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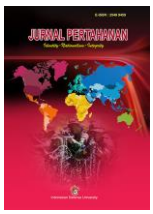

ANALYSIS OF THE EFFECTIVENESS OF JOINT HYDROGRAPHIC SURVEY INDONESIA - SINGAPORE - MALAYSIA TO ENHANCE SAFETY NAVIGATION IN THE STRAIT OF MALACCA AND SINGAPORE

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Abstract

The purpose of the Joint Hydrographic Survey (JHS) implementation in Straits of Malacca and Singapore (SOMS) is to improve navigation safety in TSS by using Multibeam Echosounder (MBES) technology. This is especially important given the increasing number of ships carrying out cross-transit through SOMS from year to year, while hydrographic information has not been updated since 1998. This study aims to analyze the effectiveness of JHS activities at SOMS conducted by Indonesia, Malaysia, and Singapore related to Indonesia's interests, specifications, and procedures, as well as the use of force in JHS activities. This study uses qualitative methods with an exploratory approach and used the NVivo Plus 12 application to find themes from field interviews and used the Soft System Methodology (SSM). Based on the results of the study can be concluded that the effectiveness of JHS activities has been following what is expected by the three coastal countries, but the Indonesian Navy Hydrographic and Oceanography Center or Pusat Hidrografi dan Oseanografi TNI AL (Pushidrosal) as a learning organization is required to continue to be able to improve its capabilities in the implementation of JHS. From the gap of research results obtained several activities that can be carried out by Pushidrosal to increase the effectiveness of JHS in SOMS namely by evaluating the implementation of Security Officer (SO) and Technical Officer (TO) as well as preparing SOP that can be used as a standard in the implementation of JHS activities.

INTRODUCTION

The Straits of Malacca and Singapore (SOMS) is one of the busiest straits and is the largest trade route in the world by international shipping. The Strait is part of the shortest route connecting Europe and Asia (Peter J. Rimmer & Paul T.w. Lee, 2007). According to The United Nations

Convention on the Law of the Sea (UNCLOS) 1982. SOMS is categorized as a transit route, a line used for international shipping connecting one part of the high seas or an exclusive economic zone with another part of the high seas or an exclusive economic zone (Novinka, 2009). In this strait, transit passage or cross-transit rights apply where the cruise through this line must be continuous or continue quickly and efficiently. However, the ship is allowed to stop at the port it passes through (Novinka, 2009).

In 2013, there were 77,973 ships cross-transiting at SOMS and are expected to increase to 100,000 by 2020. Marine traffic accidents, whether ships crash or collisions that occur at SOMS can cause navigational disruption and impact the marine environment. The wider impact of the crash at SOMS will disrupt world trade which will ultimately affect the economy of the Association of Southeast Asian Nations (ASEAN).

Singapore and Malaysia have long taken advantage of the strait by building international ports. While Indonesia is carrying out the development of an industrial area in Kuala Tanjung that is integrated with a multipurpose terminal port on an international scale to take advantage of the potential of international traffic at SOMS which is expected to boost the regional and national economy (National Geospatial-Intelligence Agency, 2019).

SOMS' shipping Traffic Separation Scheme (TSS) has been agreed by an international organization and all three coastal countries to be used as international transit routes. In cross-transit operations, foreign vessels including marine scientific research vessels and hydrographic survey vessels cannot conduct any research or surveys without prior permission from countries bordering the strait (Novinka, 2009).

Indonesia, Singapore, and Malaysia as coastal countries on SOMS must organize and maintain this line together to ensure the safety and security of cruise navigation. The availability of up-to-date and accurate hydrographic information must be guaranteed. It is the responsibility of all three coastal countries in providing safety guarantees of cruise navigation (Novinka, 2009).

The joint hydrographic survey was conducted by the three coastal countries with the help of one of the strait's user countries, Japan. This joint hydrographic survey is known as the Joint Hydrographic Survey (JHS) which has been conducted since 1969. JHS implemented in the SOMS Traffic Separation Scheme (TSS) area by Indonesia, Malaysia, Singapore, and Japan is one of the efforts of the three coastal countries to ensure navigation safety at SOMS. This activity uses funding from the Japan-ASEAN Integration Fund (JAIF) approved by all ASEAN countries (*JAIF Project Proposal for Hydrographic Survey on SOMS*, 2016)

Since the 1980s, several initiatives for the Straits were undertaken, which covered various aspects of maritime activities, the safety of navigation, and marine environment protection (Said & Saharuddin, 2009). JHS is expected to produce comprehensive hydrographic information with a high level of accuracy in accordance with the requirements set by the International Hydrographic Organization (IHO). The hydrographic information obtained will be used as Electronic Navigational Chart (ENC) update material as well as nautical publication to ensure cruise safety at SOMS. The availability of up-to-date and accurate hydrographic information will have an impact on the development of marine transportation and ASEAN economic expansion.

