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Policy Review of the Effectiveness of the Submarine Technology Transfer Roadmap between Indonesia and South Korea

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Abstract

Indonesia is a country with enormous water areas with maritime security threats that require high security in their territorial waters including by using submarines, but the number of fleets is not optimal yet because Indonesia is required to have 12 submarines to protect their waters from threats of law violations. Indonesia took steps to build a strong defense posture by procuring submarines technology transfer cooperation with South Korea, this decision was made by Indonesia because of their limited knowledge and ability to design and produce submarines. This study is about a policy review of the effectiveness of the submarine technology transfer roadmap between PT PAL Indonesia and DSME Korea. This study aims to analyze the policy effectiveness of submarine technology transfer policies within the framework of Indonesia's maritime defense and security. Data obtained from interviews and literature were then analyzed using qualitative analysis methods. The research's results show first the batch submarine technology transfer policy had been implemented ineffective in supporting Indonesia's ability to produce its submarines, and there was a gap between the target to be achieved and the technology transfer knowledge that had been obtained, the effectiveness of technology transfer could be increased by improvements in the next cooperation contract to maximize the quality of the submarine. This research concludes that the knowledge of the submarine transfer of technology in the first batch is ineffective in supporting the ability to produce submarines, it is necessary to continue technology transfer to the second batch to support Indonesia's target in the ability to build its submarines with still consider the evaluation of the 1st batch to improvements in the next batch of transfer technology and also engage the educational institution, Indonesia Defense University as a knowledge base thus facilitate better output in future technology transfer cooperation.

INTRODUCTION

Indonesia is the largest archipelagic country in the world and has abundant marine assets and natural wealth. Indonesia has a lot of potential that can be exploited for the welfare of the people, equity of life, and economic resources for the country. Indonesia has sea waters of approximately 5.8 million km^2 or around 75% consisting of 0.3 million km^2 of territorial sea waters; 2.8 million km^2 of Indonesia archipelago sea waters; and 2.7 million km^2 of Indonesia Exclusive Economic Zone (ZEEI) waters (Muhamad, 2012).

The vast environment of Indonesian waters creates threats related to the territorial sovereignty of Indonesia, such as the issue that is currently happening around Indonesian territory which China claims that the North Natuna waters are also included in their traditional fishing grounds (Simanjuntak, 2018). The North Natuna Sea area is directly adjacent to the South China Sea which is an area with geopolitical dynamics due to the presence of two dominant powers, that is America and China, which influence strategic security conditions in the Indo-Pacific region. In addition, there are still claims from other countries against Indonesia's sovereign territory, such as what was done by Malaysia against Indonesian waters in the South Malacca Strait. Australian Navy ships that violate the sovereignty of the Republic of Indonesia by entering Indonesian waters without permission (Karyono, 2016).

Indonesia is responsible for maintaining and securing territorial integrity from various security threats to the Republic of Indonesia. This maritime security led to the existence of a naval military strategy to secure and supervise Indonesia's maritime borders and vital areas in the sea which are the passageways for ships for trade. This maritime security condition plays an important role in the thoughts and policies taken about Indonesian maritime affairs. Therefore, strategies and policies related to maritime are needed.

The area around Indonesia's EEZ also experiences an uncertain situation making this area prone to illegal things occurring which makes Indonesia want to strengthen its defense and security in its territorial waters since transnational crimes often occur in Indonesian waters, such as piracy, illegal fishing, people smuggling (Karyono, 2016). The government is trying to secure the sea using ships, however, this is a challenge because the current number of fleets is not optimal to protect the sea from the threat of violations of law and sovereignty. Based on this condition, Indonesia must take steps to build a strong national defense posture in terms of safeguarding and deterrence. Indonesia needs to have a submarine defense system as it may provide an effective deterrence effect for its enemies (Rizanny, 2017), to have an impact on Indonesia's deterrence against other countries that try to illegally enter national waters (Ayu & Meidiani, 2018), and also rise the impact of diplomacy of Indonesian politics in the eyes of the international community.

