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Strategy Implementation of Naval Technology Mastery for Indonesia Navy using Balanced Scorecard (BSC) and Analytical Hierarchy Process (AHP)

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Abstract: Nowadays, the use of naval technology has several limitations such as the level of technology is still limited, the lack of research development, technology dependence from foreign parties. Based on these conditions, it is necessary to develop strategies in the context of naval technology mastery to supporting the main task of the Navy. Based on the research problem, the study aims to provide an analysis of strategy implementation of naval technology mastering. This research uses the Balanced Scorecard (BSC) and Analytical Hierarchy Process (AHP) method approaches. The BSC method is used as a strategy implementation model for mastering naval technology while the AHP method is used to give weight for sub-strategy. Based on the results of the research, the strategy of mastering the naval technology has 10 strategic steps. This study is expected giving contribute to the Navy's policy makers in the management of strategy implementation to support the main task of the Indonesia Navy (TNI AL).

Key words: Naval technology, Indonesia Navy (TNI AL), Balanced Scorecard (BSC), Analytical Hierarchy Process (AHP), sub-strategy, implementation

INTRODUCTION

Indonesia is an archipelago with a wider sea area than land and is a country that has the second longest coastline in the world (Ramadhani, 2015). The sea has a strategic meaning for Indonesia, namely as (Putra *et al*., 2017): territory of national sovereignty, environment and resources, media of contact (social, economic and cultural), geostrategy, geopolitics, geocultural and geoeconomics of the country.

The Indonesian Navy (TNI AL) as part of the Indonesia Armed Forces (TNI) is a major component of national defense at sea and has the duty and responsibility to carry out the main tasks of the TNI in the field of marine defense, especially, in the national jurisdiction waters (Ahmadi *et al*., 2017). The success of the main task depends on the level of ability, structure and degree pattern of strength which is integrated in the posture of the Navy. The development of the Navy posture is closely related to the mastery of naval technology. Mastery of naval technology consists of 3 aspects, namely: aspects of technology use, aspects of human resources, aspects of the education and training system.

Nowadays, the use of naval technology has several limitations such as the level of technology is still limited, the lack of research development, technology dependence from Foreign parties. Based on these conditions, it is necessary to develop strategies in the context of naval technology mastery to supporting the main task of the Navy.

Based on the research problem, the study aims to provide an analysis of strategy implementation of naval technology mastering. This research uses the Balanced Scorecard (BSC) and Analytical Hierarchy Process (AHP) method approaches. The BSC method is used as a strategy implementation model for mastering naval technology while the AHP method is used to give weight for sub-strategy.

Literatures about Balanced Scorecard (BSC) such as BSC as a methodological concept for performance assessment based on system dynamics (Nielsen and Nielsen, 2015). The relevance of BSC to improving financial performance (Sahiti *et al*., 2016). Implement BSC on the performance of strategic management for the banking industry (Ozturk and Coskun, 2014). BSC to evaluate performance, implement organizational mission and strategy (Quesado *et al*., 2018). BSC to measure the performance of higher education (Binden *et al*., 2014). BSC to examine employee performance appraisal in implementing the company's new strategy (Johnson *et al*., 2014). BSC to observe the organization's strategic planning process in directing its efforts (Stefanovska and Soklevski, 2014).

Literatures about Analytical Hierarchy Process (AHP) likely AHP as a model of consumer decision making in the

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digital market (Singh *et al*., 2016). AHP as a measure of performance indicators in companies based on four aspects of the BSC (Maharma and Saleh, 2014). AHP as a weight to aspects and criteria for sustainability in the industry (Kalutara *et al*., 2018). AHP as a framework for selection of building maintenance procurement (Chua *et al*., 2015). AHP aims to assess and control related problems at the Higher Learning Institution (HLI) (Anis and Islam, 2015). AHP to design a human resource performance appraisal system (Mutmainah and Panudju, 2017). AHP for determining the menu selection strategy at the cafe (Hou *et al*., 2015). AHP to identify critical success factors in the management of veteran personnel (Chien and Barthorpe, 2013).