JHS at SOMS is an agenda that is implemented periodically and systematically as one of the three coastal countries' responsibilities for the safety of shipping in SOMS waters. JHS is part of The Marine Electronic Highway (MEH) project which is an innovation of three coastal countries in preparing marine information and infrastructure system by

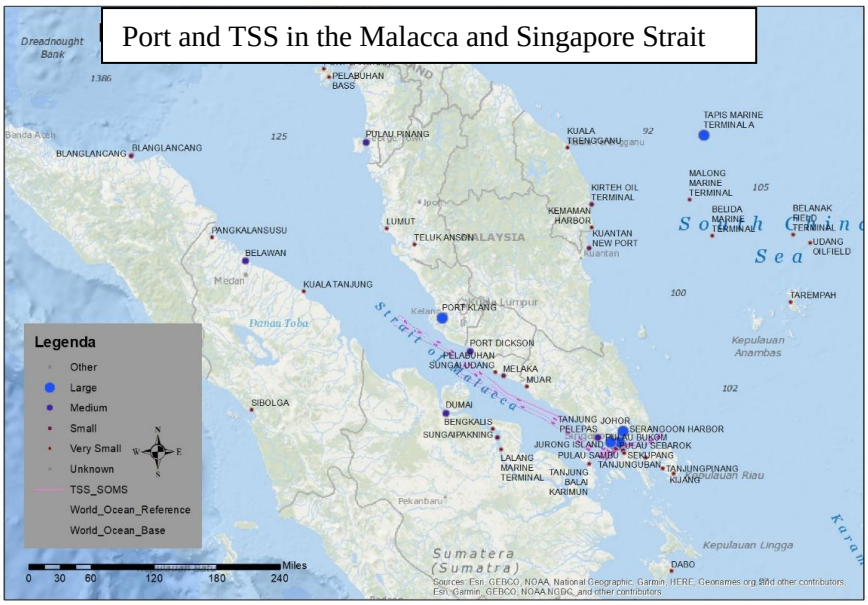

Figure 1. Port at SOMS
Source: Pushidrosal data compilation: TSS, National Geospatial-Intelligent Agency: Word Port Index, and Arcgis Basemap, 2019

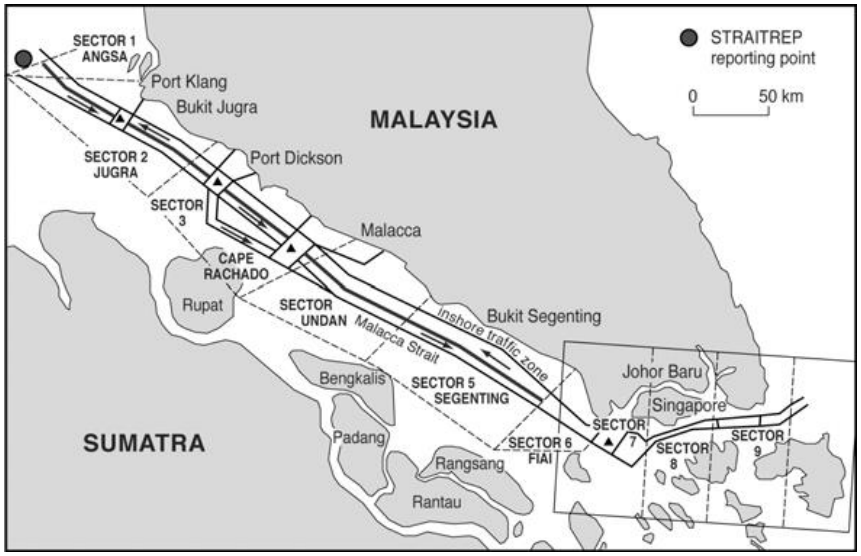

Figure 2. TSS at SOMS
Source: Peter J. Rimmer & Paul T.w. Lee, 2007

integrating environmental management and protection systems and maritime safety technologies to improve navigation safety services and protection of the strait environment. The data obtained from JHS at SOMS is then presented into a chart and other information and it must be used by all strait users in ensuring the safety of navigation in this strait

The effectiveness of the implementation of JHS activities needs to be understood by all parties, both in terms of the national interest, the use of force, and the Standard Operation Procedure (SOP) used. By obtaining knowledge about the effectiveness of JHS activities, coastal countries can better evaluate and plan for future activities. Related to this, this study was conducted to raise the issue of the effectiveness of JHS activities at SOMS conducted by Indonesia, Malaysia, and Singapore and to analyze the effectiveness

of JHS activities at SOMS conducted by Indonesia, Malaysia, and Singapore.

METHODS

The method used in this study is a qualitative method with an exploratory approach. A qualitative research method is an approach to explore and understand a central symptom. Researchers interviewed informants by asking common and rather broad questions to understand the central symptoms. This study is exploratory. Exploratory means finding out more deeply about a case to then be able to provide a hypothesis (Raco, 2010).

Data Source

a. Primary data is data obtained directly by researchers during the research process. Data is collected by researchers directly from the first source or place where the research object was conducted. The primary data source used in this study is interviews from informants according to the research subject as well as documents of meeting results related to Joint Hydrographic Survey activities that make it possible to obtain from research subjects.
b. Secondary data is data obtained through other parties or not obtained directly from the research carried out. In this study, the secondary data sources are literature, articles, journals, and sites on the internet related to JHS conducted.

