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SUBMARINE CAPABILITY ASSESSMENT TO INCREASE DETERRENCE EFFECT IN THE ALKI II REGION

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ABSTRACT

Regional dynamics marked by an increase in submarine operations by several countries need to be balanced with an increase in Indonesia's capabilities in underwater warfare and contribute to increasing the country's defence system at sea. herefore, the purpose of this study is to consider the competitive dimension of submarine capability development on a country's deterrence effect and assess the extent of the literature review. This research is a statement that there is no instrument for assessing the capability and sustainability of submarines in an effort to increase the deterrence effect in the ALKI II region associated with the development of current dynamics so that this research is expected to contribute to getting an instrument for assessing submarine capability and submarine deterrence effect in the ALKI II region.

Keywords: Deterrence Effect, Capability, Submarine, Submarine Capability, ALKII

1. Introduction

After determining Indonesia's identity as an archipelagic state, the country ratified UNCLOS 1982. The Indonesian Navy (TNI AL) has a submarine unit that is an important part of the defence equipment and strategic weapons. A discussion of modern conventional submarine capabilities, and some possible future developments, in Australia and in ASEAN countries. The transformation of a country's security strategy and system is strongly influenced by the dynamics of an evolving and changing strategic environment. The dynamics of the region are characterized by an increase in submarine operations. This research is expected to provide the acquisition of an assessment model that can measure submarine capability and submarine deterrence effect.

The evolution of a country's security strategy and system is strongly influenced by the dynamics of the evolving and changing strategic environment. A defence must be able to retaliate in the event of an attack, either directly at the time of any indication of an attack from an opponent having the ability to strike back safely from submarine missiles (Andersson, 2015). In the international environment, the security dimension is a top priority so that every country will try to strengthen security by increasing military expenditure When a country increases its military strength, other countries will do the same (Nugraha, 2017).

The dynamics of the region, marked by an increase in submarine operations by several countries, need to be matched by Indonesia's improved capabilities in underwater warfare (Defence, 2014). Indonesia's Defence Strategic Plan 2024 to develop a submarine fleet (Andersson, 2015). Analyzing the relationship between external, internal and operational factors of submarines to the country's defence system's deterrence explains that submarines can contribute to increasing the country's defence system's deterrence at sea (Haryanto AR et al., 2021). The purpose of this study is therefore to consider the competitive dimension of submarine capability development to analyze capability against deterrence effect in the ALKI II region.

This research is in line with previous research conducted by Timbul Haryanto AR (2022). From the existing literature, there is no submarine capability assessment instrument to increase the deterrence effect in the ALKI II region associated with the development of the dynamics of changes in the ALKI II environment regarding the transfer of the country's capital. In Addition to this, the rapid development of submarine technology owned by neighbouring countries, the Navy needs to keep pace with these changes to defend and increase the deterrence effect of Navy submarines. This research is expected to provide the acquisition of an instrument that can measure the capability of submarines and the deterrence effect of submarines in the ALKI II region.

As an analytical approach, this research adopts a statistical descriptive qualitative method to provide an overview of the research subject to create a researcher's foundation for more comprehensive data collection using AHP-Dynamic System. This research project can describe and provide new insights into the hierarchical model between submarine capability factors and submarine deterrence effect as a key to knowledge development in determining submarine capability assessment instruments. This research is focused on ASEAN countries that have interests in the

ALKI II region, this research is also supported by 7 expert panels as a target for distributing questionnaires. As such, the upgrade of submarine capabilities will contribute to the renewal of the Navy's deterrence and striking power. Deterrence theory states that extended deterrence threats tend to be more effective when potential challengers perceive them as capable and trustworthy (Johnson et al., 2015). To have more information about capabilities at the individual level, a capability approach can be used by developing a survey instrument (Anand et al., 2009).

2. Literature Review

Military deterrence strategy is dynamic, through the preparedness of defence forces to face actual threats in the form of war or other forms of military threats. In peacetime, the presence of submarines has a major deterrence impact on other parties so as to strengthen the diplomacy efforts undertaken by the government. (Defence, 2014). On this section The theoretical review includes several related theories, namely: a) Seapower theory. b) Capability theory.

