advanced commerce mission and vision, distinguish viewpoints of organizational openings and dangers remotely, decide angles of managerial qualities and shortcomings inside, decide long-term corporate objectives, plan elective organizational techniques, and define chosen procedures for advancement (Fariyatul, 2017).

Within the military circle, technique alludes to a common arrangement of assault or defense. In this case, it includes courses of action made sometime recently really lock in the foe and plan to hurt that adversary. In this setting, the procedure is concerned with the sending of assets. As a result, there are continuously two adaptations of a given methodology: (1) technique as mulled over or expecting, and (2) procedure as realized (Özleblebici, et al., 2015). These days, military qualities go up against various challenges around the world.

2.5 SWOT Analysis

The SWOT strategy is the foremost common strategy that can be utilized to analyze strategic cases. SWOT could be an apparatus that's regularly utilized to analyze the inside and outside environment to attain an orderly approach and support for choice circumstances. SWOT is an acronym for qualities (S), shortcomings (W), openings (O), and dangers (T). The primary two components (qualities and shortcomings) relate to the inner components of the organization, whereas openings and dangers cover the more extensive setting or environment in which the substance works.

2.6 Ten Components of Education

The pattern and structure of the Education of Indonesian navy Soldiers refers to the 10 (ten) Educational Components, which are the design of education as a series of vertical and horizontal education arrangements and administrations and are arranged based on the spectrum of assignments, strata/position/class and qualifications of personnel. which will be projected on the current and subsequent assignments. This component refers to the main components of education consisting of input, process, output, environmental, and outcomes (Sudjana, 2010).

The Education Components listed in the Regulation of the Commander of the Indonesian National Armed Forces No. Perpang/51/IX/2008, concerning the Instruction Manual for the Education of Indonesian National Army Soldiers, includes :

a. The educational modules may be a set of subjects and instructive programs given by an instructive institution that contains lesson plans that will be given to lesson members in one period of instruction level.

b. The Instruction Package is the completeness of educators in their readiness to provide subject matter in order to achieve curricular/lesson goals that contain teaching materials directed at achieving instructional goals.

c. Educators are personnel in charge of providing knowledge, skills and the formation and development of personality through teaching, training and nurturing/guiding efforts.

d. Educational Personnel are all organic

personnel of educational institutions who are directly or indirectly involved in the operational implementation of an education who fill structural positions in educational institutions and have the same status as staff personnel in general.

e. Students are personnel who are carrying out learning tasks at the officer, non-commissioned and enlisted levels organized by educational institutions in tiered or non-tiered.

f. Instructional Tools and Instructional Assistance Tools.

1) Instructional tools are equipment used in education to: acquire certain skills, describe or demonstrate a process or concept so that students get the desired knowledge, and create a situation or environment that students can use to practice knowledge and skills.

2) Instructional aids are equipment used for the functioning of an instructional device. In the implementation of education, it is possible to have equipment that functions as an instructional tool, but it can also function as an instructional assistant. Vice versa, equipment that functions as a tool to help instructions but also functions as an instructional tool.

g. Teaching Method is a way of delivering teaching materials in the implementation of education. The teaching methods in detail are as follows:

1) Centered on Educators include: Lectures, Lectures and Instructions.

2) Student-centered includes: reading assignments, student presentations, discussions, seminars, participant exercises, simulations, research and assessments, case studies, formal debates and tutorials.

h. Educational Evaluation. It is a tool to measure the development level of students as well as the level of efficiency and effectiveness of the curriculum.

i. Educational facilities are buildings and their equipment and other facilities where education is held, the development of which is regulated in accordance with the provisions concerning the logistics development of the Indonesian National Armed Forces in force.

j. The Education Budget consists of three components:

1) Fixed costs, which are maintenance costs, the amount of which is adjusted to the respective Lemdik assets.

2) Variable costs according to the index, namely the operating costs of education, the amount of which is adjusted to the number of classes and the length of education based on the index.

3) Variable costs of operating instructional tools, determined according to the needs of an education.

3. RESULT AND DISCUSSION

3.1 Criteria Identification

The investigation arrange starts with information collection by conducting interviews with eleven Master staff which speaking to from each partner (E1; E2; E3; E4; E5; E6; E7; E8; E9; E10; E11) within the advancement of the Regulatory Help Instruction Center. Respondents in this essential information collection are specialists and official officers who have competence in their areas and are prepared with official involvement and have a vital introduction of considering approximately the improvement of the Authoritative Help Instruction Center with all the issues in it and it is anticipated that discernment information the legitimacy of the respondents can be met.

3.2. Strategy Formulation

Based on the examination of inner variables gotten 15 (fifteen) inner components with 8 (eight)

quality components and 7 (seven) shortcoming components and 15 (fifteen) outside components with 8 (eight) opportunity variables and 7 (seven) danger components. This area examines the investigation of the comes about of the weighting of criteria and elective techniques for creating Authoritative Help Instruction Center utilizing EFI and EFE weighting through the utilization of surveys given to partners in the Regulatory Help Instruction Center advancement technique.

3.3. Internal Factor Evaluation (EFI) Matrix

Table 1. Internal Factor Weighting

STRENGTH					
NO	FACTOR	ACCUMULATIVE VALUE	WEIGHT	RATING	SCORE (W X R)
1.	Support for the vision and mission of the Administrative Assistance Education Center for the achievement of the Indonesian Navy vision and mission.	34	0,066	1,782	1,848
2.	The work program of the Administrative Assistance Education Center in supporting organizational development in the Navy.	35	0,068	1,370	1,438
3.	Organizational and managerial performance within the Administrative Assistance Education Center supports the organization.	35	0,068	1,287	1,354
4.	Conformity of the workload index value of the Administrative Assistance Education Center personnel with the organization's inside.	35	0,068	1,763	1,831
5.	The work spirit of the educators and teaching assistants of the Administrative Assistance Education Center.	35	0,068	3,311	3,379
6.	The existence of practical exercises to improve the quality of student outcomes.	35	0,068	3,659	3,727
7.	Student's ability to interact with developing technology.	35	0,068	3,311	3,379
8.	Internet network support that can be accessed by both students and personnel.	35	0,068	3,659	3,727
	Total	279			20,683

WEAKNESS					
NO	FACTOR	ACCUMULATIVE VALUE	WEIGHT	RATING	SCORE (W X R)
1.	The existence of the Administrative Assistance Education Center and the Schools under it are currently in the face of developments and technology.	32	0,062	2,686	2,748
2.	Competence of educators & teaching assistants Education Center for Administrative Assistance supports the teaching and learning process.	34	0,066	3,000	3,066
3.	The number of teaching staff & teaching assistant staff at the Administrative Assistance Education Center in carrying out the main task to the maximum.	35	0,068	1,782	1,850
4.	Readiness of facilities and infrastructure to support the implementation of education and training such as buildings, messes, sports facilities.	34	0,066	2,065	2,131
5.	Readiness of e-learning based teaching methods.	34	0,066	1,782	1,848
6.	The suitability of the instruction package is faced with the development of the outside situation.	34	0,066	1,782	1,848
7.	Instructional tools / instructional support tools, especially hardware and software according to the latest standard rules.	34	0,066	1,782	1,848
	Total	237			15,339
	Total of accumulative value	516			

Weighting is done to discover how much impact or effect these components have on the procedure itself. The illustration for the evaluation of the quality figure (S) sub-criteria no. 1 is gotten from adding up to the appraisal of respondent's answers is 34. The figure is 516 (from 279+237). Though the weight of the quality sub-criteria no.1 is gotten from the value in column 1 partitioned by the entire number of appraisals, (weight = 34/516 = 0.066).

3.4 External Factor Evaluation (EFE) Matrix

Table 2 External Factor Weighting

OPPORTUNITIES					
NO	FACTOR	ACCUMULATIVE VALUE	WEIGHT	RATING	SCORE (W X R)
1.	The influence of government programs, world maritime axis demands the readiness of defense equipment and crews.	38	0,083	2,075	2,158
2.	The development of situations and conditions outside the very dynamic of the organization.	36	0,078	1,782	1,861
3.	Validation of organizations within the Navy to the organization of the Administrative Assistance Education Center itself.	37	0,081	2,354	2,434
4.	Interaction/cooperation relationship with other related institutions both at home and abroad for the Administrative Assistance Education Center.	37	0,081	1,613	1,693
5.	The ability of the government's budget in the defense sector, especially for education within the Navy.	38	0,083	1,948	2,031
6.	Preparation of human resources in the national strategic industry independence program for student outcomes.	36	0,078	2,000	2,078
7.	The development of the internet world is increasingly rapid in increasing good knowledge to personnel and students.	36	0,078	1,782	1,861
8.	The influence of the country's geopolitical conditions on students and personnel.	35	0,076	1,736	1,812
	Total	293			15,929

THREAT					
NO	FACTOR	ACCUMULATIVE VALUE	WEIGHT	RATING	SCORE (W X R)
1.	The existence of the Administrative Assistance Education Center and the Schools under it are currently in the face of developments and technology.	17	0,037	3,510	3,547
2.	Competence of educators & teaching assistants Education Center for Administrative Assistance supports the teaching and learning process.	25	0,054	2,830	2,885
3.	The number of teaching staff & teaching assistant staff at the Administrative Assistance Education Center in carrying out the main task to the maximum.	26	0,057	3,142	3,199
4.	Readiness of facilities and infrastructure to support the implementation of education and training such as buildings, messes, sports facilities.	24	0,052	3,061	3,113
5.	Readiness of e-learning based teaching methods.	25	0,054	3,603	3,657
6.	The suitability of the instruction package is faced with the development of the outside situation.	29	0,063	2,318	2,381
7.	Instructional tools / instructional support tools, especially hardware and software according to the latest standard rules.	20	0,044	3,603	3,646
	Total	166			22,428
	Total of accumulative value	459			

Weighting is done to discover how much impact or effect these variables have on the technique itself. Illustration for the appraisal of the openings calculate (O) sub-criteria no. 1 is gotten from add up to the appraisal of respondent's answers is 38. The entire evaluation of each quality and shortcoming calculate is 459 (from 293+156). Though the weight of the quality sub-criteria no.1 is gotten from the value in column 1 partitioned by the whole number of evaluations, (weight = 38/459 = 0.083).

3.5 Recapitulation of the calculation results of the EFE / EFI matrix

Based on the comes about of calculations that have been carried out through SWOT framework examination, the ultimate esteem of outside variables, openings and dangers, and inside

variables, qualities, and shortcomings, is obtained, as appeared within the table underneath :

Table 3. EFE / EFI Matrix Calculation Results

NO	FACTOR	VALUE
1	**Internal Factor**	
	Strength	20,683
	Weakness	15,339
2	**External Factor**	
	Opportunities	15,929
	Threat	22,428

At that point orchestrated a cross technique between variables or a SWOT framework to decide the chosen procedure to be utilized in issue fathoming. Through the technique quadrant, the chosen elective technique is gotten from the contrast between each calculation as appeared within the taking after table :

Table 4. Analysis of the intersection of the lines of the SWOT matrix

S W O T				X axis	Y axis
S	W	O	T	(S – W)	(O – T)
20,683	15,340	15,929	22,428	5,343	-6,500

From the picture over, it can be seen that the technique for creating the Authoritative Help Instruction Center to progress the quality of understudy results is in quadrant IV.

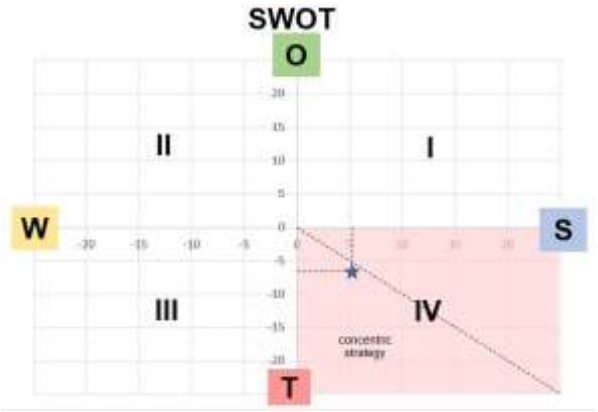

Figure 2. SWOT Kuadrant

The crossing point position in quadrant IV distinguished conditions that bolster the utilization of the concentric broadening procedure which procedure to include unused things related to maximizing the advancement of undermining variables by utilizing existing strengths. From the comes about of making the Strength-Threat methodology concept, interviews were carried out with specialists to approve the S-T technique that had been conceptualized. From the comes about of interviews with specialists, 5 S-T methodologies were chosen, to be specific ST 1, ST 2, ST 3, ST 4, and ST 5 strategies.