It is important to carry out efforts to guard water areas so that security is realized in land areas, as safe sea areas will protect state territory. Maritime security or maritime security refers to the naval strategy in the aspect of maintaining and securing national maritime borders and sensitive areas in the seas that are used as trade routes (sensitive maritime trade choke points) (Mudric, 2016). Maritime security is a small part of national security so the practice of a country's national security determines how maritime security is practiced in national policy (Octavian & Yulianto, 2014). The theory of maritime security put forward by Christian Buerger conveys three schemes used to help study maritime security theory, that is the matrix framework, that maritime security contains a rule that combines the concepts of sea power, marine safety, blue economy, and human resilience (Buerger, 2015).

The Indonesian military defense posture is divided into 3 parts, the Indonesian Army (TNI AD), the Indonesian Navy (TNI AL), and the Indonesian Air Force (TNI AU). Indonesia has a Defense Strategic Plan for 2024 is ideally Indonesia required to have 12 units of submarines by 2024 (Suhardono, Baihaqi, & Ikhwan, 2017). These 12 units of submarines become Indonesia's Minimum Essential Force, this is a form of basic force that becomes minimum standards that has a deterrent effect (Rusman, 2018). This means Indonesia needs to hold the ability to build submarines independently so Indonesia can make its own and have more submarines to strengthen Indonesia's maritime defense and security posture. The necessity to have more marine defense equipment is carried out through international cooperation, that is the technology transfer policy with South Korean company, Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME). Arms transfer activities provide an opportunity for countries to increase their military arms through cooperation with other parties who have more advanced defense technology in various forms.

The cooperation contract or Memorandum of Understanding (MoU) was signed by the Indonesian government through the Ministry of Defense with DSME Korea (Jannah, 2018) on December 20th, 2011 for the procurement of 3 submarines with a contract value of $1.08 billion. South Korea was chosen as the place to buy submarines because of considerations that prices are cheaper than other countries (Al-Fadhat & Effendi, 2019). The cooperation contract signed states that two submarines were built in South Korea in coordination with PT PAL's shipbuilders, while one submarine was built at PT PAL's shipbuilding facility in Surabaya, Indonesia. PT PAL Indonesia is a subsidiary of Len Industri which operates in the shipbuilding sector. PT PAL Indonesia is one of the state-owned companies that produces the main equipment for Indonesia's defense system, especially for maritime dimensions. The collaboration requires the implementation of strategies and methods including the capabilities and experience of human resources from related organizations, as support to preparing adequate infrastructure from related parties (Sulistijono, 2017).

This technology transfer policy occurs because Indonesia has not been able to build its submarines with their original design, PT PAL Indonesia as a state-owned company faces challenges when building designs due to protected information from DSME Korea. According to Indonesia's needs, the technology transfer is insufficient the development of submarines is not fully handed over to Indonesia. DSME Korea said PT PAL Indonesia facing obstacles in mastering technology transfer due to their human resources and less qualified technology to build submarines.

South Korea was chosen as the country to cooperate with Indonesia in the other defense projects, namely the Korean Fighter Xperiment/Indonesian Fighter Xperiment (KFX/IFX) Jet Fighter Cooperation Project. The Government of the Republic of Indonesia and the Government of the Republic of Korea signed an Agreement on Cooperation in the Field of Defense on October 12, 2013 (Pattisina, E. C & Yossiharra, 2021). The KFX/IFX cooperation is a government-to-government cooperation program between Indonesia and South Korea in the field of joint jet fighter development and production to achieve the independence of the defense industries of the two countries (Ministry of Defense of the Republic of Indonesia, 2019). This project facing a halt in the process, mainly because of financial and transfer technology scheme, in the context of the transfer of technology, Indonesia does not have full ownership of the KFX/IFX jet fighter prototype Indonesia only has a minority ownership portion, which is 15%, while the majority ownership portion belongs to South Korea, it makes both of the government should conducting a meeting to reviewing the contract and renegotiate about the project (Sari, 2021).

Effectiveness is an important point to fulfill in cooperation and policy, because if a program is considered to have been run effectively by the collaborating parties, then it can be a good evaluation for similar plans in the future and can establish closer cooperation between cooperating parties, such as Indonesia and South Korea. Effectiveness is the level of achievement to reach a goal, the intended goal is a situation that is expected or desired. This effectiveness comes from the word effective, which is a job that can be said to be effective if the job can produce a unit of output promptly (Steers, 1985). Effectiveness is the judgment we make concerning the achievements of individuals, groups, and organizations, the closer their achievements are to the expected performance, the more effective this assessment (Gibson, 1985).