This research is limited to the aspect of naval technology usage. This study is expected giving contribute to the Navy's policy makers in the management of strategy implementation to support the main task of the Indonesia Navy (TNI AL).

MATERIALS AND METHODS

Indonesia Navy (TNI AL): The Indonesian Navy (Indonesian Navy) is one of the branches of the army and is part of the Indonesian National Army (TNI) which is responsible for the Republic of Indonesia's national defense operations at sea. According to Law No. 34/2004 on the Indonesian National Armed Forces, Article 9, the Navy has the following tasks (Indonesia Department Pertahanan, 2015):

- Perform military duties in national defense
- Enforce the law and secure the order in the sea area of national jurisdiction in accordance with national laws and ratified international laws
- Perform diplomatic duties in support of Foreign policy set by the government
- Engage with other duties relevant for the maintenance and development of naval power
- Support civilian empowerment in sea defense areas

Ability of Indonesia Navy posture: The development of posture is projected towards a regional maritime with an active principle that is defensive. This posture is designed to address possible threats, actual problems and to support defense forces. There are several components in the posture such as (Indonesia Department Pertahanan, 2015):

Strength: The main components of strength are built through the modernization of major weapons systems, improved maintenance, organizational development and support of facilities and infrastructure supported by defense industries, professionalism and welfare of soldiers.

Capability: The capabilities of the Navy are designed for intelligence, diplomacy, defense, security, regional empowerment and support capabilities.

Deployment: The deployment of the Navy includes organization, strength and ability. This is aligned with the establishment of a fleet command organizational structure including centralized, territorial and support unit strength.

Naval technology: In conducting naval operations in the future, there is a need for highly skilled personnel with an effective response to an attack. In designing new systems and equipment, flexibility and adaptability are needed to manage technology improvements. In testing skills and providing training, there needs to be a closer relationship between naval personnel and the defense industry to provide feedback on developing new capabilities (Shenoi *et al*., 2015).

The general trend towards fewer crews will encourage the application of technological capacity to improve crew capability. The role of warships by 2030 will begin to change with the use of unmanned systems and remote control systems. It will have a greater effect with less risk of the aircraft carrier. In addition, the need for mission flexibility and energy efficiency in naval vessels will encourage the application of technology which is related to energy storage, production, shipping and reuse or energy management (Shenoi *et al*, 2015).

In the Global Marine Technology Trends 2030 will focus on 8 technology fields with the potential to change naval operations in the future. These 8 technologies will play an important role in future war battles (Shenoi *et al*, 2015). The eight technologies include advanced material, autonomus system, big data analytic, advanced manufacturing, energy management, cyber and electronic warfare, human computer interaction, human augmentation.

Balanced Scorecard (BSC): Balanced scorecard is a method developed to measure every activity carried out by a company in order to realize the goals of the company. Balanced scorecard is a separate activity related to targeting but then integrated with the strategy management system. Strategic management system is the process of formulating and implementing strategies to realize the vision continuously and structured. Balanced scorecard is further developed as a means to communicate from various units within an organization. Balanced scorecard is also developed as a tool for organizations to focus on strategy management (Kaplan and Norton, 2001). The balanced scorecard benefits the organization which explains the organization's vision, aligns the