Table 5. Strategies ST

CODE	STRATEGY
ST 1	Maintaining and increasing support and implementation of the vision and mission of the Administrative Assistance Education Center by fully responding to the needs of administrative assistance personnel in the field so that they are ready to serve in their respective fields.
ST 2	Maximizing the implementation of work programs to support the organization of the Navy, especially in leadership policies that are now very concerned about rotation and assignments, especially for educators and teaching assistants.

ST 3	One of the ways to improve performance and managerial skills is by involving outside experts in teaching students and in organizational development to be able to keep up with updates in the field of administrative assistance in accordance with the development of various external regulations.
ST 4	Maintain and increase the enthusiasm and loyalty of personnel, both students and staff of the Administrative Assistance Education Center, to prepare themselves to face the challenges of the times, both from outside and individually.
ST 5	Improving the quality and quantity of practical training in accordance with technological developments as well as updating various software and hardware to be ready to meet the needs of personnel in developing a new organization within the Indonesian navy.

4. CONCLUSION

Based on the results of the research that has been done, conclusions :

a. The variables that can be distinguished within the SWOT examination in defining the technique for creating the Regulatory Help Instruction Center are 15 (fifteen) inner variables with 8 (eight) quality variables and 7 (seven) shortcoming components and 15 (fifteen) outside components with 8 (eight) opportunity variables and 7 (seven) danger components.

b. Based on the comes about of the detailing of the technique for the improvement of the Authoritative Help Instruction Center utilizing SWOT examination, it produces a point of the crossing point of inner and outside components to the Lattice Space quadrant, the point (5,343; -6,500) is found in quadrant IV. Quadrant IV is indistinguishable from the concentric expansion quadrant where this procedure includes unused things related to maximizing the change of undermining components by utilizing existing qualities. The technique concept in quadrant IV utilized is the ST procedure (Strength-Threat) with five elective need techniques.

ACKNOWLEDGEMENT

Improvement Procedure for Regulatory Help Instruction Center could be a shape of reaction to the advancement and approval of the Navy's organization. This investigation is anticipated to be one of the contemplations and inputs within the decision-making preparation. The subject of the research consider is communicated in factors that speak to the organization with the point of not causing negative discernments. Thank you to the institutions that have given back and the opportunity for analysts to supply input on their thoughts and to honorable authorities and administrators so that this paper can be composed this may be organized.

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COMPOSITE DEVELOPMENT STRATEGY IN THE NATUNA AREA COASTAL DEFENSE IN SUPPORTING THE MAIN TASKS OF THE INDONESIAN ARMED FORCE

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ABSTRACT

The Unitary State of the Republic of Indonesia is the largest archipelagic country in the world, where its geographical constellation which is in a cross-world position places the sea area of national jurisdiction very strategically for both Indonesia and for other countries. The State Defense Policy of 2020 set by the Minister of Defense of the Republic of Indonesia formulates that the implementation of National Defense is carried out in a directed, measurable, transparent and accountable manner, demanding the establishment of a Universal People's Security Defense System (Sishankamrata) through efforts to manage national resources which include all human resources, human resources and human resources. natural resources, artificial resources and national infrastructure throughout the territory of the Republic of Indonesia as a defense unit in overcoming threats. Composite Company capabilities can still be developed by increasing the strength and capabilities of composite companies and optimizing the degree pattern. The Composite Company development strategy can be started by first studying the potential threats that may be in the future and analyzing the condition of the Composite Company which must be improved to create national maritime security. Based on these problems, this research offers a strategy for developing a composite company in maintaining national marine security that takes into account potential threats in the future. In this study, the authors analyzed the problem using the SWOT method. The SWOT method is used to formulate the main strategy for the development of Composite Companies in the face of national maritime security threats, used to analyze the implementation of the Composite Company development strategy in the face of national maritime security threats. The AHP method is used for decision making involving a number of criteria and alternatives selected based on consideration of all related criteria are used to determine the priority scale of the strategy to be implemented for the advancement of the Navy.

Keywords: Strategy, Composite Company, SWOT Method, Analytical Hierarchy Process (AHP) Method

1. INTRODUCTION

The Unitary State of the Republic of Indonesia is the largest archipelagic country in the world, where its geographical location which is in a cross-world position places the territorial sea of national jurisdiction very strategically both for Indonesia and for other countries. In addition to Indonesia's strategic geographical position, the Indonesian navy's Hydro Oceanography Centerstates that Indonesia has 17,508 islands, 6.40 million km² of Indonesian waters, 0.29 million km² of territorial waters, 3.11 million km² of archipelagic waters, and the exclusive economic zone. 3.00 million km², Indonesia's land area 1.90 million km², Indonesia's area of 8.30 million km², Indonesia's coastline length of 108.000 km (Pushidrosal, 2018).

Figure 1. Indonesian Teritorial

Indonesia is the largest archipelagic country in the world which is located between two oceans and two continents which makes its waters become

one of the arteries of international trade.In the development of the strategic environment, this has an impact on military threats from outside. As a sovereign state, it must prepare a strong national defense system in order to maintain the integrity and sovereignty of the Unitary State of the Republic of Indonesia (NKRI). The development of the national defense system is faced with the vastness of the territorial waters leaving many vulnerabilities that can be a threat to the Unitary State of the Republic of Indonesia. In addition to the change in the national defense paradigm, there are vulnerabilities in strategic areas which, if not immediately fully controlled, can be exploited for the benefit of other countries.

Figure 2. Nine Dash Line Map

The State Defense Policy of 2020 set by the Minister of Defense of the Republic of Indonesia formulates that the implementation of National Defense is carried out in a directed, measurable, transparent and accountable manner, demanding the establishment of a Universal People's Security Defense System (Sishankamrata) through efforts to manage national resources which include all human resources, human resources and human resources. natural resources, man-made resources and national infrastructurethe territory of the Republic of Indonesia as a defense unit in overcoming threats. on national defense policy. In particular, the South China Sea (LCS) conflict has not yet shown a peaceful settlement in the medium term. The South China Sea conflict involves Southeast Asian countries such as the Philippines, Vietnam, Malaysia and Brunei Darussalam including Indonesia, this maritime boundary conflict is an issue that the Indonesian government pays attention to.

The South China Sea is a semi-enclosed sea area or a semi-enclosed area, if usually the land is surrounded by the sea in the South China Sea, the opposite is the sea surrounded by land. According to the international law of the sea, UNCLOS (United Convention on the Law Of the Sea) in 1982, states have the right to the sea, namely the territorial sea measured from the coastline as far as 12 miles, an additional zone of 24 miles and then there is an EEZ (Exclusive Economic Zone) as far as 200 miles. (Marsetio, 2014). To be able to realize security conditions at sea, there needs to be efforts to enforce sovereignty and law enforcement. In addition, there is a need for security control in the form of a pattern for the operation of the Navy's

forces. So that the problem of law enforcement at sea becomes one of the very important national issues, Indonesia's strategic role and awareness of the importance of the sea to improve the economy is an urgent need for Indonesia so that it requires a maritime concept that will bring a strong Indonesian economy. Maritime itself is a system that connects the global pulse of countries in the world and becomes the most important path in the continuity of the global economy. The meaning of the sea for the Indonesian people has four strategic meanings, namely: 1) As a natural resource and a medium for the national economy; 2) As a means of unifying the nation; 3) As a defense medium; 4) As a medium of communication. Indonesian waters are strategic for commercial activities, such as fishing, laying submarine cables and pipelines, exploiting oil and gas and conducting scientific research. However,

Several maritime security issues are quite prominent, and the concerns of the world community are: (a) High threats of violence, such as piracy, sabotage, and terror of vital objects; (b) navigational threats, such as shortages and theft of navigational aids; (c) resource threats, such as damage and pollution of the sea and its ecosystems; and (d) sovereign and legal threats, such as illegal fishing, illegal immigrants, illegal treasure hunting, illegal exploration and exploitation of natural resources, and smuggling of goods, people and weapons (Poerwowidagdo, 2015).

The South China Sea (LCS) is an international shipping lane that is quite dense and strategic and directly borders with countries in the Southeast Asian region with a high level of economic activity so that it has the potential for conflicts over natural resources. Faced with the development of the strategic environment, the possible threats faced in the region are maritime border issues, various forms of security disturbances and violations of law at sea, problems with Sea Line of Communication (SLOC) users and problems with ALKI I users as well as the influence of superpowers who feel competent in the area. the area. Viewed from the economic aspect, the use of marine areas and the use of marine resources around the border are factors that trigger conflicts between nations. this will have an impact on security and legal factors related to violations at sea, especially in border areas. As an archipelagic country, the potential of marine resources is very abundant and has strategic value for the sustainability of national development. In addition, the strategic position of the Indonesian state places Indonesian waters in a very important position and determines the smooth distribution of goods and services that are needed to support regional economic growth, thus providing realistic expectations to accelerate the process of national economic growth.

Indonesia as a country that has very rich marine natural resources, it can lure certain parties to exploit them illegally. This not only disturbs the stability of security at sea, the factual and actual challenges and demands following the development of science and technology encourage the advancement of weapons technology and changes in military tactics and strategies. It is estimated that threats and disturbances to Indonesia's defense interests in the future are classified into three types, namely military threats, both armed and unarmed, non-military threats and hydride threats. These threats are categorized in the form of real and non-real threats. Real threats can be 1) International terrorism, 2) Separatist movements, 3) Radicalism, 4) Communal conflicts, 5) Transnational crimes, 6) illegal immigration, 7) maritime security disturbances, 8) Air security disturbances, 9) Disease outbreaks , 10) Cyber attacks and espionage, 11) Drug trafficking and abuse. Meanwhile, the unreal threat itself is a form of threat in the form of open conflict or conventional war, with the presence of armed forces between countries.

But the threat is still a small possibility (Kemhan, 2015).

A number of maritime security threats in non-military contexts that often occur in Indonesia include: 1) Illegal fishing and related crimes, namely fraud, tax evasion of illegal fuel transactions; 2) Smuggling activities in maritime circles, namely drug smuggling, people smuggling, weapons smuggling, illegal goods smuggling, smuggling of agricultural products and similar commodities, technology smuggling; 3) Illegal immigrants; 4) Piracy and armed crime; 5) Terrorism; 6) Threats of technological developments, information systems; 7) Human rights violations, namely underage work, labor inequality, poor living conditions (Morris and Paoli, 2018).

In accordance with Article 9 of Law Number 34 of 2004 concerning the TNI, the duties of the Navy are as follows: 1) Carry out the duties of the Marine Corps in the defense sector; 2) Enforce the law and maintain security in the marine area of national jurisdiction in accordance with the provisions of national law, international law that has been ratified; 3) Carry out the task of Navy diplomacy in the context of supporting foreign policy policies set by the government; 4) Carry out the duties of the TNI in the development and development of the Marine Matra power; 5) Implementing the empowerment of marine defense areas.

This requires the Navy Composite Company to improve the professionalism of soldiers according to the function of their positions, supported by increased knowledge and modernization of defense equipment. Based on the consideration of future task challenges as a necessity in adapting to the development of science and technology and the strategic environment to achieve organizational goals. In the organizational structure of the TNI, it consists of units/organizations directly under the guidance of the Indonesian Armed Force Headquarters and units/organizations under the Army Headquarters up to the level of the TNI Naval Main Base. Changes in the strategic environment globally and regionally, following the development of global defense technology which is growing rapidly as it is today,

Faced with existing problems and vulnerabilities, there needs to be a change with the development of the coastal defense system through the formation of coastal defense units by theComposite CompanyNavy(Sekmilpres, 2019) which functions as a unitanti-access/buffer area (anti-access/area denial) to prevent, confront and thwart military operations or enemy attacks carried out by sea at several strategic choke points located in the Waters of the Indonesian National Jurisdiction,can provide fire reinforcement and protection to Kogasgabhantai in the context of the implementation of Opshantai and provide reinforcement for other military operations.

Indonesian Presidential Regulation Number 66 of 2019 concerning the Organizational Structure of the TNI and emphasized through the Regulation of the Commander of the TNI Number 49 of 2019 concerning the Organizational Principles and Procedures of the Navy Headquarters which states that the Marine Corps of the Indonesian navy is the TNI Operations Municipality as the main organizer of amphibious operations. , coastal defense operations and security operations for strategic outer islands within the framework of OMP and OMSP as well as other operations in accordance with the policy of the TNI Commander.

With the ratification of Presidential Decree No. 66 of 2019 concerning the Organizational Structure of the TNI, there is clarity on Duties and AuthoritiesThe Indonesian navy Composite Company in the implementation of coastal defense requires regulation, adjustment and development of the coastal defense system according to the development of existing threat factors, as well as

adjustments to the concept of national defense, namely the implementation of the management of defense areas through the realization of defense strengthening at choke points or strategic straits. . In line with this, the form of coastal defense is divided into two, namely coastal defense as a form of defense operation that is carried out continuously through supervision and control of water areas and coastal defense as a form of combined coastal defense operations.

