ANALYSIS OF THE DETERMINANT INFRASTRUCTURE EFFECT IN SUPPORTING SUBMARINE OPERATIONAL DURABILITY TO INCREASE THE RESILIENCE OF THE INDONESIAN STATE DEFENSE SYSTEM AT SEA

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Abstract:*The Indonesian nation is currently continuing to develop the strength of the Indonesian Navy's submarine fleet to increase the deterrence of the national defense system and to ensure the security and safety of shipping in strategic maritime routes. The Indonesian Navy submarine is capable of supervising ships sailing or entering and leaving Indonesian waters freely and without being detected by the sonar of warships and submarines of other countries. The limited operational time of the submarine can be caused by several things, both related to the characteristics of the submarine related to the technology used, and the availability of logistics and supporting infrastructure for the submarine's operations. The Submarine cannot continuously dive during its operation to secure and enforce the sovereignty of the Indonesian national jurisdiction. Focus of research is on the determinant influence of infrastructure on submarine operational durability to increase the deterrence of the state defense system at sea. This research uses a qualitative analysis method with the development of thinking through interviews, Focus Group Discussions (FGD), Round Table Discussions (RTD), and semi-structured interviews to obtain data about submarine operational durability. This research found that there was a significant influence on the causal relationship between the two variables with the following information: 1) Submarines can only contribute to increase the deterrence of the state defense system at sea; 2) To be able to realize submarine operational resilience, determinant infrastructure support is needed that can be provided by the Indonesian National Army (TNI), in this case, the Navy and the Defense Industry (State and Private Owned Enterprises).*

Key words*: Indonesian Navy, Indonesia Warship (KRI), Determinant Infrastructure, Submarine Technology, Focus Group Discussions (FGD), Round Table Discussions (RTD).*

INTRODUCTION

As an archipelagic country with 2/3 of its territory constituting the sea (Sebastian et al., 2014), it is necessary to carry out the development of Navy to realize a state defense system at sea (Putri: 2017). To answer the needs of the development of a Navy force that has deterrent capabilities, the Indonesian Navy is responsible with the development of a national defense strategy at, and/or by sea, hereinafter known as the Archipelago Marine Defense Strategy (SPLN) (Putra et al., 2017). This strategy is an elaboration of the defense system that takes into account the geographical conditions of Indonesia as an archipelagic country and implements state defense in an active, multi-layered manner, and can ward off all threats to prevent war, overcoming threats from the marine aspect, internal security disturbances and armed rebellion in the territory of the Republic of Indonesia in creating a safe and controlled Archipelago Sea (Marsetio: 2014).

The development of the naval force also needs to be carried out strategically and effectively to realize the desired deterrence as mandated in Law Number 3 of 2002 Article 3 Paragraph 2 and Article 6. One of the effective forces to build deterrence in the national defense strategy at sea is a submarine fleet (Green & Long, 2017). The effectiveness of the submarine force is expressed in its ability to launch continuous attacks into strategic areas of the opposing country and ward off potential threats from countries that have greater military power (Andersson: 2016). Regarding the strategic value of submarines, silence, and speed of a submarine can paralyze a strategic maritime route (maritime chokepoint) and threaten the safety of shipping commercial vessels and the navy (Joiner & Atkinson, 2016).

Indonesian waters, which are located on the Equator, are tropical waters that contain a lot of fish, plankton, and also many straits that can be used as a strategic tool, as an effective place to avoid detection of other countries' naval forces infiltrating Indonesian waters (Susilo et al., 2019). The Indonesian nation is currently continuing to develop the strength of the Indonesian Navy's submarine fleet to increase the deterrence of the national defense system and to ensure the security and safety of shipping in strategic maritime routes (Indonesian Archipelago Sea Route - ALKI) (Susilo et al., 2019). The Indonesian Navy submarine is

capable of supervising ships sailing or entering and leaving Indonesian waters freely and without being detected by the sonar of warships and submarines of other countries (Ministry of Defence, 2015).

The ability of a submarine to be undetectable during its operational life both at the bottom of the water (operational depth) and at the water surface (periscope depth and surface depth) is both an advantage and a weakness regarding the operational durability of the submarine. This shows the importance of submarines to always be felt in the area of operation, but the exact location cannot be known. Based on Table 1, information on the operational time of KRI for submarine types for the period 2012 - 2019 which is the cumulative data on submarine operational days (CKA-401, NGL-402, NPS-403, ADL-404).