2.1. Seapower theory.

Alfred Thayer Mahan, his perspective became the basis for great nations in achieving the greatness of being an ideal maritime nation. Mahan emphasised the importance of great powers building sea power evenly across strategic regions. Furthermore, Mahan also emphasised the great emphasis on the role of countries in building a sustainable maritime infrastructure. Mahan explained about six characteristics that a country must have in developing its seapower to the greatest extent in order to achieve the progress and glory of a country.

2.2. Capability theory

Capability theory is an important construct in understanding an individual's potential and opportunities. Capabilities are an opportunity set and are specific to a person, which can significantly affect their lives. In the application of this theory, it is important to recognised that capabilities are not only limited to the physical aspects or technical skills of a person, but also involve psychological, social, and even emotional aspects. Capabilities are also influenced by external factors such as the social environment, culture, and public policy.Teori deterrence.

In the concept of strategy, deterrence is always aligned with defence and focuses more on military capabilities. This theory states that actors seek to increase their capabilities and strengths to ward off attacks from opponents, or at least suppress and force opponents to rethink attacks. The purpose of using the military is to make the opponent realise the risks they face if they attack. The instruments used to implement deterrence policies can be the use of weapons of mass destruction (WMDs), the power of conventional weapons, increasing military capabilities in general, forming alliances, economic sanctions or embargoes, and threats of retaliation.

3. Methods

The stages of the research method that will be used in this research include the stages of literature review, weighting criteria using the AHP method and scoring criteria and sub criteria using Likert and then simulated using a dynamic system.

3.1. Literature Review

To obtain literature reviews of international journals, researchers used Harzing's Publish or Perish 8 application software using keywords capabilities, submarine capabilities, deterrence effect. in the range of years of publication ranging from 2012 to 2023. The criteria and sub criteria obtained were validated using Content validation index (CVI) by distributing questionnaires to expert personnel. The formula for calculating CVI (Lawshe, 1975) is:

$$CVI = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

The conceptual design of this method is described as follows.

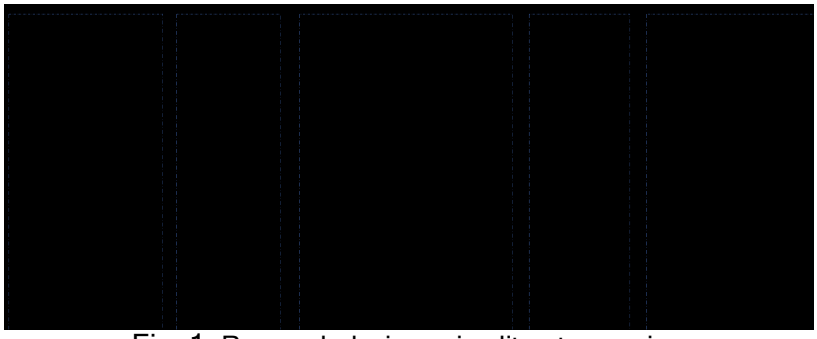

Fig. 1. Research design using literature review

3.2. AHP-LIKERT

Analytical Hierarchy Process (AHP) analyses complex multi-factor or multi-criteria problems into a hierarchy, according to Saaty hierarchy is defined as a representation of a complex problem in a multi-level structure, where the first level is the goal, followed by the level of factors, criteria, sub-criteria and so on down to the last level of alternatives with a hierarchy of a complex problem can be described in groups which are then arranged into a hierarchy as the problem will appear more structured systematically (Improta et al., 2018). This method uses the criteria and sub criteria from the CVI literature review into a hierarchy diagram.