The success of a policy or program is usually measured using an indicator of policy effectiveness. In this study, the indicators proposed by Nugroho (2012) were used, namely the right policy, the right implementation, and the right target. In measuring the effectiveness of this technology transfer policy, the right policy indicator is used to assess how appropriate the submarine technology transfer policy taken by the government can be a solution to the problems faced, secondly, the right implementation indicator, is deciding whether the actors implementing this policy are carried out by the right people between cooperating parties, between government agencies or community institutions, and the third is right on target indicators, that is determine the efforts made to achieve the planned target is match.

The policy indicators stated by Nugroho used in this research have sub-indicators, in the right policy indicator, we need to determine that the policy made can solve the problem that must be faced, then is the policy formulated in accordance with the type of problem faced and is the policy issued by an accordance institution with its authority or competence in resolving the problem. Then the right implementation indicator, is the institutions collaborating with the government, as implementers of technology transfer policies matching with the problem faced. The third is the right target indicator, is the targets are achieved according to the planned time, is the targets can be achieved according to the desired quality and expected quantity, is the target in line with other policies. Based on the description of this technology transfer cooperation, this research aims to discuss policies, and policy effectiveness, and analyze obstacles in the transfer of submarine technology between Indonesia and South Korea within the framework of Indonesia's maritime defense and security.

METHODS

The method used in this research is descriptive qualitative research. This study uses data collection techniques, namely interviews and literature studies. This research was conducted in Jakarta and Surabaya. The interview technique was carried out using a question-and-answer process between the researcher and the informants directly. While literature studies were obtained from documents provided by the informants. This data is then analyzed using triangulation techniques to ensure the validity of the data.

Table 1. List of Informants

Informants	Date
PT PAL Indonesia	November 8, 2022
DSME Korea	December 14, 2022
Directorate General of Defense Strategy of the Indonesian Ministry of Defense	January 27, 2023
Directorate General of Defense Potential of the Indonesian Ministry of Defense	January 30, 2023

Indonesian Navy (TNI-AL)	November 8, 2022
Indonesian Navy Base in Banten	October 20, 2022

RESULT AND DISCUSSION

Indonesia aims to achieve independence by building submarines that function as a means of defense and maritime security in Indonesian territorial waters, the Indonesian government provides a sufficient budget to build the necessary facilities and infrastructure to support the construction of PT PAL Indonesia's submarines so that they can master the ability to produce submarines independently for Indonesia. The contract of transfer technology was signed between the Indonesia Ministry of Defence and DSME Korea. The implementation of the first batch of technology transfers began with the Contract for the Procurement of 3 Submarines with DSME number TRAK/1495/KE/XII/2011/AL dated December 20, 2011. This cooperation contract contains the main points of cooperation in building submarines, with joint sections and maintenance, repair, and operation (MRO), involving the Indonesian Navy as ship users, but cooperation with educational institutions such as the Defense University and the implementation of local content and offset return policies mechanism (*Implementasi Kebijakan Imbal Dagang Kandungan Lokal dan Ofset* or IDKLO) has not been included in this cooperation contract.

Stages of Submarine Technology Transfer Policy

The technology transfer policy between PT PAL Indonesia and DSME Korea consists of 4 stages.