This aims to maintain sovereignty and wealth as well as a form of government responsibility in maintaining shipping safety and maritime security. The Unitary State of the Republic of Indonesia as the largest archipelagic country in the world that has abundant natural resources that can actually make this country a super power country as well as preparing coastal defense operations on the outermost/strategic islands that are prone to threats from within and outside the country. Implementation of defense operations for the Navy base in accordance with situational developments. Develop a combat force plan in order to meet the needs of combat operations forces. Develop an action plan to deal with contingency situations based on the Kasal policy. Coordinate and cooperate with relevant agencies and agencies inside and outside the Navy for the smooth implementation of main tasks. Submitting considerations and suggestions to Kasal regarding matters related to his field of duty. In order to carry out the basic objectives and military strategy of the Indonesian navy.

The strategy of developing an organization requires strategic steps that can be applied in the strategic policies of the Navy. Strategic policy is the determination of the direction of an organization to achieve future goals. The SWOT concept is used as a determination of the Intensity value score possessed by the sub-components in each component carried out by*Stakeholders*, in this case the researcher determines the Composite Company Commander as*expert*In determining the priority scale, the SWOT analysis is used as a strategy formulation to obtain alternative strategies from Internal and External factors.

The Analytical Hierarchy Process (AHP) method is a decision-making method that involves a number of criteria and alternatives that are selected based on the consideration of all related criteria used to determine the priority scale of the strategy to be implemented first to improve the technological components of concern to be improved.(saaty, 2004). It is hoped that this method is able to provide development recommendations so that the right strategy stages can be obtained for the development of composite companies in the Natuna area. From the results of the selected strategic priorities, it will be able to formulate a*Roadmap*within a period of 5 (five) years which will be used as a guideline in the development of a Composite Company in the Natuna area to support the main tasks of the TNI in the South China Sea. From the results of this study, it is hoped that it can help provide advice and input to the leadership of the Indonesian navy in the development, development of the Natuna Composite Company in the future.

2. RESEARCH METHODOLOGY

The model design of this research can be presented in the form of input, process and output diagrams that describe the research process starting from obtaining data, processing data, analyzing and evaluating the results / outputs of research data. At the initial stage, input and identification of data variables are carried out that affect the optimization of the composite company's ability in the Natuna area, then in the process stage an analysis and strategy of optimizing the composite company's ability in the Natuna area is carried out in the face of marine security threats. In this process, all variables as a system are included

as variables that interact with one another. The integration of several theoretical concepts and methods is applied to the assessment of threat criteria,

2.1 SWOT METHOD

In this study, the SWOT or Strength (S), Weakness (W), Opportunity (O) and Threat (T) analysis methods were used to identify and formulate several main strategies for developing posture capabilities in the face of national maritime security threats. This SWOT stage consists of several steps, namely: (1) identifying/determining Internal factors consisting of strengths and weaknesses of the composite company; (2) identify/determine External factors consisting of opportunities and threats for the development of a composite company. Illustration of the identification of external factors and internal factors

The variable identification process is carried out by conducting open interviews with experts to identify internal factors and identify external factors, then the data is processed to obtain the Strength (S), Weakness (W), Opportunity (O) and Threat (T) factors. After obtaining the Strength (S), Weakness (W), Opportunity (O) and Threat (T) factors, the SO (Strength-Opportunity) strategy matrix was prepared; determination of WO (Weakness Opportunity) Strategy; determination of ST Strategy (Strength-Threat); determination of WT (Weakness-Threat) Strategy. Illustration of matrix arrangement

After the Strategy Matrix is formed, it is followed by compiling the compilation of the main strategies and mapping the main strategies to be able to sort out the main strategies based on the category of capability development strategy, strength development strategy and degree pattern development strategy. Main Strategy Compilation and Mapping Illustrations.

SWOT analysis, after obtaining several sub-strategies, a model and hierarchical level were formed to determine priorities for the selected sub-strategies using an approach to optimizing the ability of composite companies in the Natuna area. The results of the SWOT analysis were carried out by a questionnaire to determine the relationship or interest between one sub-strategy and another sub-strategy using the AHP method approach to determine strategic priorities and a strategic road map.

2.2. RESEARCH FLOWCHART

In this study there are several stages to achieve the expected goals. Starting with the problem identification stage and collecting data taken from books, journals, field studies, as well as questionnaires onexpertchoice. Then proceed with the identification and formulation of strategies. In this research.

3. RESULT AND DISSCUSSION

This chapter will discuss the results of data analysis and interpretation based on the results of questionnaires and interviews from experts regarding internal factors containing strengths and weaknesses, as well as external factors containing opportunities and threats that most influence the posture development strategy in supporting the main tasks of the Indonesian navy. The first step in this research is to use a SWOT analysis to identify and formulate several composite company development strategies. Next, the AHP method is used to determine strategic priorities and a composite company strategy road map to support the TNI's main tasks

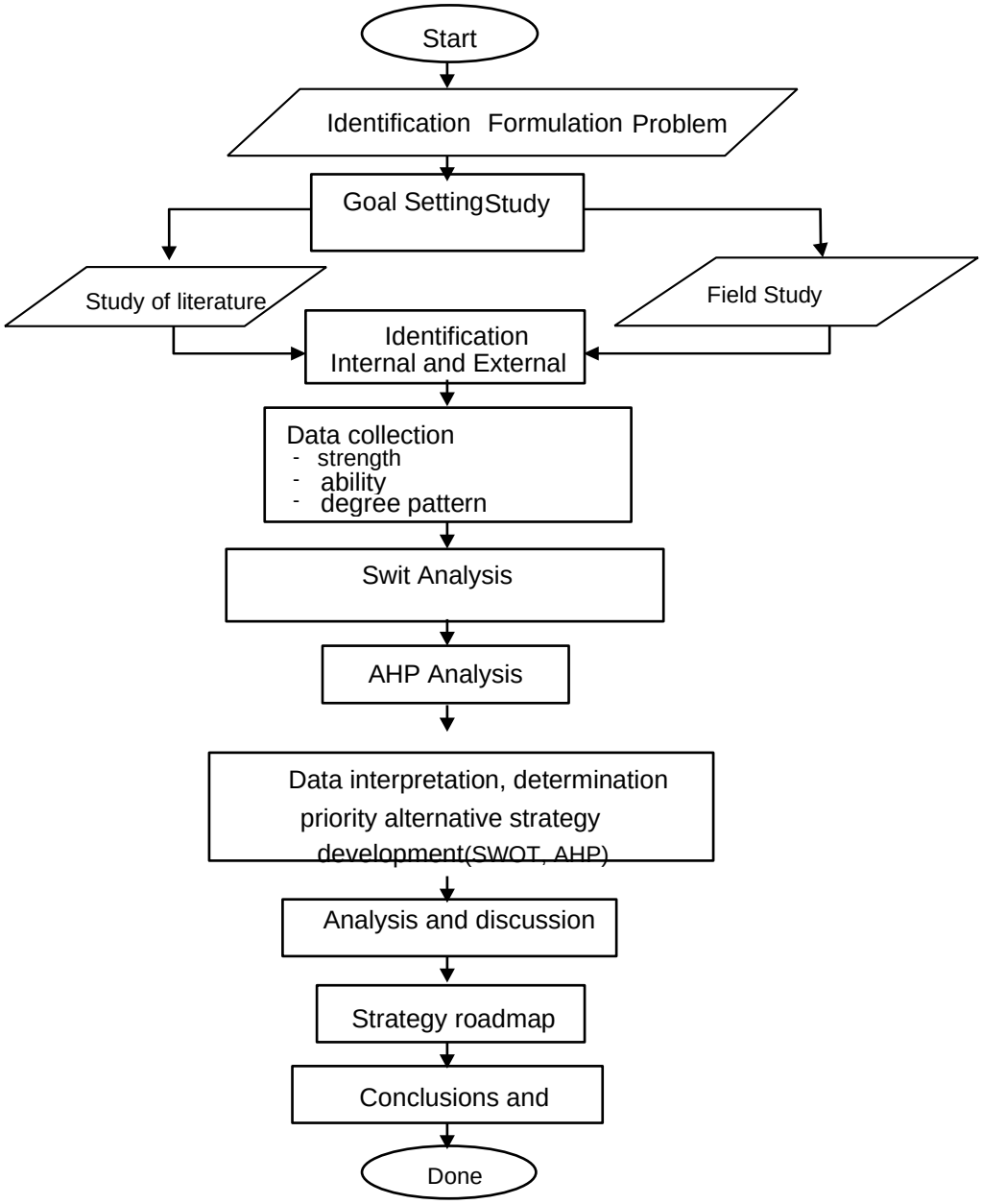


Figure 2. Research Methodology

3.1 IDENTIFICATION OF RESEARCH VARIABLES

The variable in this research is the development model of this Composite Company, which consists of: the level of strength, ability and pattern of the Navy's strength**.**

Table 1. Identification Research

No.	Variable	Description
1	Navy Strength	The main tool of the Navy weapon system used to achieve task performance and achievement
2	Naval Ability	Navy performance in using strength in a professional manner to carry out tasks
3	Navy Degree Pattern	Placement and assignment of elements of the Navy

Based on Table 1. it can be seen that internal and external factors in influencing the Composite Company development strategy in supporting the main tasks of the TNI. Identification of internal

factors that influence the development of posture in support of the TNI's main tasks, including: strengths marked with the symbol "S", and weaknesses with the symbol "W". Identification of external factors that influence the development of marine posture in supporting the TNI's main tasks, these include: Opportunities marked with the symbol "O", and threats with the symbol "T".

3.2 Analysis of Internal Factors Identification

Organizational internal factorsNavyis an activity within the Composite Company development management environment, which consists of the strengths and weaknesses of the CompanyNavy. The aspects used to identify the internal strengths and weaknesses of the Composite Company, which include the Composite Company's strengths, the Composite Company's capabilities, and the Composite Company's degree pattern. The detailed identification of the strength factor (S) is measured from the aspect of the strength of the Composite Company which consists of: (1) Minimum essential force (MEF) policy to makeNavyworld class through modernizing the main weapon system/defense equipment; (2) The condition of defense equipment that is always ready to meet needsNavyto carry out the function as a landing force in the form of power projection from the sea; and (3)Navyhas complete equipment for coastal defense, such as field artillery (Armed), coastal radar, including facing electronic and cyber warfare. Furthermore, the identification of strength (S) as measured from the aspect of the ability of the Composite Company, namely: (4) Intelligence abilityNavyto deal with irregular warfare & special Ops information technology; (5) The ability of soldiers to serve in OMP and OMSP in units; and (6)Navyhave good diplomatic skills to get to a reliable Expeditionary and Multirole. And the Strength Factor (S) measured from the aspect of the Composite Company degree pattern, namely: (7)Navyincreasing the professionalism of soldiers by training in accordance with the cycle of training, courses, and specialization education; (8)Navycurrently has a Natuna composite company to make it easier to carry out tasks; and (9) Lantamal Class A is projected to have 1 battalion in strength to assist with base defense. For Lanal type B, it will be filled by one company plus. While Lanal type C will be filled with one minus company so that the power is spread throughout Indonesia and participates in accelerating regional development.

The detailed identification of the weakness factor (W) is measured from the aspect of the Composite Company's strength which consists of: (10). Limitations of meeting the needs of defense equipment against the APBN; (11). Limitations of the information system in presenting data on the condition of defense equipment to the leadership elements; (12) Limited number of coastal defense equipment, such as field artillery (Armed), coastal radar, etc. Furthermore, the weakness factor of the Composite Company (W) is measured from the aspect of the ability of the Composite Company which consists of: (13). Limitations of meeting the needs of defense equipment against the APBN; (14). The technical capabilities of soldiers in the field are not evenly distributed and need to be improved; (15) The diplomatic ability of soldiers to go to Expeditionary and Multirole is not evenly distributed; and Furthermore, this weakness factor (W) is measured from the aspect of the Composite Company degree pattern which consists of: (16). The different professional abilities of individual soldiers; (17). The formation of a battalion depends on certain policies and conditions; and (18) The pattern of filling in personnel at the level of lantamal type A, lanal type B, and C is still not fulfilled.