Data Processing Techniques

NVivo 12 Plus

The data used in this data includes primary and secondary data. Primary data is obtained from the interview results, which to facilitate the analysis process, informants are grouped into groups of regulators, operators, and observers. Secondary data in the form of white paper documents related to JHS phase 2 implementations. Findings derived from the primary data collection process are the main foundation of this study.

The research data obtained is then processed using NVivo by creating a data grouping category to assist in the preparation of themes and explore how the relationship between attributes or thematic things of the findings in the field. Node systems are based on themes on research titles, research questions, and interview questions. Coding is done by combing through all the transcripts of the interview results and the documents obtained. NVivo coding is grouped into previously created system nodes. Furthermore, researchers utilized word frequency query analysis tools and text search text queries contained in NVivo software. It is not clear that not all informants have a focus on each category proposed during the interview process. This can be seen from the results of coding formed into a tree chart that leads to any informant focusing on what category. The results of data processing using NVivo show the relationship between research questions, the interconnectedness between research informants, and also topics that are the focus of research.

Based on the results of data processing using NVivo Software obtained several findings as follows:

1. Findings from the Operators group
   There are several findings from the operator group regarding the theme of the research question:
   a. JHS products as expected by all three coastal countries.
   b. The implementers of the survey activities are from Japan.
   c. JHS's activity planning involves all three coastal countries.
   d. TO and SO involvement (Indonesia Only).
   e. Confirmation of Survey Schedule and Project Implementation Plan As a field implementation guide.
   f. zero accident during the implementation of hydrographic survey activities.
   g. Hydrographic survey data quality standards meet IHO requirements.

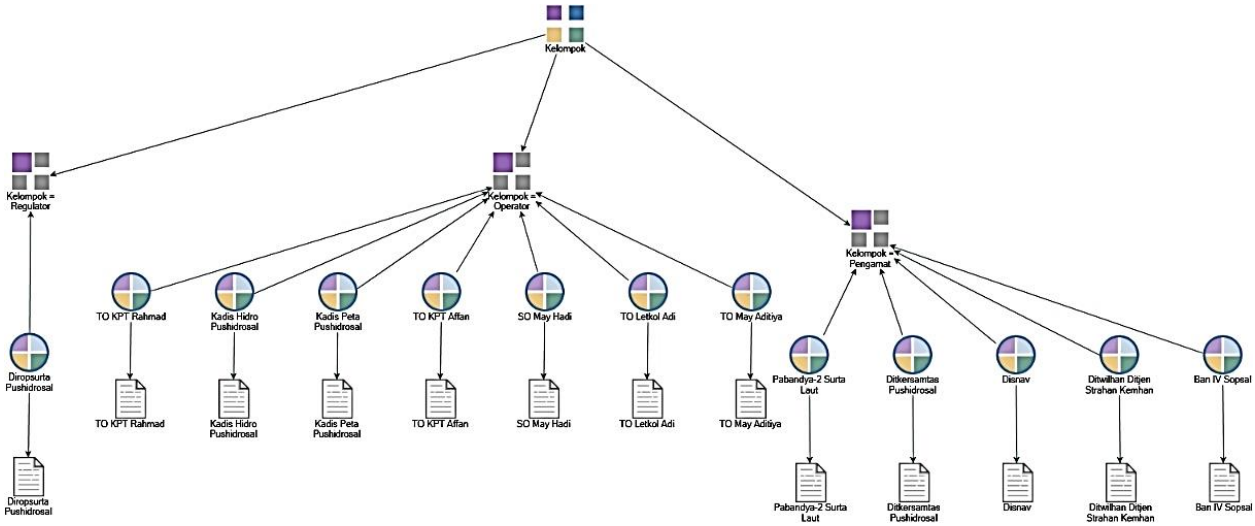

Figure 3. Grouping of Research Informants
Source: Processed by Authors, 2020

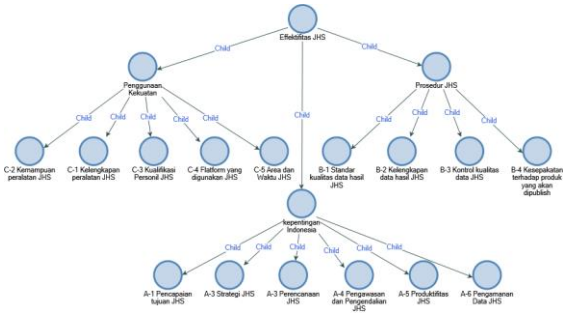

Figure 4. Node Systems in Data Processing
Source: Processed by Authors, 2020

h. Validation of survey equipment is carried out regularly.
i. Quality control is implemented by all parties.
j. The hydrographic survey uses the latest technology recommended by IHO.
k. Hydrographic surveyor competency following the requirements agreed by the three littoral states.