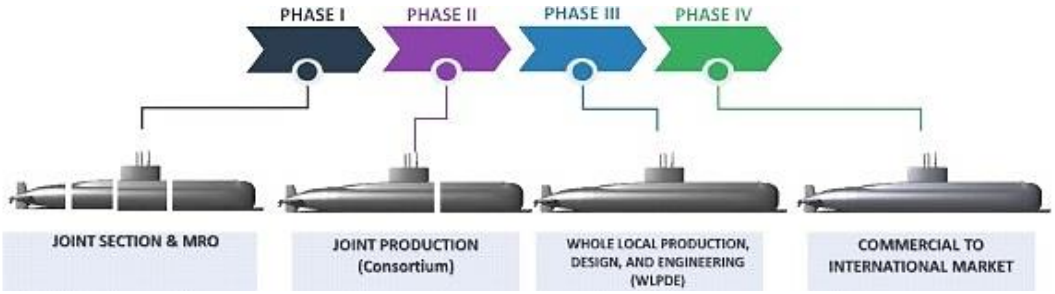

Figure 1. Road Map for Mastering Submarine Technology

The first batch is the Joint Section and MRO, in the contract there is no collaboration with the Defense University educational institution. The second batch is Joint Production, namely the construction of submarines together. The third batch is whole local production or overall development in Indonesia. The fourth batch will focus on selling submarines designed by PT PAL Indonesia to the international market. PT PAL Indonesia has just completed first batch of technology transfer and gained the basics of knowledge in building submarines, starting with maintenance, repair, and operation (MRO), that is the overhaul of the Nanggala-402 and Cakra-401 submarines, then learning for the construction of DSME 209 submarines in South Korea is given to PT PAL Indonesia experts through the On the Job Training (OJT) program by DSME in South Korea.

All stages of technology transfer material listed in the cooperation contract have been completed, but the knowledge gained in the first batch is still insufficient for the construction of domestic submarines, so if the knowledge and capabilities that have been possessed do not continue, then it is feared that the previous knowledge and capabilities that have been studied before can disappear because the absence of activities in the field of submarine building, and limited knowledge of technology to build a submarine,

including production activities. The 1st batch cooperation contract, the Indonesia Defense University as an educational institution is not involved in cooperation in the academic or educational realm, if university components such as teachers and students are involved, they can contribute to the research and development, knowledge base that can support basic competency improvement, build a map of industrial capability systems, including technical capabilities, project management, transfer of technology, so it's more beneficial for the development of submarine defense and security procurement in Indonesia.

Submarine Technology Transfer Policy Budget

The submarine technology transfer cooperation between PT PAL Indonesia and DSME Korea began at the signing of the purchase contract between the Ministry of Defense of the Republic of Indonesia and a South Korean shipbuilding company. The cooperation contract worth $1.08 billion was signed by the Indonesian Ministry of Defense represented by the Head of the Defense Facilities Agency of the Indonesian Ministry, Major General Ediwan Prabowo, while DSME was represented by DSME President & CEO Sang-Tae Nam in December 2011 (Ministry of Defense of the Republic of Indonesia, 2012).

The submarine development technology mastery program by PT PAL Indonesia is in line with the Master Plan made by the Government, PT PAL Indonesia requires the readiness of submarine production facilities to support the implementation of technology transfer. The stages of implementing a strategic plan, namely the First Strategic Plan for 2010-2014, the Second Strategic Plan for 2015-2019, and finally the Third Strategic Plan for 2020-2024. In the First Strategic Plan, the government has budgeted funds of 1.56 trillion for the provision of defense equipment (Saragih, 2013), this funding is budgeted in the Indonesian State Revenue and Expenditure Budget 2015 (*Penyertaan Modal Negara* or PMN), and the Ministry of Finance provides funds through State Investment. Furthermore, in the Second Strategic Plan, the government budgeted funds for the Indonesian National Armed Forces (*Tentara Nasional Indonesia or TNI*) 1.06 trillion (Supriatin, 2018). This encourages the fact that the facilities, infrastructure, and technology at the PT PAL Indonesia shipyard are already appropriate to support the First batch of submarine joint section. During the implementation of the technology transfer policy, the Indonesian government has also provided a budget to carry out the construction of facilities and infrastructure in preparing personnel, and all human resources training processes. Furthermore, in the State Budget for Fiscal Year 2021, the Ministry of Finance provided more funds to PT PAL Indonesia through State Investment (*Penyertaan Modal Negara* or PMN) of IDR 1.28 trillion so that PT PAL Indonesia could complete facilities to support submarine production. The budget obtained by PT PAL Indonesia is still waiting to be spent, this is because PT PAL Indonesia needs to wait for directions and orders from the Ministry of Defense regarding the purchase of further submarines with South Korea again or there are other considerations from the Ministry of Defense. Furthermore, PT PAL Indonesia will complete the submarine production facilities according to the type chosen by the Ministry of Defence.