Table 2 Identification of Internal Factors

No.	Internal factors	
	Strength Factor	**Weakness Factor**
	Strength Composite Company	
1	Minimum essential force (MEF) policy to make the navy a world class through modernizing the main weapons system/defense equipment	Limitations of meeting the needs of defense equipment against the state budget
2	The condition of defense equipment that is always ready to meet the needs of the navy to carry out its function as a landing force is a form of power projection from the sea	Limitations of information systems in presenting data about the condition of defense equipment to the leadership elements
3	the navy has complete equipment for coastal defense, such as field artillery (Armed), coastal radar, including facing electronic and cyber warfare	Limited number of coastal defense equipment, such as field artillery (Armed), coastal radar, etc
	Ability Composite Company	
4	Intelligence capability to deal with irregular warfare & special Ops information technology.	Intelligence to deal with irregular warfare & special Ops information technology that is not yet optimal
5	The ability of soldiers to serve in OMP and OMSP with units	The technical ability of soldiers in the field is not evenly distributed and needs to be improved
6	have good diplomatic skills to get to a reliable Expeditionary and Multirole	The diplomatic ability of soldiers to go to Expeditionary and Multirole is not evenly distributed
	Degree Pattern Composite Company	
7	improve the professionalism of soldiers by training according to the Kormar training cycle, courses, and specialization education	The different professional abilities of individual soldiers
8	currently has a Natuna composite company to make it easier to carry out tasks	The formation of the market depends on certain policies and conditions
9	Lantamal Class A is projected to have a strength of 1 battalion to help defend the base. For Lanal type B, it will be filled by one company plus. Meanwhile, Lanal type C will be filled with one minus company so that the power is spread throughout Indonesia and participates in accelerating regional development	The pattern of filling in personnel at the level of lantamal type A, lanal type B, and C is still not fulfilled

(Source: Data Processed, 2022)

3.3 IFE Matrix Analysis (Internal Factor Evaluation)

The results of identification, data tabulation and weighting score calculations according to expert answers to the questionnaire on Internal Factors in the form of strengths and weaknesses that have been weighted and rated have obtained a score on the IFE matrix of 3.26, the IFE value indicates that the current posture is in a strong position (3.00). – 4.00), which means that currently the posture has a strong internal condition in utilizing the strengths and overcoming the weaknesses of the existing postures.

Table 3. IFE Matrix

No.	Internal factors	Weight	Rating	Weighted Score
STRENGTH				
Posture Strength				
1	Minimum essential force (MEF) policy to make it world class through modernizing the main weapons system/defense equipment	0.05	3	0.14
2	The condition of defense equipment that is always ready to fulfill the need to carry out its function as a landing force is a form of power projection from the sea	0.05	3	0.15
3	has complete equipment for coastal defense, such as field artillery (Armed), coastal radar, including facing electronic and cyber warfare	0.06	3	0.18
Posture Ability				
4	Intelligence capability to deal with irregular warfare & special Ops information technology.	0.07	4	0.27
5	The ability of soldiers to serve in OMP and OMSP with units	0.06	3	0.18
6	have good diplomatic skills to get to a reliable Expeditionary and Multirole	0.05	3	0.16
Posture Degree Pattern				
7	improve the professionalism of soldiers by training in accordance with the cycle of training, courses, and specialization education	0.06	4	0.24
8	currently has a Natuna composite company to make it easier to carry out tasks	0.06	3	0.17

No.	Internal factors	Weight	Rating	Weighted Score
9	Lantamal Class A is projected to have a strength of 1 battalion to help defend the base. For Lanal type B, it will be filled by one company plus. Meanwhile, Lanal type C will be filled with one minus company so that the power is spread throughout Indonesia and participates in accelerating regional development	0.05	3	0.14
			Total Strength Score (S)	**1.64**
WEAKNESS				
Posture Strength				
1	Limitations of meeting the needs of defense equipment against the state budget	0.06	4	0.24
2	Limitations of information systems in presenting data about the condition of defense equipment to the leadership elements	0.05	3	0.15
3	Limited number of coastal defense equipment, such as field artillery (Armed), coastal radar, etc	0.05	3	0.14
Posture Ability				
4	Intelligence to deal with irregular warfare & special Ops information technology that is not yet optimal	0.05	3	0.14
5	The technical ability of soldiers in the field is not evenly distributed and needs to be improved	0.05	3	0.14
6	The diplomatic ability of soldiers to go to Expeditionary and Multirole is not evenly distributed	0.06	3	0.18
Posture Degree Pattern				
7	The different professional abilities of individual soldiers	0.06	3	0.18
8	Formation depends on certain policies and conditions	0.05	3	0.15
9	The pattern of filling in personnel at the level of lantamal type A, lanal type B, and C is still not fulfilled	0.08	4	0.31
			Total Weakness Score (W)	**1.62**
			Total Score S+W	**3.26**

(Source: Data processed, 2022)

The data shows that the IFE matrix has the main strength of posture, which lies in the aspect of posture ability, namely: "intelligence ability to deal with irregular warfare & special Ops information technology" with the highest score of 0.27. then the second strength lies in the strength of the degree pattern posture, namely: "improving the professionalism of soldiers by training in accordance with the cycle of training, courses, and specialization education". Then in the third rank of posture strength and posture ability, namely: "having complete equipment for coastal defense, such as field artillery (Armed), coastal radar, including facing electronic and cyber warfare" and "The ability of soldiers to serve in OMP and OMSP with units" .

The main weakness faced by students lies in the pattern of posture degrees, namely: "The pattern of filling in personnel at the level of type A, type B, and C floors is still not fulfilled". And the second weakness to facelies in the strength of the posture, namely: "Limits on the fulfillment of defense equipment needs to the state budget".

3.4 Analysis of Identification of External Factors Posture

Organizational external factors are activities in the external environment of posture development management, which consist of opportunities and threats they have. These aspects are used to identify external opportunities and threats of posture, which include posture strength, posture ability, and posture degree patterns.

The detailed identification of the opportunity factor (O) is measured from the aspect of posture strength which consists of: (1) having a positive image so that it can be well received by the local community, when in the assignment service. Furthermore, identification of Opportunities (O) which is measured from the aspect of posture ability, namely: (2) Ability in law enforcement at sea; and (3) The ability to establish bilateral relations and share technology with developed countries. And the Opportunity Factor (O) which is measured from the aspect of the degree pattern, namely: (4) Geographically, Indonesia is a maritime country in the world's traffic lane; and (5) The level of military resources that are not limited by population demographics.

The detailed identification of the threat factor (T) is measured from the aspect of posture strength which consists of: (1). People easily panic, when there is a global issue. Furthermore, the threat factor (T) is measured from the aspect of posture ability which consists of: (2). There is no information system that can present an accurate description of the tactical situation; and (3). The risk is very high, because the defense industry is still dependent on foreign technology. And then the threat factor (T) is measured from the aspect of the posture degree pattern which consists of: (4). Geographical risk that marine areas require extra supervision; and (5). The level of soldier resource is not limited by population demographics. Based on the description above, the Opportunities and Threats factors possessed by Posture in supporting the main tasks of the TNI.

Table 4. Identify External Factors

No.	External Factors	
	Opportunity Factor	**Threat Factor**
Posture Strength		
1	have a positive image so that it can be well received by the local community, when in the assignment service.	People easily panic, when there is a global issue

No.	External Factors	
	Opportunity Factor	**Threat Factor**
Posture Ability		
2	Ability in law enforcement at sea	There is no information system that can present a picture of the tactical situation in real time.
3	Ability to establish bilateral relations and share technology with developed countries	The risk is very high, because the defense industry is still dependent on foreign technology
Posture Degree Pattern		
4	Geographically, Indonesia is a maritime country in the world's traffic lane	Geographical risk so that marine areas require extra supervision
5	Unlimited soldier resource levels by population demographics	Unlimited soldier resource levels by population demographics

(Source: Data processed, 2022)

3.5 EFE Matrix Analysis (External Factor Evaluation)

The results of identification, data tabulation and weighting score calculations according to expert answers to the questionnaire on External Factors in the form of strengths and weaknesses that have been weighted and rated have obtained a score on the EFE matrix of 3.21, the EFE value indicates that the current posture is in a strong position (3.00 – 4.00), which means that currently the posture has a strong external condition to take advantage of the opportunities and threats of the existing posture.

Table 5. EFE Matrix

No.	External Factors	Weight	Rating	Weighted Score
OPPORTUNITY				
Posture Strength				
1	have a positive image so that it can be well received by the local community, when in the assignment service.	0.10	4	0.42
Posture Ability				
2	Ability in law enforcement at sea	0.10	3	0.31
3	Ability to establish bilateral relations and share technology with developed countries	0.10	3	0.29

No.	External Factors	Weight	Rating	Weighted Score
			Total Odds Score (O)	**1.55**
Posture Degree Pattern				
4	Geographically, Indonesia is a maritime country in the world's traffic lane	0.09	3	0.27
5	Unlimited soldier resource levels by population demographics	0.09	3	0.26
			Total Odds Score (O)	**1.55**
THREAT				
Posture Strength				
1	People easily panic, when there is a global issue	0.10	3	0.29
Posture Ability				
2	There is no information system that can present an accurate description of the tactical situation.	0.11	4	0.44
3	The risk is very high, because the defense industry is still dependent on foreign technology	0.10	3	0.31
Posture Degree Pattern				
4	Geographical risk so that marine areas require extra supervision	0.11	3	0.34
5	Unlimited soldier resource levels by population demographics	0.10	3	0.29
			Total Threat Score (T)	**1.66**
			Total Score (O+T)	**3.21**

(Source: Data processed, 2022)

Table 5. shows that the EFE matrix has the main opportunity factor (O) as measured from the aspect of posture strength which consists of: "having a positive image so that it can be well received by the local community, when in the assignment service" with the highest score of 0.42. Then the probability (O) of the second rank posture is measured from the aspect of posture ability, namely: "Ability in law enforcement at sea" with a score of 0.31. And then the third (O) opportunity rank, measured by posture ability, namely "The ability to establish bilateral relations and share technology with developed countries" with a score of 0.29.

The main threat faced lies in the ability of posture, namely: "There is no information system that can present an accurate description of the tactical situation" with the highest score of 0.44. And the second rank threat that must be faced lies in the postu title pattern, namely: "Geographical risk so that the sea area requires extra supervision" with a score of 0.34. Furthermore, the third rank threat that must be faced by the marines lies in the ability of posture, namely: "The risk is very high, because the defense industry is still dependent on foreign technology" with a score of 0.31.

4. RESULT AND DISCUSSION

4.1. Internal – External Matrix Analysis

Internal-external matrix (IE) analysis is obtained from the total weighted score of the IFE and EFE matrices, then the resulting weighted

score is entered into the IE matrix to map the company's current position, it is known that the IFE value is 3.26 and the EFE is 3.21. This means the position of the posture strategy in Cell I, namely: Growth and Build.

4.2. Strategy Development

The SWOT matrix is used to formulate strategies based on a combination of internal and external environmental analysis. There are four main strategies used, namely;

a. SO strategy, namely: a strategy that uses strengths to take advantage of opportunities. Strategies that use strengths to take advantage of existing opportunities. The findings of alternative SO strategies in the field, namely:

1) Improving the HR of Soldiers by continuing to learn the technology of developed countries and managing the quality and quantity of defense equipment
2) Improving the brand image in the community and the world's traffic lanes through professionalism

b. ST strategy, namely: a strategy that utilizes strengths to overcome threats, Strategies that utilize strengths to overcome threats. The findings of alternative ST strategies in the field, namely:

1) Improving the modernization of quality defense equipment and human resources of soldiers to convince the public and provide the right information
2) Developing battalions to improve the welfare of soldiers' resources

c. WO strategy, namely: a strategy that minimizes weaknesses by taking advantage of opportunities. Strategies that minimize weaknesses by taking advantage of opportunities. Findings of alternative WO strategies in the field, namely:

1) improve a positive image by increasing modernization defense equipment
2) Establish bilateral relations with developed countries to increase the human resources of soldiers and determine battalion development strategies

d. WT strategy, namely: a strategy that minimizes weaknesses, and at the same time anticipates threats. Strategies that minimize weaknesses, and at the same time anticipate threats. The findings of alternative WT strategies in the field, namely:

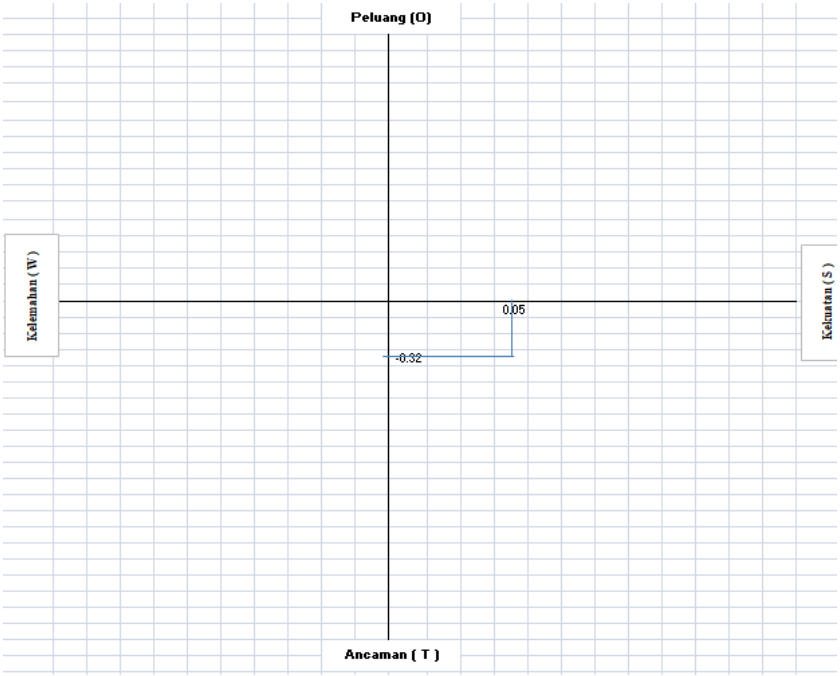
1) Improving the modernization of quality defense equipment and human resources of soldiers to convince the public and provide the right information
2) Develop defense equipment technology by increasing the knowledge of human resources of soldiers

Shows that SWOT (Strengths, Weaknesses, Opportunities and Threals) which are arranged in a systematic and structured manner that forms four matrix strategies, namely: SO, ST, WO and WT strategies. The results of the calculation of the IFAS – EFAS score for the SWOT matrix strategy can be seen in Table 6.