2. Findings from the Regulatory Group
There are several findings from the regulator group regarding the theme of the research question:
a. Restrictions area survey, personnel, and equipment as well as data quality following the agreement of the three littoral states.
b. Literal states send technical officer (TO) in each hydrographic survey activity and specifically for Indonesia send Security Officer (SO) who is a representative of the Indonesian Ministry of Foreign Affairs.
c. Raw Data survey results are owned by littoral states.
d. The data format of the survey results must be compatible with the hydrographic data processing system in Pushidrosal.
e. The TO report and the SO Report are created at the end of the TO and SO assignments.
f. Completeness of data following IHO standards as necessary for the safety of navigation.
g. Platform, Equipment, Surveyor in JHS activities prepared Japan with the

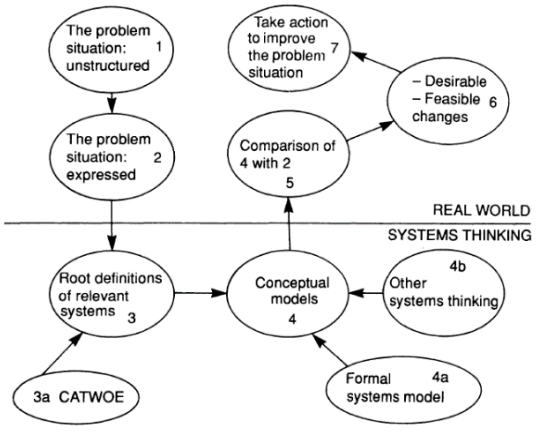

Figure 5. SSM Stage
Source: Davies & Ledington, 1991

approval of the three coastal countries.

3. Findings from the Observer Group
   There are several findings from the observer group regarding the theme of the research question
   a. JHS went smoothly with results that matched expectations.
   b. Safety navigation at SOMS is highly dependent on the availability of accurate hydrographic data.
   c. SO, and TO involvement is very effective.
   d. Raw Data survey results are owned by littoral states.
   e. An up-to-date chart can reduce accidents at SOMS.
   f. TO and SO are involved in data quality control.
   g. The survey results have consistent quality.
   h. The implementers of field survey activities are from Japan.
   i. Foreign executors who conduct surveys in Indonesian waters are equipped with Security clearance.
   j. The survey equipment used meets the standards agreed upon.

Soft System Methodology (SSM)

Further data analysis using Soft System Methodology (SSM) was carried out using seven stages. Stage one, stage two, stage five, stage six, and stage seven are all about real-world situations (real world) while stages three and four are all-system thinking stages (system thinking). SSM is a methodology used to analyze, with a systematic focus, on existing organizational problems and is an analytical action for real-world improvement.

According to Checkland, SSM contains a logical explanation for scientific applications divided into seven stages as follows (Wilson, 2001):

Stage 1. Problem situations are structured issues and are key when the process is defined to start the analysis and review stages. An analyst can see the structure of the problem situation in terms of physical design, report structure, formal and informal communication patterns.

Stage 2. Organizational structures and processes, as well as specific management and hardware technologies, are reviewed using specific techniques, to describe problem situations used to select information to support analysis.

Stage 3. The relevant system is addressed by using root definition to reveal the main purpose of the selected activity system and also using the CATWOE technique, a technique in which some elements are used to understand the analysis of the root definition sentence.

Stage 4. Conceptual models are built to be models of strict human thought patterns according to the root definition using a minimal set of activities that can be drawn by applying system thinking.

Stage 5. Compare conceptual models with reality. Back to the real world, think about the adopted pattern. Conceptual models (stage 4) should be compared to real-world expressions (stage 2).

Stage 6. Develop a viable and desired system by making changes to the identified results.

Stage 7. Action to fix the problem situation to prepare a solution and determine how to apply accordingly at stage 6.

RESULT AND DISCUSSION

Problem Situation

Rich Picture

The research problem is expressed by using a rich picture. Rich Picture serves to provide an early understanding of the general real situation of the organization or institution that is the focus of research. The creation of a rich picture is carried out based on three types or stages of analysis of the introduction of problematic situations,

namely intervention analysis, social analysis, and political analysis.

The Root Definition of Relevant Systems and Conceptual Model

After describing the problems and research findings into a rich picture, the third process is determining the root definitions of relevant systems. Root definition is a structured description of a system of human activity that is relevant to problematic situations that are of concern in action-based SSM research. Root definition in this research is formulated based on three questions that represent research questions, namely RD1, RD2, and RD3.

Root definition is further tested and enhanced with the CATWOE analysis tool. CATWOE tool is a reminder tool (mnemonic) so that root definition is made to describe a relevant system of human activity. Here's a CATWOE analysis of root definitions (RD-1, RD-2, and RD-3).

a. RD 1, Protecting Indonesia's interests (P), by supervising JHS (Q) activities, to safeguard Indonesia's sovereignty (R).
b. RD 2, Implement JHS (P) procedures, by ensuring the results obtained under mutually agreed standards (P), to obtain accurate and accountable hydrographic data (R)
c. RD 3, Using platforms, survey equipment, and personnel that has ideal technical specifications (P), by carrying out validation (Q), so that JHS activities can run smoothly and reach the target as expected.

