The Republic of Indonesia
Ministry of Transportation
Directorate General of Sea Transportation

The Republic of Indonesia
The Project for Review of the Study For Maritime Traffic Safety System Development Plan

Report (Phase-1)

April, 2023

Japan International Cooperation Agency (JICA)
Japan Aids to Navigation Association (JANA)

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ABBREVIATION LIST

A	AIS	Automatic Identification System
	APBS	Alur Pelayaran Barat Surabaya (Surabaya West Ship Route)
	APTS	Alur Pelayaran Timur Surabaya (Surabaya East Ship Route)
	ARPA	Automatic Radar Plotting Aids
	AtoN AIS	Aids to Navigation AIS
B	BAPPENAS	Badan Perencanaan Pembagunan Nasional (National Development Planning Agency)
	BASARNAS	Badan SAR Nasional (National SAR Agency)
	BDF	Bio Diesel Fuel
	BMKG	Badan Meteorologi, Klimatologi dan Geofisika (Indonesian Agency for Meteorology, Climatology and Geophysics)
	BPPTL	Balaipendidikan Dan Pelatihan Transportasi Laut (Sea Transportation Education and Training Center)
	BPS	Badan Pusat Statistik (Central Bureau of Statistics)
C	CCTV	Closed-Circuit Television
	COVID-19	Novel Coronavirus disease 2019
	CRS	Coastal Radio Station
D	DGPS	Differential Global Positioning System
	DGST	Directorate General of Sea Transportation
	DISNAV	District Navigation Office
	DSC	Digital Selective Calling
	DSI	Daftar Suar Indonesia (List of Lights in Indonesia)
	DWT	Dead Weight Tonnage
E	E/G	Engine Generator
	ECDIS	Electronic Chart Display and Information System
	EGNOS	European Geostationary Navigation Overlay Service
	ENC	Electronic Navigational Chart
	EPIRB	Emergency Position Indicating Radio Beacon
F	FAA	Federal Aviation Administration
	FAL	Convention on Facilitation of International Maritime Traffic
	FAME	Fatty Acid Methyl Esters
	FO/LO	Fuel Oil/Lubricating Oil
	FOC	Fuel Oil Consumption
	FRP	Fiber Reinforced Plastics
G	GAM	Gerakan Aceh Merdeka (Free Aceh Movement)
	GDP	Gross Domestic Product
	GEO	Geo-stationary Orbit
	GIS	Geographic Information System

G	GMDSS	Global Maritime Distress and Safety System
	GNP	Gross National Product
	GOI	Government of the Republic of Indonesia
	GOJ	Government of Japan
	GPRS	General Packet Radio Service
	GPS	Global Positioning System
	GT	Gross Tonnage
H	HF	High Frequency
	HP	Horse Power
I	IACS	International Association of
	ICT	Information & Communication Technology
	IMO	International Maritime Organization
	INAPORTNET	(Non)
	IP	Internet Protocol
	ISM	International Safety Management
	ISRS	Indonesian Ship Reporting System
	IT	Information Technology
	IWRAP	IALA Waterway Risk Assessment Program
J	JANA	Japan Aids to Navigation Association
	JCC	Joint Coordination Committee
	JICA	Japan International Cooperation Agency
	JST	JICA Study Team
K	KBP	Kapal Bantu Perambuan (Aids-Tender)
	KIP	Kapal Induk Perambuan (Buoy Tender)
	KNKT	Komite Nasional Keselamatan Transportasi (National Transportation
	KPA	Komite Peralinan Ache (Ache Transitional Committee)
	KPLP	Kesatuan Penjagaan Laut dan Pantai (Indonesia Coast Guard)
	KPP	Kapal Pengamat Perambuan (Inspection Boat)
L	LED	Light Emitting Diode
	LOA	Length Overall
	LRIT	Long-Range Identification and Tracking of Ships
	LTE	Long Term Evolution
M	MCC	Marine Command Center
	MF	Medium Frequency
	MFC	Multi Funtion Console
	MMSI	Maritime Mobile Service Identity
	MOT	Ministry of Transportation
	MP	Master Plan
	MSAS	MTSAT Satellite- based Augmentation System
	MSC(1)	Maritime Safety Committee

M	MSC(2)	Malacca Strait Council
	MSI	Maritime Safety Information
N	NAVAREA	World-wide Navigation Warning Service Area
	NAVIGASI	Directorate of Navigation
N	NAVTEX	Navigation Telex
	NM	Nautical Mile
	NNSS	Navy Navigation Satellite. System
	NPMP	National Ports Master Plan
	NTSC	National Transportation Safety Committee
O	ODA	Official Development Assistance
	OJT	On the JOB Training
P	PC	Personal Computer
	PELINDO	Indonesian Port Corporation
	PELNI	Pelayaran Nasional Indonesia (Indonesian National Shipping)
	PIANC	Permanent International Association of Navigation Congresses
	PNBP	Non-Taxation State Revenue-Light Dues
	PP	Peraturan Pemerintah (Government Regulation)
	PROPENAS	National Development Program
	PSC	Port State Control
R	RC	Reinforced Concrete
	RCC	Rescue Coordination Center
	RENSTA	Rencana Strategis (Strategic Plan)
	RLB	Resilient Light Beacon
	RR	Radio Regulation
	RS	Reference Station
	RX, R x	Receiving Station Receiver
S	SA	Selective Availability
	SAR	Search and Rescue
	SBAS	Satellite-based Augmentation System
	SBNP	Sarana Bantu Navigasi Pelayaran (Visual Aids to Navigation)
	SOLAS	International Convention on the Safety of Life at Sea
	SOP	Standard Operating Procedure
	SSB	Single Side Band
	STCW	International Convention on Standards of Training, Certificates and Watchkeeping for Seafarers
	SWL	Safe Working Load
T	TC	Technical Condition
	TEU	Twenty-Foot Equivalent of Unit
	Tg.	Tanjung (Cape)

T	TRX	Transmitter and Receiver
	TSS	Traffic Separation Scheme
	TX	Transmitting Station or Transmitter
U	UNCLOS	United Nations Convention on the Law of the Sea
	VDES	VHF Data Exchange System
V	VHF	Very High Frequency
V	VLCC	Very Large Crude oil Carrier
	VMS	Vessel Managemant System
	VSAT	Very Small Aperture Terminal
	VTIS	Vessel Traffic Information Services
	VTMS	Vessel Traffic Management Services
	VTS	Vessel Traffic Services
W	WARC	World Administrative Radio Conference
	WASS	Wide Area Augmentation System

Chapter 1

Introduction

1 Introduction

1.1 Background of the Study

As the country, the Republic of Indonesia (hereinafter referred to as “ROI”), has grown, its maritime traffic has become more active. Maritime traffic safety has also been recognized as an important issue.

The Directorate General of Sea Transportation (hereinafter referred to as “DGST”), the Ministry of Transportation (hereinafter referred to as “MOT”) of the Government of Republic Indonesia (hereafter referred to as “GOI”), has worked on a development plan for safety navigation, such as “Survey Report on Long Term Development Plan of Maritime Communication System” issued in March 1982”, “The Master Plan on the Development of Aids to Navigation” issued in October 1985 and “The Study for the Maritime Traffic Safety System Development Plan” issued June 2002 (hereinafter referred to as “Previous Plan”), with the cooperation of Japan International Cooperation Agency (hereinafter referred to as “JICA”).

With the maximum effort of DGST, some of the proposed projects have been implemented. However, more than 10 years have passed since the Previous Plan, and social environment surrounding maritime affaires in ROI has significantly changed during this period compared to before. Furthermore, the volume of maritime traffic has become larger than expected along with the economic development of ROI and the technologies in the field of shipping have been improving drastically, such as the improvement of GPS accuracy, the advent of AIS, and so on.

In addition, GOI, led by the President Joko Widodo, has lunched the new vision called “Global Maritime Axis” consisting of five pillars, such as “Maritime Infrastructure” which includes the projects of “Sea-Toll”, “Islands’ Connectivity”, “Short Sea Shipping”, and so on.

To cope with this situation, GOI requested the Government of Japan to conduct the project to review and update Previous Plan.

In response to this request, JICA dispatched a mission to Indonesia in March 2016 and in January 2017 in order to prepare for the establishment of a project.

In March 2017, DGST and JICA exchanged the “Record of Discussions on the Project for Review of the Study for maritime Traffic Safety Development Plan in the Republic of Indonesia”.

After that, JICA and Japan Aids to Navigation Association (hereinafter referred to as “JANA”) have signed the project implementation contract on February 22, 2019. JANA has organized the JICA Study Team (hereinafter referred to as “JST”).

1.2 Objectives of the Study

The purpose of this project is to review the Previous Plan, to understand the current situation surrounding maritime affairs in Indonesia, and to propose a new Master Plan that contributes to the safety and efficiency of maritime traffic.

In this study, a short term plan is proposed as a priority project and another one be done as an important project on a national scale and over the long-term.

1.3 Area of the Study

The study is covered all regions of the ROI, where the geographical area under the jurisdiction of District Office of Navigation (hereinafter referred to as “DISNAV”) is shown in the Figure below.

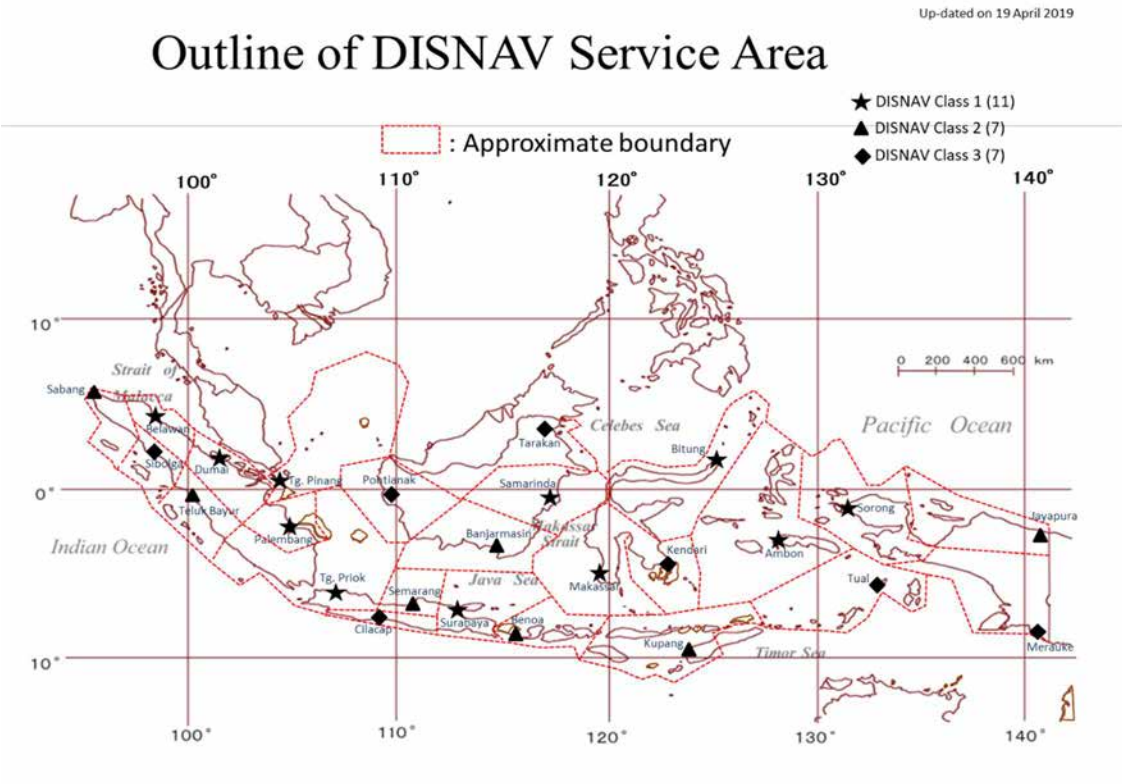


Figure 1.3 -1 : Jurisdiction Area of DISNAV

1.4 Scope of the Study

In this study, the following items related to the present situation are examined and analyzed from the perspective of maritime traffic safety, and the Previous Plan is reviewed for updating the Master Plan.

a. Social Economy of Marine Transportation

b. National Maritime Policy

c. Seaborne Cargoes and Passengers

d. Maritime Accident

e. Maritime Traffic Route and Flow

f. Relevant Statistic Information

g. Current Status of Aids to Navigation

1.5 Implementation of the Study

The project officially started on February 22, 2019 under contract with JANA as a consultant.

First of all, the collection of relevant information began for making the Inception Report in Japan. Then, in early April, the presentation of the Inception Report and the first Joint Coordinating Committee (hereinafter referred to as “JCC”), established under the “RECORD OF DISCUSSIONS ON THE PROJECT FOR REVIEW OF THE STUDY FOR MARITIME TRAFFIC SAFETY SYSTEM DEVELOPMENT PLAN” signed in March 2017, was held in Jakarta, Indonesia.

After that, preparation work for the field survey was completed in Japan, and a formal field survey began in June. The field survey was conducted by visiting the headquarters of 15 of the 25 DISNAVs, divided into three groups. Besides, the contracts of an outsourced work on a questionnaire survey and a traffic flow/volume survey were made with local agents. The aggregate results of the questionnaire are attached as an Appendix 1.5 -1.

Meanwhile, a workshop was held in June, and the 2nd JCC was provided in August to present the Interim Report.

After the field survey in October and November, the progress report was prepared, and the 3rd JCC was conducted in early March, 2020. Around this time, the worldwide influence of COVID-19 became widespread, and the restrictions were imposed on travel. Some of the JCC members who scheduled to attend the meeting from Japan could not participate in the JCC.

Since then, the effects of the corona infection have continued on a global scale, and necessary surveys, such as a feasibility study, could not be carried out, and a seminar on IWRAP (IALA Waterway Risk Assessment Program) in Jakarta and the training in Japan were cancelled.

The 4th meeting of JCC, in which the draft final report was explained, was held on August 4, 2020 via Web-meeting using the Zoom system.

The detail schedule is shown in Paragraph 1.5.3.

1.5.1 Joint Coordinating Committee

JCC convened its first meeting on April 11, 2019.

At this meeting, discussions were held on the Inception Report. Opinions about how to proceed with the work and the field surveys were summarized.

The minutes are attached to Appendix 1.5.1 -1.

Picture 1.5.1 -1 : The meeting of the 1st JCC at Mercure Hotel

The 2nd JCC was held on August 7, 2019.

There was discussion about the outline of the project in each field, such as VTS (Vessel Traffic Service), AtoN (Aids to Navigation), CRS (Coastal Radio Station) and so on.

The minutes are attached to Appendix 1.5.1 -2.

Picture 1.5.1 -2 : The meeting of the 2nd JCC at Aryaduta Hotel

The 3rd JCC was held on 5 March, 2020. The Progress Report was discussed and priority projects to be included in the final report were also discussed.

Due to the corona outbreak, only DGST, JICA Indonesia and JST were in attendance at the meeting.

The minutes are attached to Appendix 1.5.1 -3.

Picture 1.5.1 -3 : The meeting of the 3rd JCC at Sari Pacific Hotel

The 4th JCC was held in a Web-meeting with a Zoom system on August 4, 2020.

The draft final report was explained and opinions were exchanged regarding the compilation of the final report. The final report was completed after several Web-meetings.

The minutes are attached to Appendix 1.5.1 -4.

1.5.2 Structure of JST

JICA Study Team (JST) was made up of 7 people in the following fields including the team leader.

1) Leader / Safety Navigation System
2) Sub Leader / Aids to Navigation, VTS
3) GMDSS, IT Technology
4) Vessels for Aids to Navigation
5) Economic and Financial Analysis
6) Education and Training
7) Natural and Environment Consideration

The implementation structure of this project is shown in the Figure at the next page.

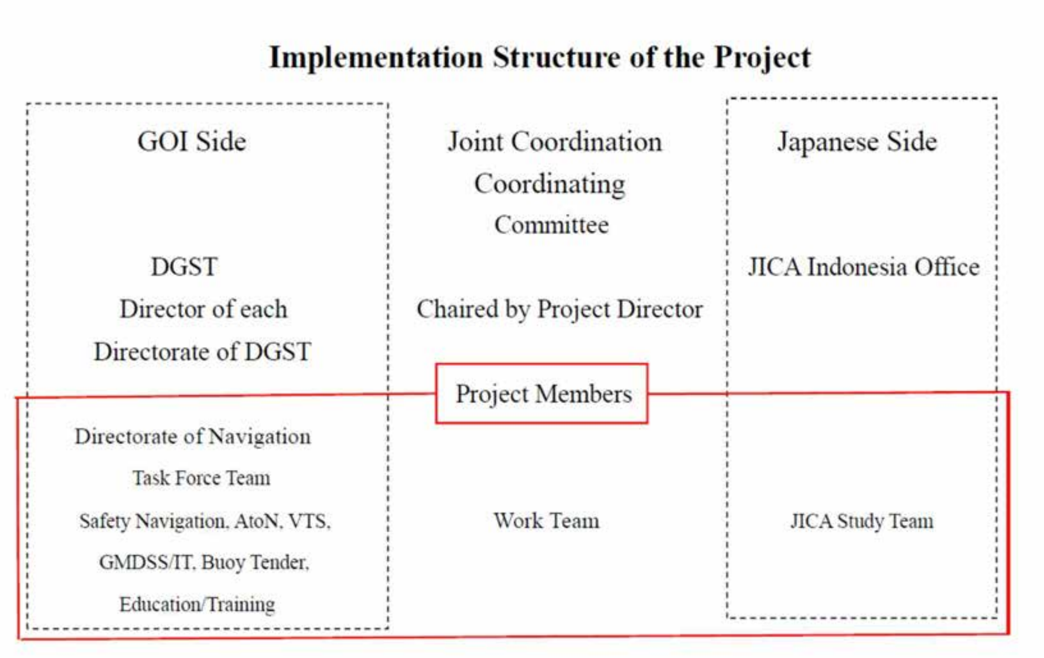


Figure 1.5.2 -1 : Structure of the Project

The organizational chart of the task forse on Indonesian side as of July 2019 is shown in the Figure below.

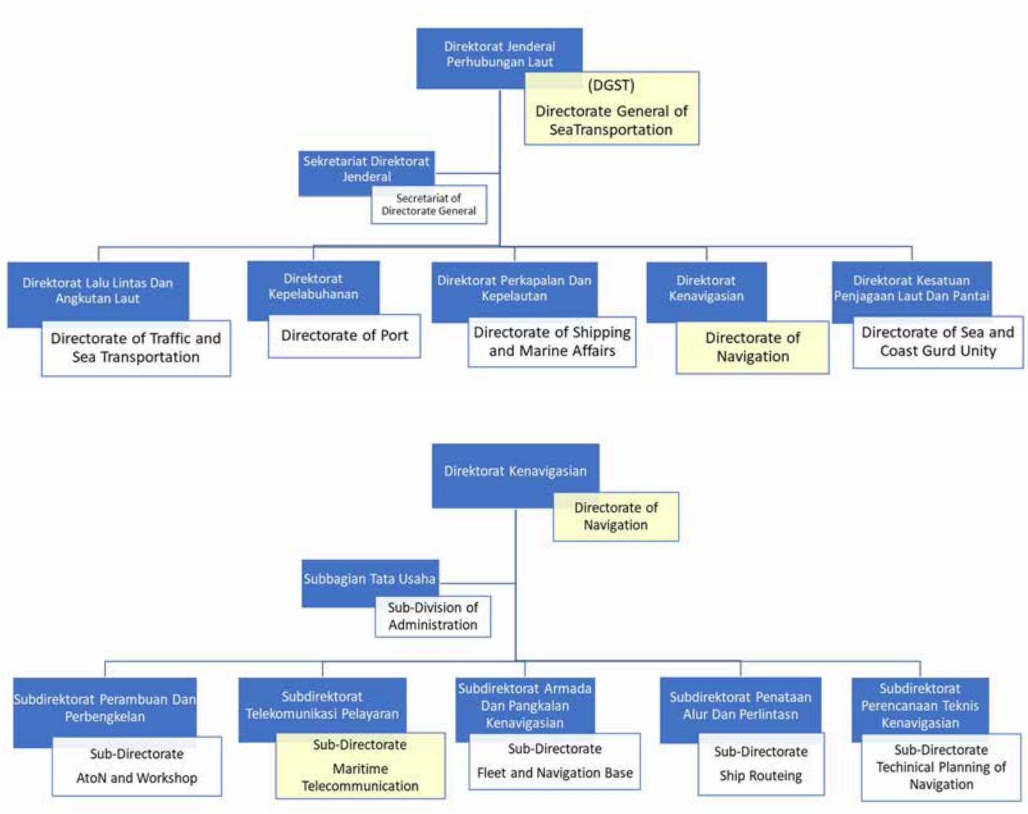


Figure 1.5.2 -2 : Organization Chart of DGST

The task and the function of Directorate of Navigation (hereinafter referred to as “NAVIGASI”) are as follows.

*TASK

NAVIGASI has the task of implementing the formulation and implementation of policies, preparation of norms, standards, procedures, and criteria, providing technical guidance and supervision as well as evaluating and reporting in the navigation field.

*FUNCTION

> Preparation of policy formulation in the field of search and workshop, shipping telecommunications, fleet and navigation bases, grooves and crossings as well as navigation technical planning;

>Preparing the implementation of policies in the field of browsing and workshop, shipping telecommunications, fleet and navigation bases, structuring of grooves and crossings and navigational technical planning;

>Preparation of norms, standards, procedures and criteria in the field of search and workshop, shipping telecommunications, fleet and navigation bases, grooves and crossings as well as navigational technical planning;

>Preparation of the implementation of the provision of technical guidance and supervision in the field of search and workshop, shipping telecommunications, fleet and navigation bases, grooves and crossings as well as navigation technical planning;

>Preparation of evaluation and reporting in the field of browsing and workshop, shipping telecommunications, fleet and navigation bases, grooves and crossings as well as navigation technical planning; and

>The implementation of administrative, financial, personnel and household affairs of the Directorate.

1.5.3 Date of Implementation

The overall implementation schedule is shown in the Table 1.5.3 -1 (and attached as an Appendix 1.5.3 -1) at the page 1-9.

1.6 Consignment Contract for the Survey

In this project, the following three surveys were outsourced as a consignment contract with a local agent.

1) Questionnaire Survey
2) Survey of Traffic Flow/Volume
3) Analysis of AIS Data

1.7 Workshop / Seminar / Training

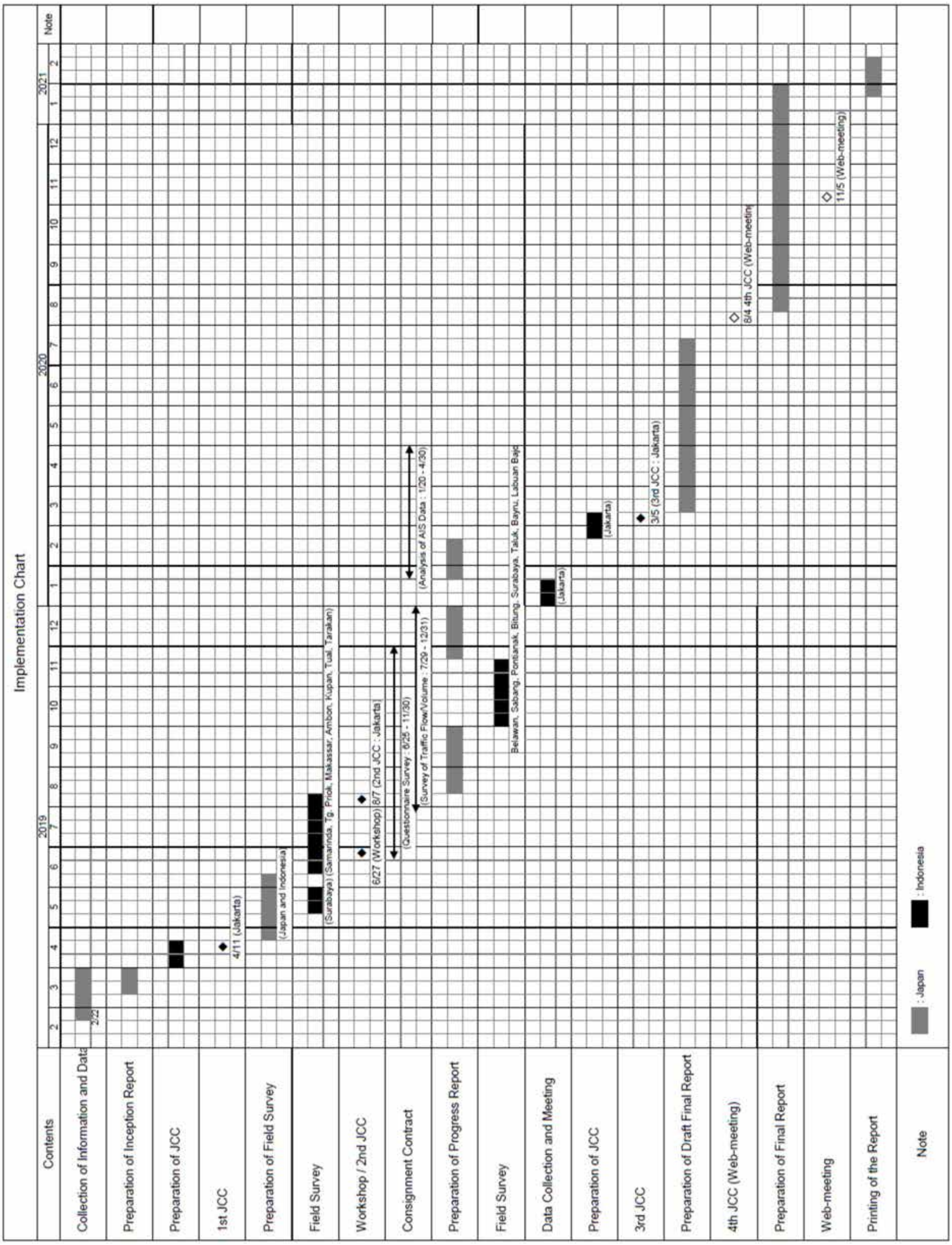
The workshop was done with nearly 50 participants not only from the headquarters of DGST but also from offices of DISNAV. The presentation on “Safety Navigation in Indonesia Waters” by DGST and on “Technology of E-Navigation” by the Emeritus Professor Imazu, Tokyo University of Maritime Science was given. (Presentation materials are attached to Appendix 1.7 -1, and Appendix 1.7 -2.)

Picture 1.7 -1 : Workshop at Aryaduta Hotel

A seminar on IWRAP (IALA Waterway Risk Assessment Program), scheduled in April 2020 in Jakarta, was canceled due to restrictions on the travel of lecturers and on movement of participants within Jakarta, which was caused by COVID-19.

The training for this project’s counterparts, scheduled in May in Japan, was also canceled for the same reason.

Table 1.5.3 -1 : Implementation Schedule



Chapter 2

Current Situation Surrounding the Maritime Traffic Safety

2 Current Situations Surrounding the Maritime Traffic Safety

2.1 National Maritime Policy

The Ministry of Transportation, which manages Indonesia's transportation administration, is promoting policy formulation and administrative accomplishment base on the following recognition (These are abstracted from the presentation by DGST).

*As a maritime nation that relies heavily on the sea to achieve economic growth

✧One of the largest maritime countries in the world

✧The largest archipelagic country in the world

✧Facing Malacca & Singapore Strait

✧Studded with 13,466 islands

✧Having 94,156 km of coastline (4th after Canada, USA, Russia)

✧Between two continents, Asia and Australia

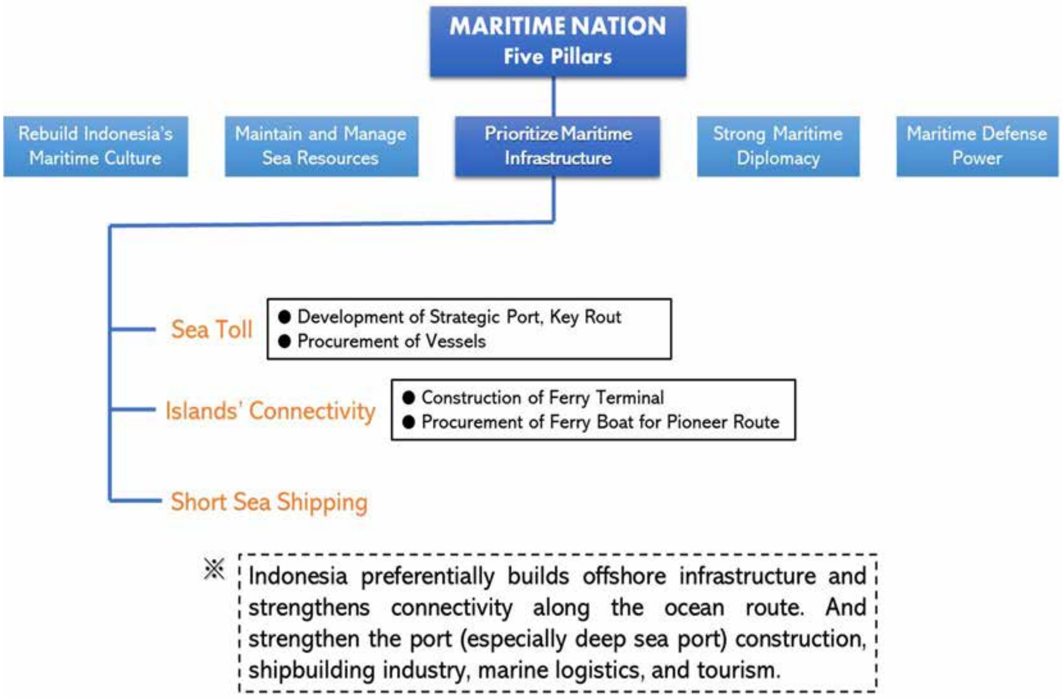
✧Having 3 archipelagic Sea-Lanes

✧Being +/- 2,400 port and terminal

✧Handling a total of 1 billion tons at Indonesian ports

The current administration in Indonesia set forth the pillars of the maritime national programs, in which the development of maritime infrastructure is one of the important policies in the maritime sector that directly leads to an increase in vessel traffic.

The contents of marine infrastructure development are shown in the Figure below.



※ Indonesia preferentially builds offshore infrastructure and strengthens connectivity along the ocean route. And strengthen the port (especially deep sea port) construction, shipbuilding industry, marine logistics, and tourism.

Figure 2.1 -1 : Frame of Five Pillars for Maritime Nation

The “Sea Toll” project, which is a major project for infrastructure development in the five pillars, includes the development of 24 strategic ports, the modernization of ports and the procurement of cargo and other ships for pioneer traffic routes, which is aimed to reduce disparities between the western and the eastern areas. The location of the strategic ports – 5 Hub ports and 19 Feeder ports across the archipelago - is shown in the Figure below.

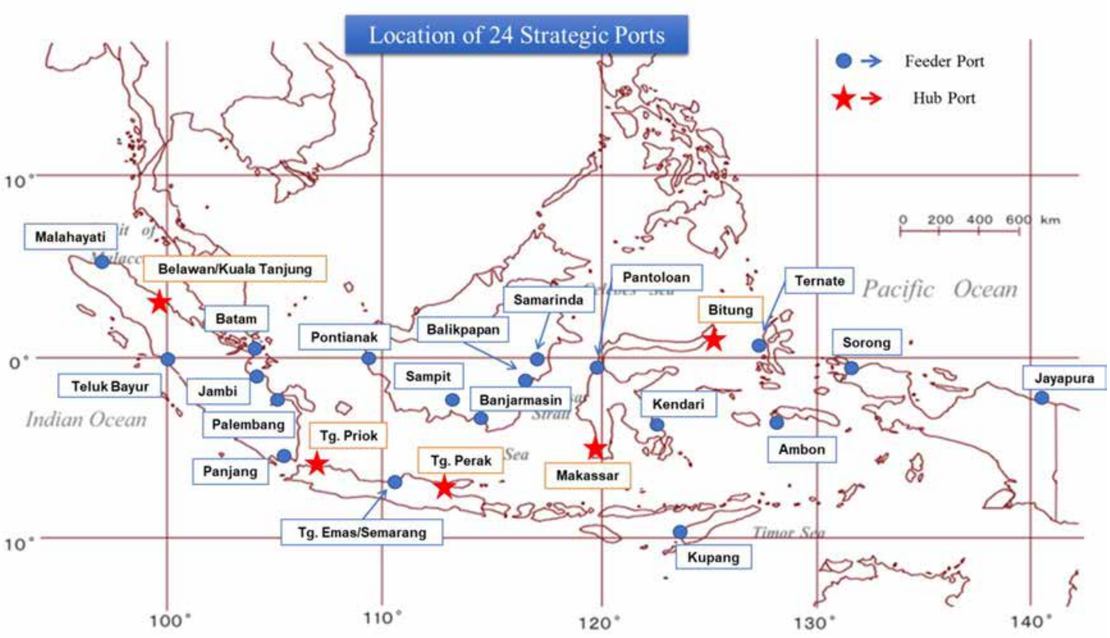


Figure 2.1 -2 : Locations of Strategic Ports

This will not only promotes further development of maritime transportation and its logistics, but also strengthens the east-west connectivity. Additionally, the construction of ferry terminals and the procurement of ferryboats for pioneer ferry routes are included in the plan of “Island’s Connectivity” and “Short Sea Shipping” to also strengthen island’s connectivity.

As a result of these promotion strategies, the flow of people and goods to the east will lead to the development of eastern tourism.

The present main ferry routes are shown in the Figure below, and the statistics of passenger and goods at the five major Indonesian ports are given in Section 2.3.

Source : Interferry Conference

Figure 2.1 -3 : Main Ferry Routes

In particular, the following five ports are designated as a hub port, and two of them are positioned as an international hub port for the port development, which is shown in the Figure below.

1. Port of Belawan / Kuala Tanjung(*)
2. Port of Tg. Priok / Kalibaru(*)
3. Port of Tg. Perak
4. Port of Makassar
5. Port of Bitung

(*) International Hub Port

Figure 2.1 -4 : Hub Port

The role of these 5 hub ports is expected to strengthen container and passenger transportation. The international hub ports will have the capacity of large container vessels over 3,000 TEU (Panamax container ship). A minimum water depth of 12m will be secured for the hub port and 7m for the feeder port.

"Short Sea Shipping", which is under the Land Transport Bureau, aims to shift the transportation to sea transport from land-based transport among islands.

The main routes in the Short Sea Shipping project are shown in the Figure below.

Figure 2.1 -5 : Routes of "Short Sea Shipping"

There are other ports determined by the decree of the Minister of Transportation than the above.

Among them, the ship's routing was designated for 6 ports and 4 general terminals out of 167 ports as a collecting port. In addition, there are 365 general ports, of which the ship's routing of 28 ports has been established, but the remaining 337 ports are still undecided. They are shown in the Figure below.

Under the Ministerial Decree, Peleng Strait and Sele Strait have been designated, but 669 custom terminals and 661 private ports are not yet.

DESIGNATED SHIP'S ROUTEING IN INDONESIA

- 🟨 Ditetapkan tahun 2015 (Pontianak, Cilacap, Semarang, Bitung, Makassar dan Teluk Bayur)
- 🟦 Ditetapkan tahun 2016 (APBS, Palembang, dan Selat Peleng)
- 🟩 Ditetapkan tahun 2017 (Benoa, Tg. Priok, Belawan, Banjarmasin, Balikpapan, Tenau Kupang, Kendari, Waisai Raja Ampat, Sorong, Arar dan Sele)
- 🟩 Progress Penetapan di Biro Hukum (APTS, Dumai, Lembar dan Ambon)
- 🟧 Studi Penetapan Alur di Tahun 2017 (Batam, Samarinda dan Kuala Tanjung)
- ⬜ Studi Penetapan TSS di Tahun 2017 (Selat Sunda dan Selat Lombok)

DIRECTORATE GENERAL OF SEA TRANSPORTATION - MINISTRY OF TRANSPORTATION

Figure 2.1 -6 : Ship's Routing

All these plans clearly show that the vessel traffic including the movement of people will be activated and the maritime traffic volume will increase.

2.2 Socioeconomic Frame

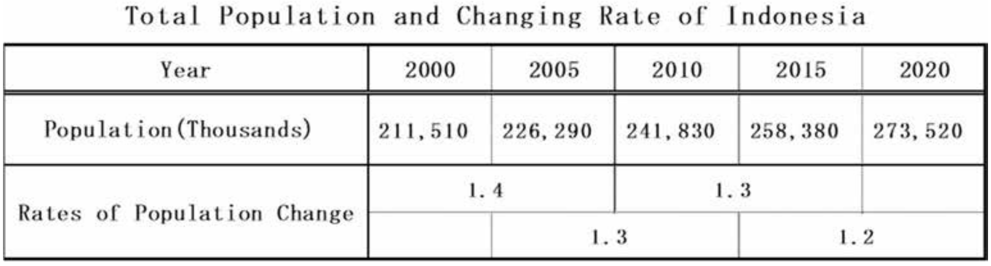
When discussing future plans, it is necessary to consider the social scale of the target year and, generally speaking, the dynamics of related fields, such as Maritime Transportation, from the population size and economic scale.

2.2.1 Total Population and Rates of Population Change

According to the statistics in World Population Prospects of United Nations, as of 2018, Indonesia's total population is about 267 million people with changing rate of 1.4 % to 1.2 % per year since 2000. Although the rate of population change will be continue to decline, the population will be estimated to be close to 300 million by 2030.