The difference of opinion between PT PAL Indonesia and DSME Korea about not continuing cooperation for now can be said not because of the budgetary issues, but because the Ministry of Defense has yet to decide on continuing the policy of buying and transferring submarine technology from South Korea, due to the result of first batch of technology transfer which did not meet expectations, the quality of the ships and the lack of knowledge obtained by PT PAL Indonesia become the main reason why Indonesia still not continue the cooperation to the next batch.

Submarine Technology Transfer Policy Effectiveness

Right Policy

This technology transfer policy was carried out because of Indonesia the lack of knowledge and ability to design and produce its submarines even though Indonesia requires a lot of submarines. It is necessary to build Indonesia's independence in the defense industry so Indonesia can produce its own submarine defense and security equipment according to its domestic needs, to minimize costs that must be incurred in the future due to buying from other countries, also Indonesia does not need to depend on other countries in the future.

Personnel from PT PAL Indonesia must have the skills and knowledge to build submarines through a technology transfer process. The technology transfer policy that has been completed in the first batch indicates that PT PAL Indonesia still does not have the opportunity to build its submarines, because PT PAL Indonesia has not received submarine design plans from DSME Korea and has not received the knowledge to design and manufacture these submarines independently, this is because in the contract written that South Korea will provide the design guide after second batch and this cooperation only runs for 1 batch until now.

Currently, the absence of the continuation of the second batch of technology transfer cooperation makes this situation even more unfavorable, which makes this goal unattainable. The gap with the targets in the 2010-2029 Indonesian Defense Industry Development Master Plan is because the ability to master technology should have been obtained in 2014-2019 but in fact, it has not been fulfilled optimally, because the ability to develop new design engineering for this type of submarine has not been carried out due to the limited knowledge obtained by PT PAL Indonesia in submarine technology transfer from the cooperation with South Korea. Failure to achieve independence in the mastery of technology has an impact on not achieving targets to resolve Indonesia’s maritime security issues.

Right Implementation

The right implementation is related to the stakeholders and the suitability of the actors implementing the submarine technology transfer policy, namely PT PAL Indonesia and DSME Korea. PT PAL Indonesia as the largest shipbuilding company in Indonesia was chosen as the company that received the technology transfer, and DSME Korea is also a South Korean shipyard that has experience in building many types of ships from reports in 1994-1995. It is known that the Indonesian Navy (TNI AL) ordered 1 Ocean Tugboat from the Daewoo Pusan shipyard because Indonesia's history of cooperation with DSME makes Indonesia confident that DSME Korea can meet Indonesia’s expectation to build its domestic submarines. This phase of cooperation is going as planned and the knowledge obtained in this batch is that PT PAL Indonesia has received technology transfer and mastered the ability of joint sections and maintenance, repair, and operation (MRO). In the quantity aspect, Indonesia has received 3 units of submarines, this is in accordance with the agreement.

The implementation of the first batch of technology transfer was first on the KRI Nanggala-402 overhaul in 2010 to 2011 which involved 8 shipbuilders from PT PAL Indonesia with lessons taught about management, hull structure design, electric design, quality management, repair electric, repair electronics. After the overhaul of the Nanggala-402 submarine has been completed, the next is the shipbuilding DSME 209 first Batch Project which began in 2013 to 2017 with a total of 206 shipbuilders who were sent

to South Korea to learn transfer of technology, the first design lectures involved 20 shipbuilders and OJT, production and management totaling 189 shipbuilders.

In 2019, the KRI Cakra-401 was overhauled which involved 2 shipbuilders with the lessons of the steering stand. The results achieved in this transfer technology of submarine in 1st phase of the Road Map are Joint Section KRI Alugoro-405 and Maintenance, Repair, and Overhaul (MRO) technology on KRI Cakra-401, and all the training achieved good results.