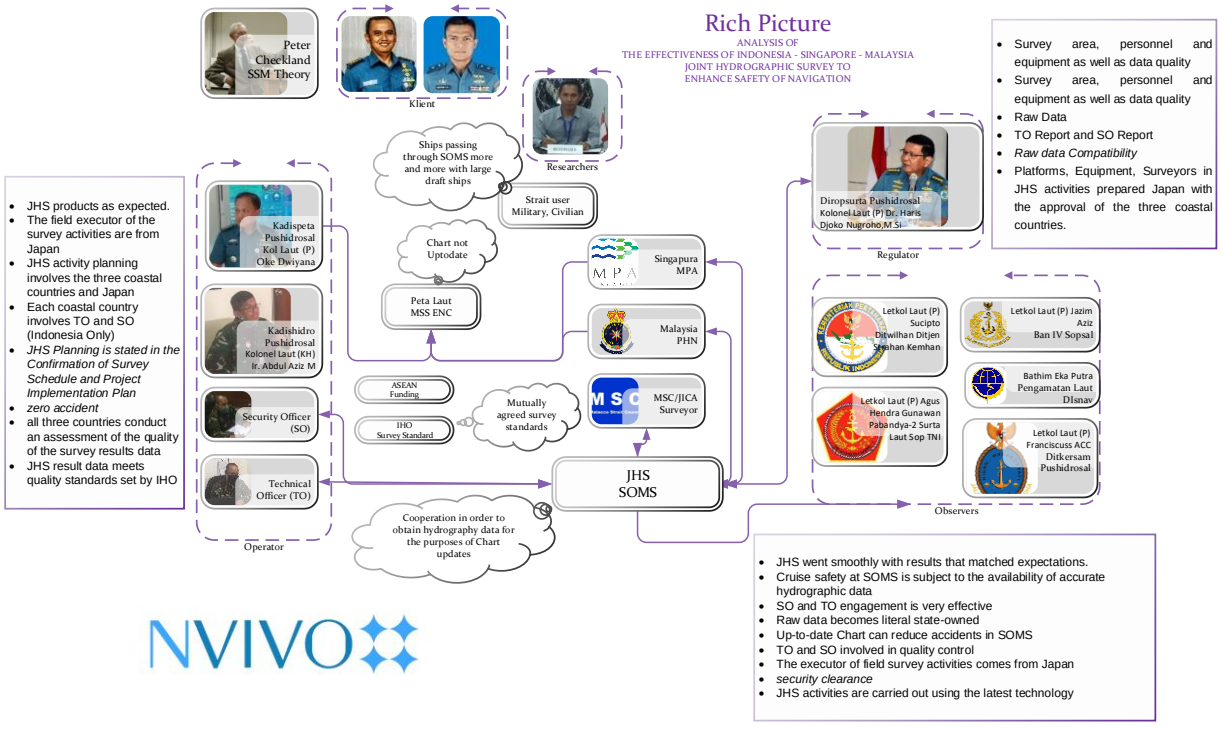

Figure 6. Rich Picture
Source: Processed Results researcher

Table 1. RD-1 CATWOE Analysis

CATWOE Analysis	
C: Customer	Indonesia
A: Actor	Pushidrosal
T: Transformation	Require a Security Officer (SO) to be onboard in any JHS activity in Indonesian waters.

W: Worldview (Weltanschauung)	Carry out supervision by SO in every JHS activity to ensure that there are no activities that can harm Indonesia's interests
O: Owners	Ministry of Defense of RI
E: Environmental Constrains	A limited number of SO Personnel, budget constraints
3E Criteria	
Efficacy	The three coastal countries and MSC as executors of JHS activities must agree to involve SO parties from Indonesia
Efficiency	Pushidrosal cooperates with Kemhan in the preparation of SO personnel who know the field of hydrography
Effectiveness	Involve SO personnel who have competencies in their fields as well as making reports on SO activities