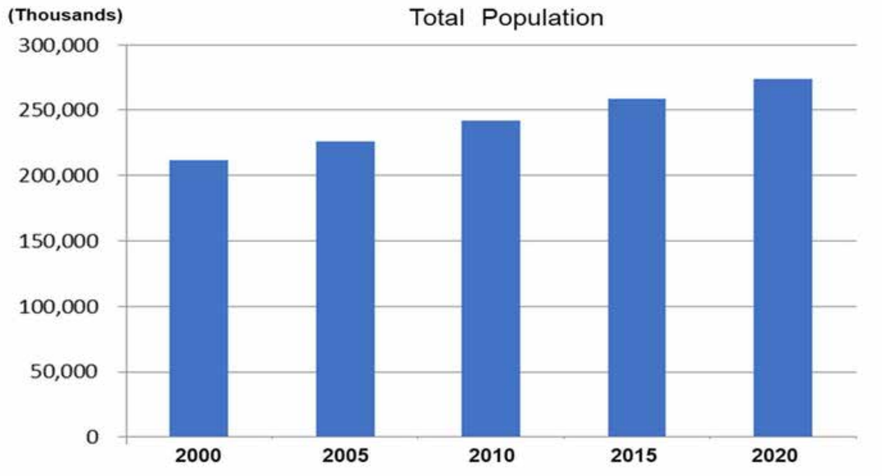
The Table and the Graph are shown next page.

Table 2.2.1 -1: Total Population and Change Rate

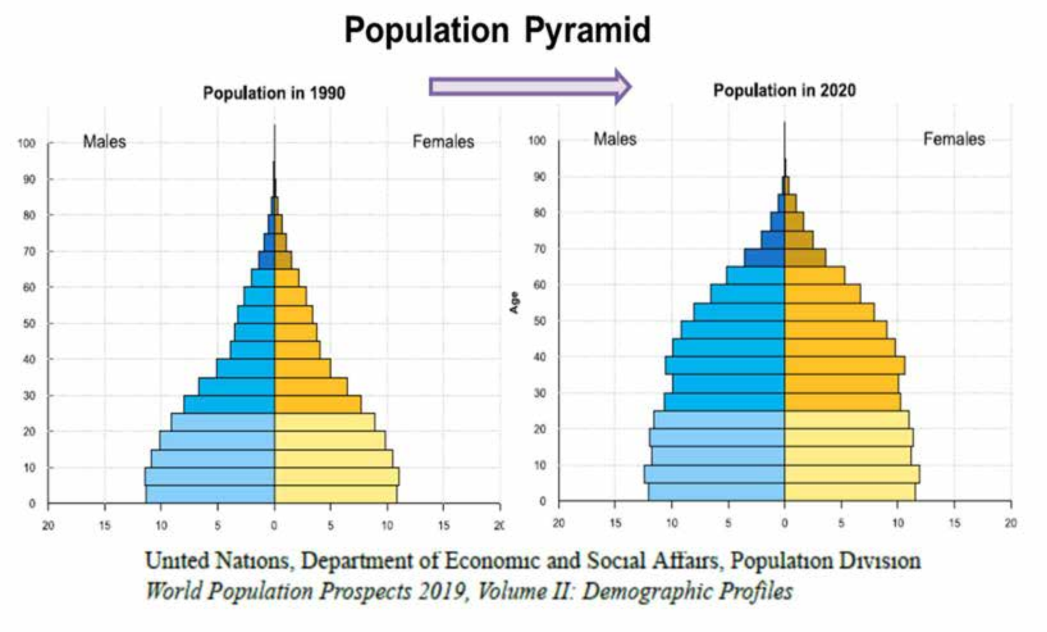


Total Population and Changing Rate of Indonesia

Year	2000	2005	2010	2015	2020
Population(Thousands)	211,510	226,290	241,830	258,380	273,520
Rates of Population Change	1.4		1.3		
		1.3		1.2	



The population pyramid as shown in the Figure below is also shifting from the pyramid type found in developing countries to the bell shape (Stationary) that is seen with development of the nation. These demographic trends seem to show similar growth trends in related fields.



United Nations, Department of Economic and Social Affairs, Population Division
World Population Prospects 2019, Volume II: Demographic Profiles

Figure 2.2.1 -1: Population Pyramid

2.2.2 The Rate of Economic Growth and the Volume of Maritime Transportation

The current social situation and economic development has clearly changed from the previous survey of those days in 2002, not only in Indonesia but also in global scale.

Since the progress of economic development is reflected in the amount of sea transport, in other words, the volume of vessel traffic, it is necessary to understand the changes in these societies in order to predict the future and to propose a new vision, into which state-of the art technologies are incorporated to respond to the times.

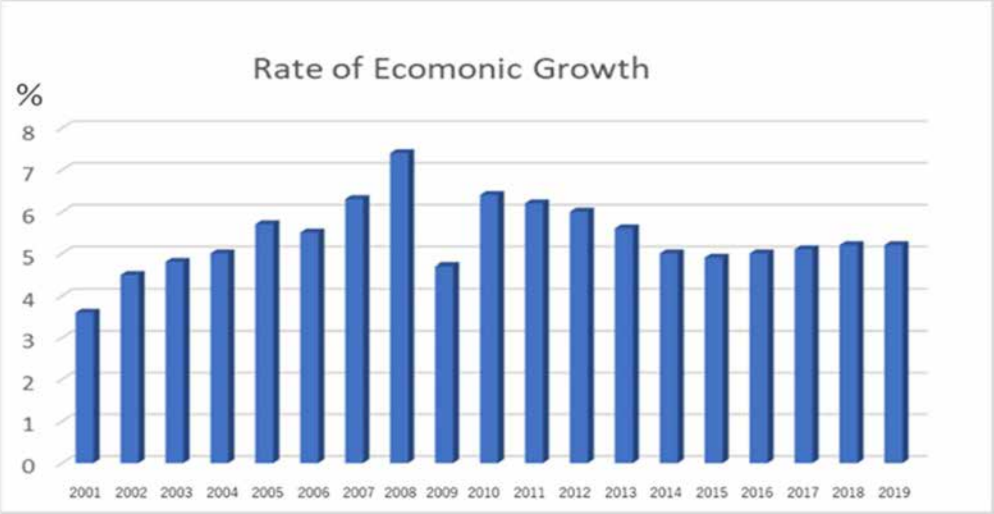
An index of economic growth can be indicated by the changes in real GDP growth rate.

And now, the economic growth rate calculated from Real GDP in Indonesia is shown in the Table and the Bar Graph below.

Table 2.2.2 -1 : Economic Growth Rate

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rate	3.6	4.5	4.8	5	5.7	5.5	6.3	7.4	4.7	6.4
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Rate	6.2	6	5.6	5	4.9	5	5.1	5.2	5.2	

※Data from SNA (System of National Accounts)



The economic growth rate since 2005 has achieved a relatively high from the 5% to 6% range except 2009, which was affected by the global financial and economic crisis.

And, looking at the growth rate by industry, the field of Transportation and Warehouse shows stable growth, similar to the overall economic growth rate. It is shown in the Table at the next page.

Table 2.2.2 -2 : Real GDP Growth Rates of Transportation and Warehouse

(by Industry Sector)

Year	2011	2012	2013	2014	2015	2016	2017	2018
Rate (%)	8.3	7.1	7	7.4	6.7	7.5	8.5	7

* Source: Complied from Indonesia Central Bank Statistics

In order to see the relationship between the economic growth rate and the volume of sea transport, the statistics of seaborne cargo in Indonesia, which is indicating the movement of sea transportation, are rendered below.

The following table shows the statistics of cargo movement in Indonesia.

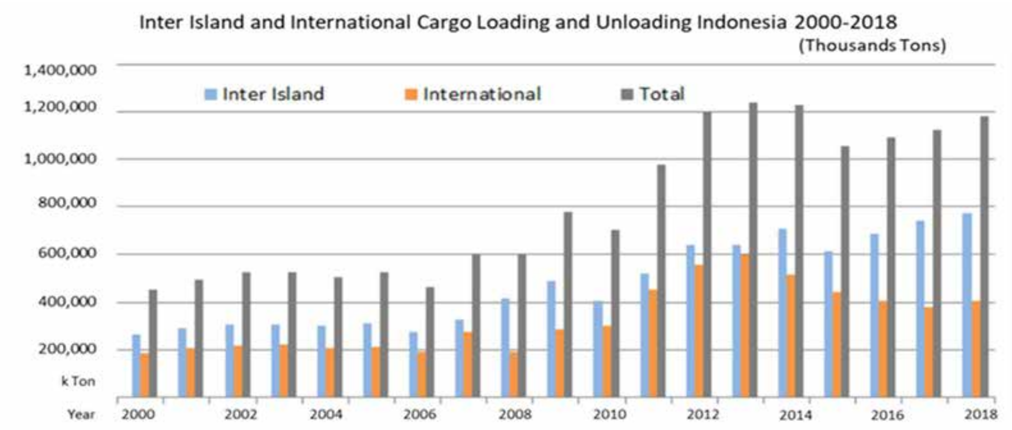
(All the data below are downloaded from "Badan Pusat Statistik" (BPS – Statistics Indonesia) website https://www.bps.go.id. A copy of data is attached as an Appendix 2.2.2 -1.)

Table 2.2.2 -3 : Inter-Island and International Cargo Loading and Unloading 2000 – 2018

(Thousands Ton)

Year	Inter Island	International	Total
2000	265.252	186.568	451.820
2001	291.340	206.095	497.435
2002	308.150	217.118	525.268
2003	305.459	223.056	528.515
2004	301.177	205.994	507.171
2005	312.864	211.129	523.993
2006	274.552	191.063	465.615
2007	326.784	274.083	600.867
2008	414.207	190.045	604.252
2009	491.162	284.815	775.977
2010	404.161	298.863	703.024
2011	523.232	455.488	978.720
2012	640.314	557.909	1.198.223
2013	639.944	600.211	1.240.155
2014	710.345	517.725	1.228.070
2015	614.850	441.186	1.056.036
2016	686.372	406.116	1.092.488
2017	743.444	377.895	1.121.339
2018	775.290	405.469	1.180.759

Source : Badan Pusat Statistik
(BPS - Statistics Indonesia, Port Authority)



These statistics show that the volume of marine transportation continues to increase along with the economic growth accordingly.

This can be regarded, namely, as an increase in the number of vessel traffic in Indonesia. That is to say, when the economy grows, it can be considered that the amount of vessel traffic increases.

As the national maritime policy is promoted, it will be easily understood that marine transportation will increase. State differently, there is no doubt that the number of vessels will increase along with the development and improvement of the port and harbor environment, and the maritime traffic will become more complex.

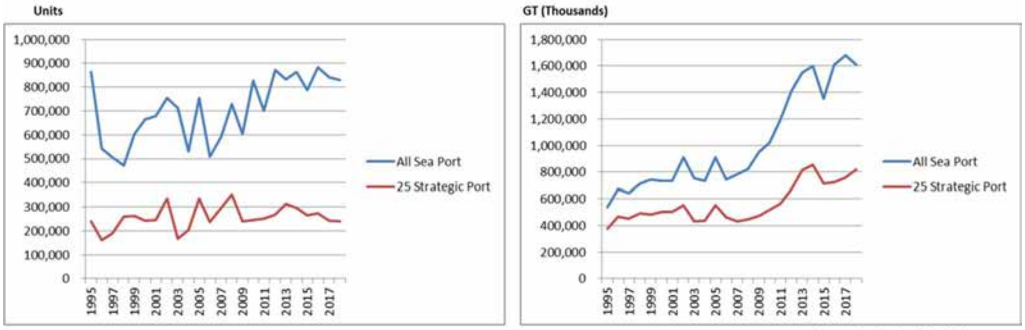
Under such circumstances, it is important to look at the risk management for navigation safety of maritime traffic in order to facilitate maritime administration smoothly.

2.2.3 Number of Ships Call and Total Gross Tonnage

In looking at the movement of marine transportation, it is necessary to see the movement of ships call at the ports.

The following graphs show the statistics on the total number and the total Gross-Tonnage of ships call at the 25 strategic ports and all other ports in Indonesia.

Graph 2.2.3 -1 : Number of Ships Call at Port Indonesia, 1995-2018



Source : Badan Pusat Statistik (BPS - Statistics Indonesia)

Number of Ships Call remains unchanged or is on the decline (especially, large ports like a strategic port). However, the total gross tonnage of ships call is increasing.

This means that the ship is getting larger.

In order to see the situation of Ships-Call at a port by region, the statistics on the number and the volume of ships call by 25 Strategic Ports in 2018 are shown in the Table and Figure next page.

Lhokseumawe	Belawan	Teluk Bayur	Dumai	Pekanbaru	Palembang	Panjang	Tanjung Pinang	Batam	Tanjung Priok
397	3,780	1,781	4,980	25,808	4,142	4,990	20,962	71,629	15,284
Tanjung Emas	Tanjung Perak	Banten	Benoa	Tenau	Pontianak	Banjarmasin	Balikpapan	Samarinda	Bitung
3,917	12,627	9,501	2,428	1,967	2,199	20,957	5,377	13,871	2,888
Makassar	Ambon	Sorong	Jayapura	Biak					
5,088	3,323	1,259	486	684					

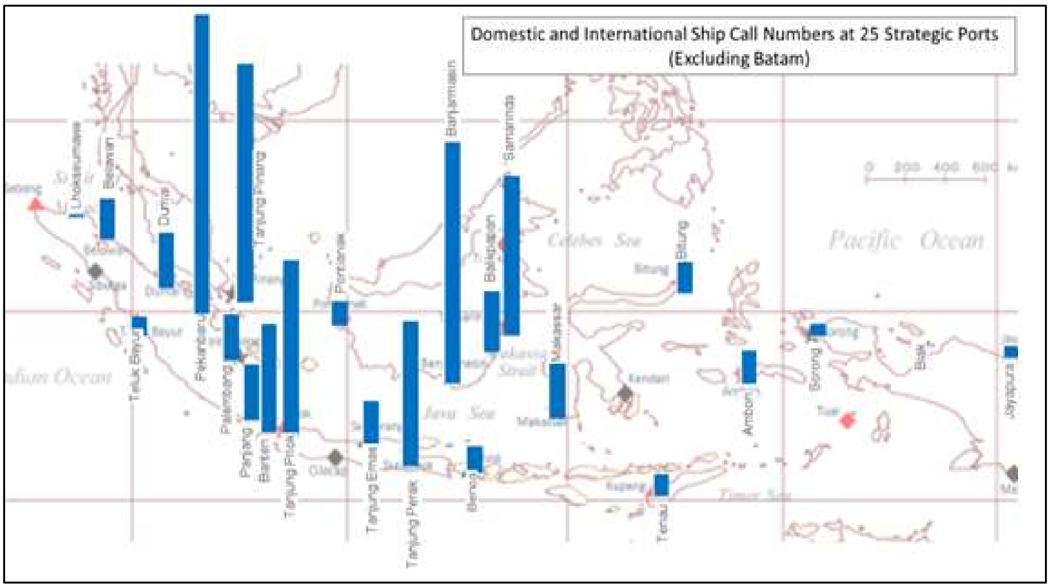


Figure 2.2.3 -1 : The number of Ships-Call at the 25 strategic ports, 2018

Lhokseumawe	Belawan	Teluk Bayur	Dumai	Pekanbaru	Palembang	Panjang	Tanjung Pinang	Batam	Tanjung Priok
3,492	28,488	12,434	39,346	15,610	8,019	36,683	3,694	31,318	160,558
Tanjung Emas	Tanjung Perak	Banten	Benoa	Tenau	Pontianak	Banjarmasin	Balikpapan	Samarinda	Bitung
28,953	103,503	61,493	6,021	3,243	5,761	89,804	42,060	66,750	10,642
Makassar	Ambon	Sorong	Jayapura	Biak					
34,232	17,124	5,464	4,432	2,743					

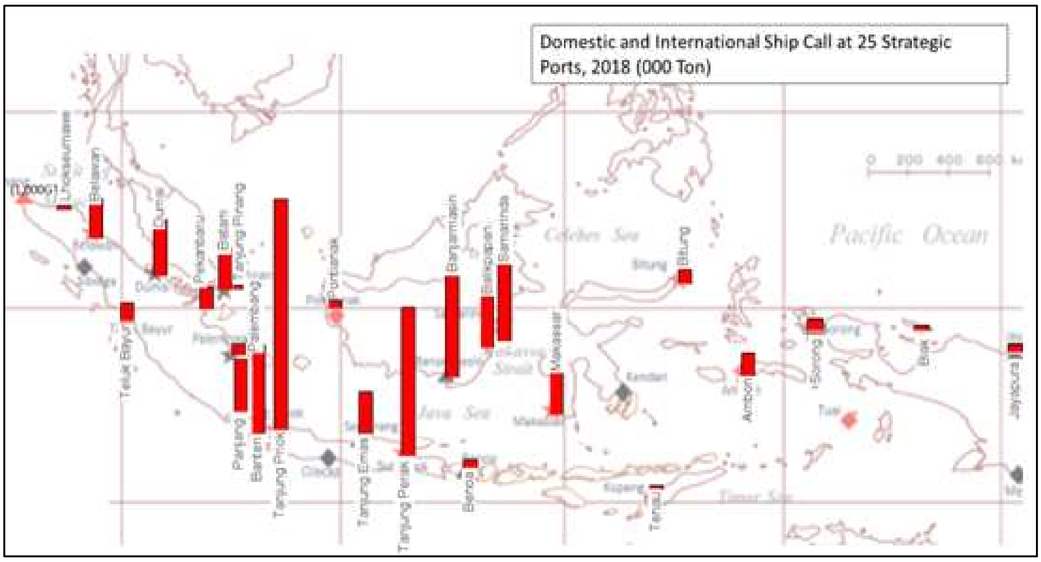


Figure 2.2.3 -2 : The volume of Ships-Call at the 25 strategic ports, 2018

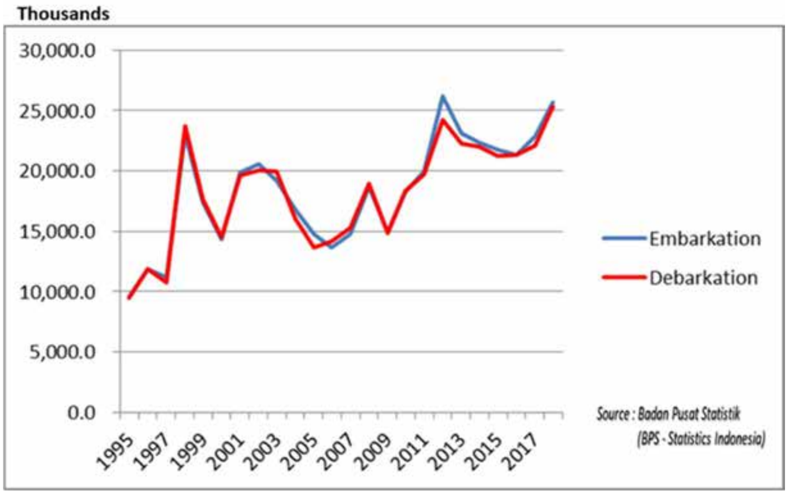
According to the statistics, the number of Ships-Call at Batam is overwhelmingly large, which includes the number of speedboats (a ferry boat) between Batam (Riau Islands) and Singapore. Therefore, Batam was excluded from the Figure.

From these figures, it can be seen that the movement of vessels is concentrated in the eastern part of Sumatra and the eastern part of Kalimantan, centering on Java Island.

Next, the number of Ships-Passengers at sea ports in Indonesia is shown in the Graph below.

Graph 2.2.3 -2 : Number of Ships Passenger

(at Commercial and Non-Commercial Sea Port, 1995-2018)



Source : Badan Pusat Statistik (BPS - Statistics Indonesia)

The graph shows that there is not very much in the number of passengers recently, even though a passenger-ship is being enlarged and ports are being improved and developed.

This is probably due to the diversification of transportation means, such as by air, by land and by sea. With the development of air and land transportation, ships passengers may remain at the same level, but the function of mass transportation by the only ship will remain unchanged.

Then, the statistics of passengers at 25 strategic ports are shown in the Figure below.

Lhokseumawe	Belawan	Teluk Bayur	Dumai	Pekanbaru	Palembang	Panjang	Tanjung Pinang	Batam	Tanjung Priok
0	164.033	0	463.328	171.883	67.175	0	2.163.196	10.192.319	236.027
Tanjung Emas	Tanjung Perak	Banten	Benoa	Tenau	Pontianak	Banjarmasin	Balikpapan	Samarinda	Bitung
376.714	615.639	9.501	661.124	333.779	73.744	70.966	432.570	123.905	104.053
Makassar	Ambon	Sorong	Jayapura	Biak					
599.777	657.560	299.849	230.419	90.680					

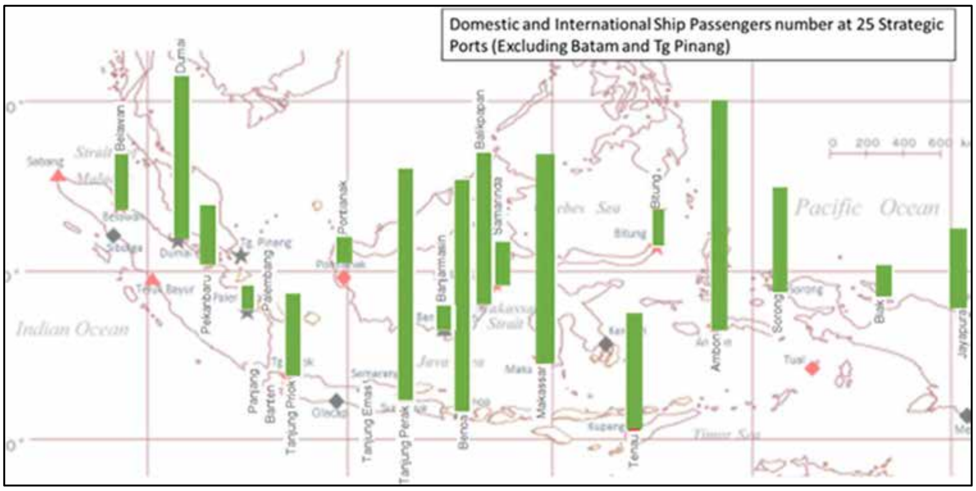


Figure 2.2.3 -3 : The number of passengers at the 25 strategic ports, 2018

When the area of Indonesia is divided into east and west as below, the results of comparison of Population, Cargo Volume, Ships-Call and Passengers are shown in the Table below.

* West Area : Sumatra, Jawa (Excluding Surabaya), Kalimantan

* East Area : East part in Indonesia excluding the above area

Table 2.2.3 -1 : Comparison of West and East

	West	East	Remarks
Population	84%	16%	Total 255mil (2015)
Cargo volume	80%	20%	
Ship calls	88%	12%	Excluding Batam
Passenger	27%	73%	Excluding Batam & Tg Pinang

From the Table above, the movement of cargos and ships are deservedly proportional to the population, but the movement of passengers is clearly large in the eastern area.

The reason for this is considered to be the well development of the maritime transportation network in the eastern region and to be the fact that the eastern area consists of a lot of islands.

As the eastern region is developing, inter-island maritime transportation is expected to expand further more.

The number of ships-passengers at the five main ports is shown in the Figure at the next page.

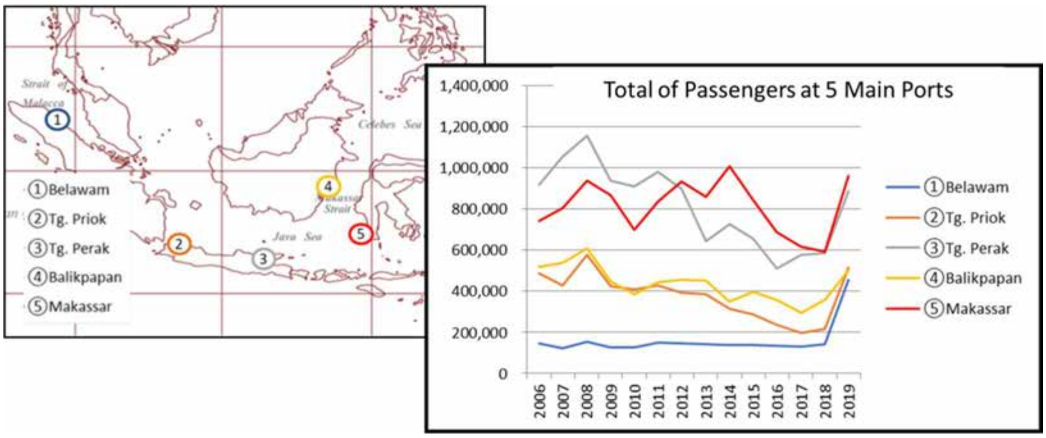


Figure 2.2.3 -4 : Total of Em/De-barkation Passenger of Domestic Voyage at 5 Main Ports, 2006-2019 (Persons)

The port with the most passengers is Makassar, followed by Tanjung Perak / Surabaya.

The figure below shows the monthly numbers of passengers at the 5 main ports in the past 10 years.

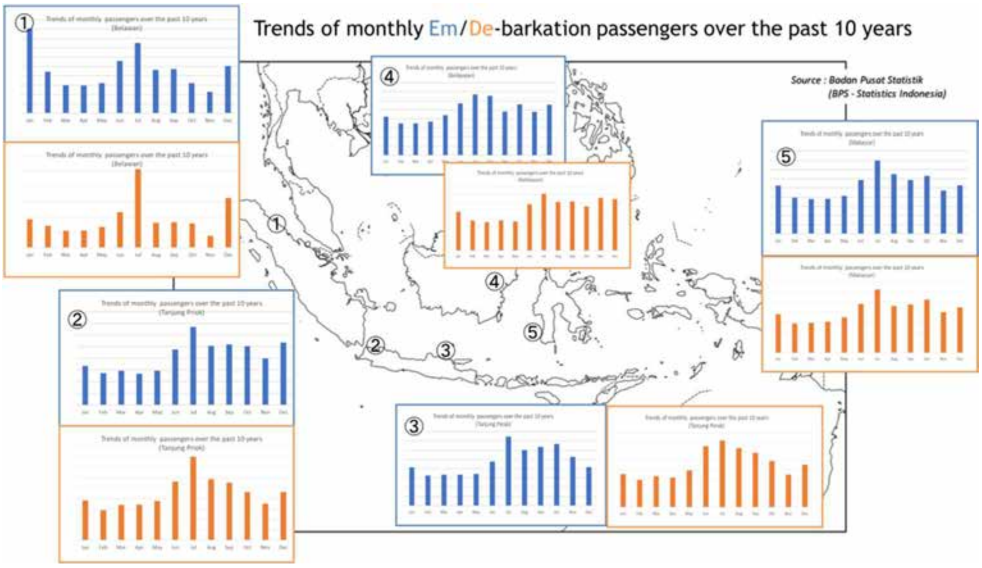


Figure 2.2.3 -5 : Monthly Numbers of Passengers over the Past 10 Years

The number of embarkation and debarkation passengers has been at a peak in almost July at each port.

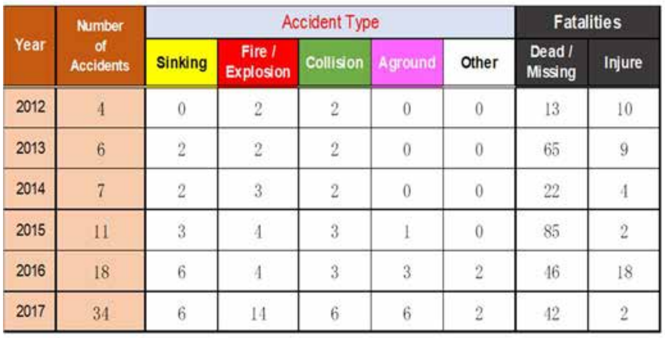
As the development of ports is strategically promoted and the number of passenger ships in service between islands increases, the number of lives that move over the sea will increase accordingly. In response to this, the risk of maritime safety will increase.

In considering risk management for maritime traffic safety, special consideration should be given to the ports with large vessels, especially large passenger ships, entering and leaving compared to other ports, because the marine accident of a large vessel have taken a heavy toll of lives and caused environmental destruction in the past.

2.3 Marine Accident

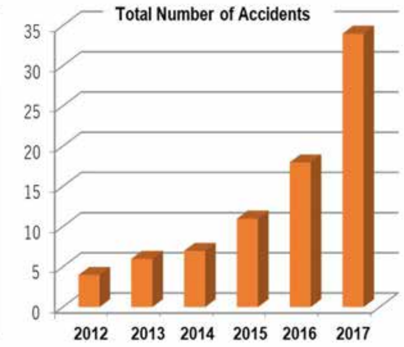
The statistics of Marine Accident in Indonesia from 2012 - 2017, which is issued by National Transportation Safety Committee (KNKT : Komite Nasional Keselamatan Transportasi), are shown in the Table below.

Table 2.3 -1 : Marine Accident in Indonesia



Year	Number of Accidents	Accident Type					Fatalities	
		Sinking	Fire / Explosion	Collision	Aground	Other	Dead / Missing	Injure
2012	4	0	2	2	0	0	13	10
2013	6	2	2	2	0	0	65	9
2014	7	2	3	2	0	0	22	4
2015	11	3	4	3	1	0	85	2
2016	18	6	4	3	3	2	46	18
2017	34	6	14	6	6	2	42	2

Data on Shipping Transportation Accidents
Investigated by KNKT (2012 - 2017)



Source : KOMITE NASIONAL KESELAMATAN TRANSPORTASI
NATIONAL TRANSPORTATION SAFETY COMMITTEE

Obviously, as the statistics shows, the marine accidents in Indonesia are increasing year by year. It may be considered that marine accidents will inevitably increase as maritime traffic becomes more active and traffic volume increases with the development of maritime infrastructure, but it is not impossible to eliminate marine accidents as much as possible if safety measures are adequately taken.

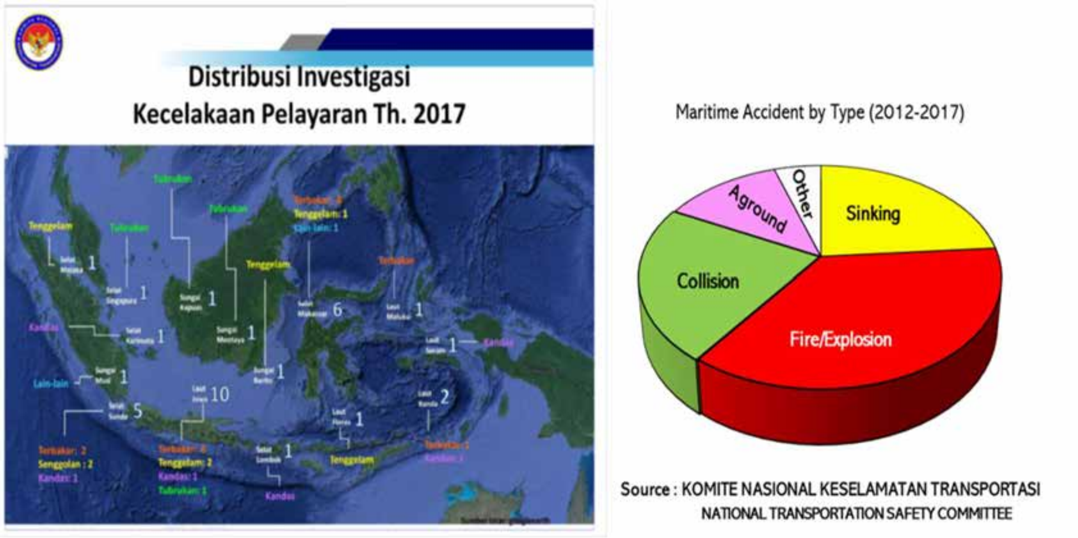
As a peculiarity that can be seen from the table is the increase in the number of landing/aground in recent years. It may indicate that the number of vessels unfamiliar with the sea area, coming from other regions, is increasing. In other words, it can be said that the marine transportation exchange becomes widespread.

And, it seems that the number of Dead/Missing related to human life is quite large for the number of accidents. This indicates that a large number of passengers or crew members are likely to have encountered a marine accident. That means the accident is a large-scale.

Among the types of accidents, the fires were constantly occurring. There seems to be a problem with maintenance. Though National Transportation Safety Committee (KNKT) issued a lot of recommendations to ship's owners and ship operators after the accidents, prior inspection before sailing is very important to prevent accidents. It is a PSC, the thorough implementation of Port State Control.

(In the statistic report, the causes are described as a fire from a generator brought in, and from the cargo, etc.)

The distribution map of the marine accidents in 2017 and the percentage graph of the accidents by types for 2012 - 2017 are shown in the Figure below.



Source : KOMITE NASIONAL KESELAMATAN TRANSPORTASI
NATIONAL TRANSPORTATION SAFETY COMMITTEE

Figure 2.3 -1: Distribution Map and Percentage Map of Marine Accidents

The Sinking and the Flooding accidents are thought to be mainly due to the effects of weather and sea conditions. The collection of weather information is the first issue for vessels, and a system that can provide real-time meteorological information such as wind direction and speed at a local site must be constructed nationwide. Unfortunately, there is no such an information system for vessels in Indonesia presently.

In promoting tourism policy, it is necessary to take into account the frequent occurrence of marine accidents involving small boats and pleasure boats, such as out of fuel, poor maintenance, poor maneuvering, over capacity, over loading, no-light operation at night and so on. Management and administration of these ships are required and demanded for the maritime traffic safety. As one of the management measures, AIS Class-B and a smartphone will be effective communication tool for exchanging information with such small ships.

2.4 Sea-Lanes and TSS

Archipelagic Sea-Lanes (Sea-Lane 1, Sea-Lane 2 and Sea-Lane 3) of Indonesia were adopted on 19 May, 1998 at the Maritime Safety Committee (MSC), International Maritime Organization (IMO), as a RESOLUTION MSC.72(69).

The layout of Sea-Lane in Indonesia is shown in the Figure next page.

Figure 2.4 -1 : Sea-Lane Map

Recently, the 101st Session of MSC, IMO in London, which runs from 5 to 14 June 2019, officially adopted the Indonesian proposal regarding a traffic separation scheme (TSS) in the Sunda Strait and the Lombok Strait to take effect in June 2020.

The layouts of a TSS map are shown in the Figure below.

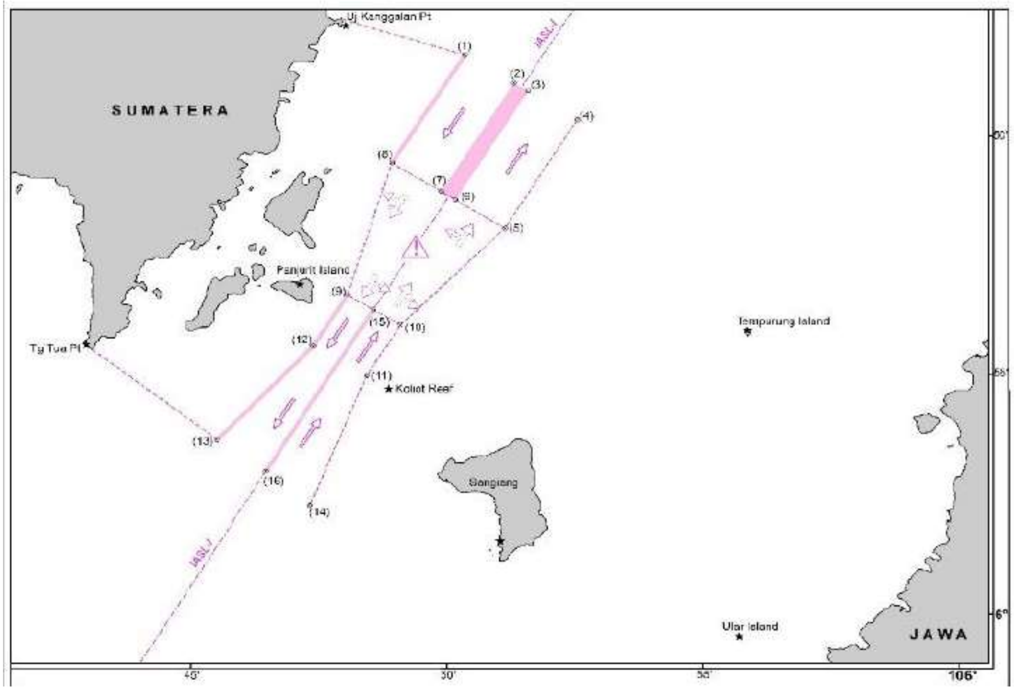


Figure 2.4 -2 : TSS Sunda Strait

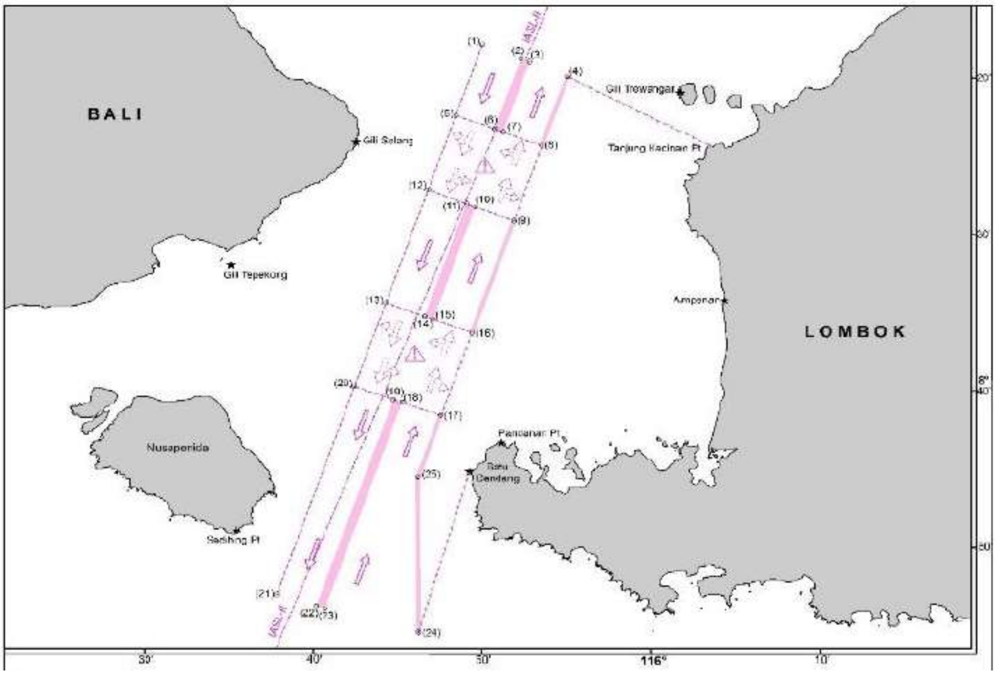


Figure 2.4 -3 : TSS Lombok Strait

Sea-Lane and TSS are a maritime traffic-management route-system ruled by the International Maritime Organization.