Based on these data, it can be seen that the longest operation was recorded for 196 days in 2017, and the shortest for 8 days in 2016. In terms of operating data per KRI, the longest operating time was only carried out by KRI NGL-402 in 2017 for 164 days. The data in Table 1 shows the limited operational time for KRI types of submarines and the vulnerability to the state defense system at sea, especially underwater security from the activities of other countries that operate their submarines through Indonesian waters. This data shows that there has been a large number of voids in guarding Indonesia's underwater areas. Following the understanding that the shorter the ability of a submarine to be in the area of operation and maintain the confidentiality of its existence, there is a sense of vulnerability as far

Table 1. Number of Submarine Operation Days 2012 – 2019

Name of KRI	2012	2013	2014	2015	2016	2017	2018	2019
CKA-401	-	114	-	-	-	-	-	-
NGL-402	76	60	75	45	8	164	93	69
NPS-403						32	42	49
ADL-404							42	9
TOTAL	**76**	**174**	**75**	**45**	**8**	**196**	**177**	**127**

as the the ability to deter the state defense system at sea is concerned (Laksmana: 2014).

The limited operational time of the submarine can be caused by several things, both related to the characteristics of the submarine related to the technology used, and the availability of logistics and supporting infrastructure for the submarine's operations. The ability of the submarine to operate depends on the fuel capacity, the battery resistance of the propulsion system, and the availability of oxygen for the crew (Herz, et al., 2017). Meanwhile, logistical needs and supporting infrastructure related to submarine operational needs include the need for improvements to equipment and systems in the submarine, as well as the support facilities at the front and forward bases to meet the needs of logistics, fuel, fresh-water, oxygen generator cartridges, and remote locations for supplies of re-availability, logistical support, battery maintenance facilities, submarine docking stations, submarine battery recharging and discharging facilities, messing facilities for personnel (Jeon: 2020).

Faced with a stretch of Indonesian waters spanning almost 4,000 nautical miles, the Submarine cannot continuously dive during its operation to secure and enforce the sovereignty of the Indonesian national jurisdiction. This shows that it is necessary to provide such infrastructure in the submarine operational area (Laksmana: 2014). Apart from supporting the operational needs of submarines, strategically the infrastructure must also be able to support operational needs to support the Navy's power projection. The preparation of infrastructure to support the operational needs of submarines and the Navy as a whole can be done by studying other countries and how they develop their infrastructure support systems. Naval forces in other countries that are currently of concern include China, the United States, Russia, and India. In the decades following the 2000s, the development of China's naval power became a topic of worldwide concern (Friedman: 2019).

The US and Chinese naval bases can be used as an ideal base facility reference to support the operational durability of the Navy in general and specifically to support submarine operational security. Referring to the US and Chinese naval base infrastructure, the Indonesian Navy base infrastructure still needs development, both in quantity and quality, to be able to support the operational durability of ships in general and submarines

in particular. Until now, submarine maintenance and repair facilities in Indonesia are only at Surabaya Naval Base. The infrastructure facilities mentioned above are the facilities needed to support the operational durability of the submarine. This condition is considered very difficult in optimizing the role of the base for the submarine fleet (Mian et al., 2019).

These facts are in line with Anderson's (2016) statement that to obtain the effectiveness of the defense system's deterrence using a submarine fleet it is necessary to increase maintenance capabilities, logistical support, crew training, command and control capabilities, submarine rescue, surveillance, and seabed mapping. This statement shows that the strategic value of the Navy's submarine capabilities is greatly influenced by the ability of its supporting infrastructure to be able to maintain the confidentiality of submarine operations. However, infrastructure development supports the operational resilience of submarines in the face of the limitations of the state's ability to meet the development and development needs of defense equipment (Ghosh: 2013). Flowing from the above discussion, it can be felt that in making strategic decisions that are relevant to the development and fostering of the submarine-type KRI force is very complex. With the background of the problems that have been described, this research is very important to do in order to describe existing conditions and can be used as a consideration in making solutions to deal with problems that exist today. Some of the literature used as support in conducting this research, such: Research by Friedman, N (2019) entitled *Strategic Submarines and Strategic Stability: Looking Towards the 2030s*, states that submarines can operate strategically in water areas where it is difficult to detect their presence. The biggest challenge to finding a submarine is due to its operational environment rather than technological factors. Anderson in *Submarine capabilities and conventional deterrence in Southeast Asia* (2016) states that submarines are the weapon of choice to fight stronger enemies. The author also examines countries in Southeast Asia that are beginning to equip their militaries with submarines.