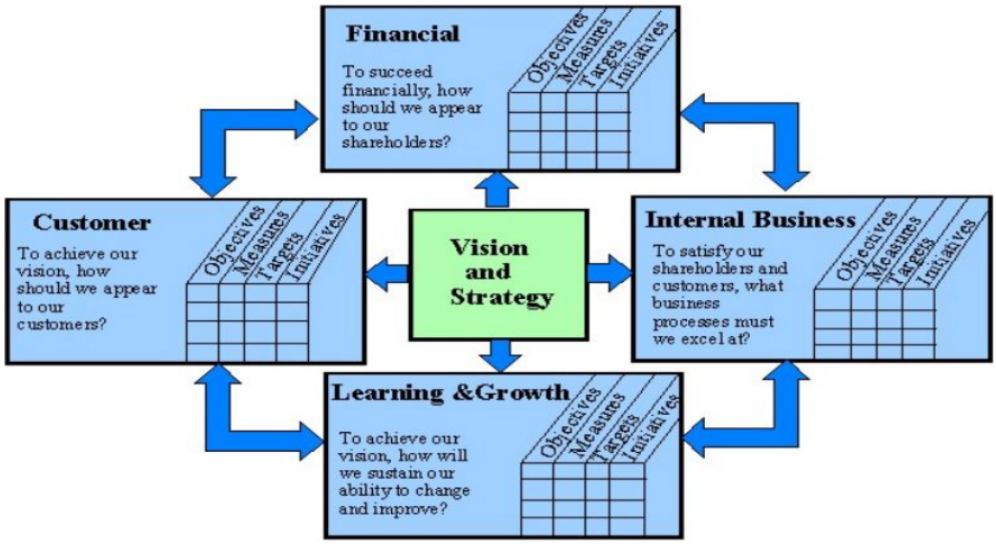


Fig. 1: The balanced scorecard (Kaplan and Norton, 1996)

organization to achieve that vision, integrates strategic planning and resource allocation, improves management effectiveness by providing appropriate information to direct change. In implementing the BSC, there are five main principles, namely: translating the strategy management system based on balanced scorecard into operational terminology, so that, everyone can understand, linking and aligning organizations with strategies (Kaplan and Norton, 2001). It is to provide direction from the executive to the staff, making a strategy is working for all people who contribute through strategic implementation; making a strategy is a continuous process through learning and organizational adaptation; implement the change agenda by the executive to mobilize change. In matrix development, data collection and data analysis, BSC refer to four perspectives, namely (Kaplan and Norton, 2001).

Financial perspective: In the financial perspective, there are three aspects of the strategy implemented by the company, revenue growth and a combination of income owned by a business organization, decreased costs and increased productivity, optimal use of assets and investment strategies.

Customer perspective (customer): In this perspective, measurements are carried out with five main aspects (Kaplan and Norton, 2001), likely:

Market share measurement: Measurement of the size of the company's market share.

Customer retention: Measurement is done by knowing the percentage of business growth with the number of customers owned by the company.

Customer acquisition: Measurement can be done through the percentage of the number of additional customers.

Customer satisfaction: Measurement of the level of customer satisfaction.

Customer profitability: Measurement of customer profitability can be done using Activity Based-Costing (ABC) techniques.

Internal process: In this perspective, the company measures all activities carried out by the company, both managers and employees to create a product which can provide satisfaction to customers and shareholders. In this case, the company focuses on three main business processes, namely: the innovation process, the operating process, the post-sale process (Kaplan and Norton, 2001).

Learning and growth: Kaplan revealed the importance of a business organization to pay attention to its employees, monitor employee welfare and increase employee knowledge because with increasing levels of employee knowledge, it will also increase the ability of employees to participate in achieving results and company goals (Kaplan and Norton, 1996) (Fig. 1).

Analytical Hierarchy Process (AHP): AHP method is developed by Saaty and used to solve complex problems where data and statistical information about the problems faced are very few. Analytical Hierarchy Process (AHP) is a form of decision-making model with multiple criteria (Saaty, 1990). One of AHP's reliability is that it can carry

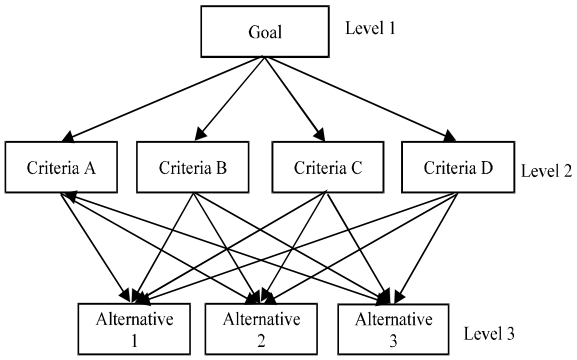


Fig. 2: AHP Model (Saaty, 1980)