The Sea-Lane is a passage for vessels to navigate, and safety of the vessels is ensured by installing aids to navigation.

The TSS indicate the general direction of the vessels navigating within a TSS and they all navigate in the same direction or they cross the lane in an angle as close to 90 degrees as possible.

These systems adopted internationally for maritime safety need to be operated under an advanced control and management, such as a VTS (Vessel Traffic Service) System, in order to meet their obligations.

2.5 Maritime Traffic Flow

The marine traffic density map of AIS vessels around Indonesia in 2017 provided by Marine Traffic Com. is shown in the Figure below.

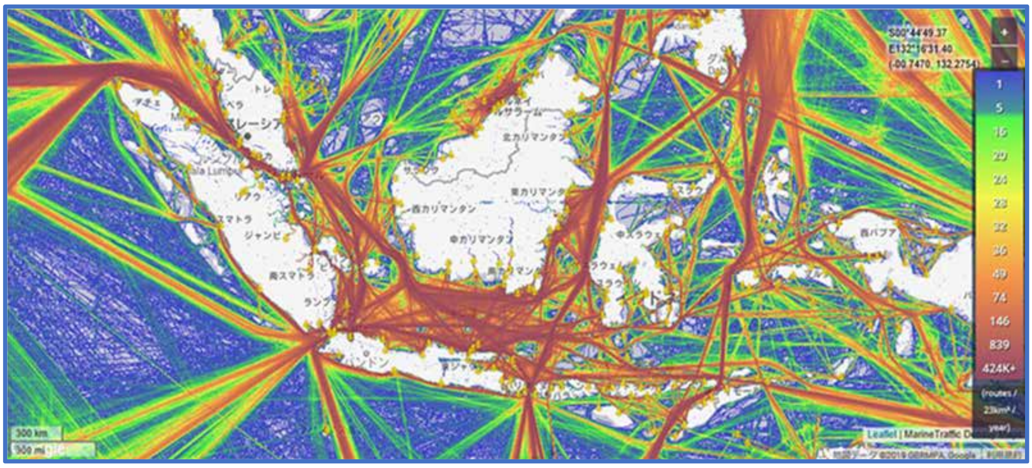


Figure 2.5 -1 : Density Map of AIS Vessels

This map shows the traffic volume of AIS-equipped vessels that sailing around Indonesia, and the darker the red of the line on the map, the greater the traffic volume.

This is accumulated data of AIS tracks for one year, and will be a great reference for understanding the navigational area and the traffic volume of vessels from a regional perspective.

2.6 INAPORTNET

There is an electronic processing system that facilitates the port-related procedures (the exchange of data and information of port service) for vessels, which have been introduced as a system of VMS (Vessel Management System) into many countries.

One of them is INAPORTNET, which is operated by DGST.

Likewise, VTS (Vessel Traffic Service) is one of the systems that support the navigation safety of vessels by collecting their movement at sea with terrestrial radar and AIS.

Both of them, VMS and VTS, have a lot something in common in collecting the movement information of vessels. And, if their systems share information with each other, the function to support the navigation safety of vessels will be strengthened. It is necessary to pay attention to INAPORTNET which is one of the VMS.

In 2002, Indonesia ratified the Convention on Facilitation of International Maritime Traffic (FAL Convention), and is working on standardization and speeding up of procedures for entry and departure of vessels.

This INAPORTNET system started from the port of Tanjung Priok and Makassar in 2016, with DGST as the operating body, and has been implemented at 16 ports as of October 2017, which is shown in the Figure next page.

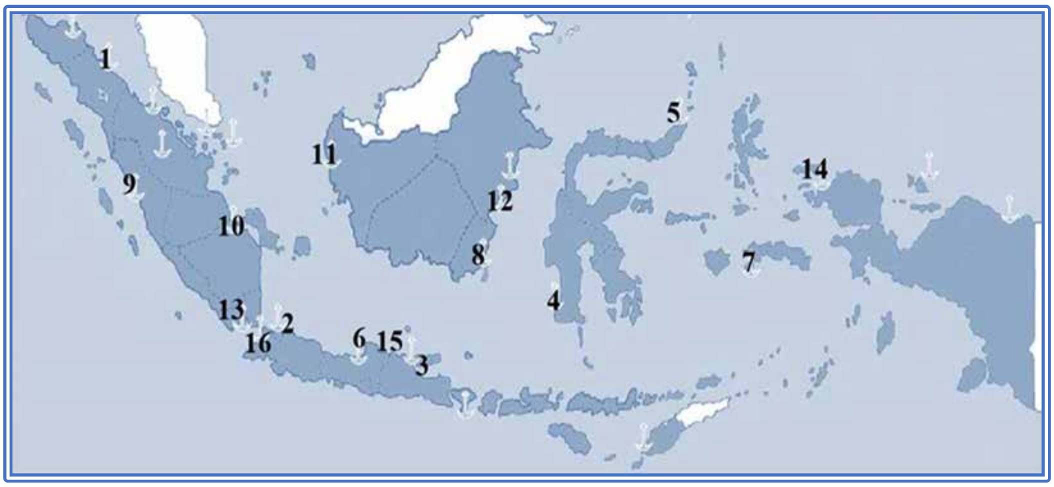


Figure 2.6 -1 : The Map of INAPORTNET in Operation

The introduction part is attached as an Appendix 2.6 -1 (INAPORTNET).

2.7 Demand Forecasting

For a nation surrounded by seas, the development of a nation depends on the development of maritime transportation, which allows for the movement of large quantities of goods. In other words, as the country develops, so does maritime transportation, and vice versa, as the maritime transportation develops, so does the country.

The development of maritime transportation means an increase in the volume of maritime traffic, which also means an increase in the risk of maritime accidents.

In order to prevent maritime accidents caused by vessels that carry large amounts of goods and human lives, it is essential to take sufficient safety measures for maritime traffic.

Vessels cannot navigate on the sea alone without a safety navigation sign. If there is no sign, it would endanger vessels that carry large amounts of goods and human lives.

Therefore, in considering future maritime traffic safety measures it is important to know the state of development of the relevant sectors, especially maritime affaires as a demand forecasting, as well as the development trend of the country, and they can be found in the Socioeconomic Framework shown in Section 2.2.

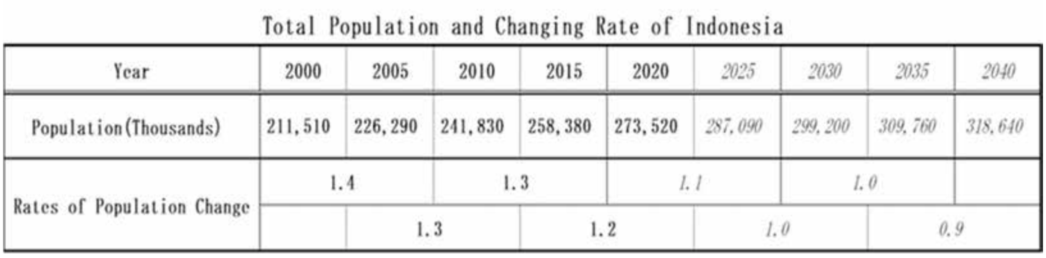
2.7.1 State of Population Trends and National Development

Indonesia's population has been growing at a rate of 1.4 % to 1.2 % per year for the past decade, although the annual growth rate has been declining. Predicting the population up to 2040 from the statistics, the growth rate is expected to change in the range of +1.1% to +0.9%. By 2030, the population will be about 300 million, and it will be about 320 million people which will be about 1.2 times greater than the current population.

The population pyramid is also changing from a Stationary Pyramid to a Constrictive Pyramid (Pot Type) that is similar to that of developed countries, and in response to the changes in population, the country is expected to continue to develop steadily.

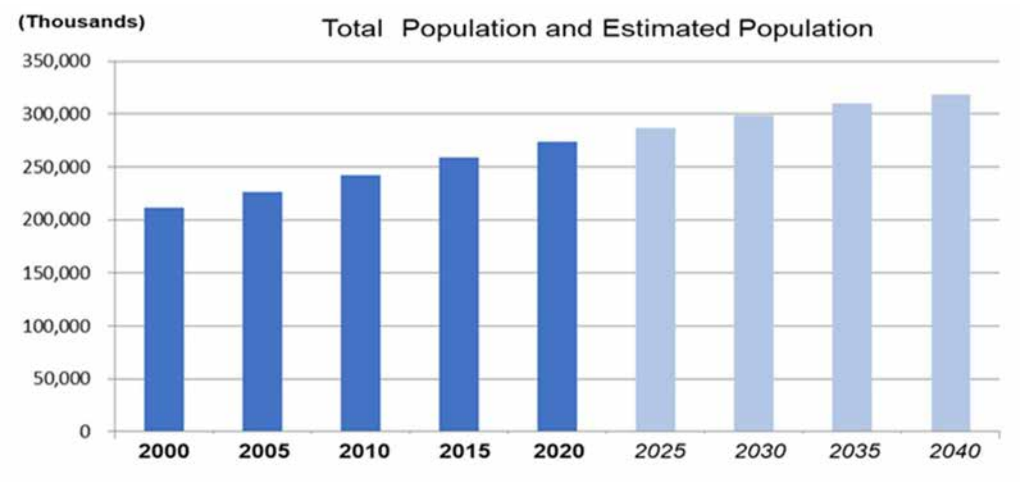
The population trends up to 2040 and the population composition (Pyramid) in 2040 is shown in the Figure below.

Table 2.7.1 -1: Change in Population and Changing Rate



Total Population and Changing Rate of Indonesia

Year	2000	2005	2010	2015	2020	*2025*	*2030*	*2035*	*2040*
Population(Thousands)	211,510	226,290	241,830	258,380	273,520	*287,090*	*299,200*	*309,760*	*318,640*
Rates of Population Change	1.4		1.3		*1.1*		*1.0*		
		1.3		1.2		*1.0*		*0.9*	



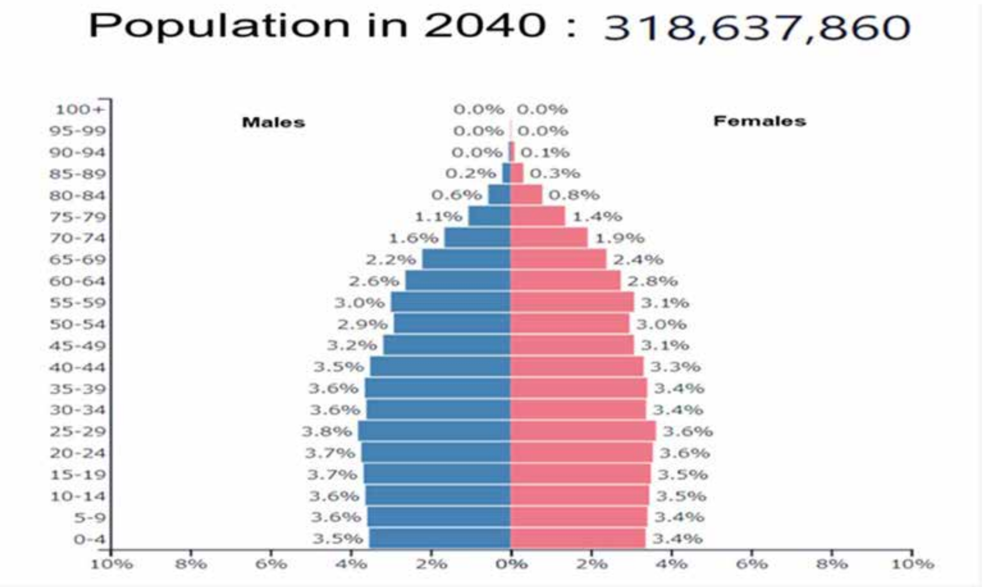


Figure 2.7.1 -1: Population Pyramid in 2040

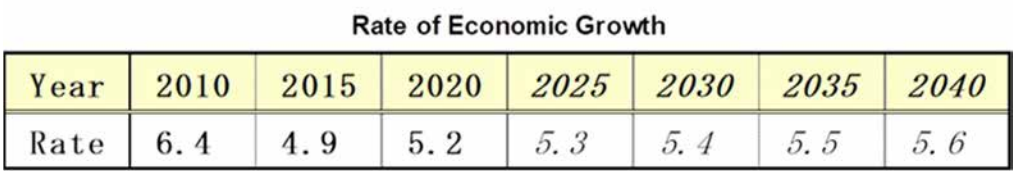
Sources : Populationpyranid.net,United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects

2.7.2 Economic Trends

Looking at the growth rate of GDP, which is an indicator of economic development, it has been growing steadily in the mid-5% range for the past 20 years.

Assuming that there are no major social changes such as the Lehman shock in 2009, as sown in the Table and the Figure below, the low and upper limits of the transition rate are not sharp until 2040, and the growth rate is expected to be in the middle of 5%.

Table 2.7.2 -1: Economic Growth Forecast



Rate of Economic Growth

Year	2010	2015	2020	2025	2030	2035	2040
Rate	6. 4	4. 9	5. 2	5. 3	5. 4	5. 5	5. 6

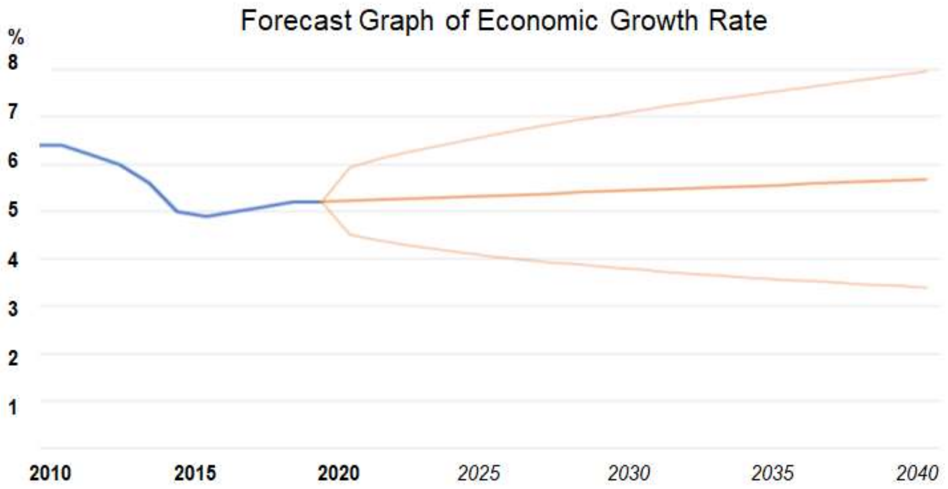
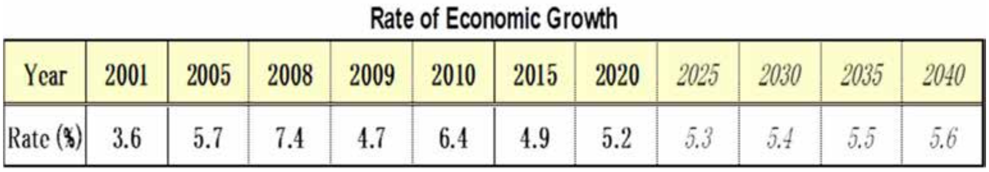


Figure 2.7.2 -1 : Forecast Graph of Growth Rate

It seems that the impact of COVID-19 on the economy will inevitably affect the future growth rate, and it is predicted that it will follow the same course as after the past Lehman's fall.

As shown in the Table and the Figure net page, the lower and upper limits of the transition will be greater than the situation without the corona chaos, but it is expected that the growth rate will remain at the mid-5% until 2040.

Table 2.7.2 -2: Economic Growth Forecast with Corona Shock



Rate of Economic Growth

Year	2001	2005	2008	2009	2010	2015	2020	2025	2030	2035	2040
Rate (%)	3.6	5.7	7.4	4.7	6.4	4.9	5.2	5.3	5.4	5.5	5.6

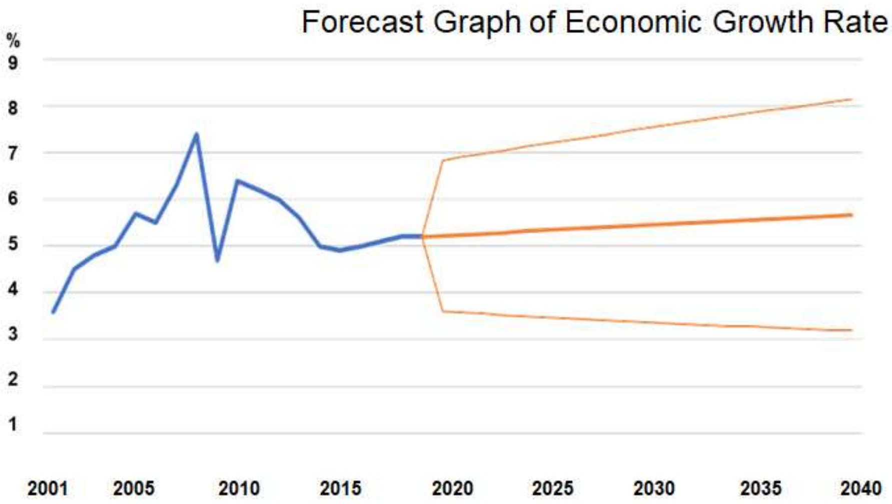
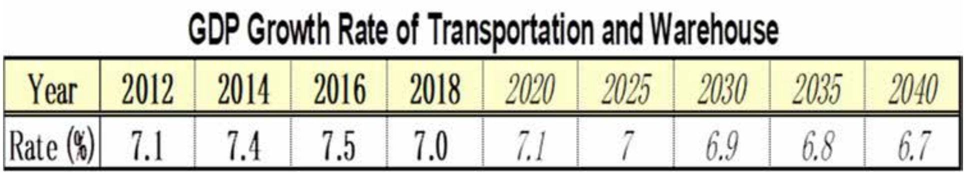


Figure 2.7.2 -2 : Forecast Graph of Growth Rate with Corona Shock

With regard to the total growth of the nation, even if a major social change occurs, the national power of Indonesia today suggests the steady and stable development until 2040. It seems that the development in the field of maritime transportation, which supports the nation’s growth, will follow the same way as the prosperity of the nation.

The growth rate of GDP for the Transportation and Warehouse Industry until 2040 is shown in the Table below.

Table 2.7.2 -3: Economic Growth Rate Forecast



GDP Growth Rate of Transportation and Warehouse

Year	2012	2014	2016	2018	2020	2025	2030	2035	2040
Rate (%)	7.1	7.4	7.5	7.0	7.1	7	6.9	6.8	6.7

Data Source : Indonesia Central Bank Statistics

The future growth rate in the Transportation and Warehouse will depend on the status of the port development, but it may be flat level or slightly decline for the port infrastructure that has been developed at a considerable rate to date. The growth of this sector will be in line with the development of the country. Indonesia has adopted a growth strategy policy, as seen in the national strategy of “Five Pillars as a Maritime Nation”, and it is easy to assume that the maritime sector will continue to grow.

2.7.3 Movement of Marine Transportation Cargo

Although the volume of marine transportation cargo is increasing every year, the volume of International cargo is leveling off against the increase in the volume of Inter-Island cargo in recent years. With these trends, the forecast for the volume of marine transportation cargo by 2040 is shown in the Figure below.

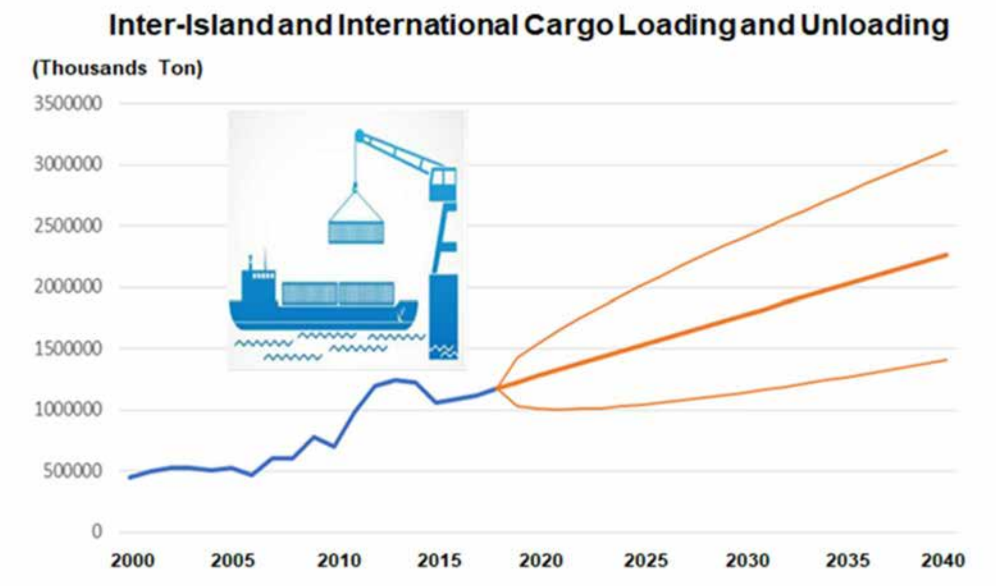


Figure 2.7.3 -1 : Forecast Graph of Marine Transportation Cargo

The trend of Inter-Island and International Cargo is separately shown in the Figure below.

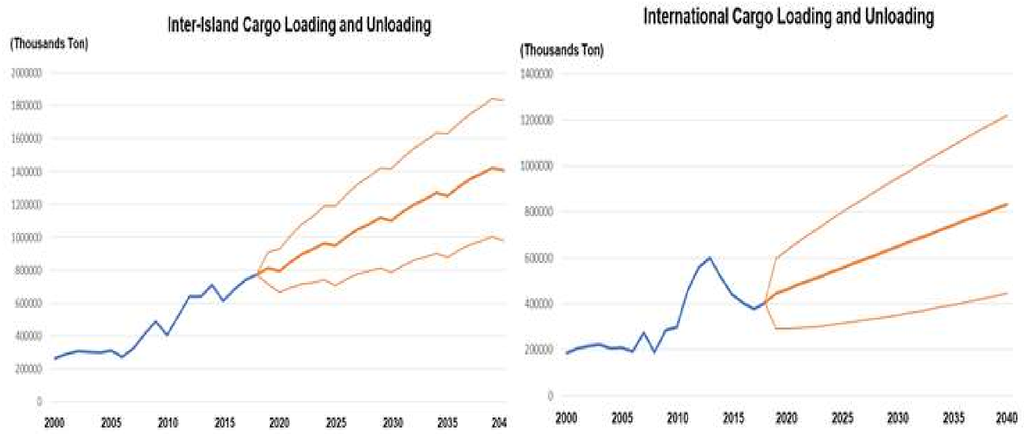


Figure 2.7.3 -2 : Forecast Graph of Inter-Island and International Cargo

And, the change ratio of Inter-Island and International Cargo is separately shown in the Figure next page.

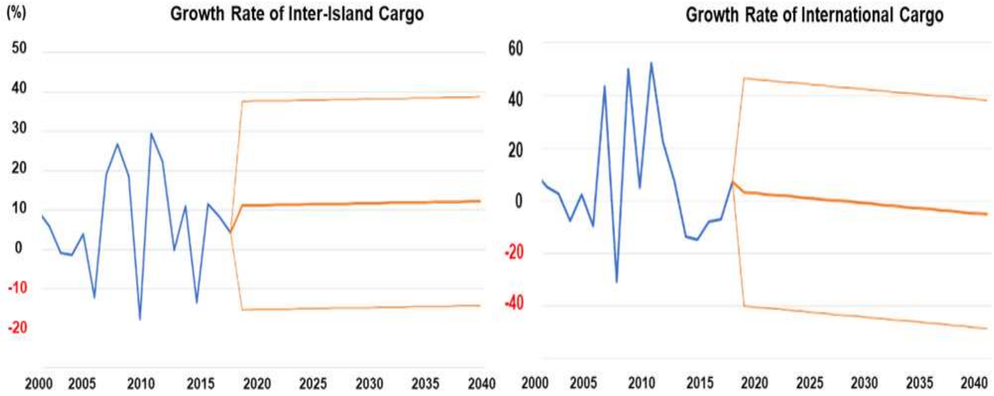


Figure 2.7.3 -3 : Forecast Graph of Change Ratio

The constant growth in the Inter-Island Cargo is due to the continuous implementation and expansion of local ports, and this trend will continue if strategic policies are promoted. Although the volume of International cargo is on the rise, it is expected that the growth rate will increase depending on the development and expansion of large ports including loading and unloading yard, but it is expected to remain almost flat for a while rather than the large growth rate of Inland-Island Cargo.

The changes in volume of domestic cargo for the five major Indonesian ports by 2040 are shown in the Figure below.

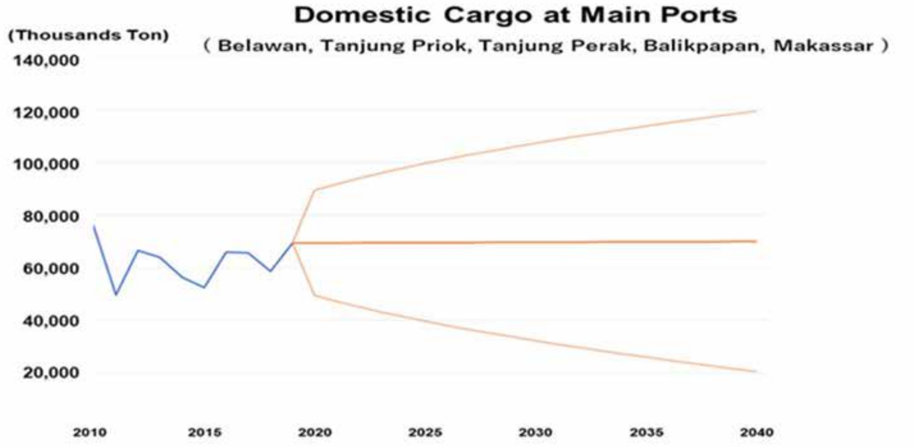


Figure 2.7.3 -4 : Forecast Graph of Cargo at Main Ports

The volume of the cargo at the five major ports has been almost constant in recent years, and it is considered that the volume is commensurate with the scale of the port. It is predicted that this trend will be maintained unless new development and expansion of these ports is carried out. *Sources : Badan Pusat Statistik (BPS - Statistics Indonesia)*

2.7.4 Trends in the Number of Ships Call and Gross Tonnage

Although the total number of Ships Call throughout Indonesia was increasing year by year, that of important strategic ports is flat. However, the total gross tonnages for all ports in Indonesia are steadily increasing. The development of the ports has been promoted nationwide, and as the number of a port increases, the number of Ships Call and the total Gross Tonnage is also increasing.

Regarding the total number of Ships Call at important strategic ports, it can be considered that the development of the ports has completed and the Ships Call has already been filled to capacity.

The changes in the number of Ships Call and the Gross Tonnage up to 2040 is shown in the Figure below, using a statistical exponentiation approximation based on the statistics of Ships Call for the past 10 years.

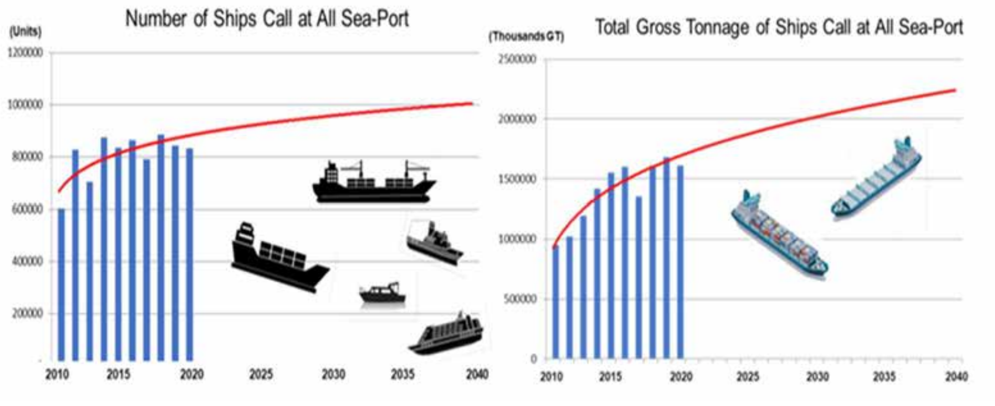


Figure 2.7.4 -1 : Number and Gross Tonnage of Ships Call (Nationwide)

Since the number of ships and the number of ports will not increase forever, it seems that the total number of Ships Call tends to converge toward a certain point (maximum number) as shown in the graph. The changes in the total number and gross tonnage of Ships Call at 25 strategic ports are shown in the Figure below.

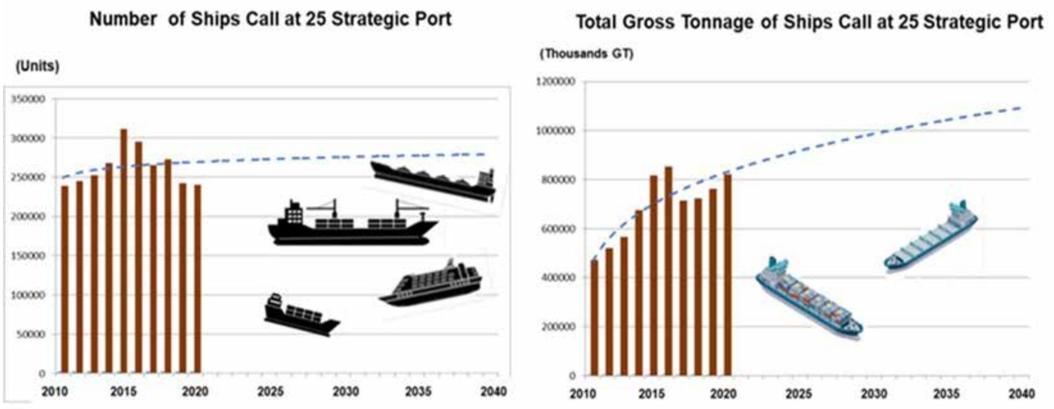


Figure 2.7.4 -2 : Number and Gross Tonnage of Ships Call (Strategic Port)

At the 25 strategic ports, the total gross tonnage of Ships Call is expected to increase, while the total number of Ships Call remains almost unchanged.

Sources : Badan Pusat Statistik (BPS - Statistics Indonesia)

2.7.5 Ships Passenger

It is clear that the policies, such as the promotion of port development, the designation of traffic routes, and the commissioning of new ferry boats and ro-ro cargo ships will increase maritime traffic flow. However, as a recent trend, the size of vessels become larger, the number of vessels itself may not increase rapidly enough to match the growth in maritime transportation.

As shown in the statistics, there is no doubt that the number of ships passenger will increase along with the development of maritime transportation as long as the nation is an island country

The number of Ships Passenger up to 2040 is shown in the Figure below.

Figure 2.7.5 -1 : Number of Ships Passenger

Since there is no means of maritime transportation other than ships among small islands, the numbers of ships passenger will continue to increase as the ferry terminals are developed.

Especially in the eastern region, the construction of ports and ferry terminals is planned in line with the policy of reducing the east-west disparities, and it is expected that the marine cargos and ships passenger will continue to increase.

2.7.6 Others

As matters to be noted, marine accidents on small crafts to promote tourism, ships routing in association with development of a port, and human resources engaged in navigation safety system should be looked ahead to consider the maritime safety measures in this project.

1) Tourism and Marine Accidents on Pleasure-Boats

It is inevitable that the marine accidents will become higher in probability with the increase in maritime traffic flow.

For large vessels, safety measures have been taken by themselves in recent years due to the development of navigational instruments, but for small boats are not sufficient in some respects, such as radio-communication, general tools, and registration.

Due to the promotion of tourism policies, it is expected that the number of small boats in tourist areas will be increase.

In Labuan Bajo, where the policy has already taken effect, there are reports that 90% of the small boats in service are unregistered.

The following is a reference newspaper article.

More than 3,600 ships operating illegally in Labuan Bajo, authorities reveal

News Desk
The Jakarta Post

≪Partial copy of the article≫

Of 4,081 ships inspected between February and July, only about 400 ships carried proper documentation and were registered to the local administration. The inspection was carried out by officials from the West Manggarai administration and Komodo National Park in Labuan Bajo.

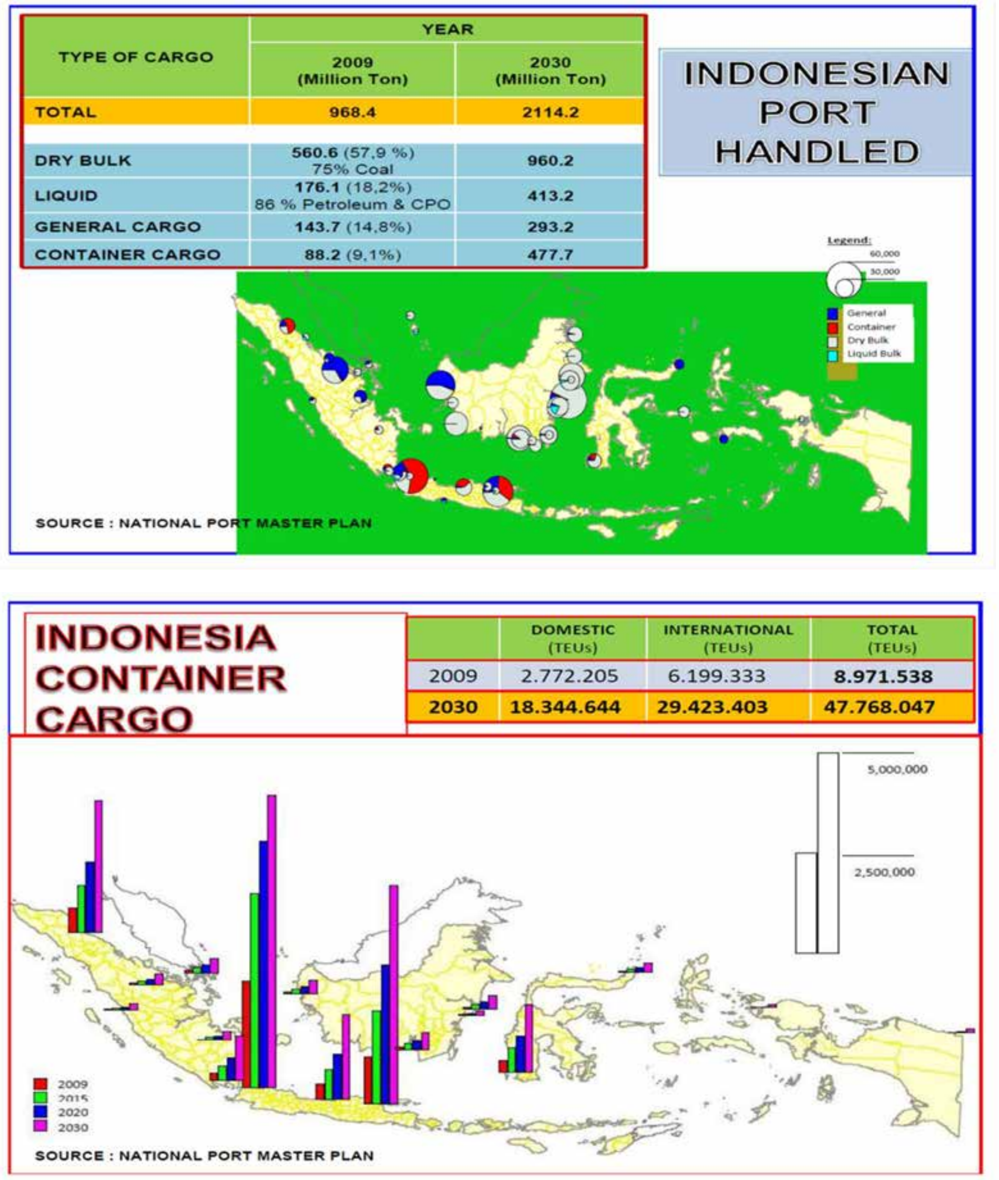
Source : Internet News

The management of these vessels is also a main issue for maritime safety measures.

2) Development of Port and Ships Routing

As mentioned in section 2.1, many local ports are being promoted under the designation of the national government in a national policy, including the development of 24 strategic ports. At the same time, the establishment of traffic routes and the installation of aids to navigation suitable for each port as a maritime traffic safety measures (Ships Routing) must be considered in consultation with the parties concerned.

According to the forecast of cargo handling volume at the 24 strategic ports from 2009 to 2030 described in the National Ports Master Plan (NPMP) shown on the next page, the total cargo volume will increase by about 2.1 times, while container cargo is expected to grow by about 5.4 times. This is likely to reflect the development of container piers and container yards.



INDONESIAN PORT HANDLED

TYPE OF CARGO	YEAR	
	2009 (Million Ton)	2030 (Million Ton)
TOTAL	968.4	2114.2
DRY BULK	560.6 (57,9 %) 75% Coal	960.2
LIQUID	176.1 (18,2%) 86 % Petroleum & CPO	413.2
GENERAL CARGO	143.7 (14,8%)	293.2
CONTAINER CARGO	88.2 (9,1%)	477.7

SOURCE : NATIONAL PORT MASTER PLAN

INDONESIA CONTAINER CARGO

	DOMESTIC (TEUs)	INTERNATIONAL (TEUs)	TOTAL (TEUs)
2009	2.772.205	6.199.333	8.971.538
2030	18.344.644	29.423.403	47.768.047

SOURCE : NATIONAL PORT MASTER PLAN

Figure 2.7.6 -1 : Cargo Volume at the Strategic Ports

It is natural that the number of containerships is expected to increase in this way, but as a trend in recent years, it is possible to predict that a container ship will become huge.
Regarding the setting of the ships routing for newly constructed ports and expanded ports, the adequate traffic width is secured for the type of new vessels such as a huge containership and aids to navigation indicating safe water areas clearly for a turning movement are required, which are considered on a case-by-case basis according to the characteristics of each port.

In addition, there is always the risk of marine accidents due to the movement of other vessels and the weather and sea conditions in ports with inadequate aids to navigation and in traffic routes with limited navigable width such as in river-port.