Research by Opresnick D. et al entitled the *Conceptualization of sustainability in operations management* (2015) discusses operational resilience in manufacturing organizations. Stebbins' in *Broaching the ship:*

rethinking submarines as a signaling tool in naval diplomacy (2015) states that submarines have strategic value in supporting naval diplomacy compared to deploying aircraft carriers. One of the beneficial factors is the factor of lower operating costs. Research entitled *Toward a theory for dissuasion (or deterrence) by denial* discusses methods for implementing deterrence in the Australian defense system (Davis, et al., 2016). There is a pool of research in the field, and some of the most relevant titles are listed as follows: *Innovation and Learning in High-Reliability Organizations: A Case Study of United States and Russian Nuclear Attack Submarines 1970-2000* (Bierly et al., 2008); Danger and New Risk for Nuclear Submarine in South Asia (Mian et al., 2019) ; Test and Evaluation for early adaptive designs in Australia's Future Submarine (Joiner & Atkinson, 2016); Study for Safety Operational Envelope of a submarine in Jamming (Park et al., 2017); Evaluation of Naval Submarine Seakeeping Criteria (Moonesun et al., 2015); Framing for Threats and Deterrence from Nuclear Submarine in the South Atlantic (Herz et al., 2017).

Locus and the object of this research are carried out on submarines owned by the Indonesian State, the focus of research is on the determinant influence of infrastructure on submarine operational durability to increase the deterrence of the state defense system at sea, making this research a novelty. This research describes qualitative analysis method with the development of thinking through interviews, Focus Group Discussions (FGD), Round Table Discussions (RTD), and semi-structured interviews to obtain data about submarine operational durability.

The results of this research can be used as a reference for determining policies in increasing the deterrence of the state defense system at sea. This paper was divided into several parts, including the second part that contains basic concepts and literature review, the third part contains research methods, the fourth part contains the results of research and discussion and the fifth part contains conclusions.

1. MATERIAL & METHOD

1.1. National Interest

By the Indonesian Defense White Paper, the Indonesian Nation builds a defense system by identifying various threats as the main factors that form the basis for the preparation of the national defense system design, both actual and potential. The types of threats identified as potential for the present and future can be classified into three types, including military threats, both armed and unarmed, non-military threats, and hybrid threats. Therefore, the development of defense forces which is manifested

in the development of military forces is an absolute necessity to guarantee and protect the national interests of the Indonesian people in the arena of international relations (Ministry of Defence, 2015).

Efforts to realize a State Defense that is capable of handling the security of the Maritime Area is carried out by deploying Sea-power in a task force capable of reaching the boundaries of the Indonesian Exclusive Economic Zone effectively and capable of exercising control of the marine area of national jurisdiction (Bueger & Edmunds, 2017). The Navy has a unique ability compared to other militaries, namely the ability to produce coercive signals and deterrence to the enemy. Naval power can effectively transmit these signals, and their effectiveness stems from two unique features of Navy capabilities (Susilo, et al., 2019).

1.2. Defense Strategy

Two basic things need to be described in the implementation of a national defense system strategy that has deterrent capabilities. First, deterrence by denial strategies to prevent an action by making the enemy predict is impossible or unlikely to succeed, thereby denying the potential enemy's confidence in achieving its objective of deploying sufficient military forces for the invasion. Second, there is the deterrence strategy that relies on threatening to give severe penalties – (deterrence by punishment) – such as nuclear escalation or heavy economic sanctions, in the event of an attack (Senol & Karacuha, 2020).

1.3. Submarines in the State Defense System at Sea

A submarine is a strategic weaponry in the Navy that has operational capability, such as tactical and strategic surveillance and reconnaissance, anti-ship war, anti-submarine war, attack to vital target on land (precision strike), raid amphibious operation, mine deployment to the SAR operation, and VVIP security (Suseto, et al., 2018). Marsetio (2014) predicted that submarines will have a leading role in the future, compared with surface combatants, considering its secret trait and mobility which can reach further water area. Infiltration and exfiltration operations will be more effective using submarines in intelligence operations against other countries.