Figure 2. The Third Submarine (KRI Alugoro-405) Joint Section from the First Batch

Indicators of achievement of Joint Section technology transfer in the construction of KRI Alugoro-405 can be explained as follows:

1. The inspection results of the joint welding process between sections in a sequential manner radiography and magnetic test stated that there was no defect (zero defect).
2. Completion of Setting to Work (STW), implementation of Harbor Acceptance Test (HAT), and Sea Acceptance Test (SAT) function tests runs well.
3. The static dive was successful in the Nominal Diving Depth (NDD) test in the North Waters of Bali Island and was declared passed by successfully diving to a depth of 250 meters. Apart from that, KRI Alugoro 405 also underwent tests such as the Harbor Acceptance Test (HAT).
4. Making mine adapter designs.

The technology transfer education provided to PT PAL Indonesia by DSME Korea is carried out through the OJT process or can be interpreted as learning that is accompanied by working on design materials and submarine production. The policy of implementing technology transfer through OJT in the first batch was carried out in a Learning by Seeing to the Indonesian side due to demands from the South Korean side. This happened because the contract is not written in detail regarding the implementation of the OJT so PT PAL Indonesia assesses that OJT is given by learning by doing or direct practical learning, but the actual implementation is done through learning by seeing. OJT with hands-on practice is most required because to have the technical ability to build, experts from PT PAL Indonesia must try the process of making submarines themselves, if it is done through learning by seeing it will be difficult for experts to gain comprehensive experience in building submarines.

Right Target

In fulfilling the target itself, it is necessary to know whether the efforts made by the planned targets in an exact time according to the contract or agreement, with quality and quantity expected, also the agreement in line with other policies. This technology transfer policy is planned to encourage the independence of the Indonesian defense industry to build its Indonesian-designed submarines, this is because Indonesia needs several submarines to be used to support Indonesia's maritime security. This policy was taken by prioritizing the interests of the nation, related to the interests of the Indonesian Navy (TNI AL) in maritime security, the purchase of 12 submarines in line with purchase policy to involved the local industry, in this cooperation is PT PAL Indonesia as the local industry who will receive the transfer technology of submarine from DSME Korea, so this

cooperation was considered obedient the Indonesian Law Number 16 of 2012 and supports the interests of increasing the capacity of the domestic industry.

Submarine technology transfer between PT PAL Indonesia and DSME Korea is included in the purchase contract, in first batch of the transfer technology conducted was Maintenance, Repair, and Overhaul (MRO) such as KRI Nanggala-402 Overhaul in 2010-2011 and KRI Cakra-401 Overhaul in South Korea in 2019, then on the OJT the construction of the DSME 209 submarine began in 2013-2017 in South Korea. The submarines purchased in the first batch are 3 units that were handed over to Indonesia, the KRI Nagapasa-403 on August 28, 2017, the second submarine is KRI Ardadedali-404 received on May 17, 2018 and the third submarine is KRI Alugoro-405 the Joint Section process in the PT PAL Indonesia shipyard was handed over on March 17th 2021. The technology transfer process during 1st batch was done over time when this cooperation was expected to be completed before 2020, but in the implementation, this cooperation experienced delays due to hard negotiations on ship construction of the third submarine together with PT PAL Indonesia. PT PAL Indonesia proposed to combine the submarine at PT PAL Indonesia's shipyard but DSME Korea would agree only if PT PAL Indonesia could fulfill the minimal infrastructure requirements, in the end PT PAL Indonesia could not fulfill these conditions, then the third submarine, Alugoro-405 was still built at DSME Korea according to the initial plan. The pandemic COVID-19 also became the reason why the first batch has been delayed, the Indonesia government made regulations to restrict the border of Indonesia to prevent the spread of the coronavirus, by closing access to Indonesia thus making DSME Korea and PT PAL Indonesia had difficulties in completing the project.

In terms of quantity, in the first batch Indonesian and South Korean submarine technology transfer cooperation was considered right on target. In terms of quality, submarines as the output of this technology transfer cooperation were more sophisticated and modern than the KRI Cakra-401 and KRI Nanggala-402 made in Germany which were purchased by Indonesia in 1977 and 1981.