In these water areas, maritime traffic safety measures including methods of providing information such as traffic conditions and weather information and of enforcing a traffic control will be considered in consultation with related parties in these waters.

For example, there are narrow passages with piers in the Mahakam River of Samarinda Port and long and narrow fairways surrounded with shallow waters at the Port of Tanjung Perak. (See Chapter 4 "Field Survey")

In addition, ports are planned even in places where such traffic routes will be potentially established, and safety traffic measures will be indispensable depending on the ships routing plan.

3) Capacity Building

DGST has several operating departments related to aids to navigation, and such fields requires a professional, such as an educational instructor, a radio operator and engineer including VTS operator, a ship operator and engineer including a marine engineer (shipbuilder), and so on.

Maritime Radio communication, VTS operation, and ship's operation, all require qualifications, and not only acquisition of those qualifications but also training after acquisition is essential.

There are about 20 coastal radio stations, even Class-1 and Class-2 (Total : 151 Stations), 23 VTS Centers, and about 70 vessels related to aids to navigation, and there are hundreds of persons engaged in these services.

There is undoubtedly a desirability of having a permanent educational institution for aids to navigation to develop human resource, and it is necessary to coordinate with other training institutions for training a lot of people of these many specific fields.

Chapter 3

Review of Previous Master Plan and Strategic Plan of DGST

3 Reviews of Previous Master Plan and the Strategic Plan of DGST

3.1 Master Plan up to 2020

The previous MP that described the establishment plans for aids to navigation by year was classified into the following 7 fields.

1) Visual Aids to Navigation
2) Radio Aids to Navigation
3) Supporting Facilities for Aids to Navigation
4) VTS System
5) GMDSS
6) Indonesia Ship Reporting System
7) Telecommunication System

Today's technological situation surrounding aids to navigation and maritime radio has changed significantly from the time of the previous survey, particularly in the field of the radio system. The review is given after consideration to this point.

The changes in the environment surrounding aids to navigation are described in Chapter 6, "Present Issues".

3.1.1 Visual Aids to Navigation

As of March 2019, 284 Lighthouses under the maintenance of DGST are being operated, and 49 ones have been increased from 235 units at the time of the previous MP (2002).

Picture 3.1.1 -1 : Lighthouse

And, 1,877 Light-Beacons (DGST) has been installed now, and 709 beacons have been increased from the previous MP. Furthermore, the number of beacons including non-DGST has increased by 1,115 units (Total : 2,720).

Picture 3.1.1 -2 : Light-Beacon

There are 1,180 Light-Buoys, 553 of which are maintained by DGST and 627 are done by non-DGST.

Picture 3.1.1 -3 : Floating Lighted Buoy

The Table below shows the number of visual aids to navigation at the time of the previous MP and the number of ones as of 2019.

Table 3.1.1 -1 : Number of Visual Aids to Navigation in Indonesia

List of ATON (DGST, non-DGST)

as of March, 2019

DISNAV		Lighthouse	Light-Beacon		Light-Buoy		Unlighted-Beacon		Unlighted-Buoy		DGST	non-DGST	Total
			DGST	non-DGST	DGST	non-DGST	DGST	non-DGST	DGST	non-DGST			
1	Sabang	10	35	1	28	10	0	0	0	0	73	11	84
2	Belawan	5	50	17	42	35	0	0	0	0	97	52	149
3	Sibolga	9	65	1	2	10	3	2	0	0	79	13	92
4	Teluk Bayur	9	71	22	10	2	2	0	0	0	92	24	116
5	Tg. Pinang	25	93	114	44	29	**57**	2	9	0	**228**	145	373
6	Dumai	6	55	61	**52**	40	0	0	0	0	113	101	214
7	Palembang	4	87	1	39	6	0	0	1	0	131	7	138
8	Pontianak	7	51	6	30	7	0	0	1	0	89	13	102
9	Tg. Priok	**29**	91	137	48	73	8	0	0	0	176	210	386
10	Cilacap	8	35	33	5	60	0	0	0	0	48	93	141
11	Semarang	7	52	33	14	16	11	3	3	0	87	52	139
12	Surabaya	22	51	18	29	53	0	11	**11**	0	113	82	195
13	Benoa	16	91	29	33	15	6	3	1	**7**	147	54	201
14	Kupang	21	92	30	13	6	12	2	0	3	138	41	179
15	Banjarmashin	11	97	68	15	75	0	2	4	0	127	145	272
16	Tarakan	3	49	17	10	15	0	0	0	0	62	32	94
17	Samarinda	6	64	**142**	41	**139**	2	1	5	3	118	**285**	**403**
18	Makassar	16	109	16	20	0	0	0	0	0	145	16	161
19	Kendari	6	87	33	12	1	1	**17**	0	0	106	51	157
20	Bitung	24	134	7	25	6	0	11	0	0	183	24	207
21	Ambon	12	**154**	24	6	0	10	11	4	3	186	38	224
22	Sorong	6	93	20	33	29	0	5	1	**7**	133	61	194
23	Jayapura	8	48	1	2	0	4	1	0	0	62	2	64
24	Merauke	3	51	0	0	0	0	0	2	0	56	0	56
25	Tual	11	72	12	0	0	10	0	0	0	93	12	105
Total		**284**	**1,877**	843	**553**	627	**126**	71	**42**	23	**2,882**	1,564	4,446
Number of ATON in 2002		**235**	**1,168**	437	**332**	396	**260**	105	**103**	45	**2,098**	983	3,081

In the previous MP, the development (newly installation) of 18 Lighthouses (Phase 1: 8 units and Phase 2:10 units) was proposed by 2010, and 91 ones by 2020.

Based on the results of the establishment until the end of 2019, 49 out of 91 proposals have been installed, so it can be said that only about 54% of the proposals were implemented.

However, this result cannot necessarily be asserted as not reaching the plan.

This is because, as mentioned above, the environment surrounding maritime traffic at the time of the previous MP and thereafter has changed significantly. Many ships have not needed to use a lighthouse to know the position of their own during normal voyages, since it is now possible to perform positioning automatically by GPS.

The following Figure shows the concept of radio navigation that does not require lighthouses and of the fixing position (Cross-Bearing) that uses lighthouses to obtain the own position of a vessel in an era when there was no radio navigation, such as GPS, Loran and so on.

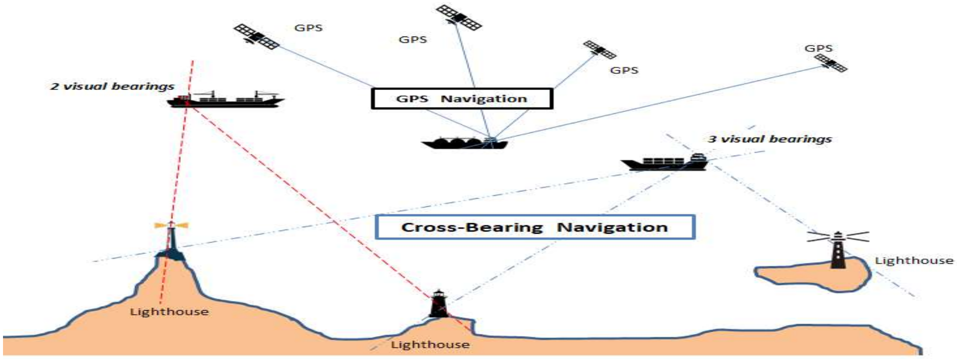


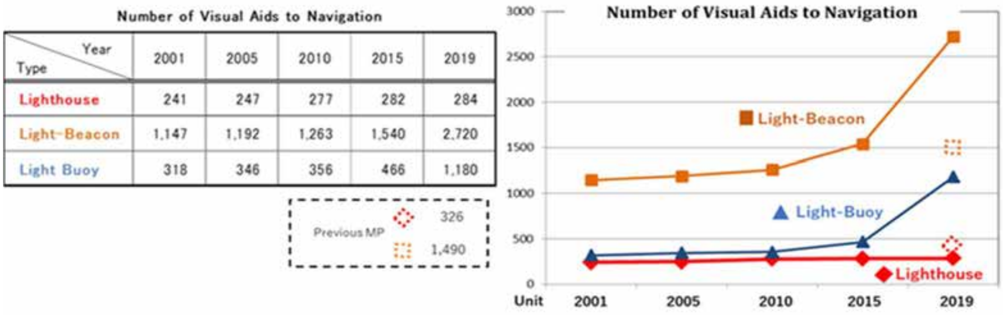
Figure 3.1.1 -1 : Concept of Cross-Bearing Navigation

With the spread of GPS, fixing position can be performed anywhere, so it is not always necessary to have many lighthouses, and the necessary types of aids to navigation will be installed at necessary places. In any case, the visual aids to navigation, which play an important role in the field of aids to navigation even, have to be advanced in concert with the development of the shipping industry with the times.

Even if the environment changes, the necessity of aids to navigation does not change and a visual aid to navigation is indispensable, but the types of aids to navigation required are changing.

This means that the number of lighthouses installed newly is less than the proposed number but the number of light beacons installed was 709 which are more than double proposed 322 units. (Light Beacons are individually examined and installed at required locations in ports and dangerous waters.)

The following Figure shows the yearly establishment status of visual aids to navigation in Indonesia.



Number of Visual Aids to Navigation

Year / Type	2001	2005	2010	2015	2019
Lighthouse	241	247	277	282	284
Light-Beacon	1,147	1,192	1,263	1,540	2,720
Light Buoy	318	346	356	466	1,180

Previous MP	
◇	326
▢	1,490

Figure 3.1.1 -2 : Transition of Visual Aids to Navigation

The Light-Beacon and Lighted-Buoy that indicates the entrance or the passage-way of a port is installed to guide a ship safely, and its type and installation place differ depending on the layout and function of each port. Therefore, the place and the type of these visual aids will be considered and decided for each port and at all such times while listening to the voice of users.

It is natural that the number of visual aids to navigation like a Light-Beacon and a Light-Buy will increase when a new port is constructed or the port is expanded. The increase in the number of Light-Beacons may be a sign that port development is going well.

Some of Light-Beacons can be considered as a Lighthouse in terms of functionality.

The lighthouses established newly after 2002 were checked with the edition 2013 of "INDONESIAN LIST OF LIGHT" to see if they were installed at a place recommended in the previous MP. No relevance to the previous MP was found.

By the way, DGST has prepared the medium-term development plan for aids to navigation in 2015, and has set a target for the number of Lighthouses, Light-Beacons and so on by 2019. Details are given in Section 3.3.

3.1.2 Radio Aids to Navigation

In Indonesia, there are Medium-Frequency Radio Beacon and Radar Beacon which have been operated as a Radio Aids to navigation.

The Radio Beacon has been completely abolished, because a vessel has become free from obligations to install the equipment on board which is able to receive the signal of the Beacon.

Instead, DGPS (Differential Global Positioning System) was planned to transmit GPS correction data with this Radio Beacon, and 15 Radio Beacon stations were proposed to be renovated to DGPS stations in the previous MP.

However, only one station has been upgraded. Since the accuracy of GPS was improved around 2006, the necessity for DGPS was reduced because SA (Selective Availability) was stopped. After that, there was no modification.

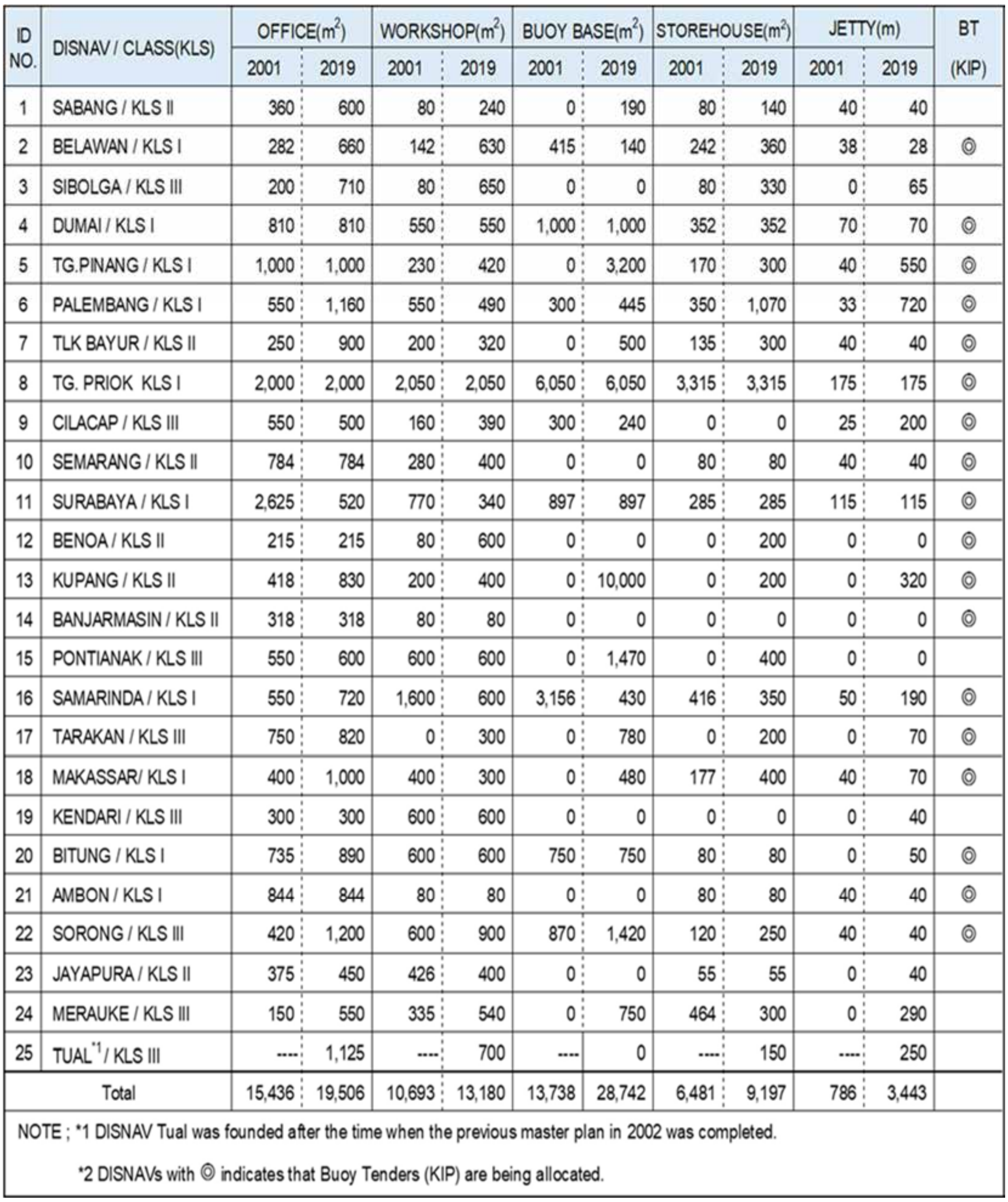
The Radar Beacon, which was attached to the lighthouse, has been established at the 84 places as a transmitting site at the time of 2000 survey, but most of them had been broken down due to damage from lightning. In the renovation plan for the Radar Beacon at that time, after the repair for lighthouses and Light-Beacons was complete, the renovation was to start in 2011. Around this time, vessels equipped with an onboard radar began to use ECDIS (Electronic Chart Display and Information System) consisting of GPS Receiver and ENC (Electronic Navigational Chart), and the role of the Radar Beacon has also changed. As a result of this situation, there was no improvement, like repair or renovation for the ***Radar*** Beacons.

3.1.3 Supporting Facilities for Aids to Navigation

A questionnaire survey was conducted in all 25 districts in order to investigate the current situation of the supporting facilities for aids to navigation.

In addition, necessary data were obtained from NAVIGASI head offices as supplementary ones. The compiled data is shown in the Table below.

Table 3.1.3 -1 : Area of Workshop and Buoy-Base



ID NO.	DISNAV / CLASS(KLS)	OFFICE(m^2)		WORKSHOP(m^2)		BUOY BASE(m^2)		STOREHOUSE(m^2)		JETTY(m)		BT
		2001	2019	2001	2019	2001	2019	2001	2019	2001	2019	(KIP)
1	SABANG / KLS II	360	600	80	240	0	190	80	140	40	40	
2	BELAWAN / KLS I	282	660	142	630	415	140	242	360	38	28	◎
3	SIBOLGA / KLS III	200	710	80	650	0	0	80	330	0	65	
4	DUMAI / KLS I	810	810	550	550	1,000	1,000	352	352	70	70	◎
5	TG.PINANG / KLS I	1,000	1,000	230	420	0	3,200	170	300	40	550	◎
6	PALEMBANG / KLS I	550	1,160	550	490	300	445	350	1,070	33	720	◎
7	TLK BAYUR / KLS II	250	900	200	320	0	500	135	300	40	40	◎
8	TG. PRIOK KLS I	2,000	2,000	2,050	2,050	6,050	6,050	3,315	3,315	175	175	◎
9	CILACAP / KLS III	550	500	160	390	300	240	0	0	25	200	◎
10	SEMARANG / KLS II	784	784	280	400	0	0	80	80	40	40	◎
11	SURABAYA / KLS I	2,625	520	770	340	897	897	285	285	115	115	◎
12	BENOA / KLS II	215	215	80	600	0	0	0	200	0	0	◎
13	KUPANG / KLS II	418	830	200	400	0	10,000	0	200	0	320	◎
14	BANJARMASIN / KLS II	318	318	80	80	0	0	0	0	0	0	◎
15	PONTIANAK / KLS III	550	600	600	600	0	1,470	0	400	0	0	
16	SAMARINDA / KLS I	550	720	1,600	600	3,156	430	416	350	50	190	◎
17	TARAKAN / KLS III	750	820	0	300	0	780	0	200	0	70	◎
18	MAKASSAR/ KLS I	400	1,000	400	300	0	480	177	400	40	70	◎
19	KENDARI / KLS III	300	300	600	600	0	0	0	0	0	40	
20	BITUNG / KLS I	735	890	600	600	750	750	80	80	0	50	◎
21	AMBON / KLS I	844	844	80	80	0	0	80	80	40	40	◎
22	SORONG / KLS III	420	1,200	600	900	870	1,420	120	250	40	40	◎
23	JAYAPURA / KLS II	375	450	426	400	0	0	55	55	0	40	
24	MERAUKE / KLS III	150	550	335	540	0	750	464	300	0	290	
25	TUAL[*1] / KLS III	----	1,125	----	700	----	0	----	150	----	250	
Total		15,436	19,506	10,693	13,180	13,738	28,742	6,481	9,197	786	3,443	

NOTE ; *1 DISNAV Tual was founded after the time when the previous master plan in 2002 was completed.

*2 DISNAVs with ◎ indicates that Buoy Tenders (KIP) are being allocated.

At the time of 2001 survey (the previous MP), there were 17 Storehouse, 9 Buoy-Bases and 13 Mooring Yards (same as the Jetty). In the previous MP, it was recommended to establish these facilities in all DISNAs.

The view of supporting facilities is shown in the Picture below.

Picture 3.1.3 -1 : Supporting Facilities for Aids to Navigation

According to this questionnaire survey, most of the supporting facilities were installed in all 21 DISNAVs that answered the questionnaire as shown in the Table above.

In addition to these onshore support facilities, the vessels which dedicate themselves to the maintenance for lighthouses on remote islands and buoys at sea are required as the supporting facilities for aids to navigation.

DGST classifies these vessels into 3 types, Buoy-Tender (KIP : Kapal Induk Perambuan), Aids-Tender (KBP : Kapal Bantu Perambuan) and Inspection Boat (KPP : Kapal Pengamat Perambuan).

The typical support vessel for aids to navigation is shown in the Picture below.

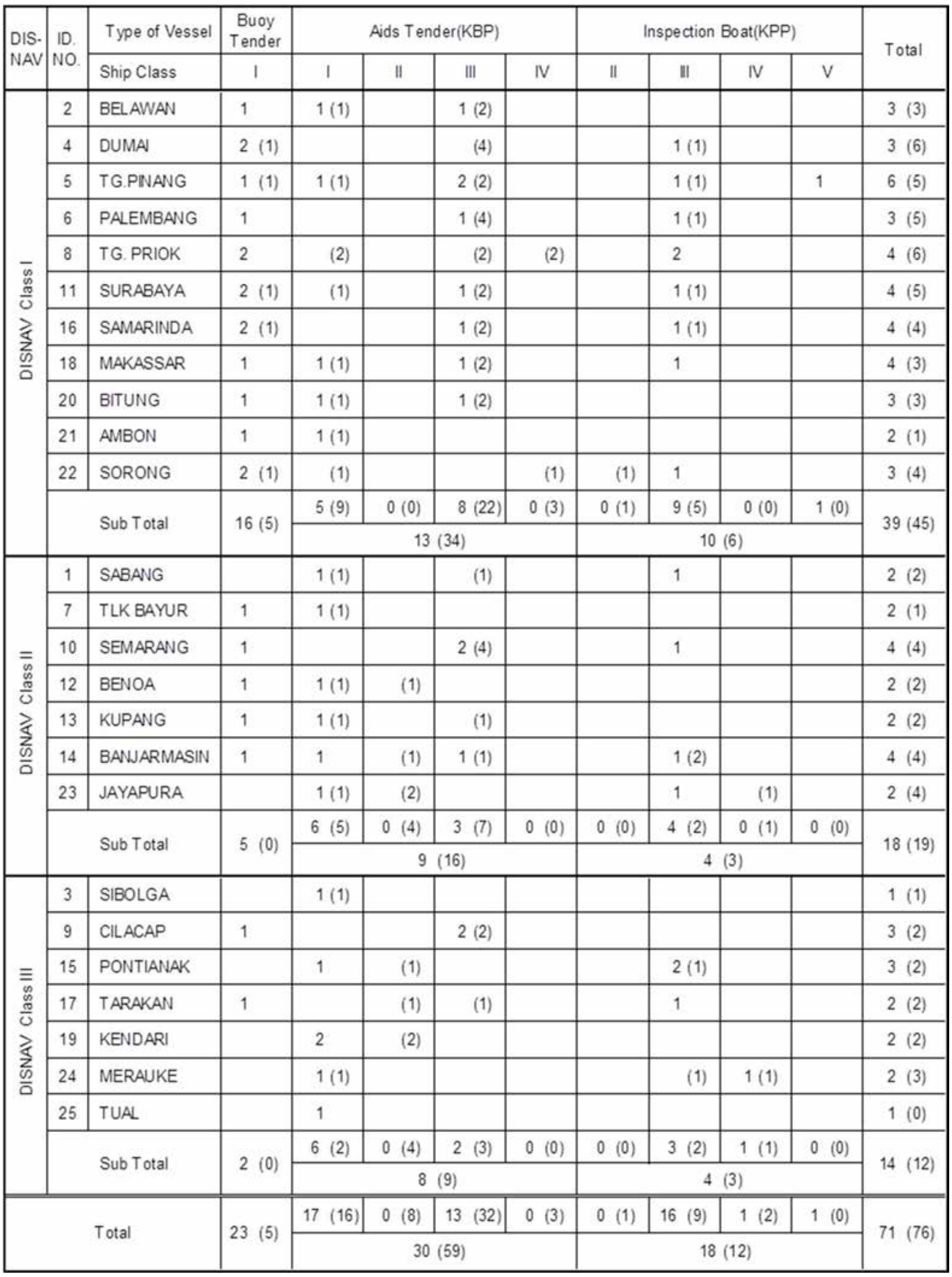
Picture 3.1.3.-2 : Support Vessel

At the time of the previous survey, 75 support vessels were enrolled in DGST, and although the ship types were different, almost the same number of vessels were enrolled in this survey.

The table below shows the number of vessels for aids to navigation deployed in the DISNAV offices by the ship class.

(The numbers in parenthesis indicate the number of vessels at the time of previous master plan in 2002.)

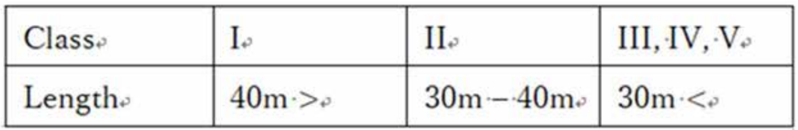
Table 3.1.3 -2 : Number of Vessels by Type and Class



DIS-NAV	ID. NO.	Type of Vessel	Buoy Tender	Aids Tender(KBP)				Inspection Boat(KPP)				Total
		Ship Class	I	I	II	III	IV	II	III	IV	V	
DISNAV Class I	2	BELAWAN	1	1 (1)		1 (2)						3 (3)
	4	DUMAI	2 (1)			(4)			1 (1)			3 (6)
	5	TG.PINANG	1 (1)	1 (1)		2 (2)			1 (1)		1	6 (5)
	6	PALEMBANG	1			1 (4)			1 (1)			3 (5)
	8	TG. PRIOK	2	(2)		(2)	(2)		2			4 (6)
	11	SURABAYA	2 (1)	(1)		1 (2)			1 (1)			4 (5)
	16	SAMARINDA	2 (1)			1 (2)			1 (1)			4 (4)
	18	MAKASSAR	1	1 (1)		1 (2)			1			4 (3)
	20	BITUNG	1	1 (1)		1 (2)						3 (3)
	21	AMBON	1	1 (1)								2 (1)
	22	SORONG	2 (1)	(1)			(1)	(1)	1			3 (4)
		Sub Total	16 (5)	5 (9)	0 (0)	8 (22)	0 (3)	0 (1)	9 (5)	0 (0)	1 (0)	39 (45)
				13 (34)				10 (6)				
DISNAV Class II	1	SABANG		1 (1)		(1)			1			2 (2)
	7	TLK BAYUR	1	1 (1)								2 (1)
	10	SEMARANG	1			2 (4)			1			4 (4)
	12	BENOA	1	1 (1)	(1)							2 (2)
	13	KUPANG	1	1 (1)		(1)						2 (2)
	14	BANJARMASIN	1	1	(1)	1 (1)			1 (2)			4 (4)
	23	JAYAPURA		1 (1)	(2)				1	(1)		2 (4)
		Sub Total	5 (0)	6 (5)	0 (4)	3 (7)	0 (0)	0 (0)	4 (2)	0 (1)	0 (0)	18 (19)
				9 (16)				4 (3)				
DISNAV Class III	3	SIBOLGA		1 (1)								1 (1)
	9	CILACAP	1			2 (2)						3 (2)
	15	PONTIANAK		1	(1)				2 (1)			3 (2)
	17	TARAKAN	1		(1)	(1)			1			2 (2)
	19	KENDARI		2	(2)							2 (2)
	24	MERAUKE		1 (1)					(1)	1 (1)		2 (3)
	25	TUAL		1								1 (0)
		Sub Total	2 (0)	6 (2)	0 (4)	2 (3)	0 (0)	0 (0)	3 (2)	1 (1)	0 (0)	14 (12)
				8 (9)				4 (3)				
Total			23 (5)	17 (16)	0 (8)	13 (32)	0 (3)	0 (1)	16 (9)	1 (2)	1 (0)	71 (76)
				30 (59)				18 (12)				

The vessels for aids to navigation are classified into 5 classes based on the length of the vessel shown at the next page.

Table 3.1.3 -3 : Classes of Vessels



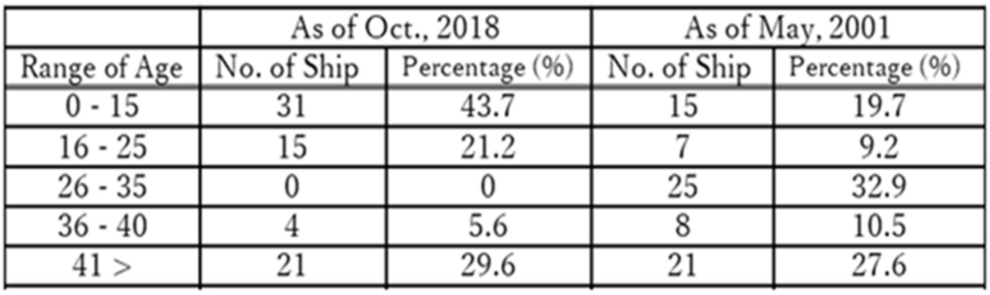
Class	I	II	III, IV, V
Length	40m >	30m – 40m	30m <

The number of the small size of Aids-Tenders (Class III) has decreased, but then the number of Buoy-Tenders has increased from 5 vessels to 23 vessels.

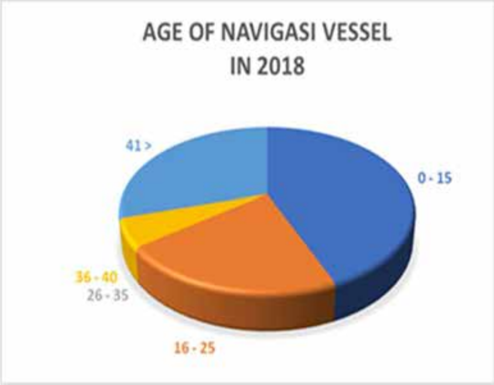
The list of Vessels for Aids to Navigation assigned to each district is attached as an Appendix 3.1.3 -1. It describes the technical conditions of each vessel in 2001 and 2018 as well as the age of the vessels.

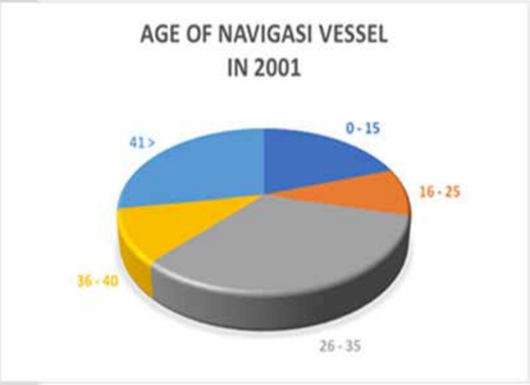
Based on this list, the age of the vessels is summarized in the Table and the Graph in comparison with the previous MP below.

Table 3.1.3 -4 : Classes of Vessels



	As of Oct., 2018		As of May, 2001	
Range of Age	No. of Ship	Percentage (%)	No. of Ship	Percentage (%)
0 - 15	31	43.7	15	19.7
16 - 25	15	21.2	7	9.2
26 - 35	0	0	25	32.9
36 - 40	4	5.6	8	10.5
41 >	21	29.6	21	27.6





At the time of 2001, mean age of total vessels is 30 years old and two third (2/3) of the vessels are older than 25 years.

In 2018, mean age of total vessels is 23 years old. Two third (2/3) of the vessels are less than 25 years old and one third (1/3) of the vessels are older than 35 years.

The table at the next page shows the list of vessels newly built after the previous MP.

Table 3.1.3 -5 : New Buoy-Tender and Aids-Tender

NO.	Shipbuilder	Disnav	Ship Name	Year of Built	DWT/GRT (tons)	Prinpipal Dimensions Loa x B x D (m)
1	NIIGATA SHIPBUILDING & REPAIR INC.	TG.PINANG	KN JADAYAT	2003	649 / 856	58.00 x 11.00 x 4.50
2	PT. DUMAS TANJUNG PERAK SHIPYARD	SURABAYA	KN BIMA SAKTI UTAMA	2008	--- / 1271	59.95 x 11.40 x 4.70
3	Ditto	BANJARMASIN	KN KUNYIT	2016	--- / 1,127	60.00 x 12.00 x 4.70
4	Ditto	TARAKAN	KN MARATUA	2016	--- / 1,127	Ditto
5	Ditto	SAMARINDA	KN MIANG BESAR	2017	--- / 1,125	Ditto
6	PT. CAPUTRA MITRA SEJATI	TELUK BAYUR	KN SIBARU-BARU	2017	628 / ---	60.00 x 12.00 x 4.70
7	Ditto	PALEMBANG	KN KALIAN	2017	628 / ---	Ditto
8	PT. ORELA SHIPYARD	AMBON	KN BACAN	2017	--- / 1,180	60.00 x 12.00 x 4.70
9	PT. MULTI OCEAN SHIPYARD	MAKASSAR	KN DE BRILL	2017	890 / 1,212	60.00 x 12.00 x 4.70
10	Ditto	BENOA	KN NUSAPENIDA	2017	890 / 1,212	Ditto
11	PT. PALINDO MARINE	BITUNG	KN MIANGAS	2017	--- / 1,208	60.00 x 12.00 x 4.70
12	Ditto	BELAWAN	KN BERHALA	2017	--- / 1,208	Ditto
13	Ditto	DUMAI	KN RUPAT	2017	--- / 1,208	Ditto
14	Ditto	TG. PRIOK	KN EDAM	2017	--- / 1,208	Ditto
15	Ditto	SORONG	KN YEFYUS	2017	--- / 1,208	Ditto
16	PT. CITRA SHIPYARD	KUPANG	KN NIPA	2017	--- / 1,208	60.00 x 12.00 x 4.70
17	Ditto	SURABAYA	KN MASALEMBO	2017	--- / 1,208	Ditto
I	PT. DUMAS TANJUNG PERAK SHIPYARD	PONTIANAK	KN ALNILAM	2008	410 / 838	51.94 x 10.20 x 4.35
II	Ditto	KENDARI	KN ANDROMEDA	2008	410 / 838	Ditto
III	Ditto	AMBON	KN ALPHARD	2008	410 / 838	Ditto

NOTE : NO.1 - 17 --> Buoy Tenders
NO. I - III --> Aids Tenders

1 Buoy-Tender was built in Japan and donated from Nippon Foundation to Indonesian Government in 2003. This vessel is under joint operation by MSC (Malacca Straight Council) and NAVIGASI.

In 2008, 1 Buoy-Tender and 3 Aids-Tenders were built under technical support and supply of machinery and equipment (so called package deal) from Damen at PT. Dumas Tanjung Perak Shipyard, Surabaya. In 2016 and 2017, 15 Buoy-Tenders were built at Indonesian shipyard.

In November 2014, the new administration of President Joko Widodo raised the fuel price by reducing fuel subsidies and further removed the subsidies for gasoline from January 1, 2015. The president defined the subsidy reduction policy as “redistribution to the appropriate sector, not subsidy reduction,” and in June of the same year, the budget was reassigned to 9 sectors. For the transportation sector, Rp.11.9 trillion for the construction of various types of ships, port facilities and information systems were allocated. Under this circumstance, 15 Buoy Tenders were built in 2016 and 2017.

3.1.4 VTS

When the previous MP was conducted, VTS had been considered to be established at the Straits of Malacca and Singapore, and at Sea-Lane I, II and III, as one of aids to navigation.

Some foreign countries made a survey for installation of VTS in Indonesia and prepared the report for the establishment. According to the report, it was proposed that VTS consisting of 3 main centers, 2 sub-centers, 2 radar stations and 14 AIS stations would be developed in four stages by 2020.

Although the present system configuration of VTS deployed all over Indonesia, is slightly different from the proposed one. The present VTS in Indonesia is classified into 3 types, one is VTS Port, tow is VTS Coastal and another is VTS Strait.

Now, there are 23 VTS Centers had been established in Indonesia under DGST and more than 3 VTS Centers operated by a private company, such as an oil and gas one. These centers are equipped with AIS too.

VTS installation places are shown in the Figure below.

Figure 3.1.4 -1 : Location Map of VTS

Recently, as one of the VTS functions, not only safety of navigation and marine environmental protection, but also security services is being demanded. In the future, sharing information with related organizations as well as stakeholders will be an issue.

A list showing the brands of the main equipment installed in the VTS center is shown in the Table next page.

Table 3.1.4 -1 : List of VTS

No.	VTS	Brand	DISNAV
1	Belawan VTS	Transas	1st Class Belawan
2	Teluk Bayur VTS	Transas	2nd Class Teluk Bayur
3	Batam VTS Center	JRC	1st Class Tanjung Pinang
4	Dumai VTS Sub-Center	JRC	1st Class Dumai
5	Palembang VTS	Transas	1st Class Palembang
6	Panjang VTS	Kongsberg	1st Class Tanjung Priok
7	Merak VTS	Kongsberg	1st Class Tanjung Priok
8	Tanjung Priok VTS	Kongsberg & Transas	1st Class Tanjung Priok
9	Cirebon VTS	Kongsberg	1st Class Tanjung Priok
10	Semarang VTS	Transas	2nd Class Semarang
11	Surabaya VTS	Sanatos	1st Class Surabaya
12	Benoa VTS	Transas & Kongsberg	2nd Class Benoa
13	Lembar VTS	Transas	2nd Class Benoa
14	Pontianak VTS	Transas	3rd Class Pontianak
15	Banjarmasin VTS	Transas	2nd Class Banjarmasin
16	Batulicin VTS	Transas	2nd Class Banjarmasin
17	Balikpapan VTS	Transas	1st Class Samarinda
18	Samarinda VTS	Transas	1st Class Samarinda
19	Tarakan VTS	Vissim	3rd Class Tarakan
20	Makassar VTS	Vissim	1st Class Makassar
21	Bitung VTS	Vissim	1st Class Bitung
22	Sorong VTS	Transas & Kongsberg	1st Class Sorong
23	Bintuni VTS	Kongsberg	1st Class Sorong

The pictures of some of VTS buildings are shown below.

Picture 3.1.4 -1 : VTS Building and Operation Room

3.1.5 GMDSS

As of 2002, 30 Coastal Radio Stations (CRS) were operated by DGST, of which 12 CRSs were equipped with radio facilities required by the SOLAS Convention for A-3 area (HF DSC), 30 CRSs for A-2 area (MF DSC) and 30 CRSs for A-1 area (VHF DSC). A-3 area for HF DSC in Indonesia was completely covered by these stations.

But there were some dead zones for MD DSC in A-2 area, and it was expected that future improvement would be made. And there were still many important sea areas, for instance, a major port, where had to be covered for VHF DSC in A-1 area. Therefore, a proposal was made to add 29 CRSs in A-2 area for a total of 59 stations and 48 CRSs in A-1 area for a total of 78 stations.

Currently, 112 CRSs are in place for GMDSS, which cover most of Indonesia's coastal waters and important port and harbor areas.

Besides these stations, there are 39 radio stations that do not support GMDSS. A total of 151 coastal radio stations are in operation now. The 151 stations are classified into 6 categories: 1st Class, 2nd Class, 3rd Class A, 3rd Class B, 4th Class A and 4th Class B. The breakdown of the classes is shown in the Table below.