Table 6. IFAS and EFAS Scores SWOT Matrix

IFAS		**EFAS**	
Category	Sub-Total	Category	Sub-Total
Strength (S)	2.15	Opportunity (O)	2.05
Weakness (W)	2.09	Threat (T)	2.37
Total (SW)	0.05	Total (OT)	-0.32

Based on Table 6, the results of IFAS and EFAS are then presented in a SWOT quadrant graph or Cartesian diagram. The point on the X axis shows the internal factor (IFAS) while the point on the Y axis shows the value of the external factor. Then a line is drawn between the two. This graph shows the position or position of the current posture, can be seen in Picture 3.



Picure 3. Position Strategy Posture

Based on Figure 3, it is known that the quadrant of the EFAS and EFAS calculations is the ST quadrant (Strength and Threal quadrant). The value obtained from IFAS is (-0.16) which is located on the axis of the SWOT quadrant. The value of EFAS is (-0.6) which is located on the ordinate axis of the SWOT quadrant. The posture position is located in quadrant III with coordinates (0.05; -0.32) which shows the ST strategy, namely the posture of utilizing strength to overcome threats. What postures can do:

a. Increasing the modernization of quality defense equipment and human resources of soldiers to convince the public and provide constant information.

b. Develop battalions to improve the welfare of soldiers' resources.

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IMPLEMENTATION OF INTEGRATED SERVICE POLICY FOR PORT SERVICES TO SUPPORT EMPOWERMENT SEA DEFENSE AREA

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ABSTRACT

PT Indonesian Port Regional III Tanjung Perak Surabaya carries out provision activities, port services, especially in loading and unloading activities for goods and containers with the right volume increase. This study aims to describe and interpret the implementation of the policy of implementing integrated port services, especially in loading and unloading activities at Port of Perak Surabaya, identifyingand investigating supporting factors and inhibiting the implementation of integrated services for stocking services, especially in loading and unloading activities at Port of Perak. Surabaya, as well as compiling the best integrated service policy models in the management of integrated port services, especially in sustainable loading and unloading activities to support the empowerment of the sea dimension defense area. The type of research used is descriptive qualitative, with the analysis of research on the implementation of grindle policies consisting *of content of* policy (policy content) and *contex of implementation*, where integrated services port services, especially in loading and unloading activities the existing one involves a lot of interests and management.

Keywords: policy implementation, integrated service, loading and unloading, ports, empowerment of sea dimension defense areas.

5. INTRODUCTION

In Government Regulation Number 31 of 2021 concerning the Implementation of the Shipping Sector, it is a rule made by the government and is part of a political decision to overcome various problems and issues that exist and develop in society. In the life of people in the jurisdiction of a country, there are often various problems. A state that holds full responsibility for the lives of its people must be able to solve these problems. Public policies made and issued by the state are expected to be a solution to these problems. Public Policy is a decision intended for the purpose of overcoming problems that arise in a certain activity carried out by government agencies in the context of government administration.

The implementation of the sea dimension defense area is an application of the policy in PP 31 of 2021 concerning the implementation of the shipping sector, an important trend for integrated services in the future is in port services, especially loading and unloading service activities described in article 9 paragraph 1 and paragraph 2 as well as article 10 paragraph 1,2,3 and integrated services, especially maritime security and order in article 172 paragraph 1,2,3 for that future problems are faced with several trends that become challenges of public services include: How to Emphasize centralization and decentralization, How to Integrate public services, How to Increase community participation and How to Impact technological change

Therefore, the Navy as the Sea dimension is present in the framework of the Development of Potmar and Opster of the sea dimension to managethe pot ensi maritime / region to be prepared into a regional force & can be utilized regional capabilities for the benefit of state security defense & improvement of community welfare. Territorial Development is an effort of work & action both stand alone / together with the relevant officials & other

components of the nation to help the government in preparing defense forces that include the defense area & supporting forces and the realization of the integrity of the Indonesian Armed Force-citizens , which is carried out in accordance with the Laws and Regulations in order to achieve the main task. We know that the Position of Regional Port III is a Crucial Geographical Position in defense because it has an infrastructure as a strong fighting Condition Tool Room (RAK) because later it can act as a regional fighting force, region is prepared to be a battle field or operation field, Logistic region and Component reserves

2. LITERATURE REVIEW

2.1 Publik Grindle Policy

The Public Policy Implementation Model proposed by Grindle (1980: 7) said that the success of the policy implementation process until the achievement of results depends on the program activities that have been designed and sufficient financing, in addition to being influenced by the content of policy and the contex of implementation.

Several theories related to variables that influence the implementation of public policy according to Subarsono (2012), one of which is teori Merilee S. Grindle. Subarsono (2012) explained that the implementation of public policy in Merilee S. Grindle's theory is influenced by two major variables, namely: the content of the policy; and the implementation environment.

The success of implementation according to Merilee S. Grindle (in Subarsono, 2012: 93) is influenced by two major variables, namely the content of policy and the implementation environment. These variables include: the extent to which the interests of the target group or target group are contained in the content of the policy, the type of benefits received by the target group, the extent to which the desired changes of a policy are made, whether the location of a program is appropriate, whether a policy has mentioned its implementor in detail, and whether a program is supported by adequate resources.

2.2 Strategic Management in Integrated Services

A public service organization that uses a strategic foresight model also focuses on developing specific areas of expertise or capabilities, and developing cooperative ventures with other organizations that it believes will be necessary to ensure that the strategic vision is realized. This type of strategic management is associated with a form of intellectual leadership that deals with involving the hearts and minds of managers and employees, and securing their approval of the established strategic direction. This type of intellectual leadership also recognizes and handles uncertainty in building capabilities and moving towards a long-term future. This uncertainty arises in part because the contextwill create dilemmas or problems -- for example, alternative opportunities (or threats) that must be evaluated for their potential in realizing (or delaying) a long-term strategic vision. These opportunities (or threats) also contain uncertainty because they are not realized (or deflected) automatically; the result contains uncertainty because realizing opportunities (or fending off threats) requires skill and judgment. So, strategic issue management is included in the strategic foresight model.

Strategicmanagement is important because it can change the way public services are run. It involves a two-stage argument. First, contrary to pessimistic views, strategic management can influence the operational management of public services. Secondly, there is a potential in strategic management, or at least certain variants of it, to not only affect public services but even change them. The term 'transformation' may seem redundant and

too ambitious for strategic management. However, after two decades of public sector reforms the answer may be made that being ambitious has become important to the future prospects of a successful public service sector. Indeed, the riskiest thing at this point may be not doing something new (Drucker 1985), or trying to do new things the old way (Hamel and Prahalad 1994). It can be said that strategic planning is not about the effectiveness of public services but rather about transactions between politicians (who allocate budgets and expect compliance with their mandates) and managers who manage public services.

As Expressed by Miesing and Andersen: 'The purpose of strategic planning in public bodies seems to be to legitimize or justify the body and its budgetary demands and meet the requirements mandated by the authorities' (1991: 131). This is the idea that the language of management and strategic planning seems to be about directing and adapting services, but this hides the fact that managers use strategic planning to manage politicians and the use of allocations.

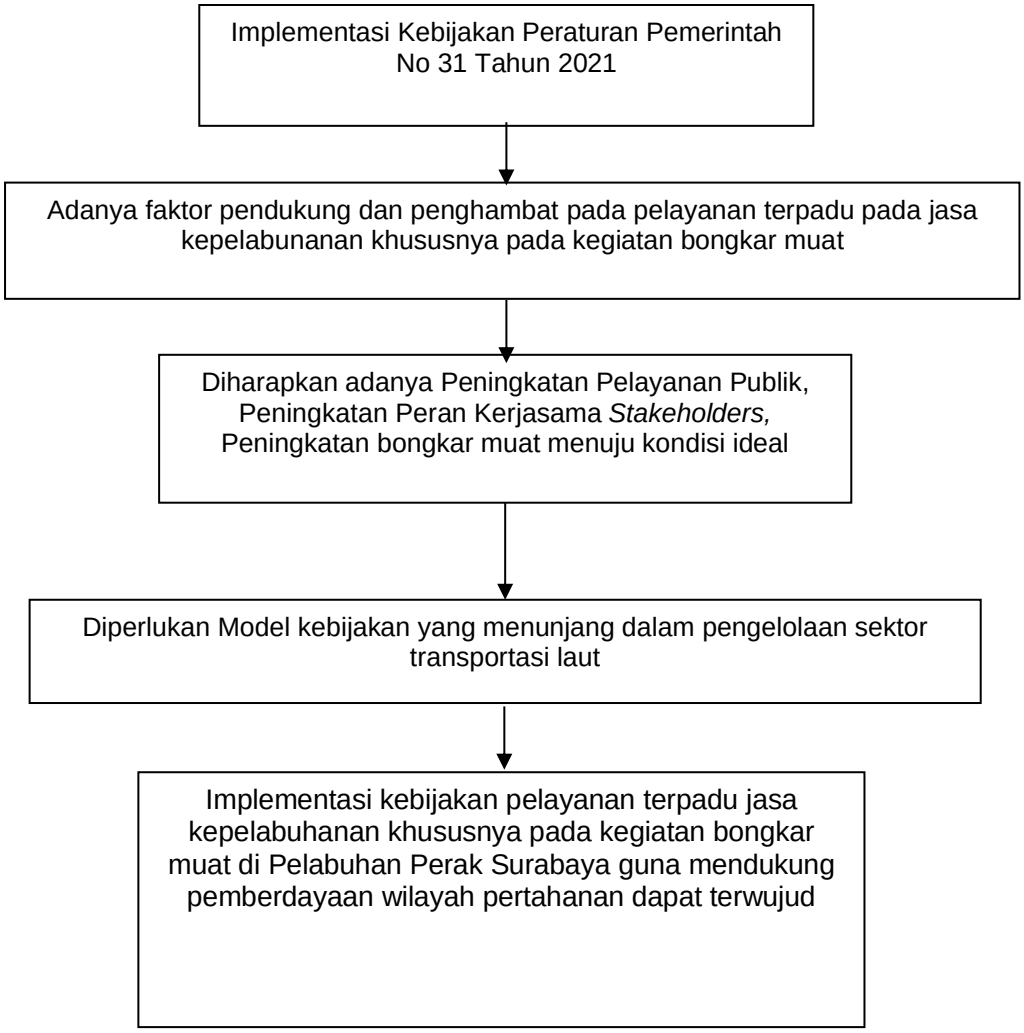

Figure 1. Research Flow

2.3 Sustainable Empowerment of Marine Defense Areas

Principles of sustainable resource management. The relationship between the analysis and management of public policy and the public management sector consists of the processing and management of resources. Each resource has its own 'laws' governing its production, reproduction and utilization. Currently, relatively well-developed knowledge of the discipline exists in the areas of personnel management ('human resource management'), money ('public finance'), organization ('sociology of organizations', 'learning of organizations') and information ('information systems'. management'). The role of sea defense empowerment through binpotmar Lantamal V Surabaya and its staff at Perak Suarabaya Port as a Vital Object in empowering sea defense areas is carried out for the benefit of the national and community. This role is carried out by Lantamal V Surabaya as a strategy or way to get support from the community in the field of defense with their respective interest. The role is also used as a communication tool to obtain information about maritime potentials in the Lantamal V work area while fulfilling the rules of an informative approach in coaching theory. However, the guidance carried out is more of a participatory *approach* by inviting directly to the target object in utilizing the maritime potential in the Lantamal V work area by prioritizing not disturbing the perspective Relevans**i** the role of empowering the sea defense area through binpotmar to the realization of the defense area that rests on the port as a vital object so that all activities can be takes place on a sustainability basis.