Source: Processed by Authors, 2020

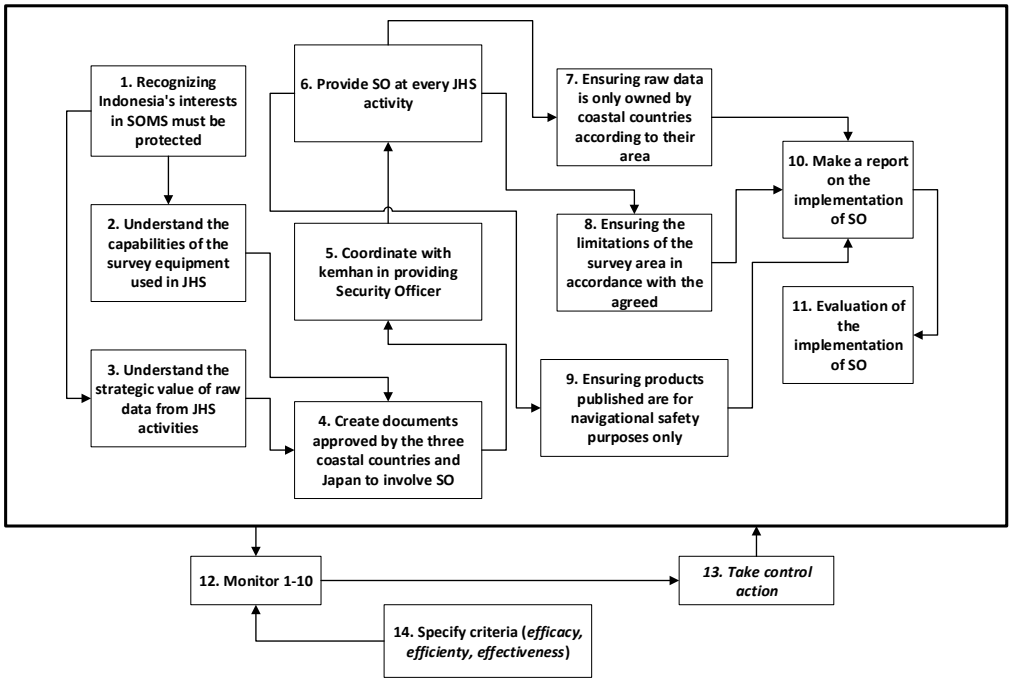

Figure 7. Conceptual Models and Activities of RD-1
Source: Processed by Authors, 2020

Table 2. RD-2 CATWOE Analysis

CATWOE Analysis	
C: Customer	Coastal States
A: Actor	Coastal States, Japan (MSC).
T: Transformation	Involving Technical Officer (TO) as well as preparing SOP, the manual book of survey equipment, as well as other references in the implementation of SOP
W: Worldview (Weltanschauung)	Implement quality control in realtime and in-approves by the state beach to maintain the quality of JHS result data.
O: Owners	Pushidrosal
E: Environmental Constrains	A limited number of TO Personnel

3E Criteria	
Efficacy	Pushidrosal prepares TO personnel who have hydrographic skills with minimum CAT-B level requirements that have a good experience and track record.
Efficiency	Ordered personal Pushidrosal personnel who have minimal CAT B qualifications to be assigned as TO
Effectiveness	Provide information about JHS target activities to personnel who will be involved as TO

Source: Processed by Authors, 2020

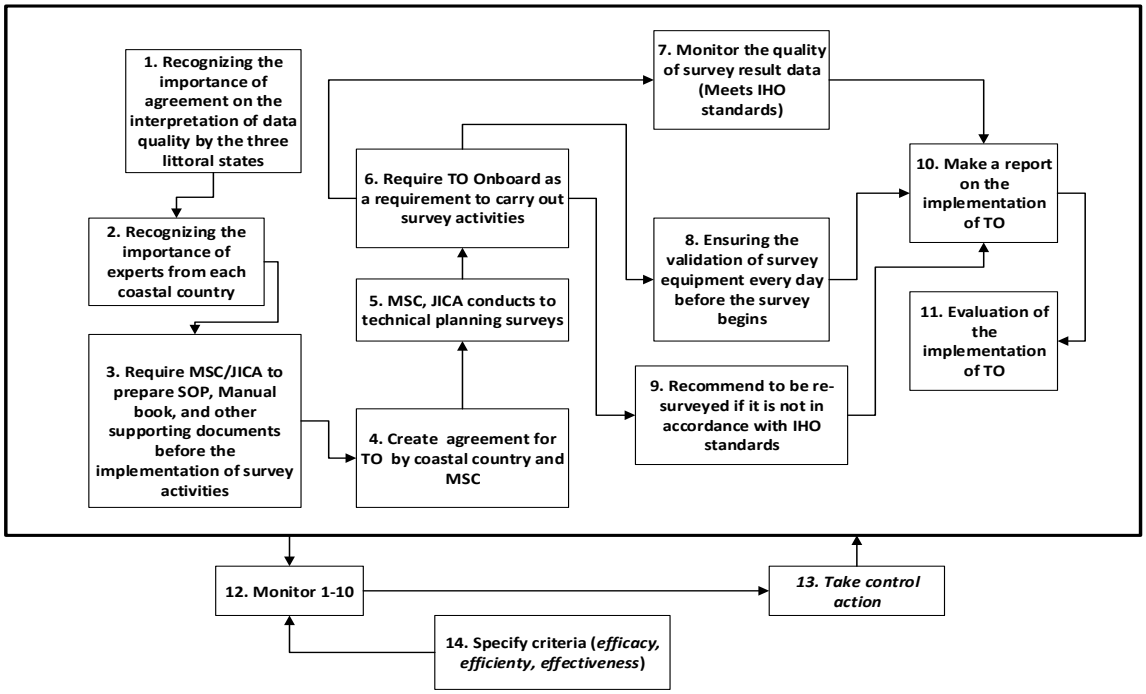

Figure 8. Conceptual Models and Activities of RD-2
Source: Processed by Authors, 2020

Table 3. RD-3 CATWOE Analysis

CATWOE Analysis	
C: Customer	Coastal States
A: Actor	Coastal States, Japan (MSC)
T: Transformation	The preparation of the feasibility index includes platform elements, elements of survey equipment, and personnel qualifications
W: Worldview (Weltanschauung)	Assess the platform, survey equipment, and personnel qualifications so that JHS activities run smoothly following the agreed schedule and achievement targets. assessment
O: Owners	MSC
E: Environmental Constrains	Limited time and budget
3E Criteria	
Efficacy	The three coastal countries and MSC must agree to require the validation of equipment and completeness of ship documents as well as surveyor qualification documents.