Table 3.1.5 -1 : Classification of CRS

Class	Station
I	12
II	6
IIIA	48
IIIB	6
IVA	66
IVB	13
Total	151

GMDSS Area	Station
A2	94
A3	18
Total	112
Non-GMDSS	39
Total CRS	151

The layout of CRSs is shown in the Figure and the list of stations is attached as an Appendix 3.1.5 -1.

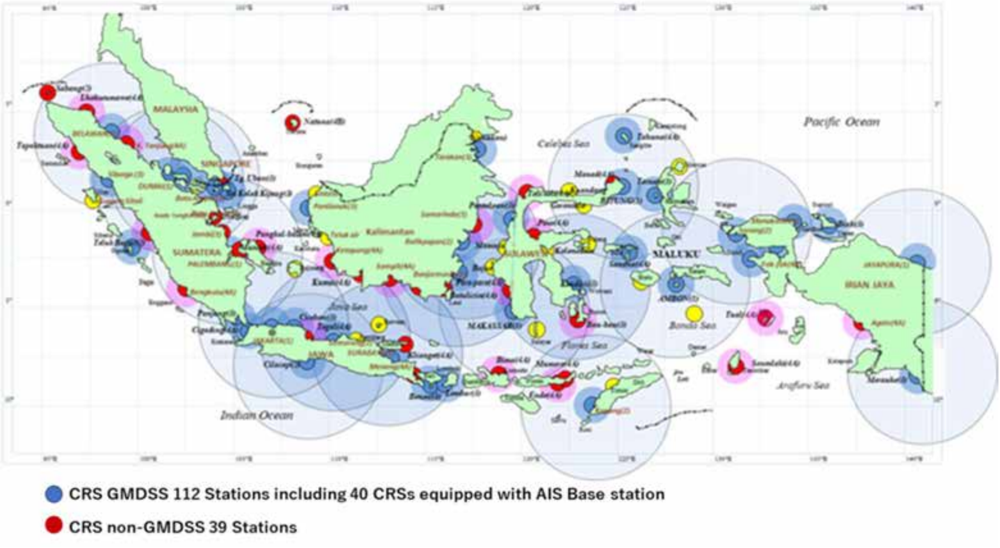


Figure 3.1.5 -1 : Location Map of CRS

NAVTEX, which distributes maritime safety information including navigational warnings, weather forecasts and warnings, and search and rescue notices to vessels, is transmitted from 4 sites of the coastal radio stations in Indonesia, Jakarta, Makassar, Ambon and Jayapura. They mostly cover the territorial waters of Indonesia. Although some waters in northern Kalimantan have been excluded from the service area, this area was assigned to be in charge of Singapore and Malaysia at the NAVAREA-XI's Coordinating Meeting. Therefore, the new expansion plan in this area was not considered.

The provision of information in Indonesia language was suggested in order to enhance the services. In the previous MP, one more transmitting site which covers the western Indonesia waters and the renovation of the existing stations are proposed, including the modification for transmitting in Indonesia language.

The map which shows the presents transmitting sites and the coverage of NAVTEX is shown in the Figure below.

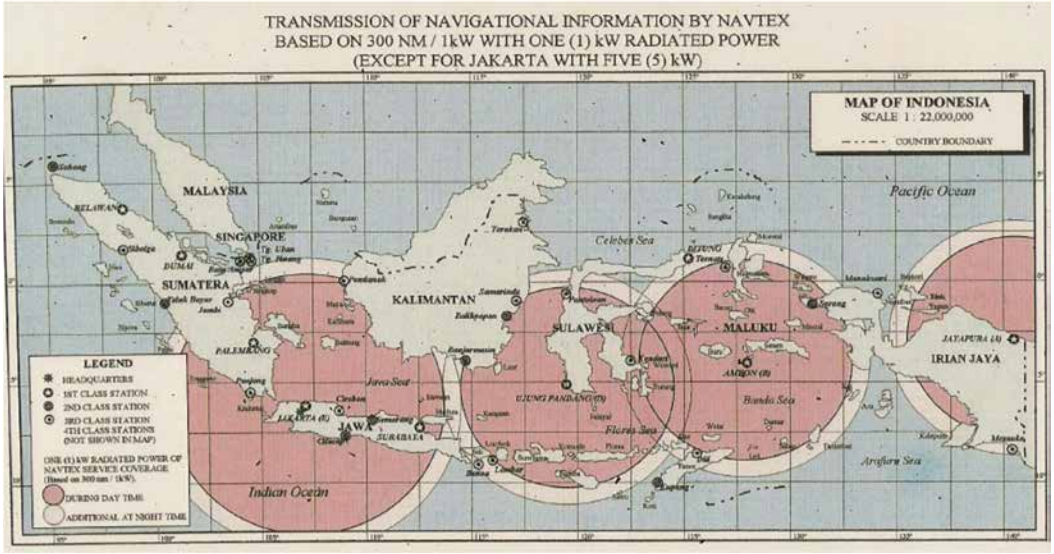


Figure 3.1.5 -2 : Map of Transmitting Sites and Coverage of NAVTEX

3.1.6 Indonesian Ship Reporting System (ISRS)

Recognizing the importance of the ship's position report system based on the SAR Treaty, it was suggested that it be established in Indonesian waters, and it was proposed that a system be built up using existing coastal radio stations.

The system started in 2013, when the MCC (Marine Command Center) at the headquarters in Jakarta was in operation. Some coastal radio stations were connected to the MCC via telecommunication lines. It is still in operation, but there are few reporting vessels. The reason seems to be that this reporting system is not compulsory and that AIS has become widespread. The MCC has received vessels' information from not only AIS but also LRIT (Long-Range Identification and Tracking of Ships) which is based on a satellite system.

The MCC is shown in the Picture below.

Picture 3.1.6 -1: Marine Command Center

3.1.7 Telecommunication System

DGST uses HF radio as means of radio communication between the regional headquarters and regional offices. However, since it was only audible communication using low-speed Telex and SSB, the use of an internet network has been planned using terrestrial telecommunication lines or/and satellite communication system. But, due to the rapid development of a smart phone, no specific communication network was provided.

3.2 Short Term Plan up to 2007

In the previous MP, the following 4 projects were proposed as Short Term priority projects until 2007. Priority Order

1) Expansion of GMDSS
2) Renovation and Development of Lighthouses
3) Development of VTS at Sunda Strait and Lombok Strait and of ISRS
4) Development of DGPS

In this survey, the implementation details, such as year, place and so on, of individual projects could not be confirmed against the proposal, but reviews were made base on the current development status.

3.2.1 GMDSS

The proposal for this pressing development of the GMDSS was implemented with Japanese consulting and financial support. 33 CRSs equipped with GMDSS were established until 2011. 4 stations of them were combined by AIS Base Station.

3.2.2 Lighthouses (Visual Aids to Navigation)

The renovation and development details of Lighthouses and Light-Beacons in the short term plan could not be confirmed in their implementation year one by one, but the project have been implemented anyway as proposed, judging from the current establish status.

The development of supporting facilities for aids to navigation can be considered to have been expanded as proposed. Because judging from the current situation along with the development of aids to navigation, supporting facilities have been developed in most of DISNAVs and it can be said that they are currently substantial.

3.2.3 VTS

In the short term plan, VTS was proposed as a system consisting of one main center, two sub-centers, two radar sites and 12 remote AIS sites, which was facing the Sunda Strait and the Lombok Strait.

But there was no progress on the project for VTS in the short term plan with the target year of 2007. 10 years later, VTS has been set up at the proposed locations, although the system configuration was different.

3.2.4 DGPS (Radio Aids to Navigation)

Only one DGPS station was established in the short term plan. Thereafter no station was set up, because the situation surrounding GPS had changed significantly, such as the cancellation of SA (Selective Availability) and the improvement of position-fix accuracy and the need of the coastal DGPS decreased in general radio navigation.

3.3 The Strategic Plan (RENSTA) of DGST for 2015 - 2020

DGST prepared the strategic Plan (RENCANA STRATEGIS [RENSTRA]) in December 2015, which refers to the National Medium Term Development Plan (RPJMN). This plan contains the goals, direction of policies, strategies, programs and development activities in accordance with the duties and functions of themselves.

As a matter of course, the field of aids to navigation is also described, and the location and year of establishment for aids to navigation are shown in detail.

A copy of the cover of the Report is shown in the Figure below, and the diagrams of an installation location for each an aid to navigation, such as Lighthouse, VTS, GMDSS, Support Facilities, and so on are attached as an Appendix 3.3 -1.

KEPUTUSAN DIREKTUR JENDERAL PERHUBUNGAN LAUT
NOMOR UM.008/100/19/DJPL-15 TENTANG
RENCANA STRATEGIS (RENSTRA)
DIREKTORAT JENDERAL PERHUBUNGAN LAUT
TAHUN 2015-2019

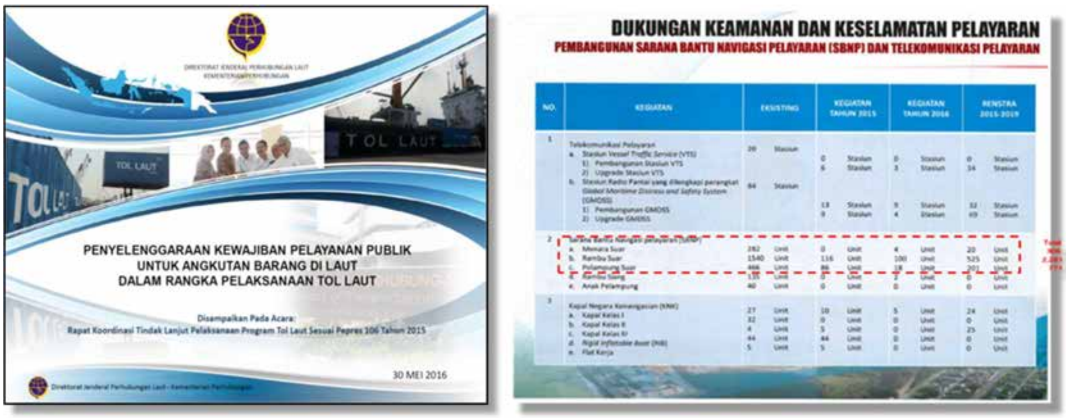
DIREKTORAT JENDERAL PERHUBUNGAN LAUT
KEMENTERIAN PERHUBUNGAN REPUBLIK INDONESIA

Strategic Plan (Renstra) for 2015-2019

PETA LOKASI KEGIATAN STRATEGIS
PEMBANGUNAN TRANSPORTASI LAUT
DALAM
RENCANA STRATEGIS
DIREKTORAT JENDERAL PERHUBUNGAN LAUT
TAHUN 2015-2019

Figure 3.3 -1 : The Cover of the Report of Strategic Plan

According this report, if only the visual aids to navigation are mentioned, 306 Lighthouses, 2,281 Light-Beacons and 771 Lighted Buoys will be installed as a goal for the development by 2019. A copy of the presentation report at that time is shown in the Figure below and the Table at the next page.



PENYELENGGARAAN KEWAJIBAN PELAYANAN PUBLIK
UNTUK ANGKUTAN BARANG DI LAUT
DALAM RANGKA PELAKSANAAN TOL LAUT

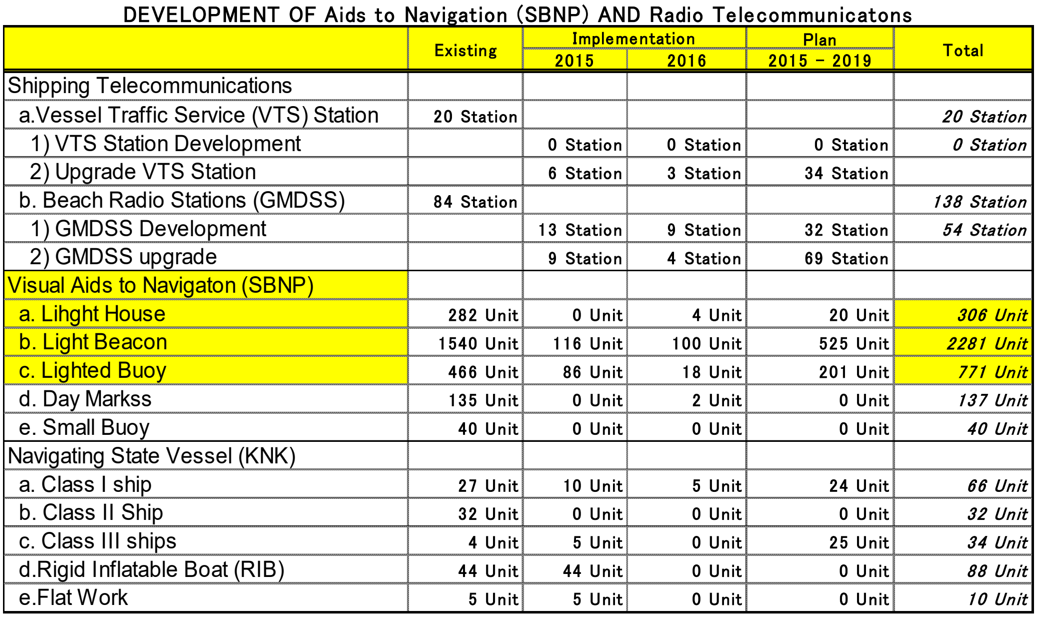
Disampaikan Pada Acara:
Rapat Koordinasi Tindak Lanjut Pelaksanaan Program Tol Laut Sesuai Pepres 106 Tahun 2015

30 MEI 2016

DUKUNGAN KEAMANAN DAN KESELAMATAN PELAYARAN
PEMBANGUNAN SARANA BANTU NAVIGASI PELAYARAN (SBNP) DAN TELEKOMUNIKASI PELAYARAN

Figure 3.3 -2 : Copy of the Presentation Report

Table 3.3 -1 : Development of Aids to Navigation for 2015 - 2019



DEVELOPMENT OF Aids to Navigation (SBNP) AND Radio Telecommunicatons

	Existing	Implementation		Plan	Total
		2015	2016	2015 - 2019	
Shipping Telecommunications					
a.Vessel Traffic Service (VTS) Station	20 Station				*20 Station*
1) VTS Station Development		0 Station	0 Station	0 Station	*0 Station*
2) Upgrade VTS Station		6 Station	3 Station	34 Station	
b. Beach Radio Stations (GMDSS)	84 Station				*138 Station*
1) GMDSS Development		13 Station	9 Station	32 Station	*54 Station*
2) GMDSS upgrade		9 Station	4 Station	69 Station	
Visual Aids to Navigaton (SBNP)					
a. Lihght House	282 Unit	0 Unit	4 Unit	20 Unit	*306 Unit*
b. Light Beacon	1540 Unit	116 Unit	100 Unit	525 Unit	*2281 Unit*
c. Lighted Buoy	466 Unit	86 Unit	18 Unit	201 Unit	*771 Unit*
d. Day Markss	135 Unit	0 Unit	2 Unit	0 Unit	*137 Unit*
e. Small Buoy	40 Unit	0 Unit	0 Unit	0 Unit	*40 Unit*
Navigating State Vessel (KNK)					
a. Class I ship	27 Unit	10 Unit	5 Unit	24 Unit	*66 Unit*
b. Class II Ship	32 Unit	0 Unit	0 Unit	0 Unit	*32 Unit*
c. Class III ships	4 Unit	5 Unit	0 Unit	25 Unit	*34 Unit*
d.Rigid Inflatable Boat (RIB)	44 Unit	44 Unit	0 Unit	0 Unit	*88 Unit*
e.Flat Work	5 Unit	5 Unit	0 Unit	0 Unit	*10 Unit*

As mentioned in the Section 3.1.1 and shown in the Table 3.1.1 -1, 284 Lighthouses, 1,877 Light-Beacons and 553 Light-Buoys are being operated as of March 2019 (Excluding non-DGST Operation).

* Total Number of Visual Aids to Navigation in Indonesia (as of March 2019)

Lighthouse	284	(DGST)
Light-Beacon	2,720	(DGST : 1,877 + non-DGST : 843)
Light-Buoy	1,180	(DGST 553 + non-DGST : 627)

Chapter 4

Field Survey

4 Field Survey

In this project, the field survey was conducted, including a visit to DISNAV, a questionnaire survey, and the survey of maritime traffic flow, to understand the current situation of related field and to identify issues.

The visit to DISNAV was conducted by JST member accompanied by the staff of the headquarters and they had a meeting with the DISNAV staff to make interviews and observed related facilities. Photographs of related facilities at the time of the field survey are attached as Appendix 4.1-1 (1-14).

In order to supplement the field survey and ascertain relevant information, a questionnaire was prepared for aids to navigation and related facilities, and its sheets were sent to all DISNAV offices between July and August 2019, commissioned by a local consultant. The response to a questionnaire was 38% and there were many blank in a sheet, but these related documents are attached as Appendix 4.1-2.

The survey of maritime traffic flow was conducted at the places where were proposed in the 1st JCC, which was carried out with AIS, and at some places a radar and visual survey was done.

4.1 Visits to DISNAV

The location and the date of visit to DISNAV are shown in the Table and the Figure below.

Table 4.1 -1 : Date of Visit to DISNAV

DISNAV Headquarters Visited in the Survey

No	Name of DISNAV	Class	Date	Remarks
1	Kupang	2	2019, 7/1-5	Survey of Traffic Volume
2	Ambon	1	2019, 7/1-5	
3	Tual	3	2019, 7/1-5	
4	Tanjung Priok	1	2019, 7/10	
5	Samarinda	1	2019, 7/15-19	
6	Tarakan	3	2019, 7/15-19	
7	Makassar	1	2019, 7/15-19	Survey of Traffic Volume
8	Belawan	1	2019, 10/13-15	
9	Sabang	2	2019, 10/16-18	Survey of Traffic Volume
10	Pontianak	3	2019, 10/21-24	
11	Bitung	1	2019, 10/22-27	
12	Surabaya	1	2019, 10/28-31	Survey of Traffic Volume
13	Teluk Bayur	2	2019, 11/4-7	
14	(Labuan Bajo)		2019, 11/4-7	Survey of Traffic Volume

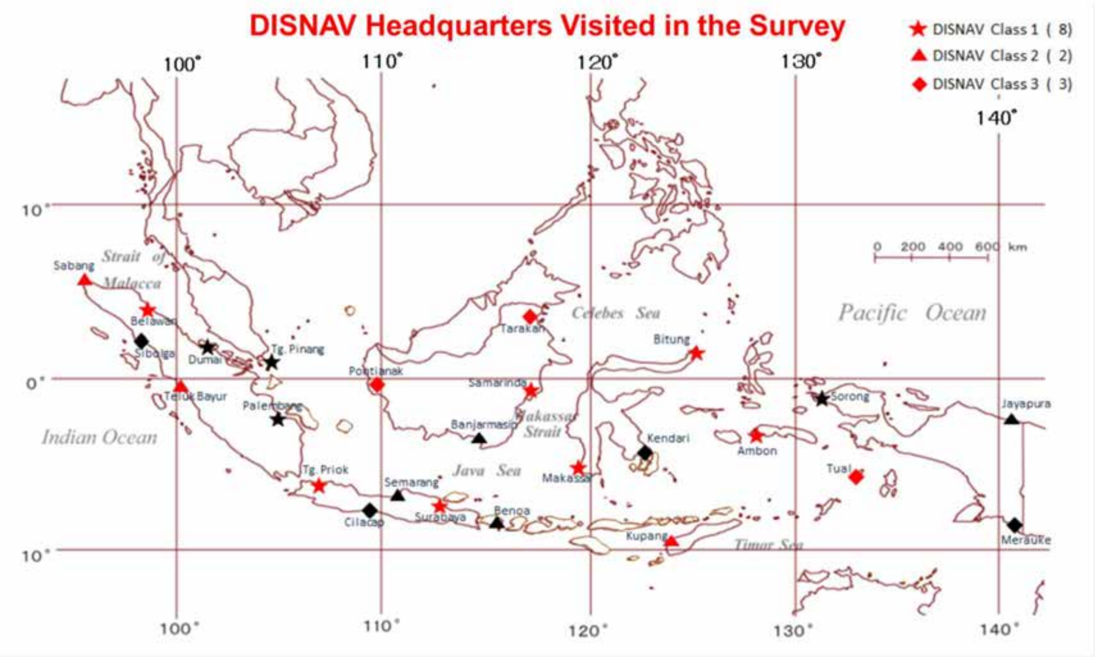


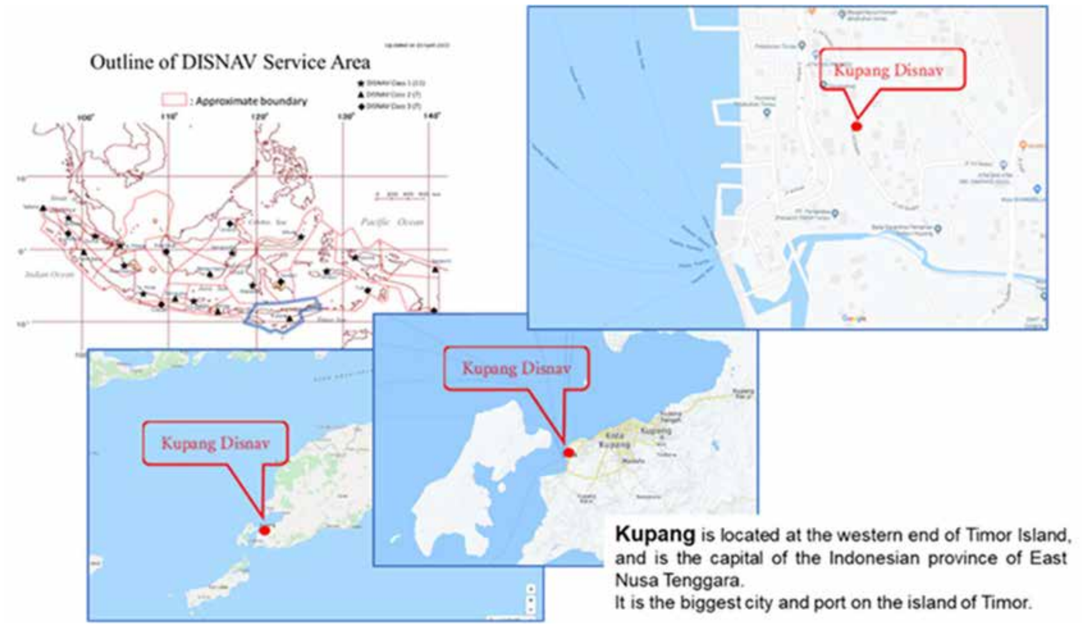
Figure 4.1 -1 : Location of Visit to DISNAV

The photograph of the visit to the district offices is attached as an Appendix 4.1 -1.

4.1.1 DISNAV Kupang Class II

1) Location

Province: East Nusa Tenggara



Kupang is located at the western end of Timor Island, and is the capital of the Indonesian province of East Nusa Tenggara.
It is the biggest city and port on the island of Timor.

Figure 4.1.1 -1 : Location of DISNAV Kupang

2) Outline of Kupang

Kupang is the capital of Province of East Nusa Tenggara and has population in 2011 of 349,344(Nusa Tenggara Timur has population in 2018 of 2,660,613). The climate is tropical wet and dry (Aw) by the Köppen climate classification.

The manufacturing sector in the Kupang area is mainly based on the cement industry.

The state-owned salt firm began building a 4,000-hectare salt farm of 500,000 tons per year in Kupang Bay in 2012 and started initial production in 2013. In addition, the fishery and livestock industries are popular.

3) Port of Kupang

The container quay with 230 meters in length at Kupang Port, operated by Pelindo 3 Kupang Office, was completed with Japanese ODA in 2005. From south of the port, a fishing port, container wharf, multipurpose wharf and passenger wharf are located.

Picture 4.1.1 -1 : Container Yard and Gantry Crane

4) DISNAV Kupang Office

About 180 employees work at the office. In the office, there are one 2nd-Class CRS, two 3rd-Class CRS, and six 4th-Class CRS. Of these stations, the 2nd-Class and 3rd-Class stations operate GMDSS. Buoy Tender Vessel and Aids Tender Vessel are assigned to the office. There are 21 lighthouses in this District, and 2 staff assigned to each lighthouse to operate and maintain it.

a) CRS Kupang (2nd-Class CRS)

18 staff works at this radio station and 2 of whom are on duty 24 hours a day. Working hours are 3 shifts, from 0800 to 1400, from 1400 to 2000 and from 2000 to 0800.

Picture 4.1.1 -2 : Operation rooms

The transmitting station is 10 km away from the receiving station, which is connected with radio link via one repeater station. The link between the transmitting and the receiving station is currently broken, and the receiving station communicates with other stations by portable radio. The receiving station is equipped with AIS.

The AIS coverage is about 46 miles radius, but AIS signals from 60 miles away are received sometimes.

This station's communication network is connected to the Internet by optical fiber cable and is equipped with Wi-Fi router. Through this network, the reports on the status of equipment are made daily as a "Daily Log", such as Transmitter Condition, Residual Fuel Quantity, Operation/Maintenance Log.

b) Kupang Lighthouse (Beacon Tower)

The height of the lighthouse (white painted angle steel tower) is 29m height and the effective intensity range is 15 miles. There is a solar power generation system as a backup for commercial power.

Two staff work at this lighthouse and shift to other lighthouse every three months. This DISNAV office has 21 manned lighthouses, which are operated and maintained by 42 lighthouse keepers.

Picture 4.1.1 -3 : Kupang Lighthouse

A new 40 m height lighthouse is under construction instead of the current lighthouse.

c) Buoy Tender Vessel and Aids Tender Vessel

a. KN NIPA (Buoy Tender Vessel)

The buoy tender vessel called KN NIPA was built in 2017 and the condition of the hull, the engine and equipment is very good. She was engaged in replacement of 5 buoys and for maintenance of 9 buoys in 2018.

Picture 4.1.1 -4 : Buoy Tender KN NIPA

b. KN MINA (Aids Tender Vessel)

The aids tender vessel called KN MINA was built in 1997. The main engine was replaced with Dresser Ruascor Guascor manufactured in Spain in 2015. It fairly takes time to get her spare parts and even consumables take 3 months. Her bottom shell is getting thinner, and the bow deck is quite rusted and requires maintenance.

She was engaged for maintenance of 4 buoys in 2018.

Picture 4.1.1 -5: Aids Tender KN MINA

5) Reporting System of "Master Cable System"

Kupang CRS operates vessel reporting system in accordance with several rules. The legal basis of this reporting system called "Master Cable System" is based on the following regulations.

a) Regulation Undang-Undang No.9/2018, stipulated as non-tax revenue

b) Government Decree No. 15/2016, stipulated as tariff

c) Government Decree No. 73/1999, that regulates how to use tax revenue

This Master Cable System started in 2019 in accordance with the Regulation Undang Undang No.9/2019.

The outline of this reporting system is as follows.

When a vessel enters a port, she will inform the Kupang CRS by radio or e-mail of an arrival note including information on, such as Vessel's Name, Pilotage, Tug Boat, Destination, and Cargo.

The Kupang CRS then reports this information to the Harbor Master.

The agent of a vessel pays a tax with the arrival note via a bank, and the Harbor Master issues a Sailing Permission when the tax payment is confirmed.

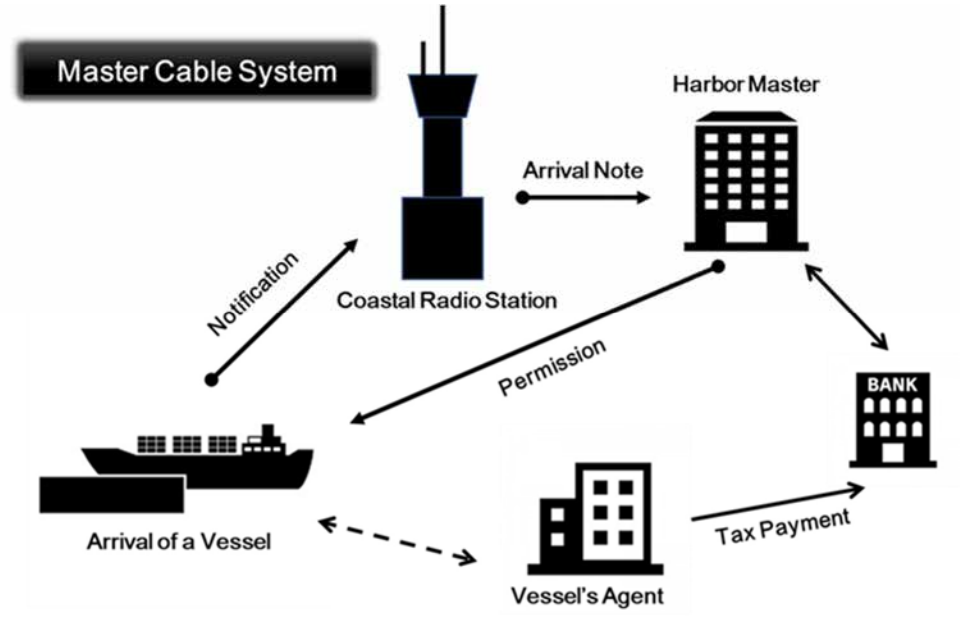


Figure 4.1.1 -2 : Master Cable System

6) Points of Concern

Based on the interviews and inspections at DISNAV Kupang office, the followings should be improved as a future subjects.

a) Consideration for unmanned lighthouse and monitoring system

As light source of many lighthouses changed to LEDs not being necessary short maintenance, unmanned operation may be possible.

b) Integration of 3rd and 4th CRSs

Development of ICT (Information & Communication Technology) may be possible to change the operation style of CRSs by adopting unmanned repeater relay stations.

c) Early procurement of vessel maintenance parts and supplies

The recent procurement network of parts and supplies necessary for maintenance of vessels may be contributed to the early operation of vessels.

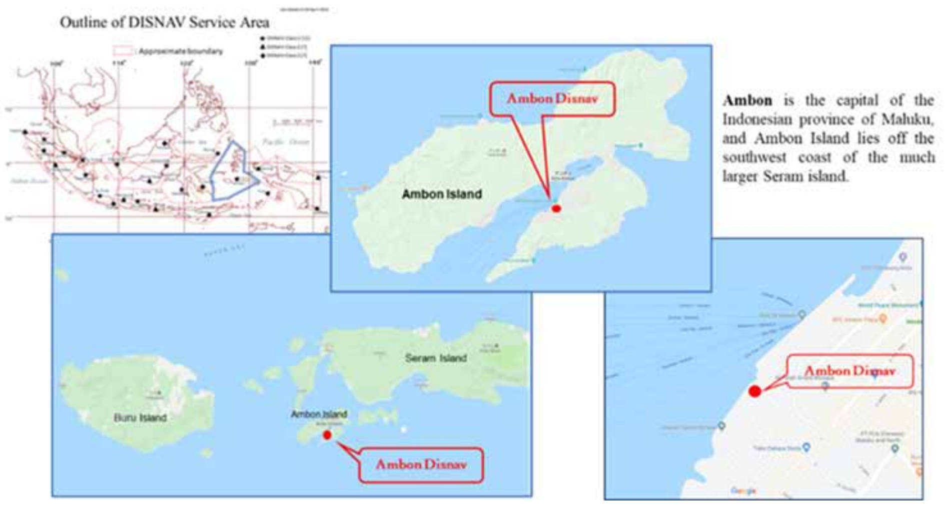
d) Establishment of functional aids to navigation

Many ports in the jurisdiction of this DISNAV Kupang are surrounded by reefs, therefore safety navigation in these ports is restricted by shallow water depth. It is to be considered about the establishment of aids to navigation with function necessary to indicate waterways clearly.

4.1.2 DISNAV Ambon Class I

1) Location

Province: Maluku



Ambon is the capital of the Indonesian province of Maluku, and Ambon Island lies off the southwest coast of the much larger Seram island.

Figure 4.1.2 -1 : Location of DISNAV Ambon

2) Outline of Ambon

Ambon is a port city on the southern shore of the bay that opened to the west, and has long flourished as the center of economics and traffic for Maluku. And, it is one of the largest cities in eastern Indonesia and the capital city of Maluku. The population is about 395,000 as of 2014. The climate is tropical rainforest (Climate Classification: “Af”) by Köppen Climate Classification as there is no real dry season. As it is located near the equator, the temperature throughout the year is constant with an average temperature of 25 to 27 degrees C.

3) Present Situation of Vessels and Facilities

The outcome of interviews and inspections at DISNAV Ambon office are as follows.

a) Buoy Tender Vessel

Two Buoy Tender Vessels, KN.ALPHARD and KN.BACAN, are assigned to this DISNAV office and are engaged in maintenance, supply and shift of a staff for lighthouses.

KN.ALPHARD was in dock, and KN. BACAN is required to repair propeller shaft, bow thruster, ECDIS, INMARSAT, and so on.

Picture 4.1.2 -1 : Vessel KN.ALPHARD Vessel KN. BACAN

b) Ambon CRS office

This station is equipped with MF/HF Receiver, which are of quite old devices.

This CRS office is conducting the operations for VHF and NAVTEX, of which signals are being received and transmitted at the unmanned site near the Ambon CRS office.

When it is heavy rain, the signal power is reduced, therefore it takes time to re-start the operation by staff, which often interfere the service.

Picture 4.1.2 -2 MF/HF Equipment MF/HF ANT MATRIX

c) Transmitting and Receiving Site of the Ambon CRS

The transmitting and receiving site is a 20 minute drive from the Ambon CRS. MF/HF devices and NAVTEX are composed of Active/Standby system. VHF devices consist of DSC Unit, TRX and International Channel Unit. The antenna tower is old, so the maintenance should be required.

Picture 4.1.2 -3 MF/HF and NAVTEX VHF Antenna tower

d) Ambon Lighthouse

The lighthouse, 30 m height and steel tower, stands at the tip of the cape at 117 m height from Sea Level. The light source is LED and the power source is a solar battery.

Picture 4.1.2 -4 : Ambon Lighthouse

e) Port

There are a large number of cargo vessels and passenger vessels in and out of the Port of Ambon, and a 14,000 GT class passenger vessel is in operation.

As for sea-transportation of container ships, the problem is on land, and specifically on the bad road conditions with narrow width and electric cable crossing the road.

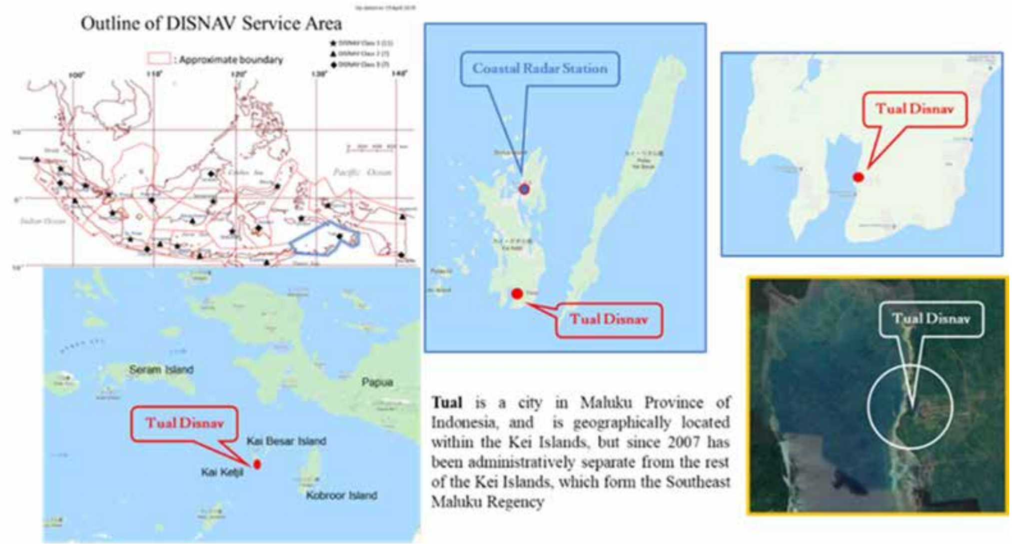
There is no floating buoy in the port, because the deep port may be difficult to set up there.

Picture 4.1.2 -5 : Port of Ambon

4.1.3 DISNAV Tual Class III

1) Location

Province: Maluku



Tual is a city in Maluku Province of Indonesia, and is geographically located within the Kei Islands, but since 2007 has been administratively separate from the rest of the Kei Islands, which form the Southeast Maluku Regency

Figure 4.1.3 -1 : Location of DISNAV Tual

2) Outline of DISNAV Tual

DISNAV Tual office locates 60 km away south from Tual town, is facing to bay with their own jetty for aids tender vessel Mhakota. As the office is far from the main town, there are no telecommunication tools such as wired telephone, mobile station. The only means is its own HF radio between the coastal radio stations, which is not used so many times.

The mobile network in the vicinity near the office is very poor, but there are places where mobile phones can be used around the jetty. So it is preferable to install a relay station on the premises.

Figure 4.1.3 -2 : Location of Office, CRS, Lighthouse

Picture 4.1.3 -1 : DISNAV Tual office

3) CRS (Coastal Radio Station)

There are 4 coastal radio stations under the jurisdiction of DISNAV Tual office, in which 3 stations operate GMDSS. Tual CRS is located on the outskirts of the town away from the office.

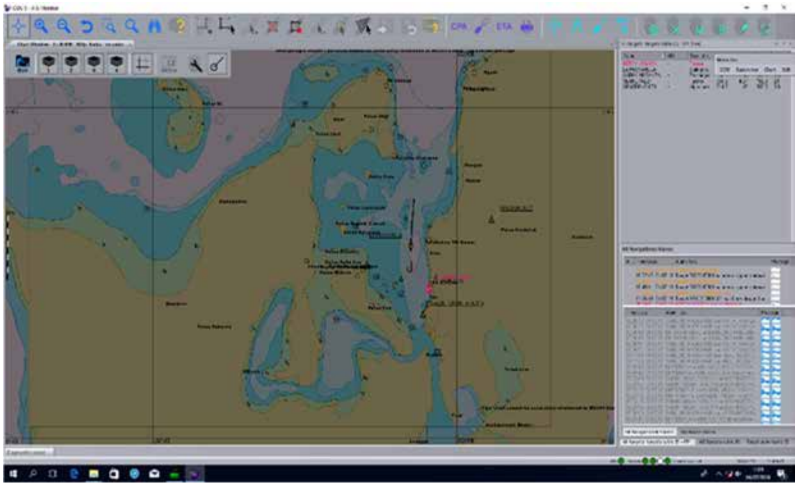
This station has had a serious problem of noise interfering in the radio for many years, and some countermeasures have to be taken.