1.4. Operational Durability

Durability is a complex concept, but it is made possible to filter the most fundamental aspects to adopt the system approach, which system is defined simply as a set of elements that relate to each other (or subsystem). The strategy of durability and sustainability of operation of State Defense System

is a secret in general, maintained by a state which uses it. Operational durability strategy in the case of the manufacturing industry is formulated through a capability approach to ensure strategy (planning) and operation (implementation) which is sustainable (Mora et al., 2009). According to research in the field, operational durability strategy must consider environmental factors (Trost: 2000). The schematic of the relationship between the enduring factors in operations management is shown in Figure 1.

1.5. Submarine Operations

In the context of operational security, Anderson (2016) states that it takes mastery and preparation in the areas of maintenance capabilities, logistical support, crew training, command and control capabilities, submarine rescue, seabed monitoring, and mapping. Determination of the technology that needs to be installed on a submarine generally takes into account the operational tasks to be carried out, the operation area-range-transit time, speed, diving depth, passive defense, weapons systems, rescue and rescue, re-support, maintenance, and average size of crew (Joiner & Atkinson, 2016).

1.6. Determinant Infrastructure

In the terminology of the United States of America military, infrastructure is defined as the whole building and permanent installation required for support, placement, and operation of military force, such as barracks, headquarters, airfield, communication, facility, warehouse, port, and maintenance station

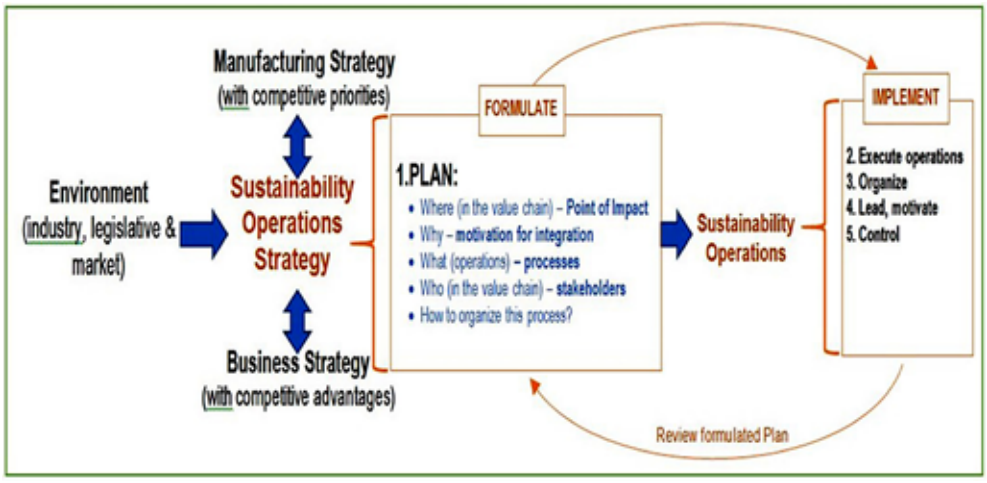

Fig. no. 1 Durability in Operations Management

(Lostumbo et al., 2013). Military infrastructure is required in supporting operational durability, but budget availability and national resource in general are limited to meet the need for development and maintenance for military infrastructure (Ghosh: 2013).

1.7. Submarine Logistical Support System

The submarine (subsurface) logistical support system is not much different from the logistical support system for above-surface warships. A good logistics system, among other things, forms the foundation that allows for flexibility and strategic mobility to support military operations and warfare. Thus, the existence of a sustainable logistics system determines the success of a strategy. Therefore, qualified logistics will greatly determine tactical readiness and success to obtain strategic results and outcomes (Jeon: 2020).

A system consists of many different elements, including those directly used in achieving the actual mission (including, the main equipment installed in the system, personnel as operators, features, and so on) and maintenance support elements (for example, maintenance personnel, test equipment, maintenance facilities, spare parts, and parts and repair inventory). Supporting infrastructure is not often considered as the main element of a system, but the system may not be able to complete its specified functions if it is not supported by the supporting infrastructure (Blanchard: 2016). Thus, the supporting infrastructure is referred to as the main element in the system, presented in the context of the system life cycle (Figure 2).