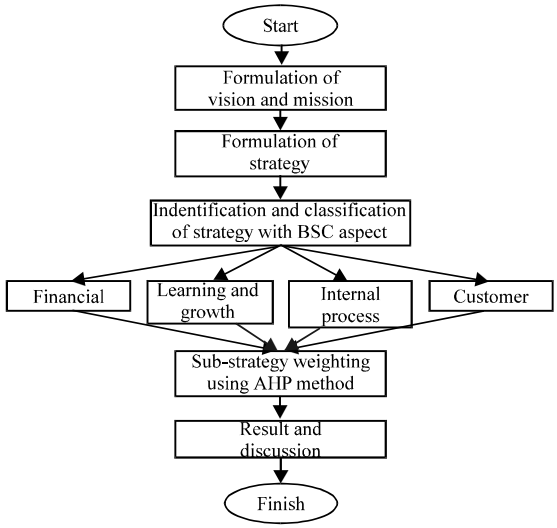


Fig. 3: Flowchart of research

out simultaneous analysis and be integrated between qualitative parameters or even quantitative ones. AHP is a comprehensive decision-making model because it takes into account qualitative and quantitative matters at once (Saaty and Vargas, 2012).

Specifically, AHP is suitable for the issue of candidate selection or priority sorting which has the following characteristics: involving qualitative criteria that are difficult to quantify, each criterion can have sub-criteria which can be formed like a hierarchy (Saaty, 1980). Assessment can be carried out by one or several decision makers at once the selected candidate is certain and limited in number. If a decision-making problem wants to be solved by the AHP method, the problem needs to be modeled as three general hierarchies (Setiarso *et al*., 2018): namely objectives, criteria (including sub-criteria below), alternatives (Fig. 2 and 3).

RESULTS AND DISCUSSION

Balanced Scorecard (BSC) analysis: In the BSC implementation phase, the first step is to determine the vision, mission and strategy of the Navy in mastering the Naval technology.

- Vision: " Professional and Modern Navy"
- Mission: "Developing the strength and capability of a professional and modern Indonesian Navy that is supported by the mastery of naval technology"

Second step: Based on the Focus Group Discussion (FGD) by planning staff, there were 10 steps in the strategy of mastering the naval technology in the aspects of technology useful. These strategies include: development of advanced material technology to the level of production in accordance with the policy of the Defense Industry Policy Committee (KKIP). Development of cyber infrastructure up to the main command level.

Carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP). Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy. Implement energy management and renewable energy development. Improve the ability of diplomacy as a balance of power in the Asia Pacific. Integrating the capabilities of big data analytics to the central/upper level organization.

Upgrade manufacturing equipment at maintenance facilities of the Navy. Carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry. Increasing the strength of the defense budget, up to 2% of Gross Domestic Product (GDP).

Third step: After determining the vision, mission and strategy, the next step is to classify several steps of the strategy into the perspective of the balanced scorecard by creating a Key Performance Indicator (KPI). The KPI is used as a determinant of indicators in the BSC perspective. The results of the classification are in Table 1.

Analytic Hierarchy Process (AHP): At this stage, the weighting process is carried out in each step strategy indicator which is taken from the assessment of experts using the AHP method with Expert Choice Software (Fig. 4).

The weighting process of KPI is carried out with data obtained from Focus Group Discussion (FGD), then the

Table 1: Classification of sub strategy

Perspective	Strategy steps	Code
Customer (C)	Improve the ability of diplomacy as a balance of power in the Asia Pacific	C-1
	Carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP)	C-2
Learning and growth (L)	Implement energy management and renewable energy development	L-1
	Integrating the capabilities of big data analytics to the central/upper level organization	L-2
	Upgrade manufacturing equipment at maintenance facilities of the Navy	L-3
Internal process (I)	Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy	I-1
	Development of advanced material technology to the level of production in accordance with the policy of the Defense Industry Policy Committee (KKIP)	I-2
	Development of cyber infrastructure up to the main command level	I-3
	Carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry	I-4
Financial (F)	Increasing the strength of the defense budget, up to 2% of Gross Domestic Product (GDP)	F-1