Efficiency	Preparing sop implementation of equipment validation as well as document stuffing template related to equipment validation activities, ship inspection, and personnel qualification checking procedures.
Effectiveness	Implementing SOP validation implementation by witnessed by TO personnel from coastal countries who have competence.

Source: Processed by Authors, 2020

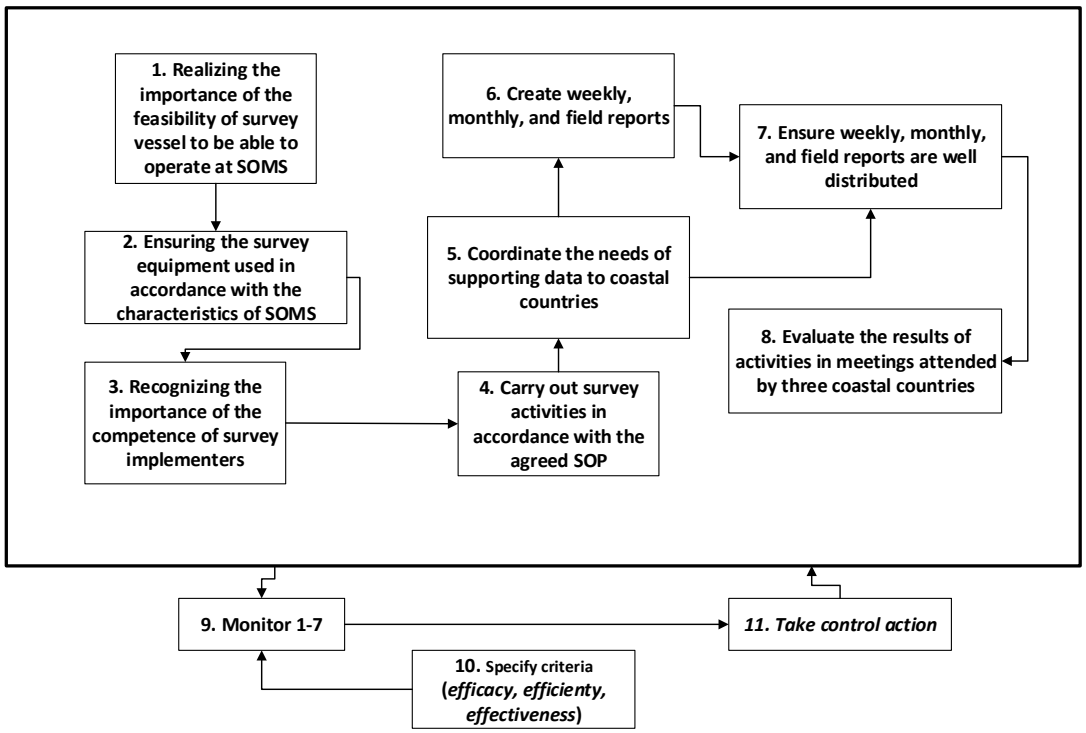

Figure 9. Conceptual Models and Activities of RD-3
Source: Processed by Authors, 2020

Comparison of Models and Real World

Based on the results of the comparison between conceptual models and the real-world in the fifth phase of SSM. Generate the following research gaps:

Tabel 10. *Gap* Research

Gap Research
There has not been an evaluation of the implementation of SO
No SOP in the implementation of hydrographic survey activities
There has not been an evaluation of the implementation of TO

Source: Processed by Authors, 2020

Improving the Situation in joint hydrographic survey activities

a. Indonesia's interest in JHS at SOMS.
   Based on the analysis of the information of interviews with informants, several Indonesian interests must be maintained in JHS. Interests in territorial sovereignty, as well as the sovereignty of hydrographic data, must always be maintained. No party should conduct surveys in the NKRI region without the approval of the Indonesian government, nor should the survey results be used for purposes other than those approved by the Indonesian government.

   Raw data obtained from JHS activities can be processed into various products outside the interests of navigational safety, therefore SO as an Indonesian representative onboard in JHS activities must ensure the ownership of raw data is absolutely the property of the Government of Indonesia. After JHS activity all parties that have raw hydrographic data area of Indonesia

must be destroyed. No party other than Indonesia is entitled to such raw data. JHS products published are only derivative products of raw data for safe navigation at SOMS in the form of Mallaca Strait electronic navigational chart (MSENC).

In Figure 7, there are eleven conceptual model activities that contain activities to safeguard Indonesia's interests by supervising JHS activities at SOMS to safeguard Indonesia's sovereignty and its comparison with the real world. The eleventh activity in the evaluation of the implementation of SO. The eleventh activity in the evaluation of the implementation of SO. This activity is very important as a follow-up report from SO and as very valuable learning that will be very useful to the next activities related to Indonesia's interests that must be maintained and fought for. As long as JHS this activity has not been carried out either by Kemhan or by Pushidrosal. This is a finding gap in this study that is expected to be implemented changes.

b. JHS Specifications and Procedures Implemented at SOMS

Based on the analysis of the information of the results of interviews with informants, it can be concluded that the provisions on the quality of data produced from JHS refer to the mutually agreed provisions. All coastal countries and The Japanese agreed to use JHS data specifications using the IHO SP-44 Order 1a standard.