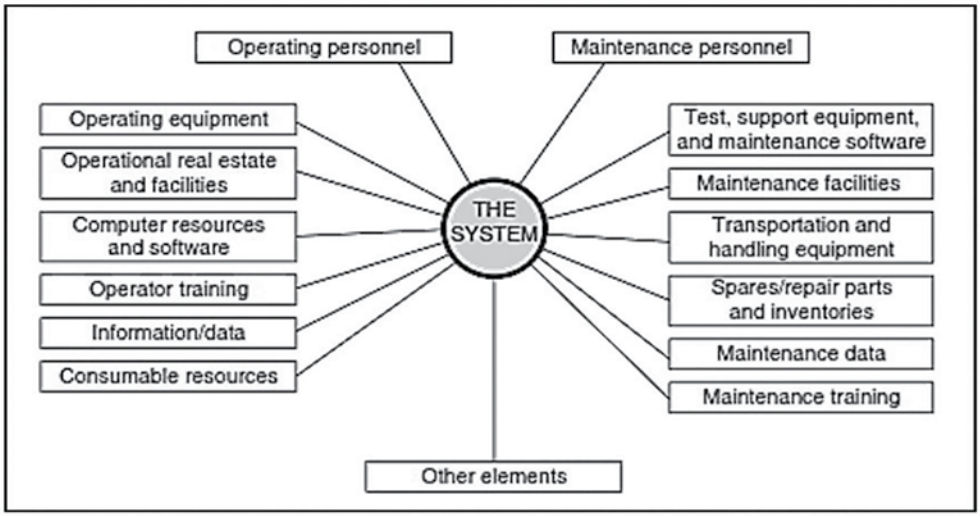

Fig. no. 2 Main Elements in a Logistic Support System (Blanchard: 2016)

This research was divided into four main parts, including a) input, b) process, c) output and outcome. The input in this research was the perceived need for a determinant infrastructure to support operational resilience of submarines to increase the deterrence of the state defense system at sea. After the formulation of the research input, it was continued with the research process that begins with the formulation of the problem and carried out a literature review to compile research hypotheses, the formulation of research methodology as a guide for data collection and analysis.

The next stage is data analysis. This research used qualitative analysis with a narrative interpretation method where the qualitative data obtained was interpreted narratively to obtain conclusions relevant to the research problem. The data obtained will be grouped into categories of opinions, facts, and knowledge. Opinions related to the informants' thoughts on a phenomenon that was asked in the interview; facts regarding what the informants know; and knowledge relating to what the informant knows about the field in question. The results of the interviews obtained from the previous stage are transcribed so that they form a database that can be used and read repeatedly as needed when interpreting data. After obtaining the qualitative research database, the data compilation was carried out by decomposing the data according to the characteristics relevant to the research problem. In the process of decomposing the database, data were sorted and reduced with a focus on the sections that were relevant to the research topic and ignoring other parts. The necessary parts are then rearranged (the reconstruction phase) to obtain a pattern that is characteristic of this research database. Upon obtaining the characteristics of the data, data interpretation and verification followed in order to obtain the meaning of each piece of information obtained by looking for relationships, similarities, and differences. Furthermore, the relevant conclusions were drawn to answer the research questions.

2. RESULTS AND DISCUSSION

2.1. Results

The qualitative data collection of this research was carried out through the implementation of Focus Group Discussions (FGD), Round Table Discussions (RTD), and semi-structured interviews. The implementation of the FGD involved the resource persons Rear Admiral Muhammad Ali, SE, MM

who at the time of the FGD served as Commander of Fleet I Command, and Marx Jefferson who served as Head of the Submarine Program of PT PAL Indonesia (Persero), and was attended by FGD participants who came from the Head Technology Transfer and Offset Division of the Defense Industry Policy Committee (Rear Admiral TNI (Ret) Rachmad Lubis), BPPT Submarine Research Representatives and Research Representatives from the Sepuluh Nopember Institute of Technology and the University of Indonesia.