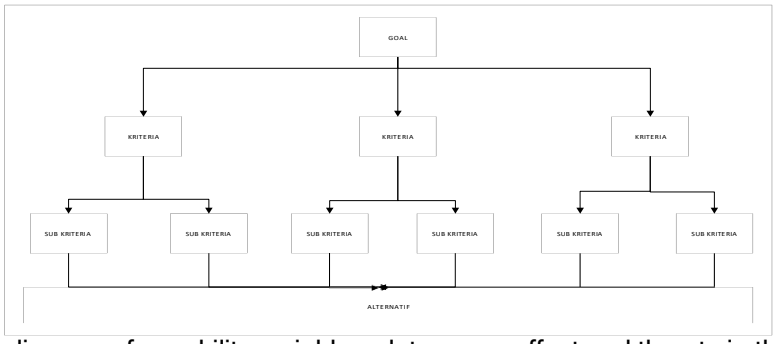

Fig. 1. Hierarchy diagram of capability variables, deterrence effect and threats in the ALKI II region

Validation of AHP results was tested using Consistency Index (CI) and Consistency Ratio (CR) assessments using the formulas:

$$CI = \frac{\lambda maks - n}{n};$$

$$CR = \frac{CI}{RI}$$

If the CR ratio is 0.1 (i.e. 10%), the matrix is considered consistent and the decision W is accepted. Instead a CR of more than that implies too more contradictions in the matrix. The precaution for the latter situation is to review the matrix. Desain model pada metode ini digambarkan sebagai berikut. The simulation design for this method is described as follows.

Fig. 2. research design using AHP-Likert method

3.3. System Dynamic

Modelling is a way to solve problems that appear in the real world. Modelling involves the process of mapping real-world problems and modelling them into a world model (abstraction process) as well as the process of analysis and optimisation to obtain solutions that can be implemented in the real world (Sterman, 2018). In the decade since its publication, the range of practical applications has expanded to include research management (Richardson, 2019). A simulation is the operation of a system model used before changes are made to an existing system to reduce the impact of failures, eliminate unforeseen bottlenecks, prevent overuse of resources, and optimise system performance.(Forrester, 2009). However, each capability procurement must identify and understand the basic needs of the strategic requirements for the capability, and what will happen over the lifetime of the capability in the decades of strategy that define strategic trends in Asia (Kopp, n.d. 2012).

System Dynamics model types that represent the structure of feedback diagrams can be in the form of causal diagrams or commonly called Causative Loop Diagrams (CLD). Such a diagram shows the direction of modification of the variable flow and its polarity. The flow polarity as mentioned above is divided into positive and negative. An additional form of diagram that collectively illustrates the structure of a system dynamics model is the flowchart. Flowcharts represented the connections to variables made during a cause and impact diagram additionally with clear and exploitative bound symbols for the various related variables (Forrester, 2010).

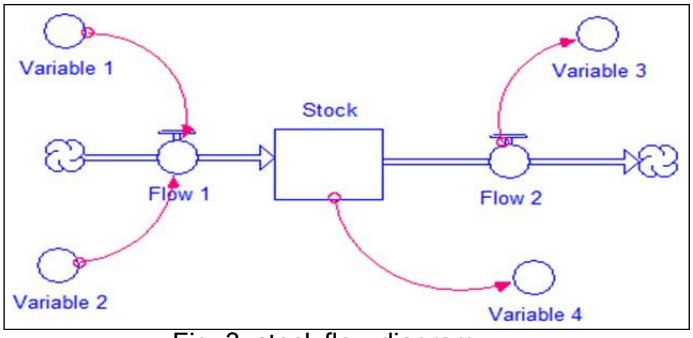

Fig. 3. stock flow diagram

In this method, causal loop diagrams and stock flow diagrams are made, then the results of AHP weighting and Likert scoring are included in the simulation of a dynamic system model with a 10-year time period so as to obtain an overview of the submarine capability value in the next 10-year period. The design of model in this method is described as follows.