Table 2: Strategy steps of naval technology mastery

Perspective	Strategy steps	Weight
Customer (C) (0.064)	Improve the ability of diplomacy as a balance of power in the Asia Pacific	0.032
	Carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP)	0.019
Learning and growth (L) (0.131)	Implement energy management and renewable energy development	0.067
	Integrating the capabilities of big data analytics to the central/upper level organization.	0.059
	Upgrade manufacturing equipment at maintenance facilities of the Navy	0.038
Internal process (I) (0.279)	Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy	0.164
	Development of advanced material technology to the level of production, in accordance with the policy of the Defense Industry Policy Committee (KKIP)	0.152
	Development of cyber infrastructure up to the main command level	0.129
	Carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry	0.084
Financial (F) (0.527)	Increasing the strength of the defense budget, up to 2% of Gross Domestic Product (GDP)	0.257

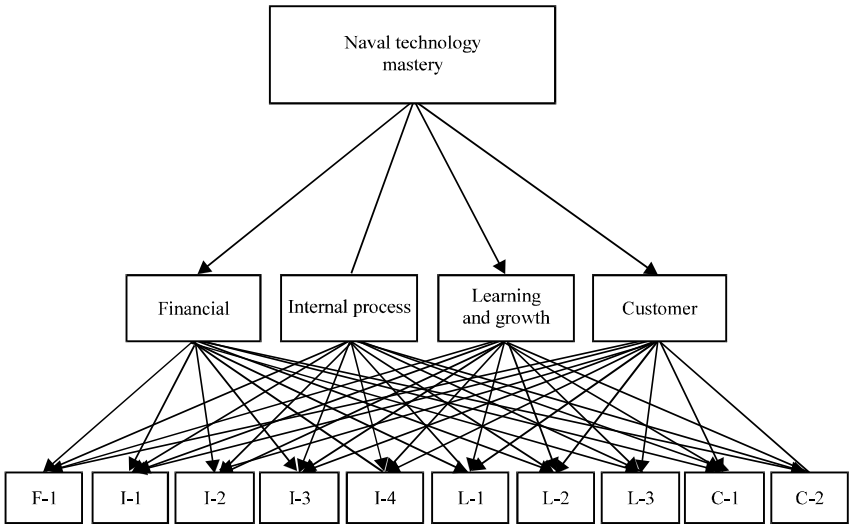


Fig. 4: Hierarchy model of Naval technology mastery

results of the strategy steps are weighted. Based on the results of the pairwise comparison questionnaire processing, obtained a balanced scorecard perspective weighting determination hierarchy. Based on the results of the AHP comparison questionnaire data processing, it obtained the priority perspectives of BSC presented in Table 2.

Based on the table and graph above, the financial aspect is the main priority with a weight of 0.527. This shows that increasing the strength of the defense budget is a main step. The internal aspect of the process has a weight of 0.279. The L&G aspect has a weight of 0.131. Finally, the customer aspect has a weight of 0.064 (Fig. 5 and 6).

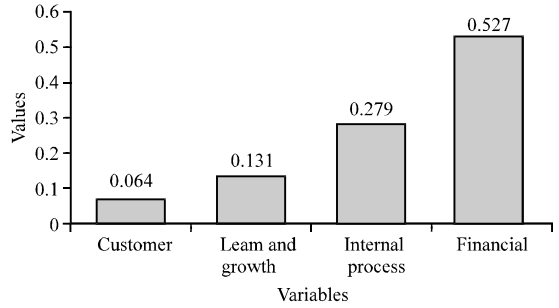


Fig. 5: Graph of BSC perspective value

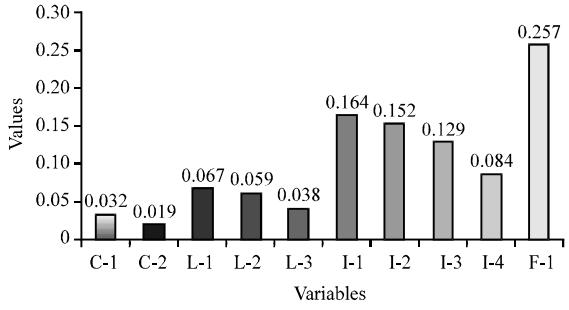


Fig. 6: Graph of sub-strategy value

Based on the graph above it can be seen below, the strategy of increasing the strength of the defense budget has a weight of 0.257 and as a top priority. Increased defense budget as a driving element of several other elements.

Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy as the second priority with a weight of 0.164. The strategic step for the implementation of transfer of technology at the level of TOK, TOKH, TOP is the last priority with a weight of 0.019 on the customer aspect.

Financial aspect: Based on the analysis of results, the strategy for increasing the strength of the defense budget has a weight of 0.257. This weight is the highest value for the other strategy steps. The implementation of naval technology mastery strategy generally requires support with the addition of a defense budget of up to 2% of GDP. The budget requirement is as a motor for the implementation of the next strategic step. The budget needs are obtained from the state budget.

Internal proses aspect: The strategy step chosen in realizing the strategic objectives of the internal process such as develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy, development of advanced material technology to the level of production in accordance with the policy of the Defense Industry Policy Committee (KKIP), development of cyber infrastructure up to the main command level, carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry (Table 3).

Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy is a strategic step that has the highest weight in the internal process aspect of 0.164. In achieving the objectives of the internal process strategy, the most important is the making of a blueprint on naval technology mastery.

The second step is the development of advanced material technology to the level of production in accordance with the KKIP policy with a weight of 0.152. The government has launched a policy on the defense industry, namely the Defense Industry Policy Committee (KKIP) as the basis for the development of the domestic defense industry. Advanced material development can be in line with technology trends 2030, KKIP and the national defense industry.

The third step is the development of cyber infrastructure to the level of the main command with a weight of 0.129. The development of war strategy in the future is predicted to no longer be conventional. Development of cyber technology will be a new method in the model of warfare in the future. At present, the strength of new cyber infrastructure is owned to the central level. The threat to the cyber system needs to be followed up by developing infrastructure strength to the level of the main command.

The forth step is to carry out research in line with the KKIP policy and defense industry with a weight of 0.084. Research and development has an important role in the development of national defense forces. The research can be directed to have a harmonious research between the KKIP and the national defense industry.

Learning and growth aspect: This aspect has three strategic steps that are used in realizing the objectives such as implement energy management and renewable energy development, integrating the capabilities of big data analytics to the central/upper level organization, upgrade manufacturing equipment at maintenance facilities of the Navy (Table 4).

Energy management is a priority strategy with a weight of 0.067. In the future, uncontrolled use of energy poses new problems for defense sustainability, especially in the Indonesia Navy (TNI AL). Energy management and the development of renewable energy are an important step as one aspect of the mastery of marine technology.

The second step is to integrate the capabilities of big data analytics to the central level with a weight of 0.059. Data analysis capabilities supported by technology can accelerate the decision making process. At present,

Table 3: Strategy steps of internal process aspect

Strategy steps	Weight	Priority
Develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy	0.164	1
Development of advanced material technology to the level of production in accordance with the policy of the Defense Industry Policy Committee (KKIP)	0.152	2
Development of cyber infrastructure up to the main command level	0.129	3
Carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry	0.084	4

Table 4: Strategy steps of learning and growth aspect

Strategy steps	Weight	Priority
Implement energy management and renewable energy development	0.067	1
Integrating the capabilities of big data analytics to the central/upper level organization	0.059	2
Upgrade manufacturing equipment at maintenance facilities of the Navy	0.038	3

Table 5: Strategy steps of customer aspect

Strategy steps	Weight	Priority
Improve the ability of diplomacy as a balance of power in the Asia Pacific	0.032	1
Carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP)	0.019	2

data processing is still partial at the level of the main command, then data integration is needed at the central level.

The third step is the upgrading of manufacturing equipment in the Navy's maintenance facilities with a weight of 0.038. Maintenance is an important aspect in the development of defense forces, this is related to the readiness of the integrated weapon system (SSAT) material. Technological development in integrated weapon system (SSAT) needs to be balanced with adequate maintenance equipment.