The resource persons and RTD participants included the Assistant for Planning and Budget for the Chief of Staff of the Indonesian Navy, the Commander of the Indonesian Navy Command and Staff School, the Governor of the Naval Academy, a researcher at the University of Indonesia, a researcher at the Sepuluh Nopember Institute of Technology and a researcher at the Defense University. Structured interviews were conducted. In this research, the informants include Indonesian Navy Maintenance and Repair Facility officials as submarine

Table 2. Experts in Research

No	Expert	Total	Code
1	Commander of First Fleet Command, Vice Admiral Muhammad Ali	1	E1
2	Head of the Submarine Program of PT PAL Indonesia, Marx Jefferson	1	E2
3	Head of the KKIP Technology Transfer and Offset Division, Vice Admiral (Ret) Rachmad Lubis	1	E3
4	Vice Admiral Iwan Isnurwanto	1	E4
5	Vice Admiral TNI Tunggul Suropati	1	E5

In this research, RTD was carried out virtually by some experts and practitioners in the field of defense and submarine technology.

maintenance operators, officials in Fleet Command II, Indonesian Navy Headquarters, Ministry of Defense, Indonesian Navy Base as submarine

operational and maintenance regulators, Directors within State-Owned Enterprise (BUMN) as determinant infrastructure service providers for ship maintenance and repair, Directors within Private Owned Enterprise (BUMS) as determinant infrastructure service providers for ship maintenance and repair, experts as expert resource persons in the field of national defense, academics as expert resource persons in the field of submarines, academics as resource person Infrastructure experts support submarine operations.

Several qualitative information is obtained from informants. The identification if the latter was made by using a purposive approach with the consideration that only certain personnel have knowledge and authority about the submarine, both the management of the submarine operation and the relevant development, maintenance, and repair processes. Some important points obtained from the results of qualitative data collection through FGD, RTD, and semi-structured interviews include:

a. The operational durability of a submarine is influenced by the condition of the submarine and the technology used, the availability and ability of material and personnel maintenance facilities as a determinant infrastructure to support submarine operational needs, the availability of submarine tenders, and submarine logistical support.

b. Determinant infrastructure to support submarine operational resilience is currently available only at Surabaya Naval Base as the base for a submarine base (initial base) and its current condition needs to increase its capacity and capability according to the needs of submarines both in terms of quantity and submarine equipment technology.

c. Shipyard (defense industry) supporting submarine operation, maintenance and repair must have mastery of submarine maintenance and repair technology which requires a large investment of capital and time. Currently, only PT PAL Indonesia (Persero) can provide submarine maintenance and repair services so that with the increasing number of submarines owned by the Indonesian Navy, the market for submarine maintenance and repair is becoming more extensive and is opening opportunities for other shipyards, both governmental and private. To play an active role in supporting the operation, maintenance, and repair of submarines.

d. To increase the operational durability of submarines, a commitment at a strategic level is also needed to ensure the availability and adequacy of submarine operational budgets, including for submarine maintenance and repair activities.

e. Submarines can operate "openly" or "covertly" to maintain confidentiality while creating the required defensive system countermeasures. However, this deterrence can only be obtained if the submarine can sail and dive following its operational strategy of maintaining secrecy.

2.2. Discussion

The influence of total submarine technology through determinant infrastructure dominantly affects the operational durability needs of the submarine. Referring to this, it can be seen that the influence of determinant infrastructure on the operational durability of submarines becomes increasingly significant after being synergized with the level of submarine technology being operated. This means that the technological level of the determinant infrastructure needs to be adjusted to the level of technology of the equipment and systems installed on the submarine. Meanwhile, the logistical needs to support the operational resilience of submarines will have an increased effect if they synergize with the determinant infrastructure. This statement is in accordance with the operating pattern that the submarine returns to base, among others, to carry out re-provisioning of logistical needs. This means that the logistical needs of submarines require the availability of a determinant infrastructure to be distributed to the submarines in need.

Referring to the results of the analysis, it can be understood that the operational durability of submarines is influenced by the determinant infrastructure, submarine technology, and submarine logistical support, either individually or simultaneously. It is known that the determinant infrastructure to support submarine operations is needed at 1) First Base; 2) Early Base; 3) Front Base. The need for determinant infrastructure in First Base is following the results of an interview which states "... in the future we will think about infrastructure that is mobile ..." (Rear Admiral TNI Muhammad Ali). This statement strengthens the estimated value of First Base as the most dominant compared to other dimensions (Early Base and Front Base). By the submarine operation pattern, First Base is an approach base before the submarines enter the combat area (operation).

Preparation of determinant infrastructure can increase the operational durability of submarines strategically because they are still in a safe area and allow submarines to immediately enter the operational area in a relatively short time. Therefore, the provision of mobile infrastructure as a determinant infrastructure for the Indonesian

Navy task force can be prepared in the area closest to the submarine operation area which is equivalent to the location of First Base.