One AIS receiver, manufactured by Company SIMRAD in Norway, was installed at this CRS and the movement of vessels was shown on this display, but it did not appear to be fully utilized for marine traffic operation.

Accordingly, it is desirable to prepare appropriate SOP (Standard Operation Procedure) and to make its operational training.

Picture 4.1.3 -2 : Coastal Radio Stattion

Picture 4.1.3 : 3 : HF TX VHF TX GMDSS Console Panel



Picture 4.1.3 -4 : AIS Display

4) Aids to Navigation

There are nearly 100 aids to navigation, including lighthouse (11), lighted beacon (78) and unlighted beacon (10), in this district, but there are no buoys.

One of the reasons is that there is no Buoy Tender for the maintenance of buoys in this DISNAV office.

Regarding the power sources for aids to navigation, all of lighthouses equip with engine-generators respectively, and the lighted beacons use solar battery-powered. The light sources have been mostly replaced by LEDs.

Picture 4.1.3 -5 : LED Lantern Solar power panels

Considering efficient and effective maintenance of aids to navigation for the future, it may be better to re-classify aids to navigation under function, equipment or importance.

5) Tg. Burang Lighthouse

This lighthouse was recently constructed (in 2014) and is located at the north end of an island called Pulau Kei Bosar. The lighthouse provides its service area to the map presented below.

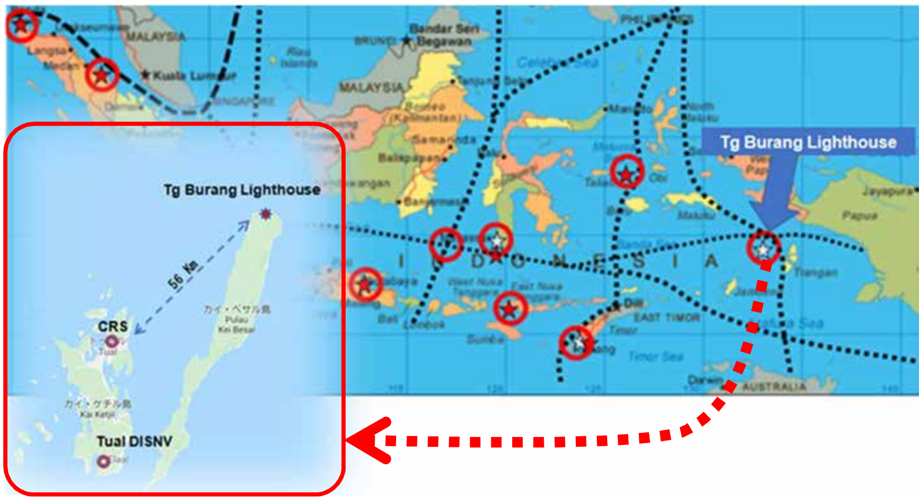


Figure 4.1.3 -3 : Location of Office, CRS, Lighthouse

The lighthouse, 40 m height steel tower, stands at 40 m height from the sea level, and the light source is LED. The power source is a solar battery powered, and the lighthouse is equipped with an engine generator as a power source for daily life. Two lighthouse-keepers are working at the site every three-month shift.

Picture 4.1.3 -6 : Tg. Burang Lighthouse

Picture 4.1.3 -7 : Living Quarters, Generator

The communication between the lighthouse and the CRS is performed by HF Radio.

Picture 4.1.3 -8 : HF Radio

Although the lighthouse is in a good location to get the movement of vessels with AIS, there is no ways to send the AIS information to the coastal radio station at present. In order to monitor vessels' movement, it should be considered to connect AIS network between the lighthouse and CRS.

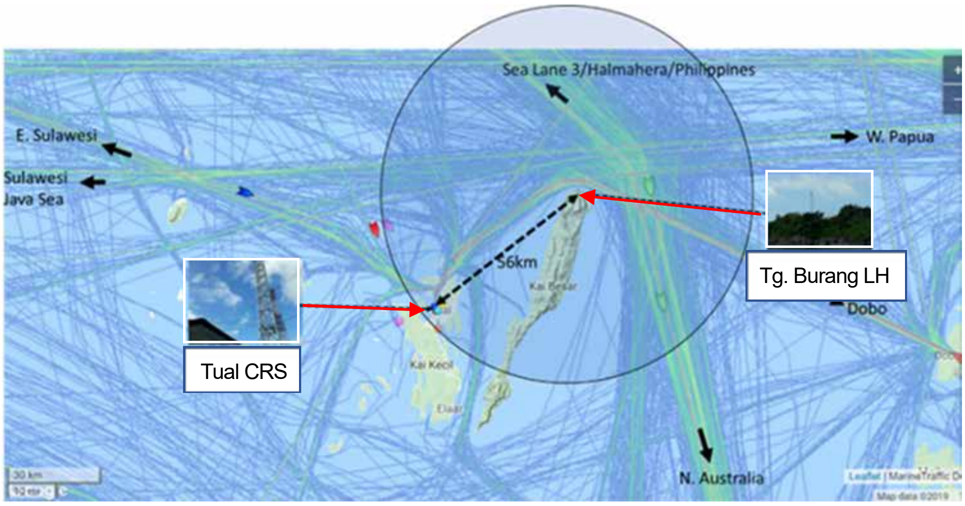


Figure 4.1.3 -4 : Location of CRS, Lighthouse

6) Port of Tual

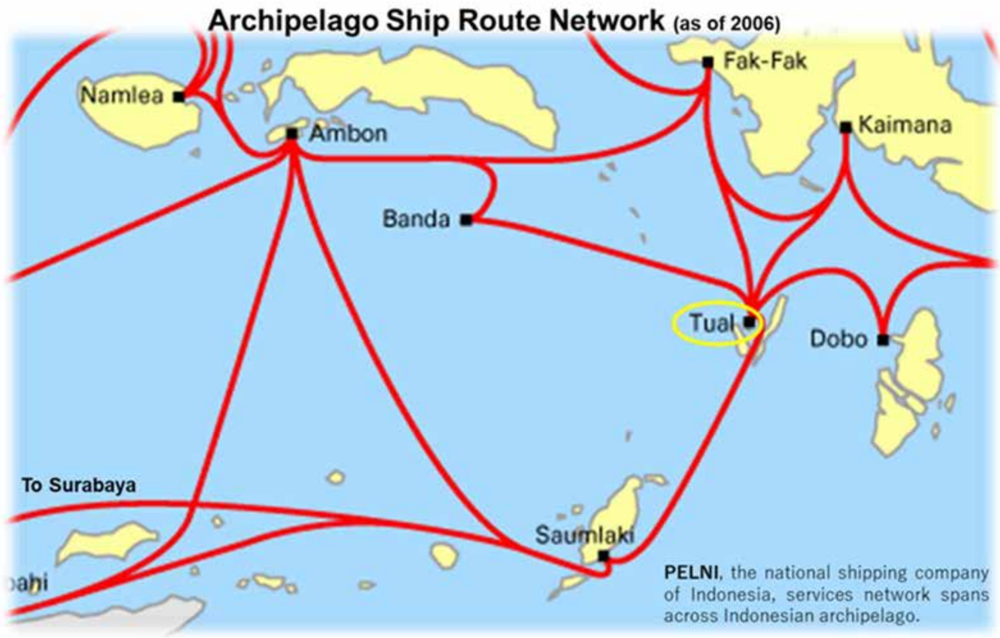
Port of Tual is located in one of the old maritime routes of the spice trade.

The largest vessel entering the port is 15,000GT, and the average tonnage of vessels is 8,000GT. On an average, 6 cargo vessels enter a day and 20 passenger boats a month.

Port Authority has a berth expansion plan and the current 300m long pier will be extended to 600m one.

Picture 4.1.3 -9 : Cargo-Passenger Vessel on the Berth

The following map shows the traffic route that PELNI, Indonesia's state-owned shipping company, operates via a Port of Tual.



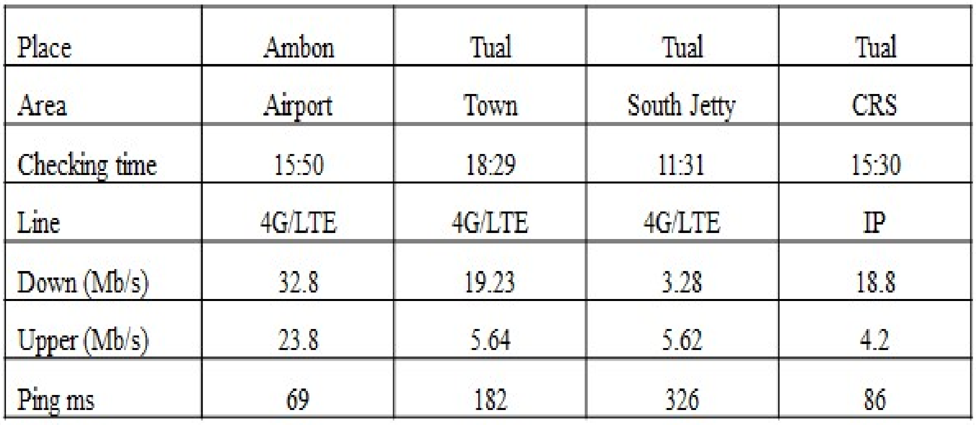
PELNI, the national shipping company of Indonesia, services network spans across Indonesian archipelago.

Figure 4.1.3 -5 : Traffic Route of PELNI

7) Others

The confirmation result of mobile telecommunication network speed measured with the smart-phone is as follows.

Table 4.1.3 -1 : Current Situation of Network Speed



Place	Ambon	Tual	Tual	Tual
Area	Airport	Town	South Jetty	CRS
Checking time	15:50	18:29	11:31	15:30
Line	4G/LTE	4G/LTE	4G/LTE	IP
Down (Mb/s)	32.8	19.23	3.28	18.8
Upper (Mb/s)	23.8	5.64	5.62	4.2
Ping ms	69	182	326	86

The data transfer checked in the field survey represented good condition, and actual bandwidth data is the proof of actual data activation in every facility. 15 KM off coastal line is still available to connect data as well. However, in order to improve operation and maintenance of facilities such as lighthouses by utilizing remote operation system, DISNAV Tual office should conduct to check the further network condition necessary for data transfer.

4.1.4 DISNAV Tanjung Priok Class I

1) Location: Jakarta

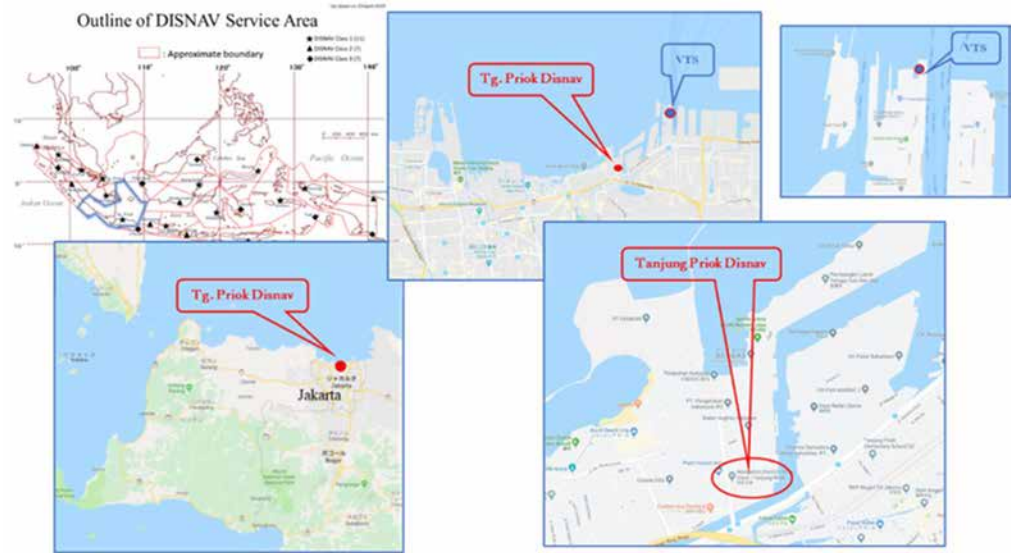


Figure 4.1.4 -1 : Location of DISNAV Tanjung Priok

2) Outline of Tanjung Priok

The Port of Tanjung Priok is the busiest and most advanced Indonesian seaport, handling the great portion of Indonesia's trans-shipment cargo traffic, and is operated by Indonesian state owned PT Pelindo II. The Port has 3 container terminals, as well as terminals that provide specialized services for general cargo, dry bulk, liquid bulk, oil and chemicals, which contains a total of 81 berths with a total length over 12,830m with alongside depths ranging from 3 to 14. "New Priok" extension project is currently ongoing, which is expected to be fully operational in 2023 (Excerpted from Wikipedia).

DISNAV Tanjung Priok office is located in the north Jakarta.

Picture 4.1.4 -1 : Vessels waiting at Anchorage for loading

3) CRS (Coastal Radio Station)

The CRS is built in front of the office. The main facilities are as follows.

a) HF, MF, VHF Communication System

b) VTS, AIS

This station operates NAVTEX under GMDSS, and VTS with Radar and AIS.

Picture 4.1.4 -2 : HF, MF Antenna Tower, Transmitter and Control Unit

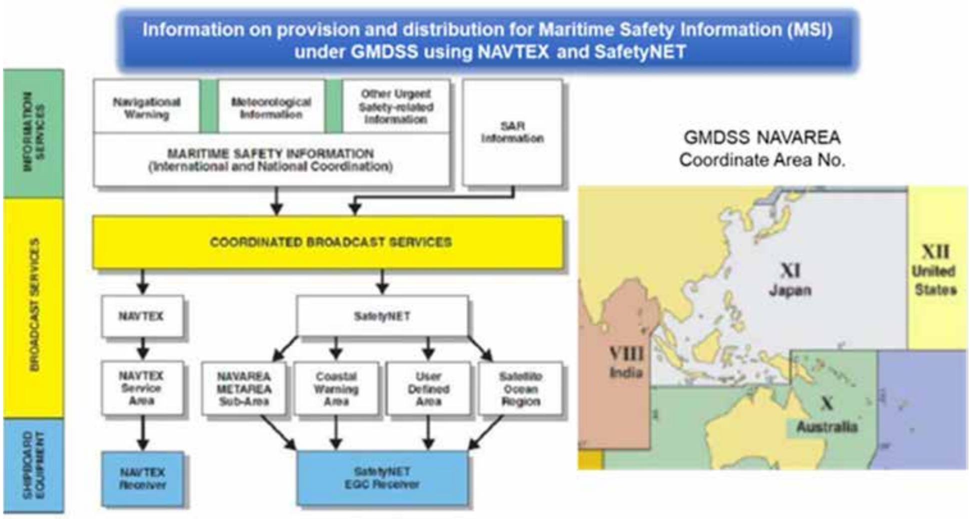
Picture 4.1.4 -3 : VTS Operation Room

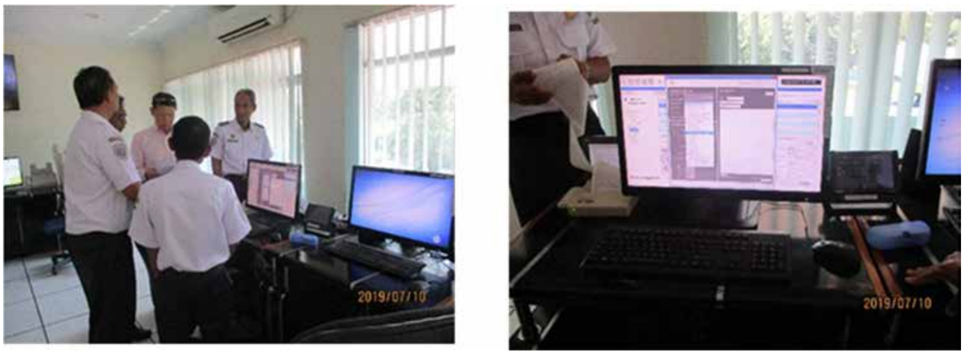
Picture 4.1.4 -4 : Radar and AIS Display

Information collected through these systems and from other organizations, such as weather, marine accidents, navigational warnings, are provided to vessels by the radio. NAVTEX is broadcasted six times a day, and it is provided by VHF as necessary. NAVTEX is a major element of the Global Maritime Distress Safety System (GMDSS), and it is as follows.

NAVTEX (Navigation Telex) is an international service that provides coastal/local navigational and meteorological warnings and forecasts, as well as urgent maritime safety information to vessels every 4 hours, six times a day. The CRS Jakarta is one of the four stations (Jayapura, Ambon, Makassar, Jakarta) operating NAVTEX in Indonesia, which belongs to NAVAREA XI.

NAVTEX provides primarily on MF Radio (the Medium Frequencies of 518 kHz and 490 kHz), which covers the area within approximately 370 km (200 Nautical Miles) off shore.





Picture 4.1.4 -5 : NAVTEX Console

Information for NAVTEX is obtained from e-mail and fax. Providers of information are an organization of waterways (Navy), BMKG, SAR (BASRNAS), DGST Message Center (notification of Mariner's Nabashi warning) and so on.

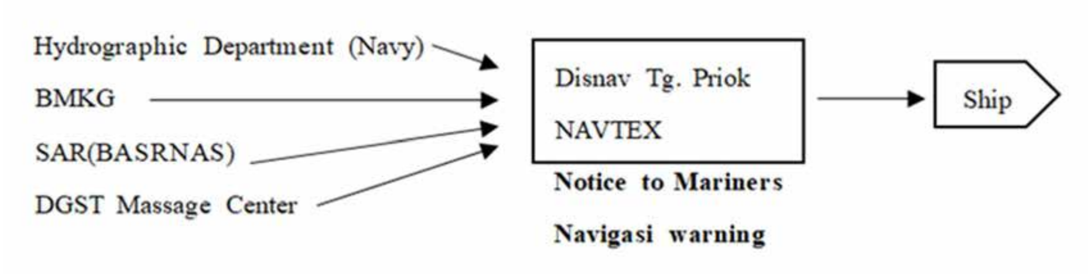


Figure 4.1.4 -2 : Source of Information

There is a micro-wave network (7.6 GHz) between the transmitting site and the receiving site.

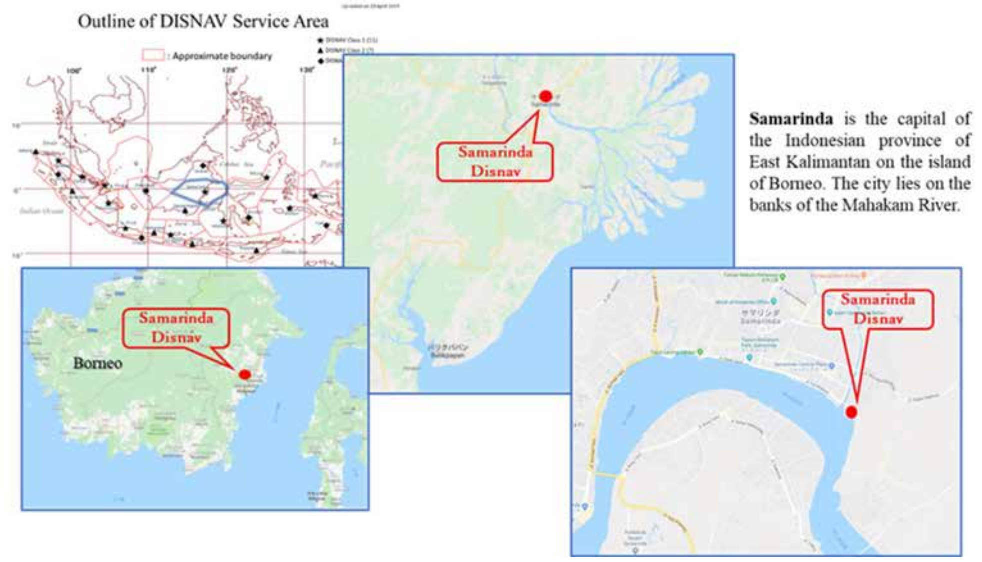
A public telephone line and an e-mail are used for a GMDSS network among Panjang, Cirebon, Bengkulu, Cigadeng and Sunda Kelapa stations, and data is sent to KPLP, Basarnas, Maritime police, Syabandar and DISNAV Tg.Priok（VTS） DGST Message Center.

After the survey, it was appeared that the collection and provision of information was not always done efficiently and effectively. Therefore it is necessary to consider how to collect, analyze and provide the information quickly, correctly, substantially and directly, including the use of an intensive communication network as found in the latest cloud system.

4.1.5 DISNAV Samarinda Class I

1) Location

Province: East Kalimantan



Samarinda is the capital of the Indonesian province of East Kalimantan on the island of Borneo. The city lies on the banks of the Mahakam River.

Figure 4.1.5 -1 : Location of DISNAV Samarinda

2) Outline of Samarinda

Samarinda, capital of East Kalimantan province with 800,000 populations developed by logging export industry historically, is currently central city of charcoal and mining products to be replaced. Mahakam Bridge completed in 1980's. During rainy season, water level in river would be more than 10 m higher than during dry season. In opposite, during dry season especially in full moon period, sea (salty) water goes up to river which create loam soil damage especially in delta area in river mouth. In such circumstances, much traffic in river shall take serious attention for safety sailing especially in crossing of multi numbers of bridges as well as river bottom depth difference in various seasons.

3) Characteristics of Mahakam River

According to the PELINDO office that operates the port, the characteristics of Mahakam River are as follows.

a) Four to five water-traffic accidents happen around Mahakam Bridge annually.

b) Typical Tugs and barge's particulars on Mahakam River as follows.

Tug 850H.P./2engines, total 1,700H.P.

Barge length 300 ft loading coal about 4000 tons, draft about 5m

c) During the rainy season, the downstream flow of the river becomes strong and hinders the maneuvering of many tugboats. As a result, a full loaded barge collides with the pillar of the Mahakam Bridge.

d) The 40 tugboats for towing a full loaded barge are adjusted to pass the bridge between 7 am and 11 am every morning. This is to prevent tug boats towing a full loaded barge and other ones towing an unloaded barge from meeting each other near the bridge.

The direction of the river flow is not considered when the tug boats tow full-load barges passing through the bridge. Because the height under the bridge affected by the tide level, barges fully loaded with coal may not pass through the bridge at high tide.

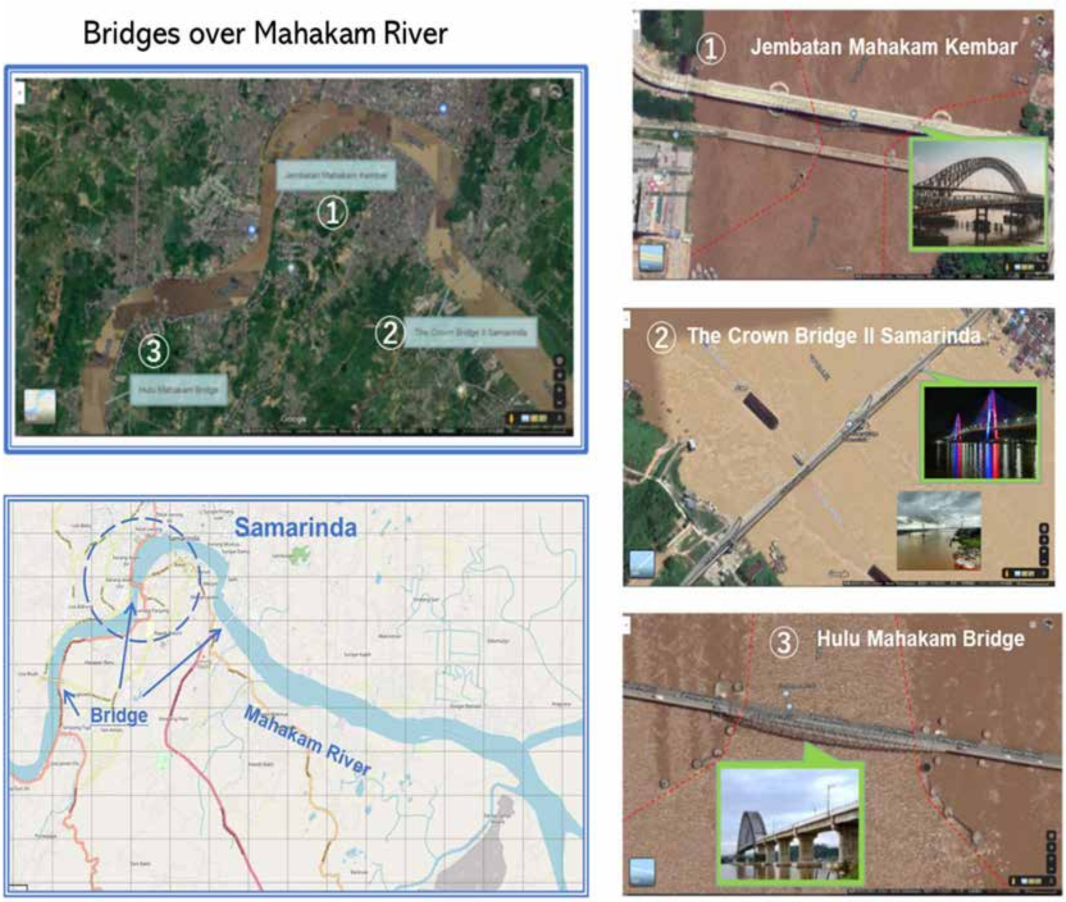
e) An accident is more likely to occur, when the river flow is strong and the flow direction of the river is heading towards the sea.

Picture 4.1.5 -1 : Mahakam Bridge, Barge towed by Tug boat

Picture 4.1.5 -2 : Google image (white arrows show barge image)

Picture 4.1.5 -3 : Loading Port (Yellow Arrow)

The following is the picture of the collision between a barge and a pier of the bridge and of the bridges over Mahakam River where is a difficult and dangerous pass, and piers are installed in the river.



Picture 4.1.5 -4 : Mahakam River and Bridges

4) Samarinda VTS sensors

Samarinda VTS has 2 sensors located. One in 50 km south river mouth of Muara Pengah is for mainly the monitoring of barge required deeper draft and big size vessel sailing in/out Mahakam River. There are several numbers of river branch from Mahakam River mouth, however it is not available for one sensor to cover full area range.

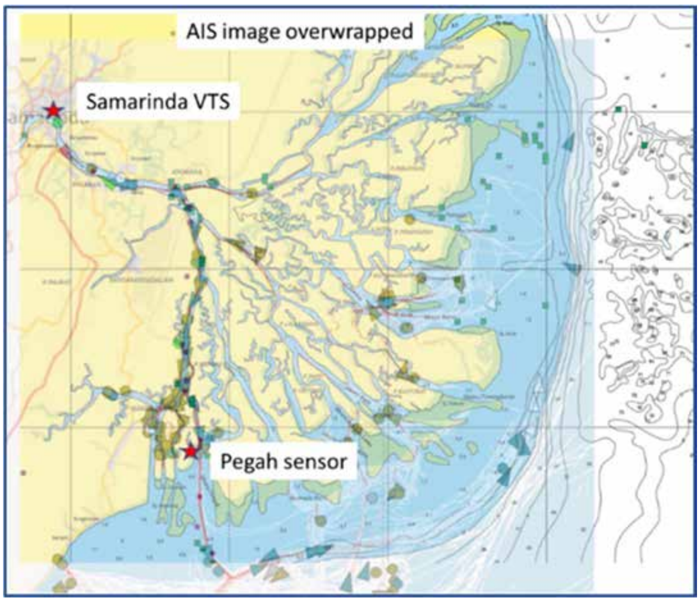


Figure 4.1.5 -2 : Samarinda VTS and Pengah AIS Station

Another sensor station at Tanjung Mangkalihat is located in North East end of peninsular just opposite of Sulawesi Island. AIS data captured in sensor are transmitted via duplex microwave to Samarinda VTS to monitor. Main aim of sensor is to detect traffic data in Makassar Strait between sensor and 75 NM (135 km) south east of Manimubaya lighthouse in North West end of Sulawesi.

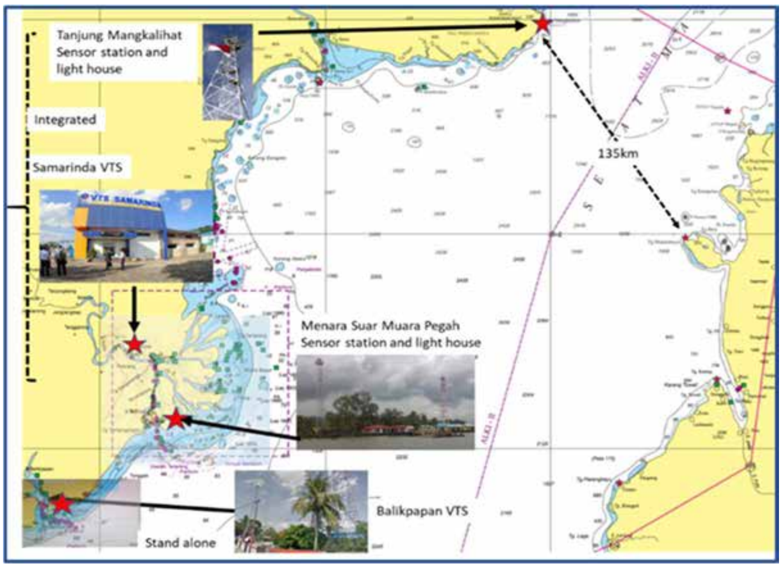


Figure 4.1.5 -3 : Tanjung Mangkalihat AIS station

5) Samarinda VTS and CRS

Both VTS and CRS are co-located at the same place and are operated together. Samarinda VTS provides weather information based on Meteorological agency's home page, and, the other hand, CRS broadcasts navigational warnings to vessels with VHF Radio.

When the Station obtains maritime accident information, the radio operator informs BASARNAS Samarinda, Syabandar Samarinda and the ship's agent of the situation by using a mobile phone. It is also submitted to DISNAV Samarinda office by the letter.

Picture 4.1.5 -5 : VTS Operation Room

6) Balikpapan VTS and CRS

Balikpapan VTS and CRS are about 90 km southwest of DISNAV Samarinda Office, and the city has the busiest seaport in Kalimantan.

The anchorage of Port of Balikpapan is divided into seven areas, and all vessels must anchor in the designated area by vessel's type and size.

The VTS operator sometimes gives instructions and advice to a vessel anchored at an inappropriate place, and/or informs navigating or anchored vessels of weather information based on the BMKG publication and navigational warnings with VHF Radio.

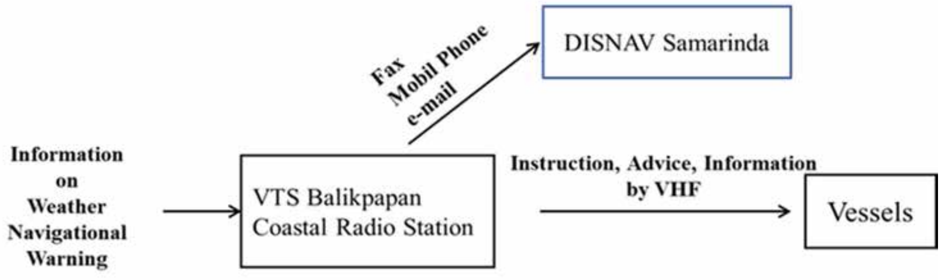


Figure 4.1.5 -4 : Flow of Information

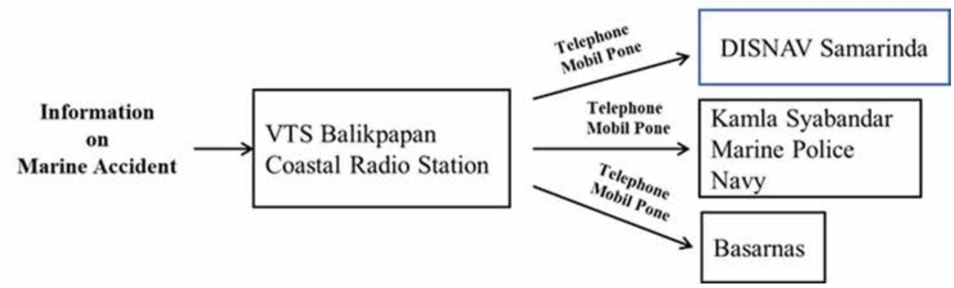


Figure 4.1.5 -5 : Information Flow when a marine accident occurs

Picture 4.1.5 -6 : Balikpapan VTS

7) Tukong Hill Lighthouse

The lighthouse stands at the entrance to Balikpapan Bay.

The light is placed at the top of the steel tower, and the radar antenna is also on the top floor of the tower to serve as a sensor station of Balikpapan VTS.

The light source has already been replaced to LED.

5 staff is assigned to this lighthouse to maintain the equipment and facilities.

Picture 4.1.5 -7 : Tukong Hill Lighthouse

8) Offshore Anchorage transshipment

Many of barges are arranged to transshipment off 10 km deep sea after Mahakam River mouth. Transshipment points have multi numbers of anchorage points in 100 km range (north to south) for transshipment of mining vessels. Current one VTS sensor does not fully cover this point's area. Multiple additional sensor stations are recommended to install in this area to be monitored by Samarinda VTS for safety operation purposes.

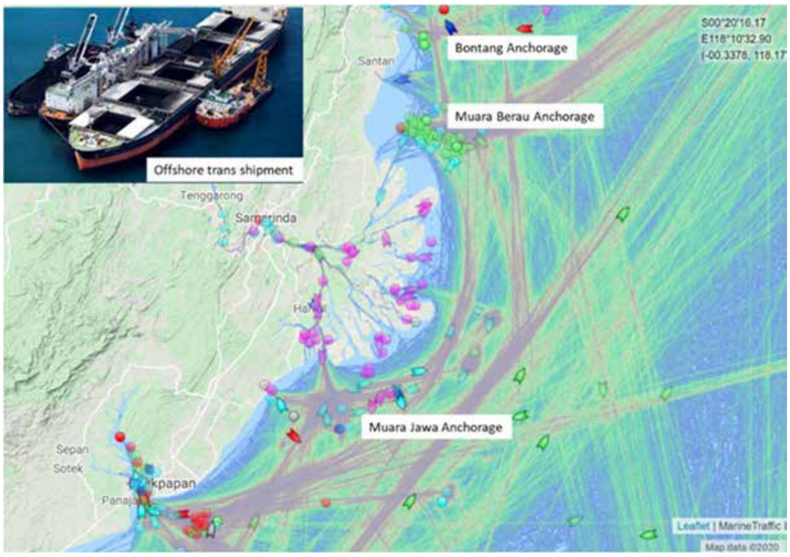


Figure 4.1.5 -6 : Vessels Flow around Samarinda

9) Buoy Tender and Aids Tender

a) KN MIANG BESAR (Buoy Tender Vessel)

The buoy tender vessel called KN MIANG BESAR was built in 2017 and the condition of the hull, engine and equipment are very good. The vessel was engaged in replacement of 3 buoys and in maintenance of 25 buoys in 2018.

b) KN MITHNA (Aids Tender Vessel)

The aids tender vessel called KN MITHUNA was built in 1974. The main engine was replaced with Dresser Ruascor Guascor manufactured in Spain in 2014.

The age of the vessel is 45 years old, but in good condition. There is no rust and corrosion. The problem is that it takes almost 3 months to obtain spare parts for the vessels, therefore it may cause to trouble for her mission. The vessel was engaged in replacement of 2 buoys and in maintenance of 37 buoys in 2018.

Picture 4.1.5 -8 : KN MITHUNA and KN MILANG BESAR

10) Issues to be improved

a) Considering the fact that the flow of Mahakam River is fast and affects the navigation of vessels, it would be effective to install a tidal signal measurement device and to provide the tidal information to vessels.

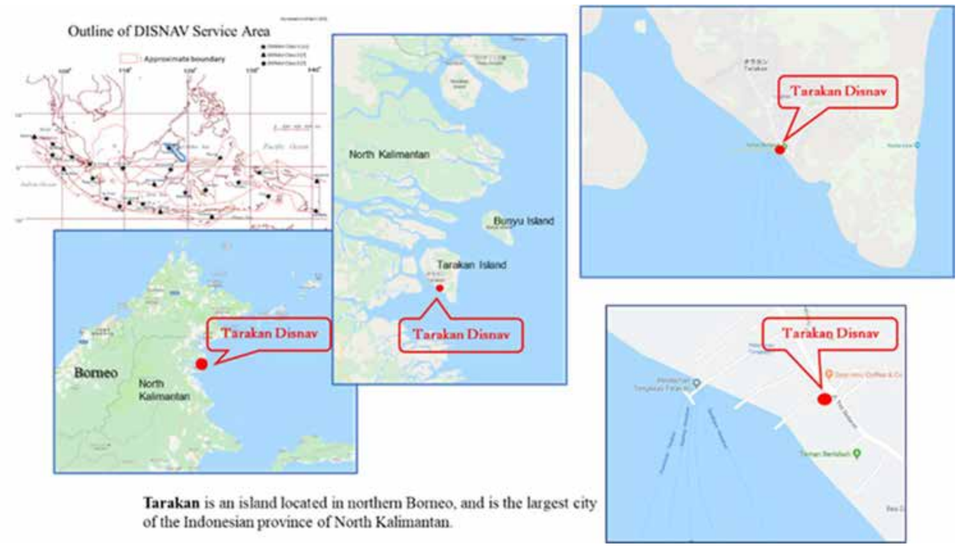
b) Since the light source of the lighthouse is replaced with LED, the maintenance is greatly improved. It may be possible to improve by the unmanned lighthouse by introducing a monitoring system.

c) There is the dead zone of VHF Radio in the sea-area controlled by the coastal radio station. It is desirable to install the additional TRX site and the repeater station.