In Figure 8, there are eleven conceptual model activities that contain activities related to JHS specifications and procedures at SOMS and its comparison with the real world. In the third activity, the coastal country must require the Japanese to prepare an SOP, manual book, and other documents to support the smooth activities of JHS. This has not been fully implemented, in the implementation of which the Japanese carried out activities based on the habits they used to carry out in carrying out hydrographic survey activities. The unavailability of SOP causes difficulty for TO to carry out its duties in controlling data quality. This is a finding gap in this study. The eleventh activity in the evaluation of the implementation of TO was carried out by Pushidrosal. The evaluation aims as a lesson learned that can be taken by Pushidrosal related to survey technical, survey progress, and other things that can be used as input material for Pushidrosal in improving the implementation of Pushidrosal main tasks. This has not been implemented by Pushidrosal and is the gap found in this study.

c. Use of Force *in Joint Hydrographic Survey* at SOMS

Based on an analysis of the information from interviews with informants, it can be concluded that the force used in JHS include the use of personnel, rides, and survey equipment. The personnel involved in JHS consist of surveyors from Japan, TO from three littoral states as well as SO from Indonesia. The vessel used in JHS activities includes one survey vessel, one base vessel, and one tender vessel used for transportation to change personnel. The main survey equipment provided by the Japanese includes hardware and software. The hardware used is Multibeam Echosounder, Single-beam Echosounder, as well as other supporting sensors. While the software used consists of different types of software used for data acquisition and processing.

In Figure 9 there are eight conceptual model activities containing the use of force-related in JHS activities at SOMS. The fourth activity is to carry out activities under the agreed SOP. This has not been fully implemented, so surveyors carry out activities based on their habits. The SOP should be prepared to facilitate and reduce errors due to surveyor limitations. This is a gap this

research should take action in implementing the changes.

CONCLUSIONS, RECOMMENDATION, AND LIMITATION

In general, the achievement of JHS activities in SOMS is following the agreement with the results as expected by the three coastal countries, although Indonesia needs to continue to improve the ability in the implementation of JHS by conducting evaluations and making studies of the importance of SOP in JHS activities. The knowledge and experience gained by Indonesian representatives both SO and TO must be conveyed to other Pushidrosal personnel so that Pushidrosal's ability can continue to improve and always up to date.

Based on the results of research and discussions that have been described, conclusions can be obtained that answer the problem formulation in this research is as follows:

1. Indonesia has succeeded in safeguarding its interests in terms of hydrographic data sovereignty. JHS data is used following the agreement of the three coastal countries to update the to improve the safety of shipping navigation in SOMS. All hydro-oceanographic data obtained from JHS activities belongs to Indonesia and no other party has such data other than Indonesia in this case Pushidrosal. The policy of including the Security Officer (SO) in JHS activities is very appropriate in safeguarding Indonesia's interests related to the sovereignty of hydrographic data in SOMS, but in practice, it is necessary to evaluate the SO activities as an effort to learn and improve the effectiveness of JHS activities in SOMS.
2. The use of force in JHS in SOMS includes personnel involved in JHS consisting of hydrographic surveyors from Japan, TO from coastal countries as well as SO from Indonesia. The platform used in JHS activities includes one survey ship, one base ship, and one tender ship. JHS used equipment with the latest technology in the world of hydrography surveys such as multibeam echosounder, Single-beam Echosounder, and other supporting sensors, while the software used consists of various types of software used for data acquisition and processing. This is following the MoU agreed upon by all parties and produces the survey products as planned in the TTEG.
3. The implementation of JHS in SOMS is carried out using standards agreed by the three coastal countries, namely international standards issued by IHO contained in the publication of IHO Standards for Hydrographic Surveys. No. 44. 5th ed. In the implementation of JHS in SOMS that has been implemented, the executor of the survey in this case the Japanese company did not provide technical SOP of the implementation of hydrographic surveys, this makes it difficult for coastal countries to do surveys supervision. Nevertheless, Indonesia's representative in this case the Technical Officer (TO) can ensure that the results of JHS at SOMS have met the criteria following the standards agreed by the three countries. In its implementation, it is necessary to evaluate the implementation of the Technical Officer as learning and efforts to increase JHS Effectiveness in SOMS.

Range (gap) obtained from the comparison of reality in the field and conceptual models can be continued with the next research topics, among others: The concept of SOP in hydrographic surveys, improvement of Pushidrosal surveyor capability by utilizing lesson learned from SO and TO activities.

Pushidrosal as a learning organization that is constantly evolving following the development of technology, can utilize lessons learned from every SO and TO activity by conducting an evaluation of SO and TO activities. This evaluation is very

useful as a means of communication between SO or TO executives with the command of both Pushidrosal and Kemhan. With SO and TO evaluation activities are expected to obtain inputs and actual suggestions that can not be accommodated in the standard report SO or TO.

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