2.3. Resilience of the State Defense System at Sea

According to the above discussion, the operational resilience of submarines in this study is defined as the ability to maintain the KRI of a submarine type to be in the operational area for as long as possible without the other party knowing (maintaining confidentiality). Admiral TNI (Ret.) Prof. Dr. Marsetio stated that the Indonesian nation needed a minimum of 25 submarines to be able to guard the country's defense system at sea, especially controlling subsurface security.

The resulting deterrence of submarine operations is the belief (perception) that a country will be able to provide significant resistance to other countries with a surprise attack on the center of power of the intended country. This is in line with the statement of Rear Admiral Muhammad Ali–and Vice Admiral (Royal Australian Navy) Tim Barret that the submarine's deterrence correlates with the sub's operational durability, mobility, and firepower. Besides, the effectiveness of submarine operations depends on the ability of a country to master the technology of operating, maintaining, repairing and providing the necessary infrastructure by the technology used (Anderson: 2016).

Based on the discussion in this research, it can be concluded that the operational durability of submarines has a significant effect on increasing the deterrence of the state defense system at sea provided that, among other things, the secrecy of the submarine can be maintained and the ship can be operated continuously at sea. Maintaining the confidentiality of the submarine requires a determinant infrastructure that correlates with the level/type of submarine technology in operation, submarine logistical support, a high level of commitment to ensure the availability of budget support for submarine operations, maintenance and repair. Besides, the involvement of shipyards and the defense industry, both state-owned (BUMN) and private-owned (BUMS) enterprises, is needed to ensure the availability of the determinant infrastructure needed to support submarine operational resilience. Following the analysis of interview data, determinant infrastructure needs to be provided (built) in Sumatra, Natuna, North Bali, Ambon, Makassar, Palu, Tarakan, and Papua. It is believed that the involvement of shipyards owned by the government and the private sector can support the

operational resilience submarines, which in turn is expected to increase the deterrence of the state defense system at sea.

3. CONCLUSIONS

The effect of submarine operational resilience on the deterrence of the state defense system at sea in this research was carried out in a qualitative analysis. The qualitative analysis method was carried out because the deterrence of a country's defense system is the perception of various parties, both (the state) that organizes the defense system and other parties (state) in relation to the host country. In a discussion of the effect of submarine operational durability on the deterrence of the state defense system at sea, this research found that there was a significant influence on the causal relationship between the two variables with the following information:

a. Submarines can only contribute to increasing the deterrence of the state defense system at sea if the ship is operating, has motion and firepower. This is consistent with the data obtained from research informants and secondary data from interviews with international news reports.

b. The operational durability of a submarine is influenced by the condition of the submarine and the technology used, the availability and ability of material and personnel maintenance facilities as a determinant infrastructure to support the operational needs of the submarine. This is supported by the fact that the Indonesian Navy submarine experiences limited operational time because the technology installed requires the submarine to return to its Surabaya base to carry out maintenance and re-provision of the logistical needs of the ship's material and personnel.

c. Determinant infrastructure to support operational resilience of submarines is currently available only at Surabaya Naval Base with conditions requiring increased capabilities by technological developments and the number of submarines of the Indonesian Navy. In line with the explanation in the previous paragraph, the Indonesian Navy submarine must return to its Surabaya Naval Base.

d. Currently, only PT PAL Indonesia (Persero) as a shipyard (defense industry) has the mastery of submarine maintenance and repair technology to support submarine operations, maintenance, and repair so a strategy is needed to increase the

involvement of the private sector to obtain an increase in the availability of determinant infrastructure effectively and efficiently.

e. A strategic level commitment is required to ensure the availability and adequacy of submarine operational budgets including for submarine maintenance and repair activities. This was supported by research informants who stated that the ship's operating capacity was limited due to limited budget support.

Based on the description above, it can be concluded that:

a. Submarine operational durability has a significant effect on increasing the deterrence of the state defense system at sea.

b. To be able to realize submarine operational resilience, determinant infrastructure support is needed that can be provided by the Indonesian National Army (TNI), in this case the Navy and the Defense Industry (State and Private Owned Enterprises).

4. ACKNOWLEDGEMENT

Researchers would like to thank all parties who have participated in completing and supporting the implementation of this research so that it can be completed smoothly. This research is supported by Indonesia Defense University.

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