3. MATERIALS AND METHODS

3.1 Data Collection

The data in this study consists of primary data and secondary data. Primary data is data obtained directly by means of measurements, observations and interviews. Primary data collection was chosen because researchers need to obtain data directly. While secondary data is data obtained indirectly. This data is obtained from literature studies and supporting documents in the institutions that play a role.

3.2 Interview

Conducting meetings with informants to share information and other matters related to research. This is done by question and answer. Question and answer is carried out with the aim of obtaining and understanding the meaning behind the problem under study. Data collection by interview is carried out if the researcher wants to get data for the introduction and can also be done to deepen the data sought.

Interviews can be conducted to deepen data about participants in interpreting the situation and symptoms that occur. This certainly cannot be obtained by means of an interview. However, in conducting this interview, researchers can also perform an observation at once. Conversely in making observations, researchers can also conduct interviews with the people involved.

3.3 Observations

According to Marshall, observation is "*through observation, the researcher learns about behavior and the meaning attached to those behaviors".* By making observations, researchers can research and learn about the behavior and meaning of research. Observation consists of structured observation, unstructured observation, participant observation, and nonparticipant observation (Cresswell, 2009:266).

Data analysis from Miles and Huberman in Sugiyono (Sugiyono, 2014: 247) was carried out after completing data collection. Activities in qualitative data analysis are carried out interactively

and take place continuously. until it is complete, so that the data is saturated (Sugiyono, 2014: 246). A qualitative data analysis can obtain regularity and systematic (Sugiyono, 2014: 246), then three lines of activities will be carried out, all three of which are interrelated as shown below:

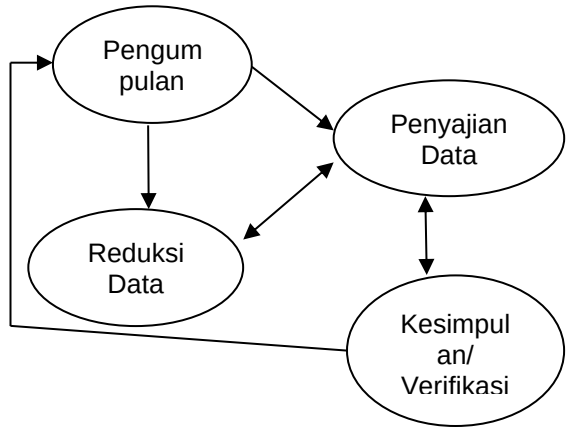

Figure 2. Interactive Model Data Analysis

4. RESULT AND DISCUSSION

4.1 Interview Results with Pelindo Regional III Perak Surabaya

PT. Port of Indonesia III or abbreviated as Pelindo III is a State-Owned Enterprise (BUMN) engaged in port services. The company's duties, authorities and responsibilities are to manage public ports in several Indonesian provinces, namely East Java, Central Java, South Kalimantan, Central Kalimantan, Bali, West Nusa Tenggara, and East Nusa Tenggara. To see the effectiveness of the implementation of the Port Services Integrated Service Policy from the existence of Government Regulation No. 31 of 2021 at Pelindo Regional III Perak Surabaya, it can be seen in the results of the interviews that have been conducted, namely, the implementation of the policy of implementing integrated services in port services, especially loading and unloading activities at Tanjung Perak Port Surabaya can run optimally from the support of policymakers.

The government's seriousness in the successful implementation of the policy of implementing integrated services in port services at Perak Port of Surabaya Based on the results of an interview with Mr. "Dodik Eko Saputra" as *Dept. Head* of Regional Head Service III stated that the implementation of the policy of implementing integrated services on port services, especially loading and unloading activities at Tanjung Perak Port, Surabaya has been carried out in accordance with existing conditions from government support.

The level of compliance of the implementers in implementing the policy of implementing integrated services in port services at the Port of Perak Surabaya Based on the results of an interview with Mr. "Dodik Eko Saputra" as *Dept. Head* of Regional Head Service III stated that in the implementation of the policy of implementing integrated services on port services, especially loading and unloading activities at Tanjung Perak Port Surabaya has had consistent compliance.

4.2 Port Services Integrated Service Policy Model

So far, the implementation of integrated port services at Tanjung Perak Port, Surabaya, still has some shortcomings and has not been fully implemented. Based on the findings described above, the right Port Services Integrated Service Policy Model applied to Tanjung Perak Port Surabaya is to apply **the "High Technology-based Port Area Synergy Team La si Model to support the security and comfort of Tanjung Perak Port** services **and facilities "** which proposes the creation of legislation that refers to Government Regulation No. 31 of 2021 concerning the Implementation of the Shipping Sector. This policy model is proposed to maximize the Port Services Integrated Service policy that has been applied to the Tanjung Perak port of Surabaya. The things that will be addressed from the implementation of this

policy model are to maximize *the inaportnet* system by integrating the system in all relevant institutions. This aims to make it easier for logistics and shipping companies that will deliver goods to be able to fill in licensing data in just 1 filling and on 1 system only (*inaportnet*) so that the delivery process can run faster, effectively and efficiently.

System maximization also includes adding time estimation information to the loading and unloading process accurately. This is so that the ship's captain can understand when and how long it takes in the loading and unloading process. In addition, this policy model also focuses on maximizing the flow of ship shipping. The application of the LBS-13 state rule and the shipping channel that still depends on tidal conditions of seawater causes the inaccuracy of the process of berthing or leaving the port. This policy model will apply more efficient shipping rules and maximize shipping flows by *sounding* and dredging so that shipping flows do not depend on sea tides.

This policy model will also maximize shipping lanes by mapping shipping lanes that are safe from sea mines left by war. The government will coordinate with the TNI, especially Lantamal V, in securing the shipping channel. Furthermore, the thing that will be addressed by the application of the policy model, namely **"Model of The Teamlasi Synergy of Port Areas based on High Technology In order to support the security and comfort of tanjung perak port** services **and facilities"** is the appointment of the highest agency as *the leader,* coordinator and decision maker. This aims to help other agencies to facilitate the implementation of a policy or regulation in each agency in one voice so that there will be integration in the application of the policy or regulation. In addition, the appointment of the highest agency can provide maritime security strengthening of inter-agency activities that integrate and synergize with each other. Then, the application of the policy model, namely **the "High Technology-based Port Area Synergy Team Model in order to support the security and comfort of Tanjung Perak Port** services **and facilities",** also serves to maximize the regulations on the basis of the duties of port agencies so that they can synergize with the implementation of the Integrated Service Service policy Port in Government Regulation No. 31 of 2021 concerning the Implementation of the Service Sector. As is the case in the Class I Navigation District of Surabaya which is still implementing the KM policy. 30 years 2006 as the cornerstone of the task of the Navigation District caused the inexperience of the process of integrating the Port Services Integrated Service policy. So with the maximization of this regulation, it can support port agencies in implementing these policies. The next thing that was improved was regarding the planning of the location of the container stacking depot inside the port. This aims to maximize the process of loading and unloading ships so that it can be done quickly and on schedule.

Currently, the location of the container stacking depot is outside the port, which is quite far away. The government will discuss with logistics and shipping companies to determine a strategic location as a container stacking depot. Furthermore, the policy model, namely "**Model of The Teamlasi Synergy of Port Areas based on High Technology In order to support the security and comfort of Tanjung Perak Port** services **and facilities"** will maximize the use of *the inaportnet* system at all ports including privately managed ports. The government can discuss with the private sector about providing certain concessions so that the logistics delivery process can be recorded starting from the origin of the logistics being sent, making it easier for the destination port to *cross-check* data. In addition, the implementation of *the inaportnet* system implemented at all ports can help the government in collecting data on the number of

logistics loading and unloading both globally and at each port. Then finally, this policy model will make regulations regarding the maximization of Human Resources in charge of ports. This policy model will require personnel to attend training and certification that supports their respective jobs. In addition, it will also be mandatory to train national insights on port personnel to increase the sense of nationalism of personnel and strengthen the port security system from the participation of port personnel

4.3 Pengembangan Implementasi Pelayanan Terpadu Jasa Kepelabuhanan

Increasing the service productivity of Tanjung Perak Port Surabaya as a port that implements integrated services, all existing systems need to be developed and the weaknesses that occur must be corrected. The development that can be done is the maximization of inaportnet system integration to all authorized institutions. This is so that logistics and shipping delivery companies can be facilitated in sending logistics and shipping data to several port institutions with only 1 time filling in the data. Of course, this increases work efficiency and reduces the risk of inequality of data filled in each port institution.

In addition, the development of a system that is integrated with all authorized institutions can make it easier for nahkoda and shipping companies to estimate the time needed in the process of loading and unloading goods. This is so that it can be done to schedule the loading and unloading of ships at the dock accurately. In addition, it is necessary to re-develop the location of stacking container containers at Tanjung Perak Port, Surabaya, which is outside and quite far from the port area. The separate stacking location causes more time to be needed to make deliveries from the container stacking depot to the port. This is also exacerbated by container delivery lines that pass through civilian routes so that there are often congestion that causes delays in delivery. It is necessary to plan the construction of a container stacking depot located in the port so that the loading and unloading process can run effectively and efficiently. The government can coordinate with logistics and shipping companies to discuss strategic locations for container stacking. Apart from the location of stacking containers, it is necessary to re-develop regarding the shipping flow that is not optimal. Every ship that will enter and leave the port area needs assistance from the Surabaya Guided Office so that the ship can sail according to the existing shipping lanes safely.

Pthere is a shipping channel that still depends on tidal conditions and still applies the LBS-13 state rule so that it can cause delays in mobilization in and out of ships at the port. So optimization is needed by *sounding* and dredging the shipping channel so that the depth of the sea can cover the size of the ship draft. In addition, it is necessary to conduct a reassessment in the application of the LBS-13 state rule so that ship mobilization can run more effectively. Then regarding the Surabaya shipping channel, which is partly a relic of war so that there are still sea mines that can risk the safety of the ship. So there is a need for cooperation between Tanjung Perak Port Surabaya and the Indonesian Navy (Lantamal V) to detect zones and map safe shipping lanes. There are several obstacles in implementing Government Regulation No. 31 of 2021 concerning the Implementation of the Service Sector, such as in the Navigation District agencies which are still hampered in their implementation due to the still use of km policies. 30 years of 2006 as a cornerstone of the task of the Navigation District needs to be a concern. In order to implement Government Regulation No. 31 of 2021 to all port *stakeholders*, it needs to be supported by updating theregulation of the work foundation of each institution in order to maximize the application of these government

regulations. This can assist relevant institutions in carrying out their duties and functions in accordance with the Integrated Port Services that have been set. The next development that can be done is to appoint the highest institution in charge of being the coordinator and decision maker. Currently, policymakers are still present in each agency with limited authority. This can cause stakeholders to be able to implement different actions according to the decisions taken by each of these institutions so that the services provided are not integrated thoroughly. Therefore, the appointment of the highest institution as coordinator and decision maker can make it easier for other institutions to do things with full integration. In terms of security, what needs to be developed is to conduct state defense training for port workers such as TKBM members and shipping company workers to become comcades and increase the sense of nationalism. This is to improve the port security system from the participation of all port personnel who have participated in the country's defense training. In addition, it can be improved again regarding the quality of employees, especially in the "alley" of TKBM workers by conducting training and certification so that the loading and unloading process runs more effectively and efficiently according to the specified schedule.

5. CONCLUSION

The most appropriate policy model in supporting the implementation of the integrated service policy for port services is to implement the policy "Model Of The Squadlasi Synergy of Port Areas based on High Technology in order to support the security and comfort of services and facilities of Tanjung Perak Port" . From the implementation of this policy, several existing problems will be maximized, such as maximizing the *Inaportnet* system by integrating data in all relevant institutions and at all ports in Indonesia as well as adding information on the estimated time of the loading and unloading process accurately, maximizing shipping flows, appointing the highest agency as *the leader,* coordinator and decision maker, maximizing regulations that hinder the implementation of policies, planning the location of container stacking depots and maximizing human resources so that the implementation of the integrated service policy for port services can run more optimally.