4.1.6 DISNAV Tarakan Class III

1) Location

Province: North Kalimantan



Tarakan is an island located in northern Borneo, and is the largest city of the Indonesian province of North Kalimantan.

Figure 4.1.6 -1 : Location of DISNAV Tarakan

2) Outline of Tarakan

Tarakan is the island city and had a population of 253,026 inhabitants as of 2017, where is served with several ferries, linking it to other cities on eastern Borneo island. The port also provides links to cities on other Indonesian islands.

Once the city of Tarakan was a leading oil producer in Dutch East Indies, however, nowadays oil only comprises 6% of the total Tarakan economy. The economy is now dominated by fisheries and forest products.

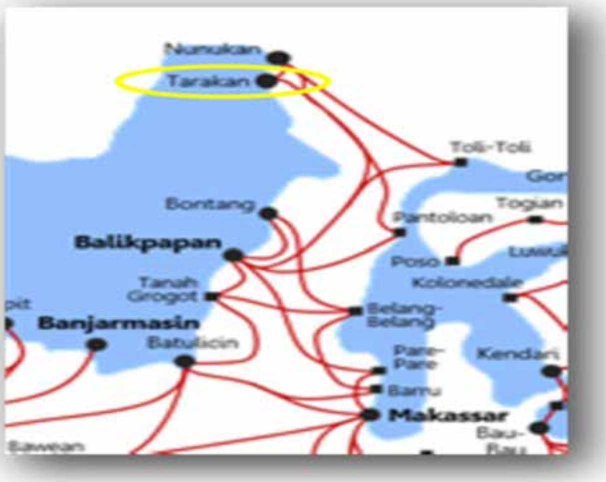


Figure 4.1.6 -2 : Regular Sea Routes

3) VTS and AIS

The VTS operation room is on the third floor of DISNAV Tarakan office, and an X-band radar is installed on the top of the 40 m steel tower on the site of the building.

Picture 4.1.6 -1 : VTS Operation Room, AIS Console

On the south side of the Tarakan Island, there are areas where AIS signals are not received due to the mountains. Therefore, there is a plan to install the repeater stations at the lighthouse on the south side of the island.

There is only one floating buoy in the port, and AtoN AIS is installed on the buoy for testing.

In relation to safety navigation, it is announced that there are still mines in the port.

4) Buoy Tender

The Buoy Tender Vessel is deployed to DISNAV Tarakan office for the installation and maintenance of floating buoys, transportation of supplies, transport of lighthouse staff and other missions, such as SAR (Search and Rescue).

Picture 4.1.6 -2 : Buoy Tender

The vessel, however, has many problems.

a) The vessel cannot work in shallow water, like the mouth of river.

b) It is required to use of fuel with frequent filter replacement.
   (20% biodiesel, 80% petrodiesel is labeled B20)

c) It is not enough manueuverability of the crane.

d) The vessel has high freeboard (weak against wind, waves).

e) Replacement of a floating buoy is limited to April and October due to bad weather conditions.

f) It is not enough automatic steering system.

g) There are less crews.

5) Buoy Base

Facilities, equipment, spare parts and machine tool are managed well.

Picture 4.1.6 -3 : Equipment and Machine Tool, Spare Buo

6) Lighted Beacon and Floating Buoy

The lighted Beacon and unlighted buoys placed around Tarakan Island are maintained every month, and the outer appearance of them is very good.

Picture 4.1.6 -4 : Lighted Beacon, Floating Buoy

7) Coastal Radio Station (CRS)

This station operates GMDSS, equipped with HF/MF/VHF radio, and AIS monitor.

The equipment is relatively new one as it was replaced several years ago. The facilities, such as an antenna tower, are getting older, but they have been repainted and been maintained well.

Pictrure 4.1.6 -5 : GMDSS Operation Room, Facilities, Antenna Tower

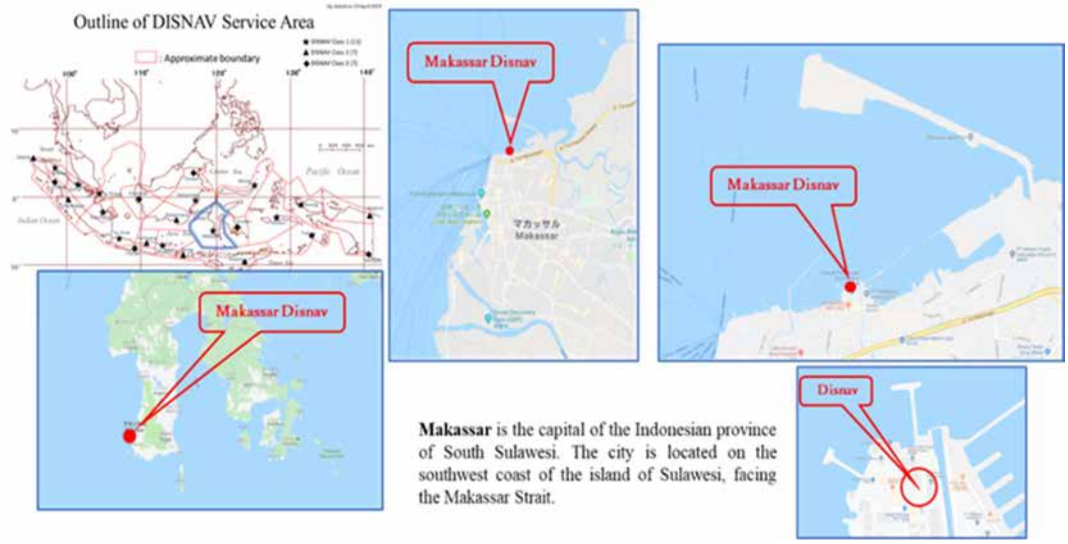
8) Other Topics

Vessels of over 60 GT in Indonesia have to be compulsory equipped with AIS Class-B from September 2019. In this district, about 200 vessels consisting from cargo vessels passenger boats and fishing boats will install AIS Class-B equipment until the notified date.

4.1.7 DISNAV Makassar Class I

1) Location

Province: South Sulawesi



Makassar is the capital of the Indonesian province of South Sulawesi. The city is located on the southwest coast of the island of Sulawesi, facing the Makassar Strait.

Figure 4.1.7 -1 : Location of DISNAV Makassar

2) Outline of Makassar

Makassar is the largest city in the region of Eastern Indonesia and primary port of southern Sulawesi, which has been an important trading port. It is also a major fishing center in Sulawesi.

3) DISNAV Makassar office and Makassar VTS

The DISNAV Makassar office owns a few AtoN vessels, Buoy Base (aids to navigation workshop) and Makassar VTS equipped with the radar system.

There is a training room for VTS operators, and the training programs are conducted by the office.

Picture 4.1.7 -1 : Makassar VTS Tower, Displays in Operation Room

Picture 4.1.7 -2 : VTS Training Room

4) Coastal Radio Station (CRS)

There are 5 stations operating GMDSS in this district, and Makassar CRS is one of them. This CRS is also one of the stations which are handling NAVTEX (Makassar, Tg. Priok, Ambon and Jayapura). But, the remote device between the receiving site and the transmitting site has failed and the system is not in operation as of July 2019.

This system is in the operation of an analog system that was introduced 10 years ago, and the distribution of information is performed in manual operation. Therefore, the present system cannot quickly treat with urgent notice, such as natural disaster of Tsunami, volcano eruption and so on.

Picture 4.1.7 -3 : GMDSS Operation Room and Equipment

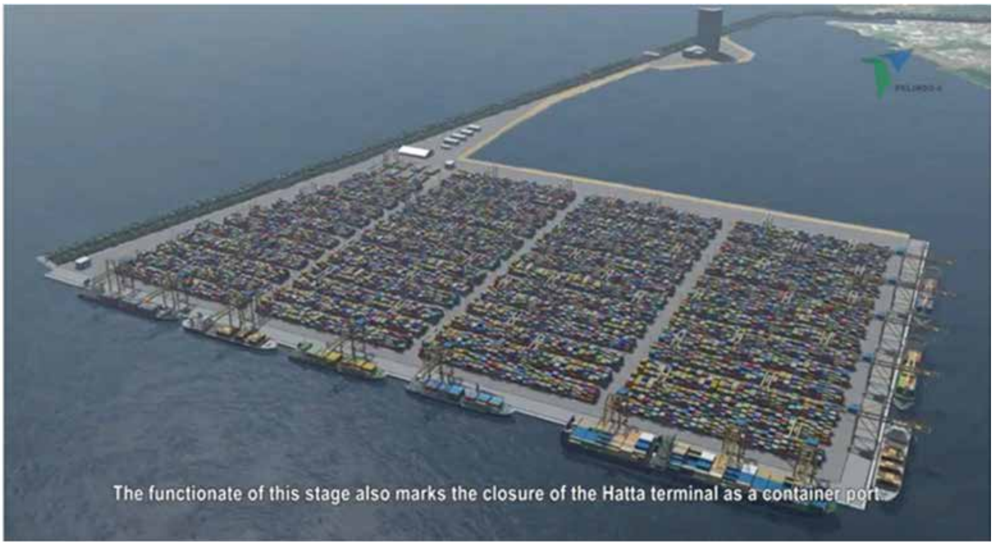
5) Port of Makassar

Port of Makassar is a major seaport in Indonesia. It has the highest passenger traffic among Indonesian ports and the largest cargo vessels traffic in Sulawesi. However, the port facilities are not sufficient for handling cargos, compared to other major ports [Tanjung Priok (Jakarta), Tanjung Perak (Surabaya), Belawan (Medan)].

Picture 4.1.7 -4 : Gantry Crane, Container Storage Yard

Under such circumstances, an expansion of the port, New Port Makassar, is under construction with an expected additional capacity of container cargos.

Along with the expansion, the number of vessels entering and leaving the port will not only increase, but also offshore marine traffic will be busy. It is understandably important to take safety measures for the traffic.



Picture 4.1.7 -5 : Composite Image at Completion

The offshore of Makassar is the crossing zone of the Lombok-Makassar Strait and the East-West Route from Jawa Sea to East Indonesia, and vessels navigating there and vessels entering the port will make a complex encounter.

Traffic management and information service are required with a kind of VTS.

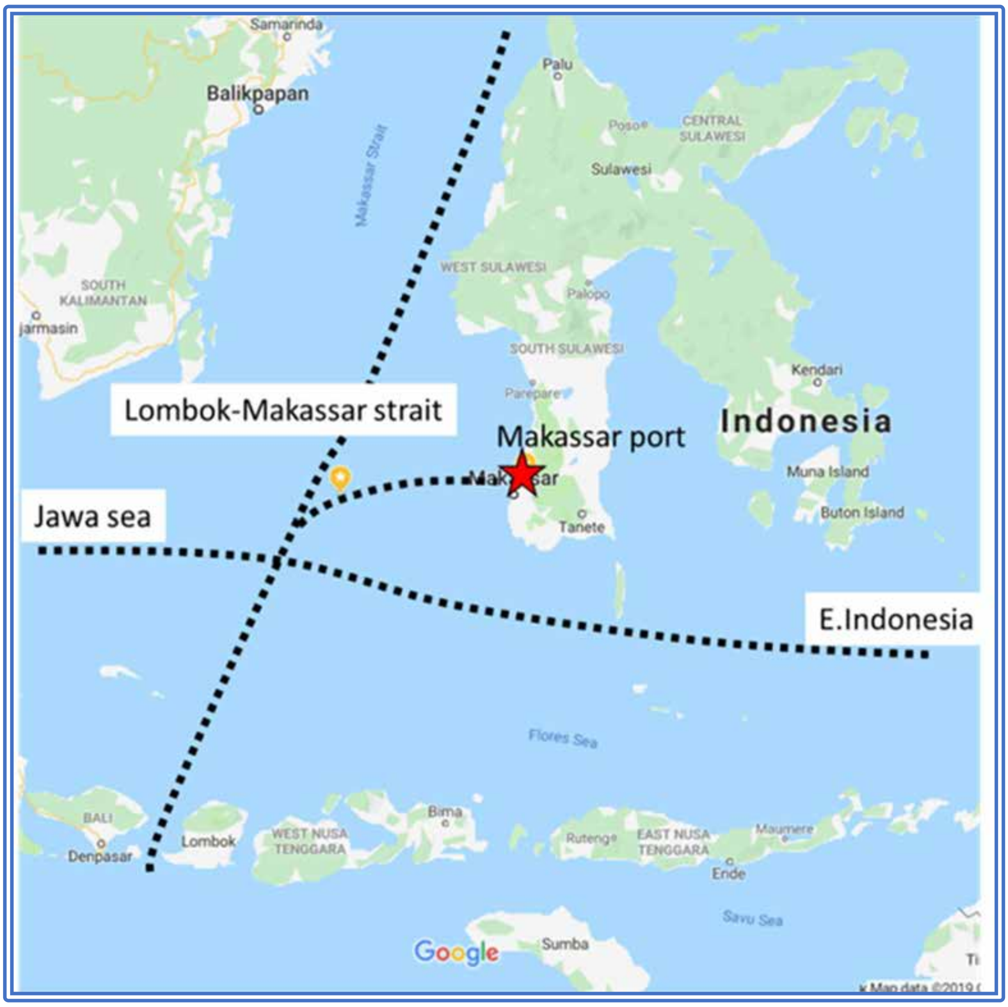


Figure 4.1.7 -2 : Imaginary Traffic Flow

4.1.8 DISNAV Belawan Class I

1) Location

Province: North Sumatra

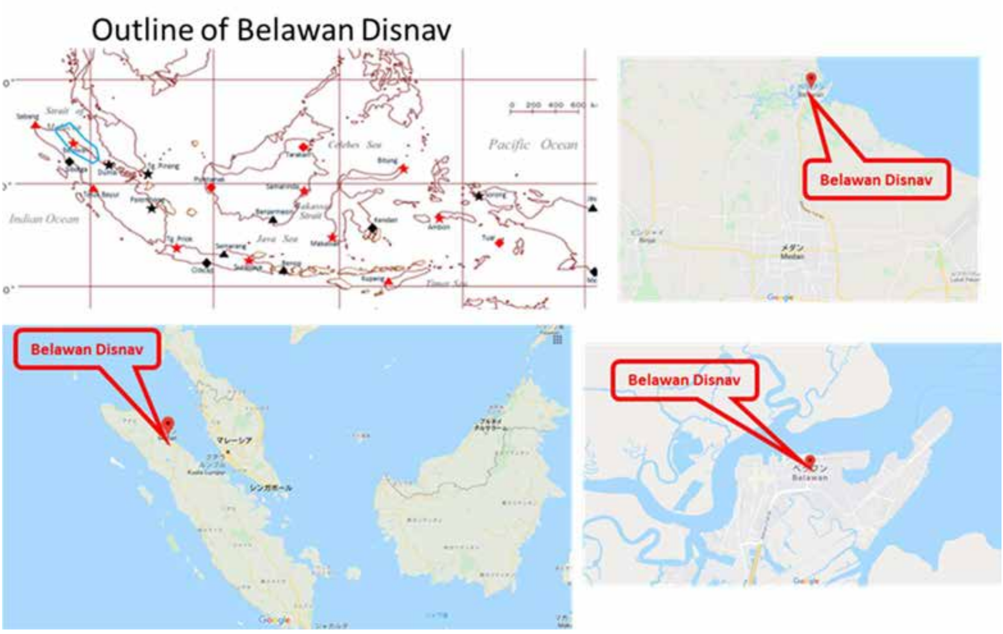


Figure 4.1.8 -1 : Location of DISNAV Belawan

2) Outline of Belawan

Belawan, the one of administrative districts of city of Medan with 2.2 million population (estimated as of 2019) was historically developed as main gate port of northern Sumatra just located 10 NM north of center of Medan. Medan, originally developed mainly for plantation industry since Dutch era in the 16th century, is the 3rd populous city currently following by Jakarta and Surabaya in Indonesia. City including greater Medan is continuously growing as business hub center of Northern Sumatra. DISNAV Belawan covered territory is mainly north Sumatra state in North East of Sumatra coastal around 280 NM distance up to half part of Ache State and located west part of the main sea lane of Malacca strait in northern part.

3) Characteristic of Belawan port

Belawan is defined one of key major national hub port with annual port handling capacity around 1.2 million TEU which is almost reached to limitation of capacity against total demand of cargo in the north Sumatra area. New port of Kuala Tanjung is newly developed in order to fulfill the shortage of handling.

Following is the specific point of Belawan port.

Historically port opened and developed at Deli river mouth, port depth is quite shallow for big ship to enter with high draft required. Shallow level is expanded up to 7NM off Belawan that route to develop shall depend on continuous dredging work twice a year.

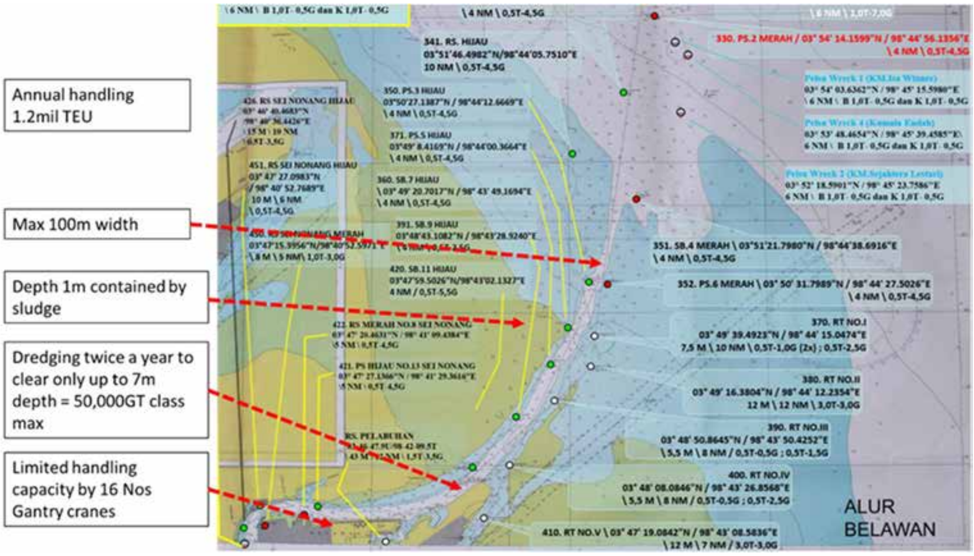


Figure 4.1.8 -2 : Port of Belawan

Even after dredging, depth can be committed up to around 7 m only which enable only max GT50, 000 class vessels to enter. It is required many hazard notice by many numbers of AtoN to indicate around entry route due to not only depth limit but maximum width limit only 100 m in dredged narrow passage.

Besides limitation of entry route, port handling limitation is due to limited numbers of gantry crane for handling container and limited space of storage area.

Picture 4.1.8 -1 : Port of Belawan

4) Belawan VTS

Belawan VTS located in front of Belawan port with 11 operators, 3 technicians and 2 administration staffs is regularly broadcasting information of accident or missing (drifting) of AtoN, crossing traffic and meteorological 4 times daily. Port radio operation is under Pelindo, not by Belawan VTS.

Picture 4.1.8 -2 : Belawan VTS

5) Operation at Belawan CRS (GMDSS) combined with Belawan VTS

In past one month before our visit, only one alert was received in designed area within Belawan territory. After confirming truth of received information, CRS is transferring to stakeholders as BASARNAS, Navy, Marine police and Harbor Master. If alert is outside territory, alert message will be transmitted to other DISNAV offices.

Picture 4.1.8 -3 : VTS and CRS

DISNAV operates 7 CRS located all in East coast of Sumatra faced to Malacca strait.

Those stations (★) indicated below are considerable for integrated and centralized to Belawan VTS with AIS and VHF voice communication & other information.

Figure 4.1.8 -3 : Location of CRS

6) Navigation service vessel

There are Buoy Tender KN Berhala (built in Batam ship yard in 2017) and Service Tender KN Arcturus in the station. KN Berhala has routine service of 187 days in 2018 with 5 lighthouses service, maintenance of 50 beacons and 41 lighted buoys, and 11 buoys replaced. Boat hull and engines are at good conditions except vibration generated from main engine.

Picture 4.1.8 -4 : KN Berhala, Belawan Buoy base

7) Outline of new Kuala Tanjung port

New port of Kuala Tanjung is constructed and developed in few separate phases.

Figure 4.1.8 -4 : Location of Port Kuala Tanjung

Currently 500 m berth is completed with 3 gantry cranes with logistic storage area. Due to shallow coastal area, 2.8 km length of pier (jetty) must be built from coastal lane vertical up to berth. Port is opened only for domestic cargo in this moment, however incompletion of facility such as inland logistic access of highway and railroad mainly to city of Medan, it is not easily expected to take over Belawan handling portion immediately. Future planned port handling is expected total 600,000 TEU per annually that includes taking over of current Malacca strait cargo transit hub function replaced from Singapore and Port Kelang and PTP, Malaysia.

Besides cargo handling, Kuala Tanjung port is planned to open for big size cruise vessel to stop and provide excursion service for passengers. Main candidate destination is to the nearest super priority resort of Lake Toba. Public port is operated under PELINDO with one jetty but others owned by private company (aluminum factory) in parallel.

Picture 4.1.8 -5 : 2.8 km Length Jetty, 500 m Length Berth

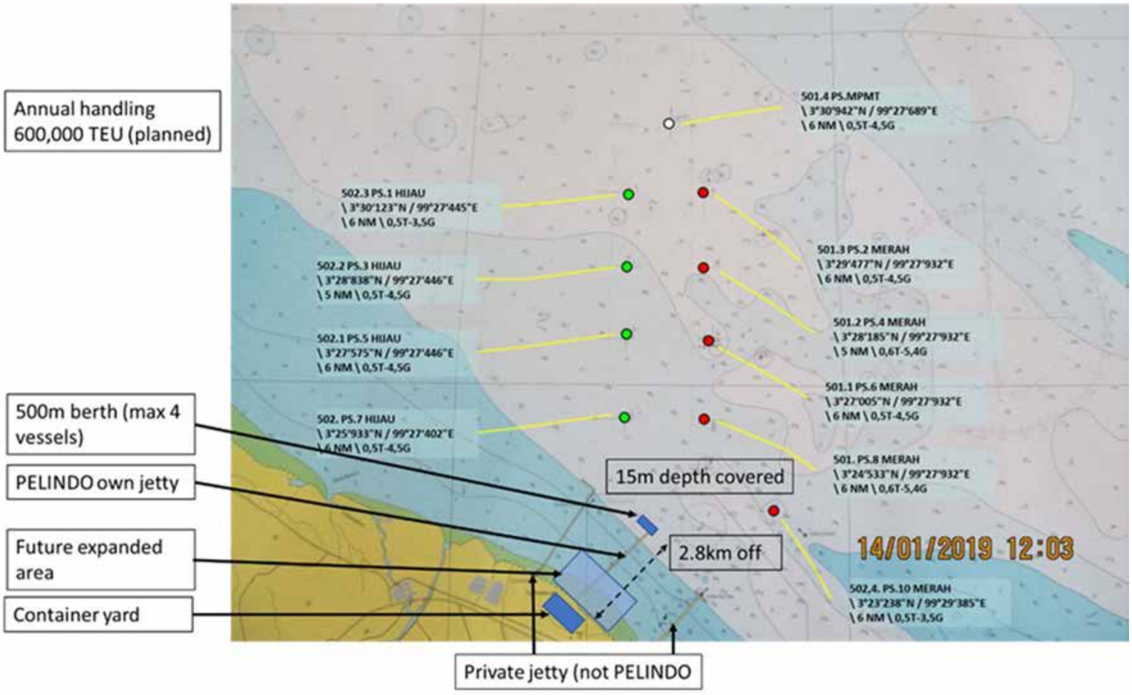


Figure 4.1.8 -5 : Location of Aids to Navigation

8) Coastal Radio Station (CRS) in Kuala Tanjung

DISNAV Belawan office operates Class 3 CRS in Kuala Tanjung located 1NM inland from port area. CRS has facility of A2 coverage equipment in JRC and Sailor mixed with standalone AIS (See the photos at the next page). However, this AIS is not shared and used by stakeholders of PELINDO office just nearby who is only monitoring of Marine Traffic website to capture vessel information via own PC. This AIS information shall be shared to all stakeholders as well as principal of Belawan VTS via IP line.

Picture 4.1.8 -6 : Kuala Tanjung CRS, AIS Display in Kuala Tanjung CRS

Picture 4.1.8 -7 : CRS Operation Room

4.1.9 DISNAV Sabang Class II

1) Location Province: North Sumatra

Figure 4.1.9 -1 : Location of DISNAV Sabang

2) Outline of Sabang

Sabang, main port town in “We” island off Bandar Ach (hereinafter generally called only “Sabang”), was developed in Dutch era. Geographically Sabang is directly facing one of internationally main gate way of sea traffic route between India Ocean and Malacca strait (whole South East Asia). In 19th century, Dutch built 25,000 tonnage capacity of charcoal fuel stock center for supplying to steam engine vessels crossing Indian Ocean or Malacca strait. Sabang was once of the busiest town to develop called as northern Singapore in that era. The Braeah island west Sabang has the national oldest lighthouse built in 1875 as well as the national oldest coastal radio station built in Sabang also. After steam engine vessel ceased, Sabang has been decayed and not much industry and activity are found in current days.

Picture 4.1.9 -1 : Sabang Port (1920)

3) DISNAV Sabang Office

The office is located in Sabang port with admin office, buoy station and 2 service tender boats. CRS Class 2 GMDSS located on half way of hill outside DISNAV office with another 5 remoted CRS in rural several areas. There is no VTS station in Sabang. Newly installed AIS is not full time in usage but only on demand basis. Data is locally captured to retrieve whenever needed only. In past one month before our visit they received 38 times alert in GMDSS but 6 times were error messages. Most serious distress happened in 2010 was grounding on the shallow reef between Rondo Island and Sabang. DISNAV Sabang Office manages 9 manned lighthouses within territory including one, the oldest lighthouse stated in above.

Picture 4.1.9 -2 : Coastal Radio Station, AIS display (Standalone)

Picture 4.1.9 -3 : GMDSS TX/RX, Buoy tender ANTARES

Picture 4.1.9 -4 : AtoN tender BENGALLA, Le Meuse light house/Sabang

4) Main sea lane off Sabang

North off Sabang 10-50 NM is the main sea lane route with estimated 100-200 traffic per day. The lane is shortest cut way between Malacca strait and Indian Ocean which has 2 different lanes split just after crossing off Sabang to India, Sri Lanka (direct to West), and to South Africa (South West). This is to say not only contribution to the nation of Indonesia but also one of the most important traffic routes in regional and global activity and political security aspects.

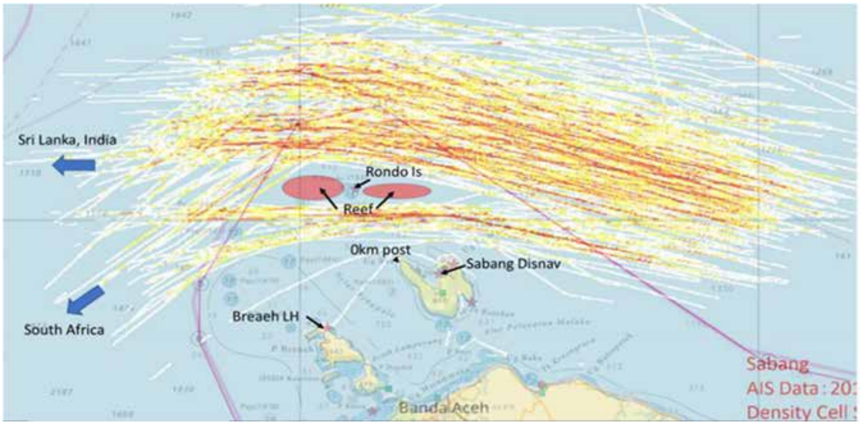


Figure 4.1.9 -2 : AIS Density Map

Above is 2 days self-captured AIS data traffic density analysis showing how busy in 2 different traffic crossing in left part. It shall be proposed at top priority to establish VTS function here with comprehensive navigational method to avoid any accident including possibility of setting up new TSS. Proposal detail is as per our priority proposal chapter.

Picture 4.1.9 -5 : Huge Vessel between the Island and Harzard

MAERSK line big container carrier crossing towards East between reef and Rondo Island

5) Highlight point of DISNAV Sabang in past and future

To repeat again here, geographically Sabang is in the one of very important location in the nation however it seems not much high priority given inside DGST currently. We assume following factors as the reasons behind.

- Economic and social activity in Sabang itself is quite limited.
- Most of busy traffic is only passing through off Sabang which does not much contribute to local benefit and effect in Sabang.

- Due to activity of The Free Ache Movement (Gerakan Aceh Merdeka, GAM) since 1970', there was over 30 years internal conflict with federal government. Ache whole state has been behind developed until 2005 after great Tsunami disaster on 26 Dec 2004. Ache Transition Committee (Komite Peralihan Aceh, KPA) takes over from GAM to have the peace agreement with federal government for recovering and development of Ache state. But development speed is still far behind from other states.
- Under such situation, Sabang was not stated or highlighted in former Master Plan in 2002 in important location of maritime safety measurement. Until now DGST does not have priority given.
- Under current busiest traffic flow off Sabang committed by AIS data analysis, it is urgently required comprehensive safety measurement to build up such as establishment of new VTS functions shared and liked with other part of East Sumatra VTS in Belawan, Dumai, and Batam. Also shallow marker AtoN has to install in reef around Rondo Island to avoid any accident as well as CRS upgrading for wider range broadcasting traffic information to whom entering Malacca strait from Indian Ocean.
- Sensor satellite candidate location

  Current CRS location is unadvisable due to not enough height from the sea level and surround by hills. Alternatively following are recommended.

  a. Rondo Island existing lighthouse tower

  b. Braeah Island lighthouse (Difficulty of data transmission to Sabang)

  c. North West of Sabang 0 km post (Top north of country)

  d. Highest point of mountain in Sabang (955 m height)

Picture 4.1.9 -6 : Rond Island, Braeah Island, 0 km Post

- Issue to overcome on human resources

  DISNAV Sabang Office has currently no experienced and skilled personnel in respect of operation and maintenance in VTS who must be required high level of skilled method of channel traffic control.

Alternatively, local operation by skilled personnel to be transferred from other VTS or fully remote operation by other VTS which installed with newly integrated system should be considered seriously in parallel and besides system introduction at site.

- Ensuring maritime traffic safety in Malacca Strait

  Off Sabang is the entrance/exit of the Malacca Strait and also the waypoint for vessels. Once marine accident/incident occurs there, the Strait would be inhibited to enter and to be forced to change to alternate traffic routes such as 2nd or 3rd Sea Lanes with additional days and economic cost. Therefore, to prevent serious disasters in these waters, the DISNAV Sabang office has a responsibility to maintain maritime traffic safety by monitoring the traffic route and providing appropriate information on the real-time traffic condition by VTS.

4.1.10 DISNAV Pontianak Class III

1) Location

Province: West Kalimantan

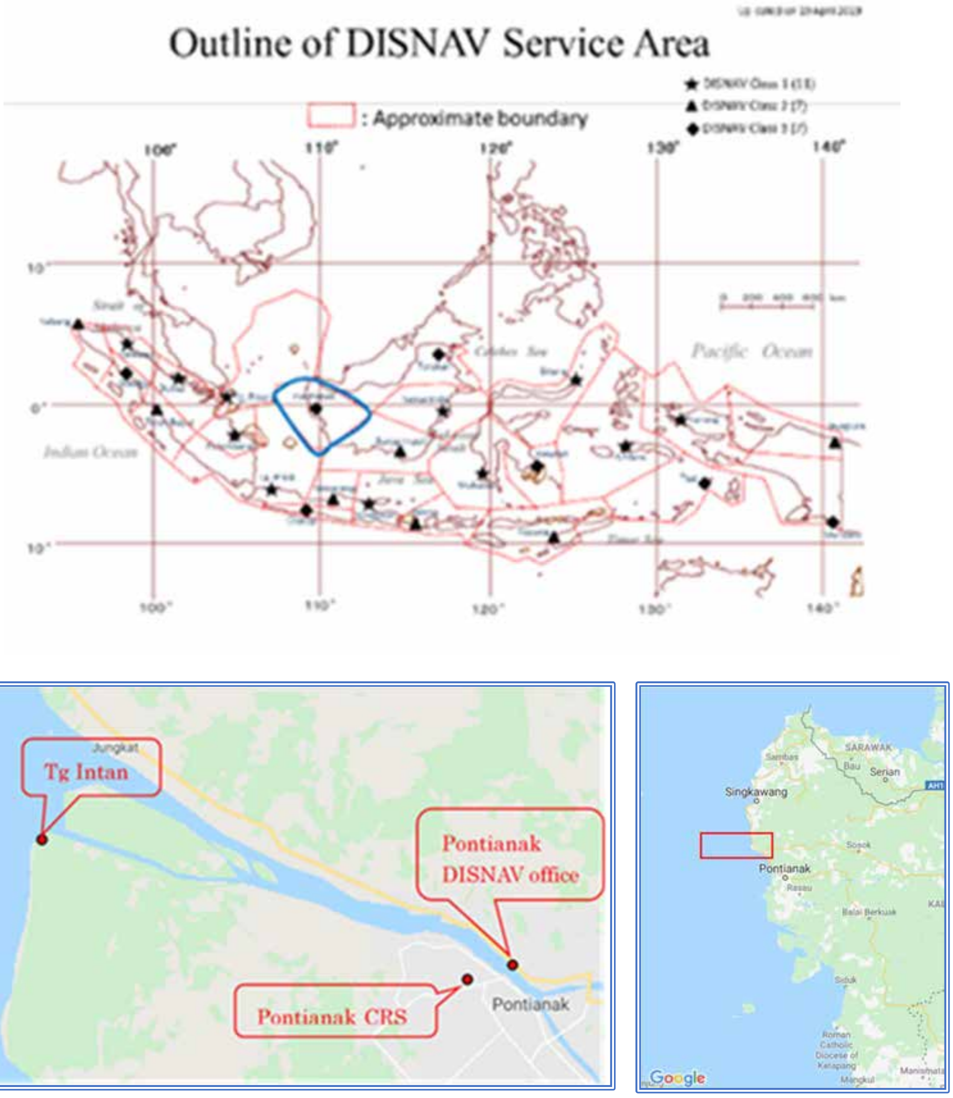


Figure 4.1.10 -1 : Location of DISNAV Pontianak

2) Outline of Pontianak

Historically Pontianak has been developed since 18 century as the main port of handing local natural resources such as logging, mining, plantation products of rubber and palm to export out. It has been world No.1 export record of logging before. Pontianak market provides the main index to control world logging market price. After logging was strictly banned to export under strict control, and other agricultural products were planted to replace.

Pontianak city has 570,000 populations consisting of many ethnic races such as Chinese, Dayak and Malay other than Javanese. 30% population of ethnic Chinese are mostly engaging of trading in town, and operation of various industries including big scale plantation.

Current Dwikora port (city center of Pontianak) has limited depth 6-7 m only due to high continuous sedimentation flown from main Kapuas river which is not available for big ship entry that require 12 m or more draft. Total handling capacity currently is 250,000 TEU only that is not enough to cover whole West Kalimantan province demand. Government decides to build new port 50 NM away from Pontianak called Kijing port in several phase enable to handle more than 1million TEU. Improvement is expected of current cargo vessels transaction that must be required transshipment in Singapore to small feeder to existing Dwikora port.

3) Present situation of Navigational vessels and facilities

a) Vessels

DISNAV Pontianak operates class 1 buoy tender KN. ALNILAM and class 3 patrol boat KN. PENGIKI. KL. ALNILAMA was built in 2009 at Demas Shipyard in Surabaya licensed by Damen Shipyard, Netherland. Vessel is at good maintenance however following issues to improve.

- ECDIS to be updated
- Inflatable rubber rescue boat is damaged severely especially for rubber material part. It assumes due to hot weather through whole year round. An only hull part is made of FRP but whole boat shall be made by FRP. Guess rubber material not appropriate to inflatable boat usage.
- Too slow winch action and movement
- Too big crane block visibility of operation

Picture 4.1.10 -1 : Buoy Tender KN. ALNILAM

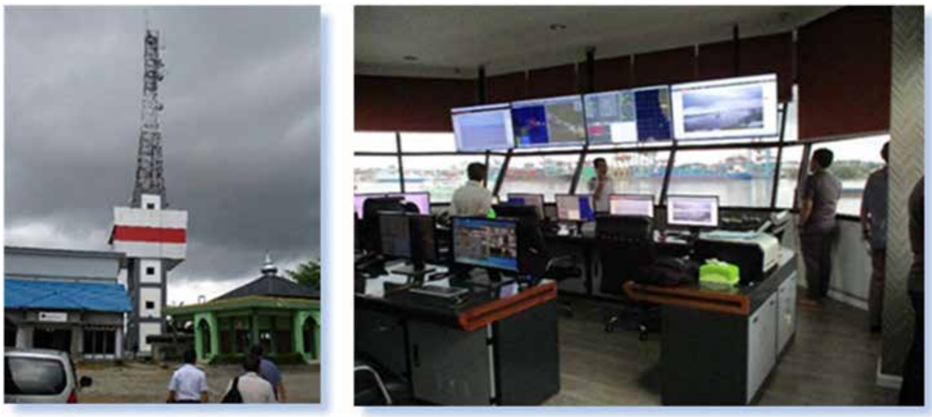
b) AtoN Workshop

Numbers of buoy are under usage not only sea but river. Regular and routine maintenance work is carried out with numbers of LED parts stock.

Picture 4.1.10 -2 : Buoy Base

c) Pontianak VTS

Pontianak VTS located in DISNAV Pontianak office is newly built in 2017 to monitor river traffic and port entry by 14 staff/24 hrs. Radar, CCTV and AIS are installed in sensor station at Tg. Intan remote sensor station (10 NM west at river mouth) to share data with VTS by duplex radio micro link. Port handling control is operated by PELINDO with closely monitoring of tide level flow to instruct vessel traffic permission.