Customer aspect: Customer aspects here are closely related to the use of naval technology. This aspect has two strategic steps including improve the ability of diplomacy as a balance of power in the Asia Pacific, carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP) (Table 5).

In Asia Pacific, sea defense capabilities are still dominated by China and the United States (US). The improvement of diplomacy capability as balance of power in Asia Pacific has a weight of 0.03 and as the first priority on the customer aspect (Naval technology mastery). Indonesia has the potential as a rebalance to power in the Asia Pacific. The diplomatic capability of the Indonesian Navy and the government of Indonesia can be used as a middle way in accordance with free and active political policies. The policy has historically been carried out in building the Non-Aligned Movement.

The second step is to carry out the transfer of technology at the level of TOK, TOKH, TOP. This strategy step has a weight of 0.019. In terms of technology, there are still some capabilities that are not yet owned. This strategy policy intends to catch up with the technological capabilities possessed by collaborating technology transfer with developed countries. The technology transfer policy must be in line with the KKIP and defense industry policies and consist of three capabilities Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP)).

CONCLUSION

As a country with the largest sea area in the world, Indonesia has potential and threats. The Navy is a major component of defense in the sea region having the duties of defense and security. In carrying out this task, the Navy is supported by the use of marine technology in the integrated weapon system (SSAT). Based on the results of the research, the strategy of mastering the naval technology has 10 strategic steps. The 10 steps of the strategy are divided into four aspects, namely the financial aspect with the strategy of increasing the defense budget strength to 2% of GDP (0.257).

The internal process aspect consists of four strategies such as develop a blueprint in accordance with the mastery of the 2030 naval technology and the World Maritime Axis (PMD) policy (0.164), development of advanced material technology to the level of production, in accordance with the policy of the Defense Industry Policy Committee (KKIP) (0.152), development of cyber infrastructure up to the main command level (0.129), carry out research that is in line with the Defense Industry Policy Committee (KKIP) policy and the national defense industry (0.084).

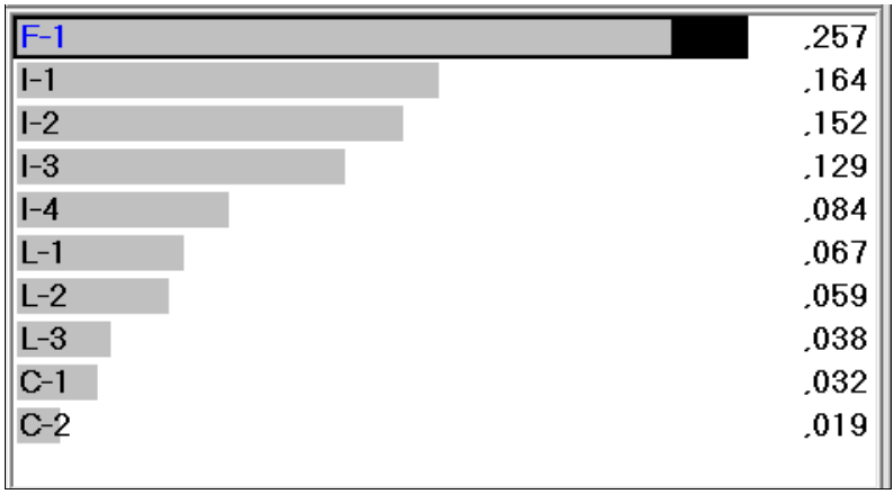
Learning and growth aspects have three strategic steps including, implement energy management and renewable energy development (0.067), integrating the capabilities of big data analytics to the central/upper level organization (0.059), upgrade manufacturing equipment at maintenance facilities of the Navy (0.038). The customer aspect that is closely related to the ability to master navtech technology has two strategic steps including improve the ability of diplomacy as a balance of power in the Asia Pacific (0.032), carry out transfer of technology at the level of Transfer of Knowledge (TOK), Transfer of Know How (TOKH), Transfer of Production (TOP) (0.019).

APPENDIX

Expert choice step: a) Result of balanced scorecard value and b) Result of sub-strategy value

(a)

(b)



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