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POLICY STRATEGY OF MARITIME POTENTIAL SERVICE (DISPOTMAR) NAVAL BASE V IN SUPPORTING THE DEVELOPMENT OF INDONESIAN MARITIME POTENTIALS

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ABSTRACT

The Maritime Potential Development Service (Dispotmar) of Naval Base V is one of the Central Implementing Elements at the Naval Base V level which is in charge of carrying out the function development and implementation of maritime potential development activities. In order to support the development of maritime potential, there are several problems that occur in the field of regional resilience development, social communication, community service, maritime service industry, socialization of fishery laws and fulfillment of infrastructure. This research is expected to overcome some of the problems faced. The stages of the research carried out were identifying and evaluating internal and external factors, selecting strategies using the SWOT method, compiling alternative strategies and determining the priority strategies selected using Borda. The result of this research find the WO 5 strategy as the higher priority value of 0.38 as , namely the preparation of a NCO legal forms to be used as a guideline and basis for NCOs personnel by utilizing government program support and the main task of Dispotmar as a coach for the maritime youth generations.

***Keywords**: Policy Strategy, Dispotmar Naval Base V, SWOT, Bordas*

1. INTRODUCTION.

The Unitary State of the Republic of Indonesia is the largest archipelagic country in the world, where its geographical constellation which is in a cross-world position places the sea area of national jurisdiction very strategic for both Indonesia and other countries (Pushidrosal, 2018). To maintain the territorial integrity of the country, a military defense posture is required consisting of main components, reserve components and supporting components, which are directed through the development of strength, capability and titles (Kemhan, 2015). The Navy has the main task as the main component of the defense of the marine dimension (DPR, 2004). In maintaining sovereignty at sea, the Indonesian Navy must be able to transform all marine potentials into state defense and security forces in the maritime field (Sutjipto, 2001).

The dynamic development of the environment and strategic context always brings changes to the spectrum of complex threats and has implications for national defense. The complexity of threats is classified into patterns and types of multidimensional threats in the form of military threats, non-military threats and hybrid threats that can be categorized in the form of real and unreal threats. Thus, future national defense requires the integration of military defense and non-military defense through efforts to build strong and respected national defense forces and capabilities and have high deterrence. Efforts to build a non-military force is to develop all the regional potentials that are owned.

Dispotmar Naval Base is tasked with carrying out the development of functions and implementation of maritime national potential development activities which include the development of human resources, natural and artificial resources, national facilities and infrastructure in the maritime sector and dynamics. The Maritime Potential Development Service (Dispotmar) of Naval Base V was established based on the Presidential Decree of 1998. The main task of the Dispotmar Naval Base V is to carry out the function development and implementation of

maritime national potential development activities which include the development of human resources, natural resources and man-made resources, facilities, and infrastructure. National infrastructure in the maritime sector and the dynamics of marine development (Progar, 2019).

Problems faced by Dispotmar Naval Base V field of Regional Resilience Development are; (1) the lack of participants in the Implementation of State Defense Awareness Education which is attended by coastal village communities; (2) the material for the implementation of State Defense Awareness Education to coastal village communities has not been socialized. This causes the low awareness of defending the state in coastal communities. Problems in the field of Social Communication are; (1) have not implemented social communication activities on an ongoing basis; (2) there is no warrant and directive from the TNI Commander related to the activities of Territorial Operations and Territorial Guidance by Dispotmar. This condition results in a lack of strong legal basis underlying the operations and territorial development carried out by Dispotmar.

Problems with the application of the fishery law are still disputes and misunderstandings between fishermen in a target area and fishermen from other targeted areas because of the use of fishing gear that is not in accordance with the fisheries law. Coastal fishing communities in the working area of Naval Base V generally do not understand the Regulation of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia concerning the prohibition of the use of fishing gear Trawls and Seine Nets in fisheries management areas within the territory of the Unitary State of the Republic of Indonesia.

This study aims to produce a strategy for developing Dispotmar Naval Base V in order to get the best solution for the various problems faced. Similar research and related to this research is the research entitled “Adoption of agroforestry practices in Bangladesh as a climate change mitigation option: Investment, drivers, and SWOT Analysis Perspectives (Jahan, 2022)”, aspects of the discussion of policy strategies in mitigating climate change in Bangladesh. The similarity with this research is discussing the development strategy using the SWOT method. This study uses the SWOT method to formulate a strategy for developing Dispotmar Naval Base V, then the combination of the selected strategies is weighted using the Borda Method to get the priority of the selected strategy.

2. MATERIALS AND METHODS

2.1 The National Defense

Indonesian defense is structured in a universal defense system (Defence, 2008). Universal defense is essentially a defense that involves all citizens according to their roles and functions. Universality in defense implies the involvement of all the people and all national resources, national infrastructure, and the entire territory of the country as a complete and comprehensive defense unit in the life of the nation and state (Kemhan, 2015). Defense systems are built to deal with threats which is increasingly complex and multidimensional with the continued presence of military and non-military threat, and hybrid threat which can be categorized as factual and non-factual. These threats include terrorism, radicalism, separatism and armed rebellions, natural disasters, border violations, sea piracy and natural resources theft, epidemics, cyber attacks and espionage, trafficking and drug abuse as well conventional war or armed conflicts (Ministry, 2015).

2.2 Strategy and Policy.

The term strategy comes from the Greek strategy, which means the art or science of becoming a general. Strategy can also be interpreted

as a plan for the distribution and use of military forces in certain areas to achieve certain goals (Tjiptono, 2006). Strategy in a business or business world is really needed for achieving the vision and mission that has been implemented by the company, as well as for achieving goals or objectives, both short-term goals and long-term goals. Strategy is an action planning process to achieve the goals that have been set, by doing things that are continuous according to joint decisions and based on the point of view of customer needs. (Pearce II & , 2008). Strategy is important for the survival of a company to achieve effective and efficient company goals or objectives; companies must be able to face any problems or obstacles that come from within the company or from outside the company. National defense policies and strategies are formulated through several basic considerations in accordance with national goals and interests.

2.3 Maritime Potential Development.

Maritime potential empowerment is directed to be able to support the transformation of national resources and infrastructure as a maritime defense force. The involvement of every citizen in national defense is based on love for their homeland which is oriented towards common goals in realizing national interests (Kemhan, 2015). The development of maritime national potential which includes the development of human resources, natural and artificial resources, national facilities and infrastructure in the maritime sector and the dynamics of maritime development. Maritime Potential Development is carried out in several aspects, namely (1) Development of Human Resources Capability Aspects; (2) Development of Maritime Potential Utilization Aspects; and (3) Development of Marine Development Program Aspects.

Development of human resource capacity aspect Dispotmar is tasked with carrying out the following activities: (1) collecting data on maritime aspect of human resource capacity development; (2) formulating activity plans and programs for capacity building; (3) compiling the necessary software for capacity building; (4) carry out the necessary support for capacity building activities; (5) coordination and cooperation with relevant agencies in the context of shared perceptions of the national potential in the maritime sector; (6) carry out control activities on the implementation for quality improvement; and (7) evaluate the implementation of capacity building activities.

In the aspect of exploiting maritime potential, Dispotmar is tasked with: (1) carrying out data collection on national maritime potential including Natural Resources, Artificial Resources, facilities and infrastructure, Maritime Service Industry and National Fleet; (2) carry out an evaluation to prepare a target plan, time and place/location for the preparation of the utilization of the national maritime potential; (3) carry out the necessary support for activities to utilize the national maritime potential; (4) organize the preparation of the necessary software in the utilization of maritime potential national; (5) implement activity plans and programs for the utilization of the national maritime potential; (6) carry out coordination and cooperation with all relevant agencies in the utilization of the national maritime potential; and (7) carry out an evaluation of the implementation of the potential utilization of the national maritime.

Dispotmar's tasks for marine programs are: (1) carrying out data collection in the context of implementing marine programs, empowering coastal village communities, state defense training, and planting trees; (2) an inventory of maritime laws and regulations and evaluation of their implementation; (3) dialogue and coordination with relevant agencies in the context of developing maritime vision and insight as well as developing national marine programs; and (4) coordination, cooperation with all

relevant agencies and institutions in training and fostering the capacity of trained people and protecting the community.

2.4 SWOT Analysis.

SWOT analysis is a method used to analyze an operational environment. SWOT analysis is applied by analyzing and sorting out various things that affect the four factors. This analysis begins with identifying internal factors and identifying external factors, then applying them to a SWOT matrix drawing (Mobaraki, 2014). SWOT analysis is based on the logic of maximizing strengths and opportunities, but at the same time minimizing weaknesses and threats (Ayub, A, et al, 2013). SWOT analysis is obtained by identifying conditions, potentials and problems using SO, WO, ST, and WT strategi strategies (Gretzky, 2010). By performing identification of internal factors or internal factor evaluation (IFE) and identification of external factors or external factor evaluation (EFE) is a decision support tool and can be used as a tool to analyze internal conditions and the organization's environment. So that the SWOT matrix formed is able to provide information on the internal and external conditions of the organization systematically (Zivkovic, Z. et al, 2015).

2.5 Borda Methods.

The Borda method is a weighting method that produces the final result in the form of a sequence of criteria from the most preferred to the least preferred. The basic idea in the Borda method is to give weight to each of the first, second and so on ranking criteria. The assessment of the importance of the most important criteria is placed in sequence 1, and gives a ranking of the criteria that are considered less important in the next ranking, for example 2, 3 and so on. The next step is the value of rank 1 is changed to a weighted rank of m-1, and rank 2 is changed to a weighted rank of m-2, where rank m becomes a weighted rank of m=0. The explanation of the importance of the assessment of criteria such as equation 2.1 is as follows:

$$R1 \sum_{j=1}^{n} Rij \text{.....(2.1)}$$

Information : R1 : The sum of the weighted rankings for all criteria1 Rij : Rank evaluated by j for criterion 1

As for the weights obtained from equation 2.2 as follows:

$$W1 \frac{R1}{\sum_{l=1}^{m} R1} \text{.....(2.2)}$$

Information : W1 : weight of criterion 1 for evaluator n.

Calculations are made to produce weights for each strategy to determine the order of priority of each interest.

3. RESULTS AND DISCUSSION.

3.1 Identification of Internal Factors (IF) and External Factors (EF)

Internal Factors (IF) and External Factors (EF) determined through literature review, interviews and filling out questionnaires. Interviews and filling out expert questionnaires involve experts in the field of maritime potential, experts in the field of defense, experts in the territorial field and elements of coastal communities. Identification of Internal and External Factors has succeeded in identifying 11 Internal Factors and 15 External Factors that affect Dispotmar Naval BaseV in fostering maritime potential in its working area. Furthermore, the assessment of expert judgment on each factor uses a Likert scale from a value of 1-5. Geomean values are used for the assessment of Strength and Weakness on Internal Factors and assessment of Opportunities and Threats on External Factors. The results of the assessment are shown in tables 1 and 2 below:

Table 1. Results of Internal Factor Identification (IFI)

NO	Internal factors	XP1	XP 2	XP 3	XP 4	XP 5	Geomean	Assessment
1	Realistic main tasks, functions and obligations	3	4	4	4	4	3.78	*Strength*
2	The legal basis for the establishment of the Dispotmar	3	3	3	4	4	3.37	*Strength*
3	There is no maritime territorial doctrine yet.	2	2	2	3	3	2.35	*Weaknesses*
4	Special briefing on territory.	2	3	2	2	2	2.17	*Weaknesses*
5	Dispotmar Work Program	3	3	3	4	3	3.18	*Strength*
6	Number of Human Resources at Dispotmar	3	3	3	3	3	3.00	*Strength*
7	5 Naval BaseDispotmar Organization	3	3	4	4	4	3.57	*Strength*
8	Lack of maritime potential NCO personnel (Babinpotmar)	3	3	2	2	2	2.35	*Weaknesses*
9	Facilities and infrastructure	2	3	3	3	2	2.55	*Weaknesses*
10	Strategic Dispotmar Location	3	3	3	3	3	3.00	*Strength*
11	The legal container or umbrella for Babinpotmar	2	3	3	3	3	2.77	*Weaknesses*

Based on the results of expert judgment data processing from internal factors, 6 (six) factors are generated as elements of strength and 5 (five) factors are elements of weakness.

Table 2. Results of Exterrnal Factor Identification (IFE)

NO	External factors	XP 1	XP 2	XP 3	XP 4	XP 5	Geomean	Assessment
1	Dispotmar Naval BaseV As the central implementing element.	4	4	3	4	4	3.78	*Opportunity*
2	The cooperation between the Lamongan local government and the Indonesian Navy	3	3	3	3	4	3.18	*Opportunity*
3	Heterogeneous society	1	1	1	2	2	1.32	*Threat*
4	climate change and weather around coastal areas.	1	1	2	1	1	1.15	*Threat*
5	Cooperation between the Surabaya local government and the Indonesian Navy	3	3	3	3	4	3.18	*Opportunity*

6	Cooperation and partnership between Dispotmar and Government/Private Agencies	3	3	3	4	4	3.37	*Opportunity*
7	Cooperation with related institutions regarding Binpotnaskuatmar	4	4	3	3	3	3.37	*Opportunity*
8	*illegal fishing*	1	1	1	1	1	1.00	*Threat*
9	*illegal logging*	1	2	2	1	1	1.32	*Threat*
10	Government policy in realizing the world maritime axis.	4	3	4	4	4	3.78	*Opportunity*
11	Government policy in managing marine resources.	3	3	4	4	4	3.57	*Opportunity*
12	Government laws or regulations regarding all forms of underwater activities.	3	3	3	4	4	3.37	*Opportunity*
13	*Illegal Mining*	1	2	1	2	1	1.32	*Threat*
14	Military threat	2	2	2	2	1	1.74	*Threat*
15	Coaching for the younger generation	3	4	3	4	4	3.57	*Opportunity*

Meanwhile, in the external factor expert judgment data processing, 9 (nine) factors are opportunity elements and 6 (six) factors are included in the threat element category.