The quality of this sophisticated submarine equipped with modern technology is known to experience several technical problems because it has not been standardized with an international license but has only been tested according to the Korean Register standard. For this reason, as a submarine user, the Indonesian Navy (TNI AL), submitted several evaluations to DSME Korea regarding submarines because all three submarines are often only at the Indonesian Navy (TNI AL) ship base when submarines must be used for maritime patrols, because of several some operational interference. DSME Korea then followed up on this problem by providing the Operation Readiness Enhancement (ORE) program, this is a program that was carried out to improve problem items, thus the operational improvements were obtained for 2 submarines from the first Batch because the Ministry of Defense and the Indonesian Navy (TNI AL) requested further support and cooperation, it is planned that the ORE Program will be completed in mid-August 2023, then the TNI AL will successfully operate the submarine.

Obstacles of Submarine Technology Transfer

The Indonesian defense industry seeks to master the military technology and human resources in Indonesia and will have the ability to build and develop its military arms according to specifications needed by the Indonesian National Armed Forces (TNI). Submarine is a ship with a complex and dynamic engineering structure and technology. To gain the ability to build submarines, it is necessary to have strategies and methods that are carried out by the capabilities of human resources supported by stakeholders and

government, with the latest infrastructure. PT PAL Indonesia has built development facilities, infrastructure, equipment, and other necessities to build submarines. This equipment concept is required by DSME Korea to support the MRO and Joint Section technology transfer cooperation at the PT PAL Indonesia shipyard.

The obstacle in the submarine transfer of technology comes from the desire to have capabilities in technology, submarine design, and submarine production. Indonesia expects to have the ability to build submarines but the knowledge gained from the cooperation for the first phase with DSME Korea is not enough, it requires the continuation of technology transfer contained in the second batch. The transfer of technology received in 1st batch is still not sufficient for PT PAL Indonesia to build submarines of their design and manufacture. This is because the plan for mastery of the ability to produce submarines is divided into four phases, where in the first phase the lesson of technology transfer is more to maintenance, repair, operation (MRO), and Joint sections or assembly of submarines where all the processes have been completed, but the shipbuilders still not able to self-build submarines. PT PAL Indonesia's interest in getting the ability to engineer the design and manufacture of submarines should be encouraged by the decision of the Ministry of Defense to continue the technology transfer cooperation to the next phase.

Discussing the readiness of the human resources of PT PAL Indonesia is considered quite qualified where the experts who receive technology transfer education are selected engineers who are the best in their fields, in the first batch of technology transfer, these experts have finished basic knowledge about submarines from DSME Korea, the scientific foundations in the field of submarines should be constantly maintained and continuously improved, but because there is no continuation of the second phase of technology transfer cooperation, now the capabilities and knowledge possessed are considered to be decreasing because they are not honed to carry out such activities to build submarines, both from the ability to master technology (knowledge), as well as mastery in the field of production or direct practice in production activities.

CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

The policy review of the effectiveness of the submarine technology transfer between Indonesia and South Korea, in terms of appropriate policy indicators, is currently still ineffective, as Indonesia has not yet conquered the ability to build its submarines and the target for the Master Plan for the Development of the Indonesian Defense Industry in 2014-2019 has not been achieved. The implementation of further cooperation may consider the evaluation of this submarine-building cooperation with South Korea.

In terms of the exact indicators of implementation, it is also considered to be still ineffective, as the implementation of technology transfer through the OJT program is provided by DSME Korea with only theory or learning by seeing, this is due to the details of the OJT implementation not being written in the contract, so in the next contract, the policymakers are expected to be more detailed in writing contracts.

In terms of the right target indicators, it is also considered to be still ineffective, because the quality of the output of this cooperation in the form of submarines is considered to have technical problems. The government needs to prioritize the next stage of submarine transfer technology cooperation to perfect and increase the ability to build submarines. Submarine technology transfer cooperation can be carried out with other partners who have more profitable offers both in terms of technology transfer and submarine product quality because the results of the policy effectiveness assessment on cooperation with DSME Korea are known to be implemented with ineffective results, but

if further cooperation continued with DSME Korea, it is necessary to fulfill the requirements related to contract points which are more detailed regarding the implementation of technology transfer. The government should include requirements for engaging educational institutions, like Indonesia Defense University as a place for research and development and also become a knowledge base that supports policy implementation, especially the development of submarines in Indonesia.

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