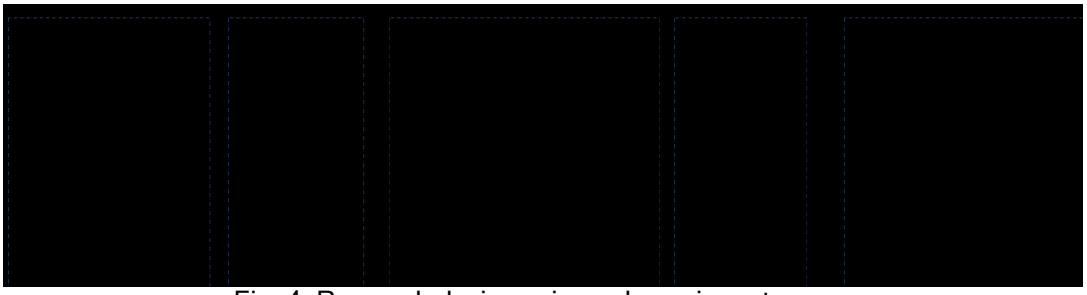

Fig. 4. Research design using a dynamic system

4. Results and discussion

In order to obtain the research objectives, data were collected through observations, interviews and literature review. To obtain data on the object of research, researchers used interview techniques then the answers were returned to the researcher. The next step was to pilot test the questionnaire using Aiken's V technique (Monge-Rogel et al., 2022).

The most straightforward process of comparison is to compare two things with an accuracy that can be accounted for. For this the quantitative scales of 1 to 9 were established to assess the comparative importance of one element to another. System Dynamics Society provides a definition of how to solve complex problems that arise due to trends, reasons, and influences of various variables in a device.

Submarine capability assessment model is obtained using literature review to determine the criteria and sub criteria that make up submarine capability, then the criteria and sub criteria are

weighted using ahp and scoring criteria and sub criteria using likert scale, then included in the dynamic system scenario to get the scale of submarine capability in the next 10 years.

4.1. Literature review analysis

This study analyses data from review literature of several journals that discuss submarine capabilities which are then taken as references in determining criteria and sub-criteria related to the assessment of submarine capabilities and the influence on the deterrence effect of submarines in the ALKI II region. Furthermore, it was validated using the Content Validation Index (CVI) by distributing questionnaires to 7 expert personnel to provide responses and assessments of the content used so as to obtain the following results:

Table 1. Content Validity Index (CVI)

SUM OF I-CVI	**36.857**	**Sum UA**	**36**
S-CVI/Ave	**0.996**	**S-CVI/UA**	**0.973**
Result	Accepted		Accepted

The result analysis of CVI stated that the content was accepted and then the list of variables was used as criteria and sub-criteria/sub-sub-criteria in the research.

4.2. Analisa Hierarcy Process-Likert (AHP-LIKERT)

4.2.1. AHP

The accepted list of variables from the CVI results is then made into an AHP hierarchy model as follows:

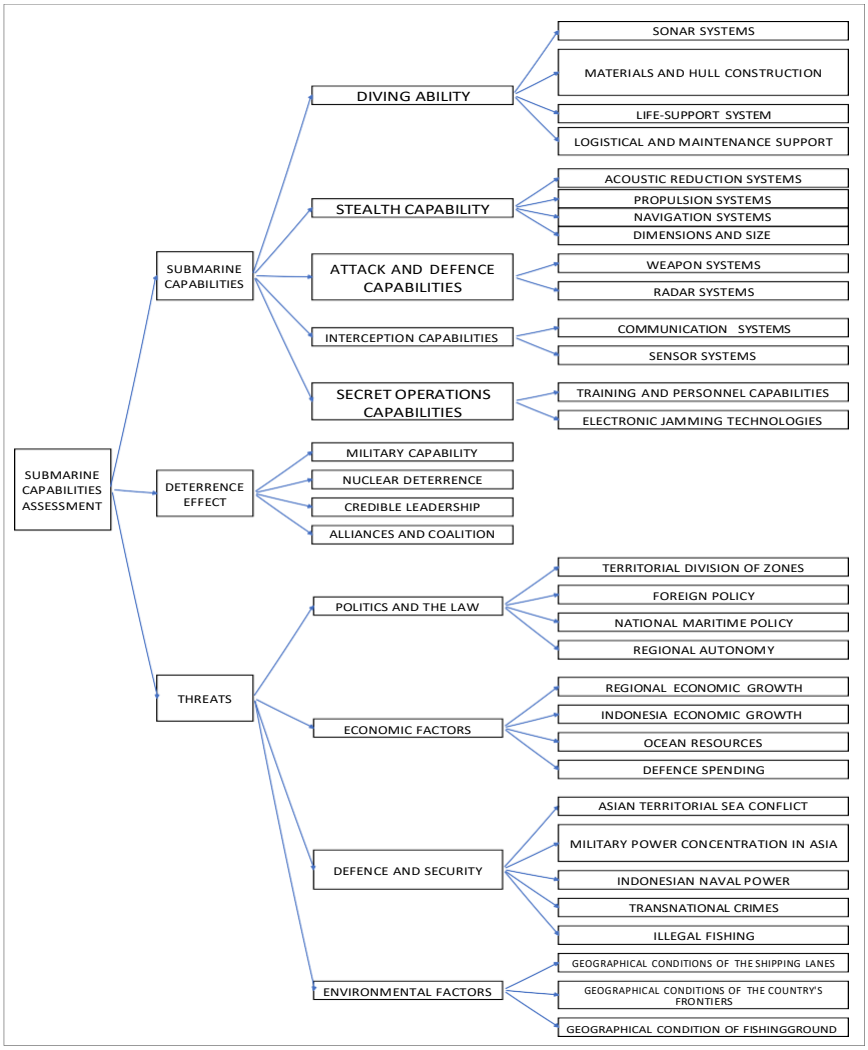

Fig. 5. Submarine Capability Assessment Hierarchy Diagram.

The hierarchical criteria and sub-criteria variables that are responsible for the assessment of submarine capability in increasing the deterrence effect of submarines in the ALKI II region are then carried out to assess the weight of the criteria and sub-criteria through expert assessment by distributing questionnaires so that the weight value of each criterion and sub-criteria is obtained as presented in Table 2 below:

Table 2. Assessment of submarine capability criteria.

CODE	DESCRIPTION	Assessment (AVE)
K-1	SUBMARINE CAPABILITIES	
K-1.1	Diving Capability	0.22
K-1.2	Stealth Capability	0.23
K-1.3	Attack and Defence Capabilities	0.21
K-1.4	Interception Capabilities	0.18
K-1.5	Secret Operations Capabilities	0.15

Table 3. Deterrence effect criteria assessment.

CODE	DESCRIPTION	Assessment (AVE)
K-2	**DETERRENCE EFFECT**	
K-2.1	Military Capability	0.29
K-2.2	Nuclear Deterrence	0.27
K-2.3	Credible Leadership	0.26
K-2.4	Alliances and Coalitions	0.18

Table 4 .Threat criteria assessment

CODE	DESCRIPTION	Assessment (AVE)
K-3	ANCAMAN	
K-3.1	Politics and Law	0.25
K-3.2	Economic Factors	0.29
K-3.3	Defence and Security	0.29
K-3.4	Environmental Factors	0.18

The AHP obtained the weight value of each criterion and sub-criteria, which then in the next step carried out the score assessment of each criterion and sub-criteria.

4.2.2. Assessment Analysis Using A Likert Scale

In the assessment analysis using Likert aims to get a value for each criterion and sub-criteria which is then used as a factor determining the value of the capability level with the result of multiplying the AHP weight with the Likert score. This assessment uses a questionnaire instrument distributed to expert personnel with a rating scale of 1-5 with the results of the score weight assessment presented in the following tables 5-7:

Table 5. Scoring of submarine capability criteria.

CODE	QUESTIONNAIRE ASPECT	AVE
K-1.1	Diving Capability	2.286
K-1.2	Stealth Capability	3.429
K-1.3	Attack and Defence Capabilities	3.286
K-1.4	Interception Capabilities	2.714
K-1.5	Secret Operations Capabilities	2.571

Table 6. Deterrence Effect Criteria score assessment.

CODE	QUESTIONNAIRE ASPECT	AVE

CODE	QUESTIONNAIRE ASPECT	AVE
K-2.1	*Military Capability*	2.714
K-2.2	*Nuclear Deterrence*	2.286
K-2.3	*Credible Leadership*	2.714
K-2.4	*Alliances and Coalitions*	2.429

Table 7.Threat criteria score assessment

CODE	QUESTIONNAIRE ASPECT	AVE
K-3.1	Politics and Law	2.571
K-3.2	Economic Factors	2.286
K-3.3	Defence and Security	2.429
K-3.4	Environmental Factors	2.286