3.2. Evaluation of SWOT Element Weights, Ratings and Values.

Each SWOT element that has been identified is weighted. The weighting is done by pairwise comparisons using the Expert Choice 11 application. On Element Strength the results of data processing show an inconsistency value of 0.088 and an inconsistency value of 0.081 on element weakness. In the opportunity element the inconsistency value is 0.091 and in the threat element the inconsistency value is 0.73. Thus, all SWOT element weights are valid.

Determination of the rating and score for each element factor is carried out by distributing questionnaires to give an assessment to Dispotmar Naval Base V for each SWOT element factor. The total value of element strength is 2,638, the total value of element weakness is 3,240, the total value of element opportunity is 3,090 and the total value of element threat is 2,920. The calculation of the value for each element is shown in table 3.3 (a) and (b) below;

Table 3. Data weights, scores and values of SWOT element Internal factors

No	**Factor**				
Strength		***Code***	**Weight**	**Rating**	**Score**
1	Realistic main tasks, functions and obligations	S1	**0.2857**	3	0.857
2	5 Naval BaseDispotmar Organization	S2	**0.1619**	2	0.324
3	Legal basis for the establishment of Dispotmar	S3	**0.1714**	3	0.514
4	Dispotmar kerja work program	S4	**0.1810**	3	0.543
5	Number of Human Resources at Dispotmar	S5	**0.1429**	2	0.286
6	Strategic Dispotmar Location	S6	**0.0571**	2	0.114
TOTAL			**1**	**Score**	**2,638**
Weakness		***Code***	**Weight**	**Rating**	**Score**
1	Provision and special education about the territory.	W1	**0.2400**	3	0.720

2	There is no maritime territorial doctrine yet.	W2	**0.2533**	3	0.760
3	Lack of maritime potential NCO personnel (Babinpotmar)	W3	**0.1600**	3	0.480
4	Facilities and infrastructure	W4	**0.1067**	3	0.320
5	The legal container or umbrella for Babinpotmar	W5	**0.2400**	4	0.960
TOTAL			**1**	**Score**	**3.240**

External Factors

No	**External Factor**				
Opportunity		***Code***	**Weight**	**Rating**	**Score**
1	Dispotmar Naval BaseV As the central implementing element.	O1	**0.1688**	3	0.507
2	Government policy in realizing the world maritime axis.	O2	**0.1600**	4	0.640
3	Government policy in managing marine resources.	O3	**0.1600**	3	0.480
4	Coaching for the younger generation	O4	**0.0933**	3	0.280
5	Cooperation and partnership between Dispotmar and Government/Private Agencies	O5	**0.1022**	3	0.307
6	Cooperation with related institutions regarding Binpotnaskuatmar	O6	**0.0711**	2	0.142
7	Government laws or regulations regarding all forms of underwater activities.	O7	**0.1066**	3	0.320
8	The cooperation between the Lamongan local government and the Indonesian Navy	O8	**0.0622**	3	0.187
9	Cooperation between the Surabaya local government and the Indonesian Navy	O9	**0.0755**	3	0.227
TOTAL			**1**	**Score**	**3.09**
Threat		***Code***	**Weight**	**Rating**	**Score**
1	*illegal fishing*	T1	**0.2190**	3	0.6570
2	climate change and weather around coastal areas.	T2	**0.1524**	2	0.3048
3	Heterogeneous society	T3	**0.1524**	2	0.3048
4	*illegal logging*	T4	**0.1524**	3	0.4572
5	*Illegal Mining*	T5	**0.0952**	3	0.2856
6	Military threat	T6	**0.2286**	4	0.9144
TOTAL			**1**	**Score**	**2.92**

3.3. Determination of Strategic Quadrants.

The selection of the strategic formulation for the development of Dispotmar Naval Base V in the context of the effectiveness of fostering maritime potential can use the SWOT quadrant matrix which can be used as a method to find the point of intersection of internal factors and analysis of external factors. With the intersection of the four lines of factors of strength, weakness, opportunities and threats from the development of Dispotmar Naval Base V in order to support the development of maritime potential. The intersection of the X-axis and Y-axis can be used to determine the position of the strategic quadrant and the type of strategy that is suitable. The results of the analysis of the

intersection of the lines and the SWOT matrix are determined in the coordinate table in table 3.4 below.

Table 4. Strategy Quadrant Coordinates Table

Score				X axis	Y axis
S	W	O	T	(S – W)	(O-T)
2,638	3.240	3.090	2,920	-0.60	0.17

The point of intersection of the coordinate lines of the X and Y axes is then plotted on the Cartesian strategy plane as shown in Figure 4.1. The point of intersection of the coordinate lines shows that the chosen strategy is in quadrant II of the Weakness Opportunities (WO) strategy.

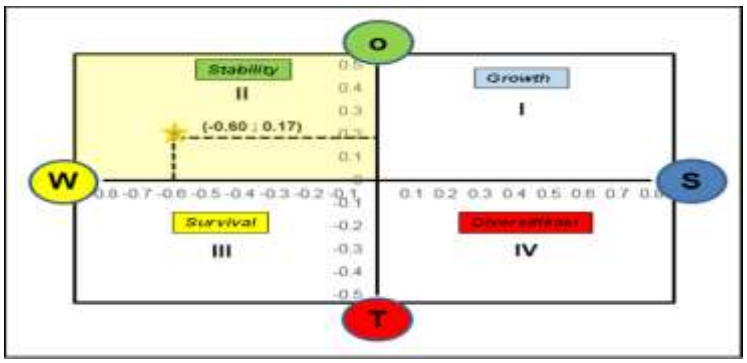

Figure 1. Plotting QuadranStrategy

3.4 Strategy Combination in Quadrant II (WO/Stability Strategy)

The WO 1 strategy is a combination of W1 and O6 which is to provide briefing and special education on territorial matters to all personnel at the Dispotmar by utilizing cooperation with relevant agencies on fostering national potential and maritime power. The WO 2 strategy is a combination of W2 and O2 which is to form and formulate a maritime territorial doctrine by utilizing government policies in realizing the world maritime axis. The WO 3 strategy is a combination of W3,O2 and O3 namely increasing the number of NCO personnel to foster maritime potential to take advantage of government policies in realizing the world maritime axis and government policies in managing marine resources. The WO 4 strategy is a combination of W4,O2 and O5 namely the procurement of facilities and infrastructure by utilizing government policies in realizing the world maritime axis and cooperation and partnerships with government/private agencies. The WO 5 strategy is a combination of W5, O2 and O4 which is to form a forum and legal basis for the NCO to foster maritime potential by utilizing government policies in realizing the world maritime axis to carry out guidance for the younger generation.

3.5 Priority and Strategy Development.

From the formulation of the strategy for developing the Dispotmar Naval Base V, then weighting is carried out for the selection of the priority of the selected strategy. The weighting is done by distributing questionnaires ranking each strategy by involving 6 experts as evaluators. The Borda

questionnaire for the weighting of the selected strategies. The ranking recapitulation by the expert is then compiled based on the number of acquisitions of each rank as in table 5 below.

Table 5. Strategy Ranking Recapitulation

CODE	Recapitulation				
	I	II	III	IV	V
WO 1	0	0	0	1	1
WO 2	1	2	2	0	0
WO 3	0	0	1	3	1
WO 4	0	2	2	1	0
WO 5	4	1	0	0	0
Weighted	**4**	**3**	**2**	**1**	**0**

Then, the weight calculation (**W**) in each strategy using the weight calculation using the Borda method as follows:

a. Score Rtotal**= R1+R2+R3+R4+R5**

Rtotal=(1*1)+(1*4+2*3+2*2)+(1*2+3*1)+(2*3+2*2+1*1)+(4*4 +3*1)

Rtotal= 50

b. Weight (W) WO1 =1/50 : 0.02

WO2 =14/50: 0.28

WO3 =5/50 : 0.10**WO4 =**11/50 : 0.22

WO5 =19/50: 0.38

Based on the results of the calculation of the strategy weights using the Borda method, the strategic priority order of the comparison chart is shown in figure 3.2 as follows:

Figure 2. Priorities and Rank Strategy

Strategy WO 5 was the higher score with value 0,380 followed by WO 2, WO 4, WO 3 and WO 1. These results are in accordance with the theory of Policy which is formulated in the form of the law as a legal gives the government some legitimacy. By having legitimate legitimacy of officials and citizens, it is hoped that will be able to influence the perpetrators to change the behavior that conflict that can hinder the course of the development process (Marhaendra, 2013). The implementation and development steps for each of the selected strategies are compiled as follows:

a. WO Strategy 5.

Forming a legal form for NCOs to develop maritime potential in carrying out their duties by utilizing government policies in realizing the world maritime axis and the responsibility of Dispotmar to carry out guidance for the younger generation. The strategic steps that need to be implemented include: (1) issuing implementation manuals, technical manuals and standard operating procedures related to the task of the NCOs for maritime potential development in carrying out maritime potential development; (2) issuing regulations for the Commander of the TNI and cief of Naval staf regulations as legal form related to the main tasks and functions of the NCO's for fostering maritime potential in the field.

b. WO 2 Strategy.

Forming and formulating maritime territorial doctrine by utilizing government policies in realizing the world maritime axis. As for the strategic steps that need to be implemented, among others, by formulating a marine territorial doctrine which contains: (1) guidance and socialization related to the law on marine and fisheries to coastal communities; (2) training for coastal communities on marine product cultivation for the welfare of coastal communities; and (3) fostering and inculcating state defense awareness to coastal communities.

c. WO 4 Strategy

Procurement of facilities and infrastructure by utilizing government policies in realizing the world maritime axis and cooperation and partnerships with government/private agencies. The strategic steps that need to be implemented are by submitting support for the procurement of facilities and infrastructure to the Navy Headquarters and the local government in the form of: (1) procurement of floating equipment (Lifeboats and Sea Riders). Each sub-district located in the coastal area is supported by 1 lifeboat and 1 sea rider for marine patrol activities; (2) procurement of official vehicles (official cars and official motorbikes). Each sub-district is supported by 1 official car and 1 official motorbike for patrol activities and regional coordination; (3) construction of Binpotmar offices in each sub-district; (4) procurement of communication tools (UHV radio, Handy talky, telephone and mobile phone). Each sub-district is supported by a package of communication tools; and logistical support for Babinpotmar personnel operations.

d. WO 3 Strategy

Increase the number of NCOs personnel for maritime potential development (Babinpotmar) by utilizing government policies in realizing the world maritime axis and government policies in managing marine data sources. As for the strategic steps that need to be implemented, among others, by adding NCOs personnel for maritime potential development in order to achieve the main tasks and functions of developing maritime potential. Each sub-district is filled by 3 personnel with intelligence and territorial knowledge qualifications.

e. WO 1 Strategy.

Dispotmar Naval Base V held debriefing and special education on territory to all personnel by utilizing cooperation with relevant agencies on fostering national potential and maritime power. As for the strategic steps that need to be implemented, among others, by holding a territorial capacity upgrading activity for Dispotmar Naval Base V personnel by collaborating with relevant agencies to add territorial materials such as: (1) Marine and fishery services regarding knowledge of marine law and fisheries; (2) Forestry Service regarding all forestry regulations and laws; (3) the Ministry of the environment regarding all regulations concerning the environment; and (4) National and political unitary bodies on the matter of defending the State.

4. CONCLUSION

This study succeeded in identifying the internal and external factors of Dispotmar Naval Base V in relation to the empowerment of maritime

potentials. These factors are arranged in the aspects of strengths, weaknesses, opportunities and threats to formulate a policy strategy. From the SWOT analysis carried out, it was found that the chosen strategy was the WO strategy which was further developed into 5 (five) strategy combinations. Prioritization of the strategy is carried out using the Borda method with the highest weighting result in the WO 5 strategy with value of 0,38 namely the preparation of a NCO legal forms to be used as a guideline and basis for NCOs personnel by utilizing government program support and Dispotmar task as a coach for the maritime youth generation.

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