4.2.3. AHP-Likert processing

Table 8. Submarine capability score-weighting assessment

CODE	DESKRIPTION	Assess. (AVE)	Score	Assess. * Score
K-1	**Submarine Capabilities**			
K-1.1	Diving Capability	0.22	2.29	51%
K-1.2	Stealth Capability	0.23	3.43	80%
K-1.3	Attack and Defence Capabilities	0.21	3.29	69%
K-1.4	Interception Capabilities	0.18	2.71	48%
K-1.5	Secret Operations Capabilities	0.15	2.57	40%

Table 9. Deterrence effect assessment score-weighting

CODE	DESKRIPTION	Assess.(AVE)	Score	Assess. * score
K-2	**DETERRENCE EFFECT**			
K-2.1	Military Capability	0.29	2.71	79%
K-2.2	Nuclear Deterrence	0.27	2.29	62%
K-2.3	Credible Leadership	0.26	2.71	70%
K-2.4	Alliances and Coalitions	0.18	2.43	45%

Table 10. Threat weight-score assessment

CODE	DESKRIPSI	Assess. (AVE)	Score	Assess * Score
K-3	THREATS			
K-3.1	Politics and Law	0.25	2.57	64%
K-3.2	Economic Factors	0.29	2.29	66%
K-3.3	Defence and Security	0.29	2.57	74%
K-3.4	Environmental Factors	0.18	2.29	40%

4.3. Dynamic system analysis and simulation

The next step is to create a causal loop diagram with a stock-flow diagram modelling with a dynamic system using Stella software. A causal loop diagram illustrating the systemic relationship between submarine capability, threat and deterrence effect of submarines in ALKI II is depicted in Figure 7 below:

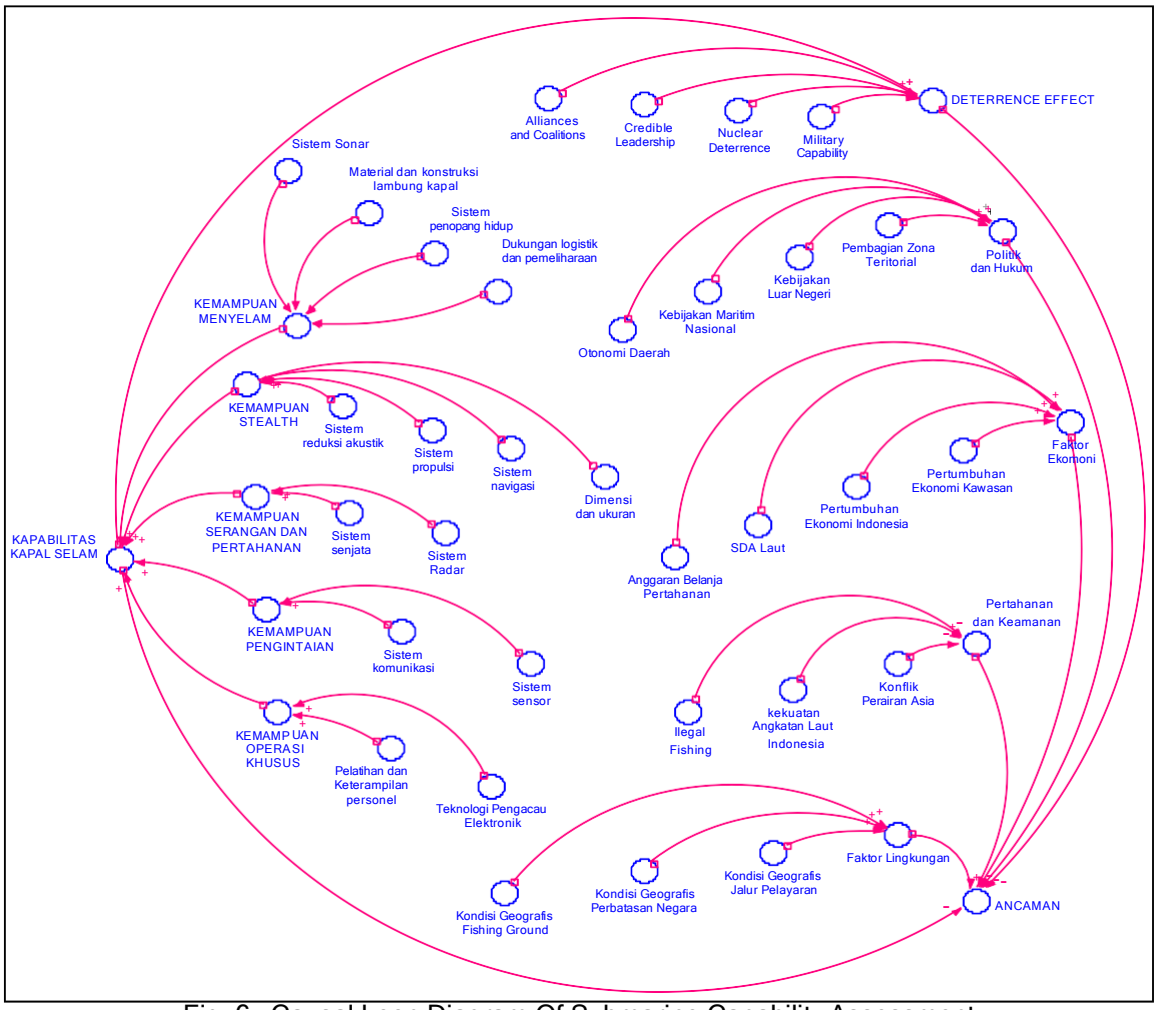

Fig. 6 . Causal Loop Diagram Of Submarine Capability Assessment

4.3.1. Verification and Validity Test of System Dynamics Model

In the dynamic system model, verification and validation of the submarine capability assessment model in providing deterrence effects in the ALKI II region are carried out, to find out the factors/criteria and sub-criteria that have a relationship to the verification of this model 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 is done by checking the formulations (equations), models and checking the units of the model variables. If of course there is no error in the model, then it can be said that the model has been verified. In this research, verification was carried out using Stella software and the results obtained were that all model formulations (equations) and units (units) of model variables were consistent as shown in Figure 8.

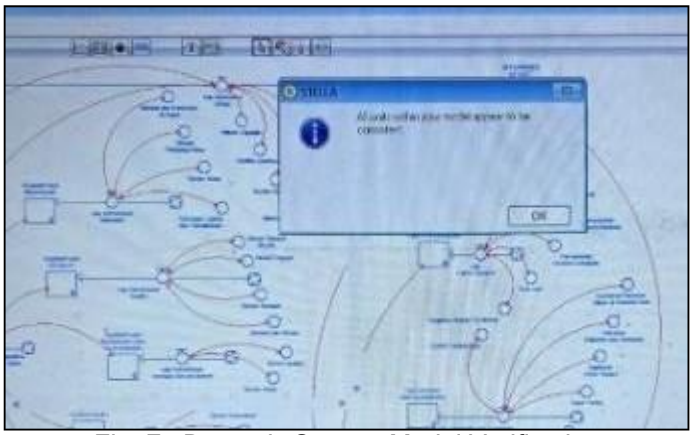

Fig. 7.. Dynamic System Model Verification

The next step after the model verification test is to test the validity of the dynamic system model simulation by distributing questionnaires to 3 experts with doctoral qualifications with the results of the simulation model being declared valid.

The next step is to simulate the CLD model to the following stock flow diagram:

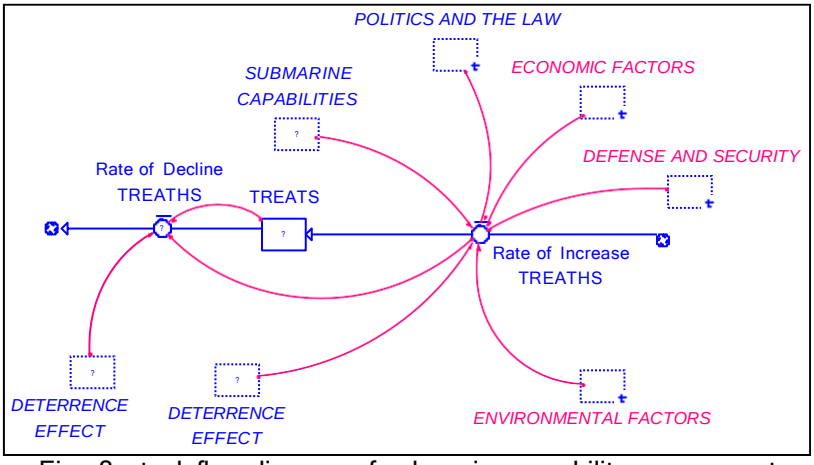

Fig. 8. stock flow diagram of submarine capability assessment

Table 4.12 Simulation of the Dynamic System of Submarine Capability Assessment in the Next 10 Years.

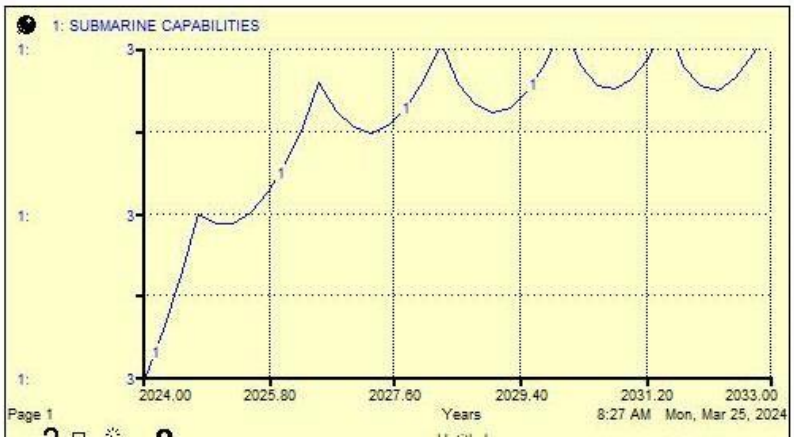

Fig. 9. Simulation Graph of Dynamic System of Submarine Capability Assessment in the Next 10 Years Period.

Table 4.13. Dynamic System Simulation Of Submarine Capability Assessment.

8:27 AM 3/25/2024 Table 1 (PENILAIAN KAPABILITAS)

Years	SUBMARINE	DETERRENC	THREATS			
2024.00	2.88	2.54	2.57			
2024.25	2.90	2.68	2.80			
2024.50	2.96	2.79	3.04			
2024.75	3.02	2.89	3.26			
2025.00	3.01	3.02	3.48			
2025.25	3.01	3.13	3.71			
2025.50	3.02	3.27	3.94			
2025.75	3.04	3.40	4.18			
2026.00	3.07	3.52	4.42			
2026.25	3.10	3.65	4.66			
2026.50	3.15	3.76	4.90			
2026.75	3.12	3.87	5.14			
2027.00	3.10	3.99	5.39			

5. Conclusions and recommendations

5.1. Conclusion

As a result of the analysis and series of data processing, scenario modelling and research results, the following conclusions can be drawn:

a. The assessment of current submarine capability in providing deterrence effect in the ALKI II region at level IV (High).

b. Submarine capability value at the time of this study (first trimester 2024). Will last until the next 8-year period (2033).

c. The assessment of submarine capability for deterrence effect in the ALKI II region will decrease in the next 9 years (2033) and will lower the capability level.5.

5.2. Recommendation.

After researchers conducted research on Submarine Capability Assessment in Efforts to Increase Deterrence Effect in the ALKI II Region, there are several suggestions and input in order to improve this research:

a. This research only discusses the assessment of submarine capabilities in the ALKI II area so that in the future it is necessary to develop the range of assessments throughout the archipelagic waters of the Republic of Indonesia.

b. The use of capability assessment instruments can be applied to other military organisations (Army and Air Force), because they have similarities in threat and deterrence effect variables/criteria.

5.3. Research limitations

This research presents a submarine capability assessment instrument in the ALKI II region while the sea sovereignty area is divided into ALKI I, II and III a,b so that this instrument still has assessment limitations and it is hoped that the next research can present assessment variables with a wider range so as to be able to provide input and suggestions for submarine development policies in creating deterrence effet in the Indonesian sea sovereignty area.

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