Picture 4.1.10 -3 : Pontianak VTS tower and its operation room

Picture 4.1.10 -4 : Tg. Intan unmanned sensor station

d) CRS

In 3 CRSs under DISNAV Pontianak operation, Class 3 Pontianak CRS isolated from DISNAV office & VTS at opposite river side has MF/HF/VHF GMDSS. Originally started by JRC but replaced to SAILOR in 2014. Other 2 CRS in Sintete and Ketapang equipped with AIS data is sharable by IP line to Pontianak CRS (not VTS) on demand basis. SRS is under CRS's monitoring operation but no data transmission to MCC. Regular report to Pontianak CRS is made once a month.

Figure 4.1.10 -2 : Location of CRS

e) Tg Intan Lighthouse

Newly built reinforced concrete structure in 2016 is under repairing due to severe damage of outside panel on roof top by strong wind. Also sea water flooding is found up to inside structure during high tide.

Picture 4.1.10 -5 : Tg. Intan Lighthouse

4.1.11 DISNAV Bitung Class I

1) Location

Province: North Sulawesi

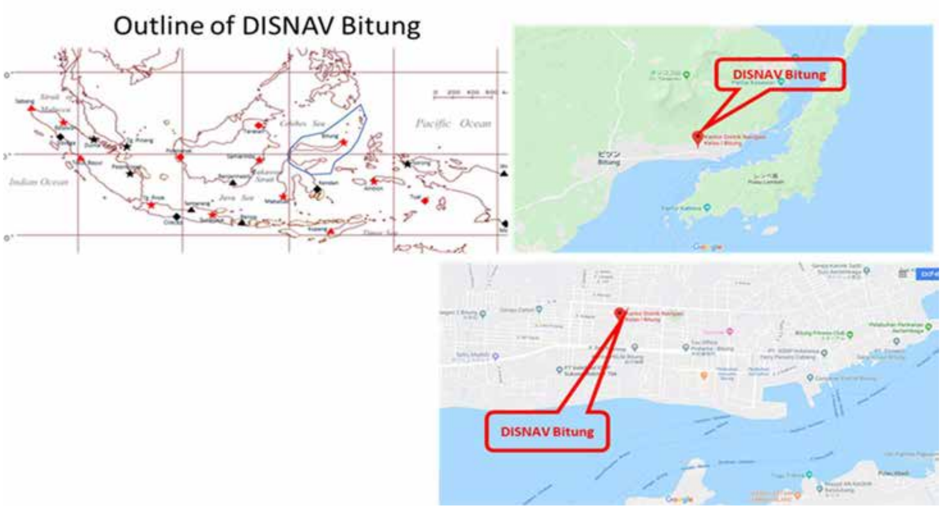


Figure 4.1.11 -1 : Location of DISNAV Bitung

2) Outline of Bitung

Bitung, the main port town of north Sulawesi state, has 220,000 population (as of 2019) to take key role of supply center of North Sulawesi state including capital city of Manado with 450,000 population. Instead of Manado already developed during Dutch era, Bitung has not much long history for city development until just after nation's independence.

Also, port function of Bitung is the important sea gate opened north of hundreds of islands in Sulu Sea spread between Sulawesi and Mindanao, Philippines called Sulu Archipelago. Bitung is designed as the one of national main hub port as well as Tol Laut hub. Port handling volume is approx. 150,000 TEU p.a. as not big as south Sulawesi Makassar port handling 800,000 TEU that is even expanding to new Makassar port under construction.

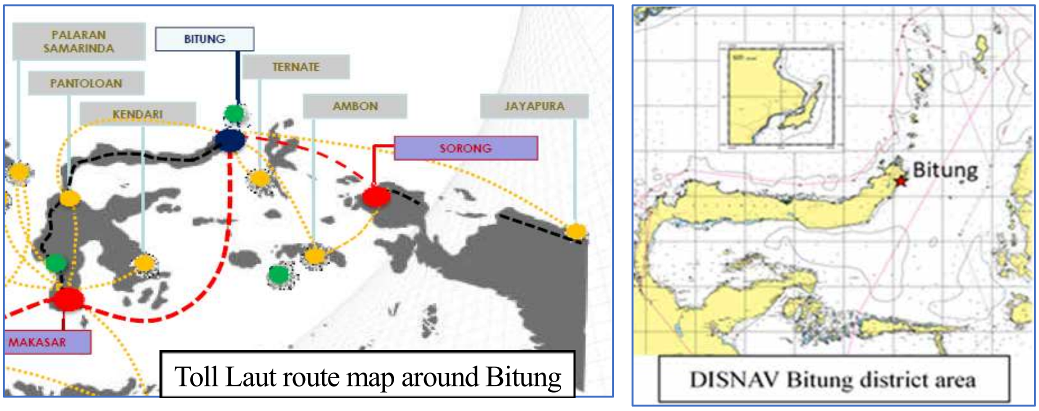
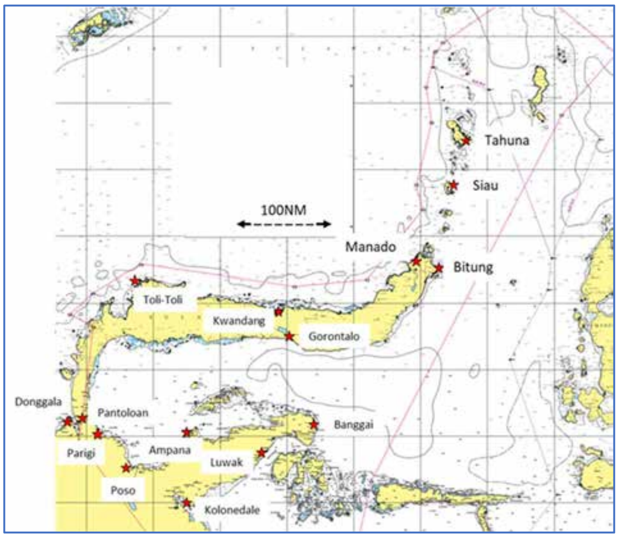


Figure 4.1.11 -2 : Highway and Railroad under construction

Between Makassar and Manado, Trans Sulawesi highway and rail road are now under construction to connect north and south island to unite and activate more economic corridors. The role of sea transport ex-Bitung would be greatly sustainable in the future.

3) DISNAV Bitung office

They are consisted by VTS, Class 1 CRS (TX, RX separated), 3 navigational boats station and buoy base in Bitung. 14 CRSs at district area is the biggest numbers of CRS among 25 district offices. This is due to cover up complicated Sulawesi island shape as well as long distance range in Sulu Archipelago to cover. Also so many numbers of AtoN, including 24 manned lighthouses in distanced location under operation, are huge burden of operation and maintenance in district office.

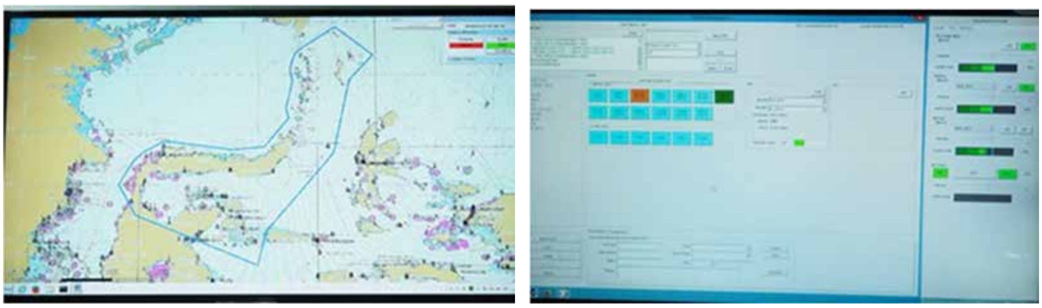


★ CRS Location

Figure 4.1.11 -3 : Location of CRS

However CRS has not much routine work to engage except regular metrological broadcasting once a day. There is the difficulty of long distance radio communication in MF/HF due to severe city noise interference in HF/MF. Basically city noise is suspected to generate by internet pulse noise jam in to radio antenna that is not existed when station built in long time ago. It is not easy to remove out those noises technically in receiver despites reception sensitivity down.

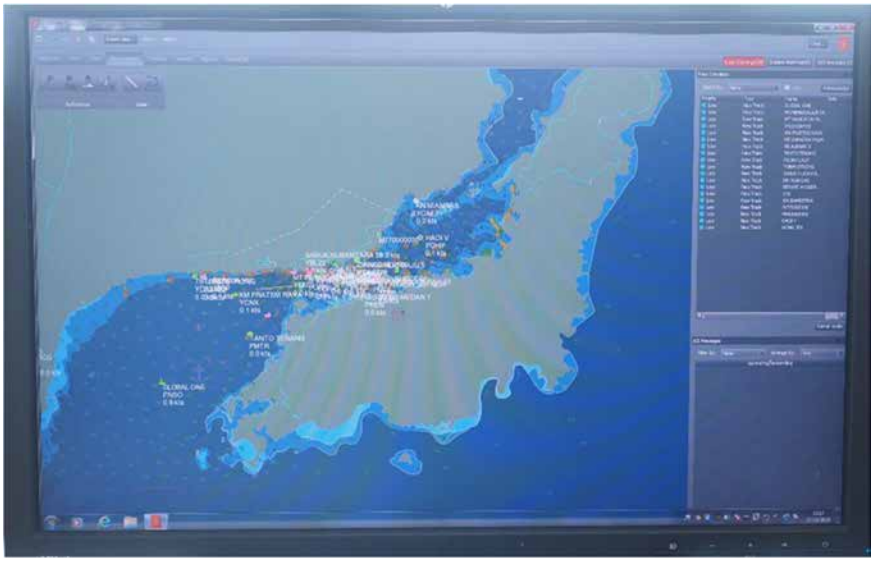
Picture 4.1.11 -1 : CRS Operation Room, CRS RX Station



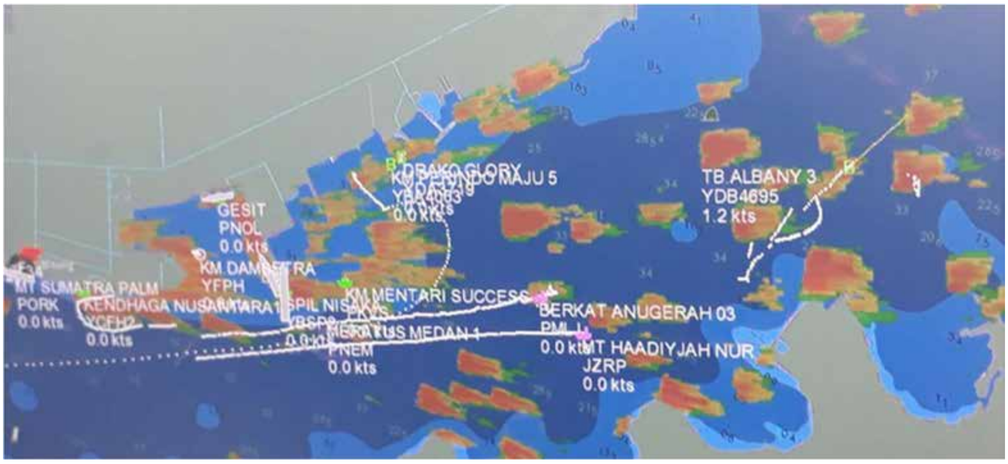
Picture 4.1.11 -2 : Display on GMDSS work station

VTS has 2 sensors data to consolidate in Bitung and Tg. Kapas (manned lighthouse). Bitung port radio is fully under PELINDO operation. VTS has no routine task to engage in this part. Ideally and originally VTS shall engage to operate in wider range of distanced route including Sulu Archipelago under Bitung service area. However, such designed system concept was not introduced but just standard and existing port monitor function installed only.

Picture 4.1.11 -3 : Bitung VTS tower, Bitung VTS operation room



Picture 4.1.11 -4 : Display of AIS



Picture 4.1.11 -5 : VTS image mostly targeted entry traffic to port only

KN Miangas 1500GT,
Built in Surabaya shipyard having engine vivration problem

Mera 450GT,
Repalced original Niiagata engine to bigger size engine cosuming more fuel

Picture 4.1.11 -6 : Buoy Tender

Picture 4.1.11 -7 : Buoy base, Workshop

4) Other facility than in Bitung

a) Tanjung Kapas Lighthouse

Located 15 NM down to south of Bitung, manned lighthouse joint with VTS censors with AIS and radar data transmitted to Bitung VTS via duplex micro link.

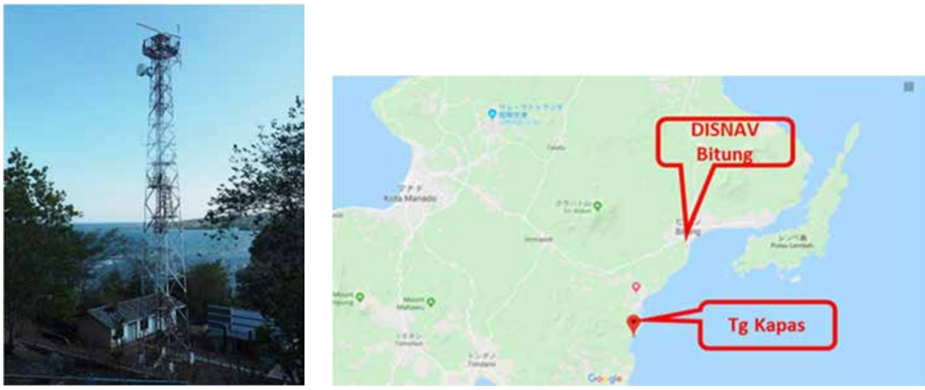


Figure 4.1.11 -4 : Tanjung Kapas Lighthouse

b) CRS Manado Class 4

Figure 4.1.11 -5 : Manado CRS

This is the only coastal radio facility in Manado city that has operation for North side of Sulawesi Island. There are many traffic on/off Manado as well as internationally well know diving resort island of Bunaken located just in front, however no VTS coverage territory by Bitung VTS. We recommend additional sensor in Manado (north side of island) to consolidate in Bitung other than class 4 CRS to depend on all traffic currently and solely.

c) Gn.Wenang (Manado) Lighthouse in Manado city

Manned lighthouse has been re-built at center of Manado as city monument just facing in front of Manado port. However due to technical problem in water drainage designing, original purpose of open public function is suspended.

Picture 4.1.11 -8 : Gn.Wenang (Manado) Lighthouse

4.1.12 DISNAV Surabaya Class I

1) Location

Province: East Jawa

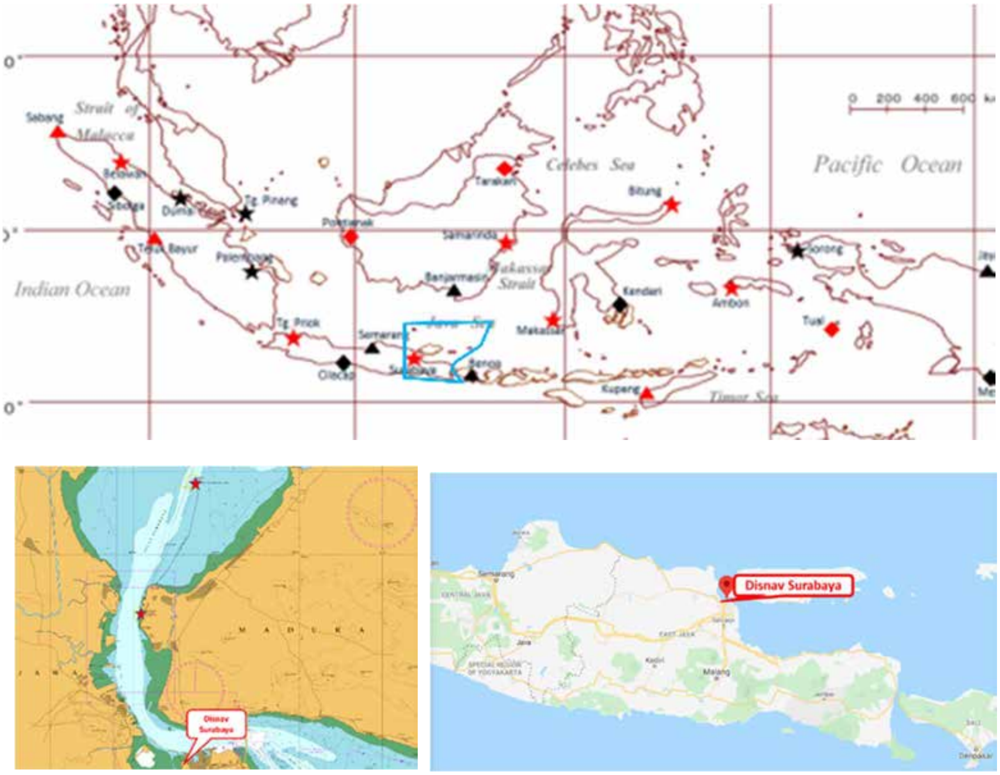


Figure 4.1.12 -1 : Location of DISNAV Surabaya

2) Outline of Surabaya

Surabaya, No.2 biggest population approx. 3.5 million following by Jakarta, is the center of West Java in commercial, industrial as well as sea transportation as well. Surabaya port named Tanjung Perak (here generally called Surabaya) is handling 800,000 TEU and 2.5 million tonnages per annually approximately.

Figure 4.1.12 -2 : Toll-Laut Route Map

Surabaya is the one of national major hub port especially for East Indonesia gateway from Java. Not only international, but domestic route vessel usage is very high portion as well as Toll-Laut route to East Indonesia.

Between Surabaya center at Jawa mainland and opposite Madura Island, narrow channel called “Selat (Channel) Surabaya” makes traffic difficulty. This is the highlight point for traffic safety implementation to avoid any accident here. This Selat Surabaya is considered to continue from port up to North Sea.

The maps below are the traffic density analysis (IWRAP) image maps produced by the AIS data captured (red = more busy traffic). From bottom of port, busy traffic in line can be seen continuously towards north up to 25 NM (direct distance), then freely sailing out to any destination. This is due to shallow sea bottom that only after 25 NM then more than 10m depth guaranteed.

Port operator (PELINDO) continues dredging this entry route to guarantee depth once a year in estimated costing RP80-85 mil. Port area is also dredged up to 13-14 m depth.

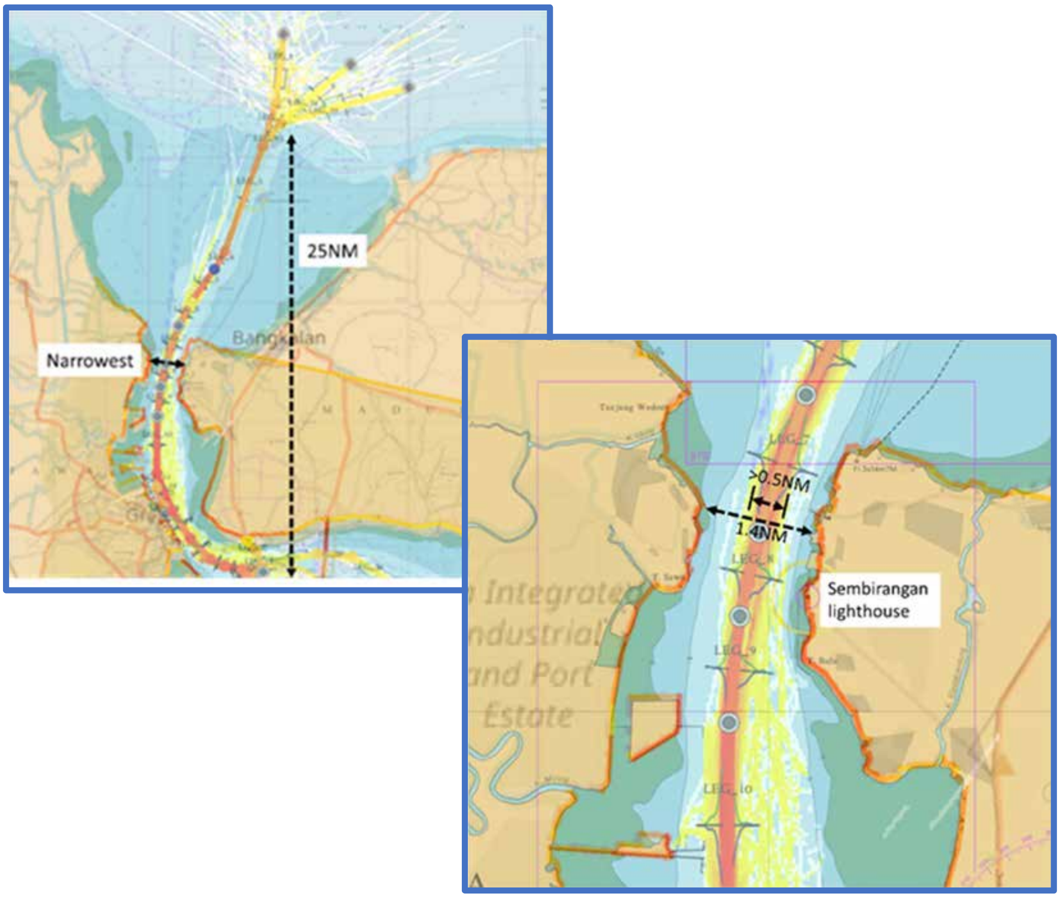


Figure 4.1.12 -3 : Traffic Flow in Surabaya

3) DISNAV Surabaya office

DISNAV Surabaya has VTS Center, 9 CRSs and buoy tender station (details of tenders introduced separately).

There is 2 main functions in DISNAV, one for port of Surabaya safety measurement and the other one for their territorial waters.

a) Surabaya VTS

For entry to Surabaya port, they need careful safety measurement required in their channel traffic control.

Actual accessible Selat Surabaya channel width would be narrower than 0.5 NM that can be found from this map. (Narrowest area is just north in front of Sembirangan lighthouse).

Safety navigation operation is fully required in VTS.

VTS located in front of port equipped by a company named SANATOS System with 12 operators with 3 technicians, 3 admin in charge per 3 shift/24hr.

There are 2 remote sensors stations following to Selat Surabaya to capture AIS, CCTV and Radar data shared with duplex micro link. Some of system is out of function.

Sembirangan lighthouse and VTS sensor tower are installed in same area at Madura Island. Radar is not functioning as magnetron does not be replaced. 3 A, B and C areas captured by 3 sensors (See the map below).

Picture 4.1.12 -1 : Surabaya VTS sensor tower and office

Figure 4.1.12 -4 : Location of VTS

b) Aids to Navigation

26 lighted buoys are arranged following to Surat Surabaya (See the chart above right side). Route divided in 2 as west side is called APBS (Alur Pelayaran Barat Surabaya) and the east side is called APTS (Alur Pelayaran Timur Surabaya). APBS is about 40 NM long and 37 lighted buoys are installed. Between the northern end of the strait and the longitude line of 7 ° N was dredged and set as a sailing route. The route is less than 0.5 NM widths.

c) CRS

DISNAV Surabaya operates 9 CRSs. Some are at remoted island on middle of Jawa Sea east. Operational cost for those stations to maintain is easily estimated high. Those remote island stations can be used for Jawa Sea traffic data captured sensors spot in the future. However, integration and merge of CRSs is seriously recommended.

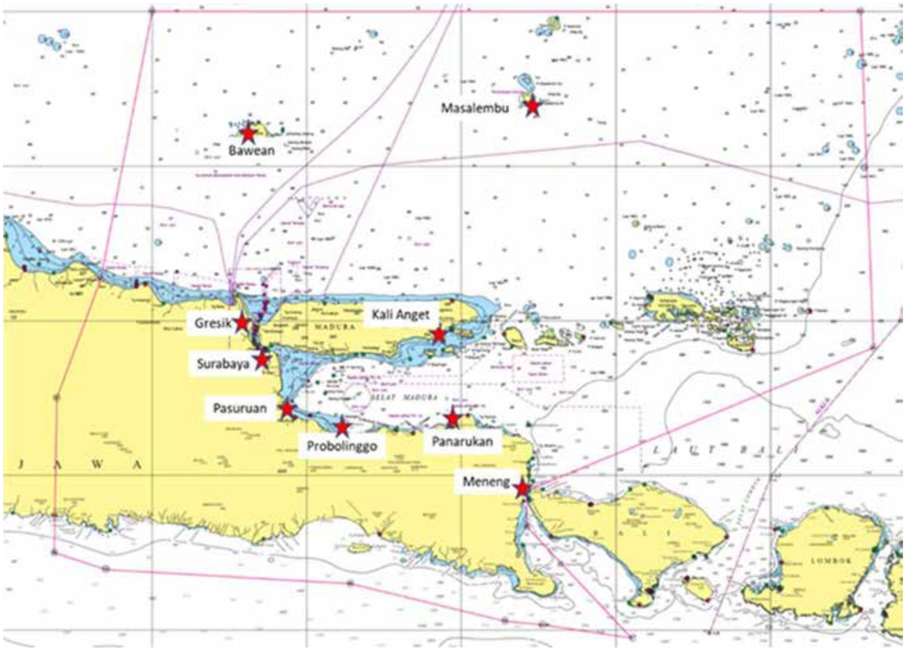


Figure 4.1.12 -5 : Location of CRS

d) Marine accident report

Following is the reported major accident report disclosed by DISNAV Surabaya for past few years for reference (See the next page: Table 4.1.12-1).

Table 4.1.12 -1 : Record of Marine Accident

Marine accident statistics (APBS) Annex 3

				2014
No	Date	Vessei's name	Position	Type of accident
1	01 Apr. 2014	KM JOURNEY KMLAMBELU	7-10'667"S 112-41'500E	Collision and JOURNEY sinking
2	31 Dec. 2104	KM TANTO HARI KM SIRIUS	7-10'667"S 112-41'500E	Collision and SIRIUS sinking
				2015
1	28 Jun. 21015	KM.NAVIGATOR ARIES KM. LEO PERDANA	6-55'38.6 S 112-41'50.8E	Collision
2	16 Dec. 2015	KM. WIHAN SEJAHTERA	7-11'03.302S 112-41'49.18"E	Sinking
				2016
1	04 Jun. 2016	KM.ASIKE-1 KM.MENTARI SUCCES	7-10'667S 112-41'500"E	Collision
2	15 July, 2016	KMINTAN DAYA 8 KM.GEORGIA	6-52'564"S 112-44'068"E	Collision
3	27 July,2016	KM.MERATUSSPIRIT	6-56'31.5"S 112-43'05.19"E	Engine trouble
4	30 July, 2016	KM.ISE BARU	7-11'28.35S 112-43'47.95"E	Collision
5	23 Sep. 2016	KM.BERKAT MULIA	7-11'00.00S 112-41'09.00E	contating wreck ship
6	27 Sep. 2016	KM.ANUGERAH INDAH	7-11'00.00S 112-41'09.00E	contating wreck ship
7	27 Sep. 2016	KM.RED ROVER TB.SDC 2	7-06'30.59S 112-39'37.90"	Collision
8	9 Oct. 2016	KM.DHARMA KARTIKA9	7-11'00.00S 112-41'09.00E	Engine trouble
9	1 Nov. 2016	KM.DEWA RUCI PERKASA	7-07'26.88"S 112-39'37.39"E	Sinking
10	21 Dec. 2016	TB.APRILIDO	6-52'27.90"S 112-44'44.48"E	Sinking
				2017
1	3 Feb. 2017	KM.MUTIARA SENTOSA1	6-51'42.80"S 112-44'33.70"E	Empty fuel
2	21 Mar. 2017	KM.MITRA PROGRESS3	6-55'06.19"S 112-43'35.58"E	Grounding
3	5 May, 2017	KM.ASIA PRIMA1	7-12'01.12S 112-93'20.79"E	Fire
4	10 July, 2017	MV.CAPE MORETON	6-52'27.90"S 112-44'44.48"E	Grounding
5	10 July, 2017	KLM.ARTO SURO	7-08'02.57"S 112-40'04.16"E	Fire
6	12 July, 2017	KM.PEKAN FAJAR	6-51742.80"S 112-44'33.70"E	Fire
7	7 Aug. 2017	KLM.SINAR PURNAMA JA	6-55'01.78"S 112-43'15.48"E	Grounding
8	27 Aug. 2017	KM MULTI ABADI 01	7-12'01.12S 112-43'20.79"E	Fire
9	4 Oct. 2017	KM.KTC1	6-53'20.00"S 112-44'11.00E	Grounding
10	9 Dec. 2017	MV.ALTAMANDA	6-55'06.19S 112-43'35.58"E	Engine trouble
11	10 Dec.2017	MV.ST ISLAND	6-52'27.90"S 112-44'44.48"E	Grounding
12	13 Dec. 2017	MT.FASTRON	6-58'23.00S 112-42'10.00"E	Engine trouble
13	20 Dec.2017	MT.SELE KM.SML9	7-08'07.49S 112-40'42.09"E	Contacting during anchoring

4.1.13 DISNAV Teluk Bayur (Padang) Class II

1) Location

Province: West Sumatra

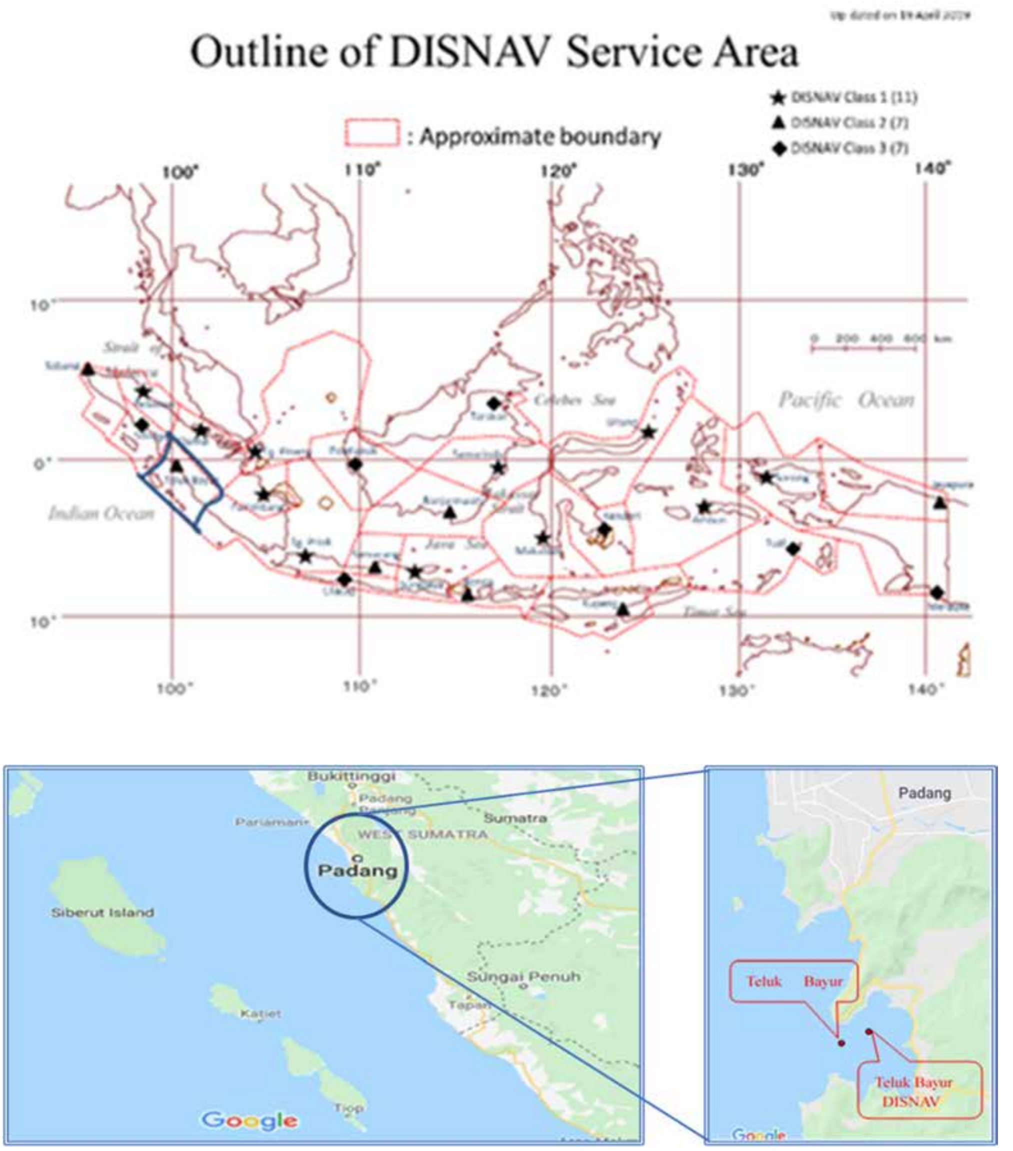


Figure 4.1.13 -1 : Location of DISNAV Teluk Bayur

2) Outline of Teluk Bayur (Padang)

Generally called Teluk Bayur is the name of port in capital city of Padang in West Sumatra state. Padang with population 930,000 (as of 2018) is mainly dealing of Palm plantation industry and cement production to export out from Teluk Bayur port. DISNAV Teluk Bayur office is located inside Teluk Bugas bay just next Teluk Bayur. Teluk Bayur port has been developed in 19th century Dutch era but renovation was recently done to expand 500 m length of container terminal from previous 150 m with 7 gantry cranes installed estimated in 70,000 TEU handling capacity per annually.

3) Present situation of Navigational vessels and facilities

a) Vessels

DISNAV Teluk Bayur operates KN Muci, KN Sibaru-Baru, and class 1 buoy tender. JST observed KN Muci which was built by Niigata in 1974 in good maintenance condition, however aging of hull and equipment, and crane handling dropped 50% to 1.5 tons only must be noted. ECDIS installed but not functioning currently due to difficulty of repairing parts availability. According to vessel crew, old built KN Muci (by PT Caputra Mitra Sejati shipyard, Merak) is not rolling than newly build KN Sibaru-Baru.

Picture 4.1.13 -1 : KN Muci, Bridge

b) Aids to Navigation

Total 10 non-lighted buoys and 108 lighted buoys are under DISNAV. Theft of battery or lantern part on the water would be found often. DISNAV is looking for any effective solution to prevent.

Picture 4.1.13 -2 : Buoy base

c) Workshop

Located inside DISNAV office equipped with lathe and welding machine for maintenance work of buoy basically. Replacement or repair parts are stocked in own warehouse. Some work needs additionally in outsource.

Picture 4.1.13 -3 : Welder, Lathe, Crane vehicle

d) Teluk Bayur VTS

(1) Located 4km away from DISNAV office at top of cape inside CRS office built in 2000 and renovated in 2014, has monitoring function for 2 ports of Teluk Bayur and Teluk Bungas by 12 operators (24hrs/3 shift).

(2) Monitoring and entry management up to 52 NM area off port by AIS is under VTS operation and inside port, pier monitor management is under Pelindo.

(3) Radar was out of function by lightning strike since 2015 until now without repairing.

(4) VTS Operator has been trained at training facility, Jakarta (BPPTL).

Picture 4.1.13 -4 : Facilities of VTS

e) CRS

Teluk Bayur CRS (Class II)

(1) Located and combined with VTS facility equipped with MF/HF/ VHF GMDSS started in 2009 CS4 project by JRC.

(2) MF/HF transceiver is out of function accordingly replaced to ICOM currently however reception sensitivity is down in single frequency mode in narrow range that might be improved immediately.

(3) VHF radio equipment has also sensitivity issues which cause difficulty of communication.

(4) SRS is not operated

(5) IP fiber optical line is under service however bandwidth looks not so efficiently.

Picture 4.1.13 -5 : MF/HF, VHF TX/RX, GMDSS Console

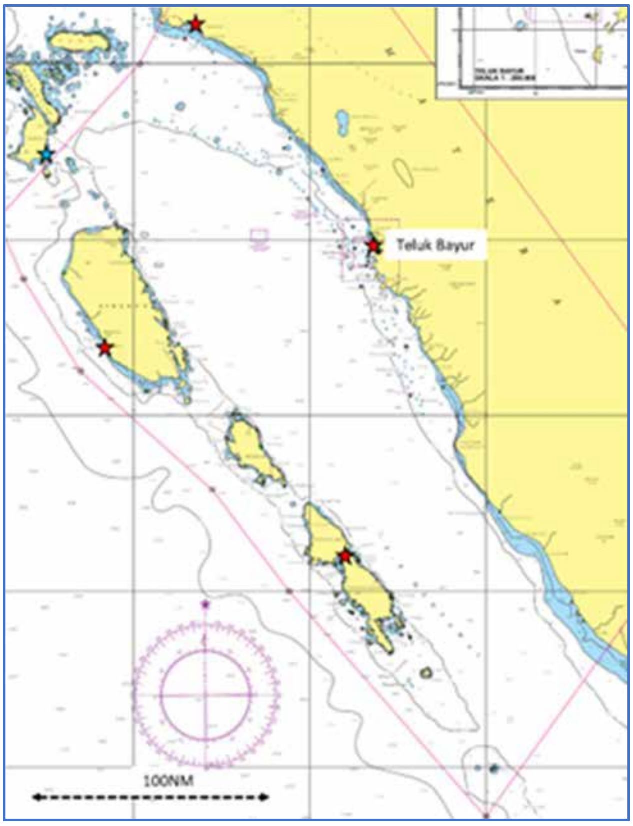


Figure 4.1.13 -2 : Location of CRS

f) Lighthouse

DISNAV manage 8 lighthouses. Below is the one located 90 km from Teluk Bayur CRS at top of cape built in 1975 made by concrete tower.

Picture 4.1.13 -6 : Lighthouse structure, Lens part

4) Future project

a) The function of VTS and CRS (GMDSS) will be moved to next to the lighthouse building currently under construction.

Picture 4.1.13 -7 : New building under construction

b) Only 2 ports are available to monitor by VTS so far, remote AIS sensor will be installed in northern port in order to integrate with VTS to monitor all 3 ports under DISNAV operation.

c) AIS sensors would be installed at remote 3 CRSs. Air Bangis has IP fiber optical line however, no fiber line existed in Sipora and Sikakap island 150 km west off Teluk Bayur are required to take into consideration of solution. In this moment communication way is by 3G/LTE mobile data (GPRS: General Packet Radio Service) or HF SSB radio.

d) Teluk Bayur port is going to improve capacity from 125 vessels per month.

4.1.14 Labuan Bajo (Komodo National Park under DISNAV Kupang territory)

1) Location

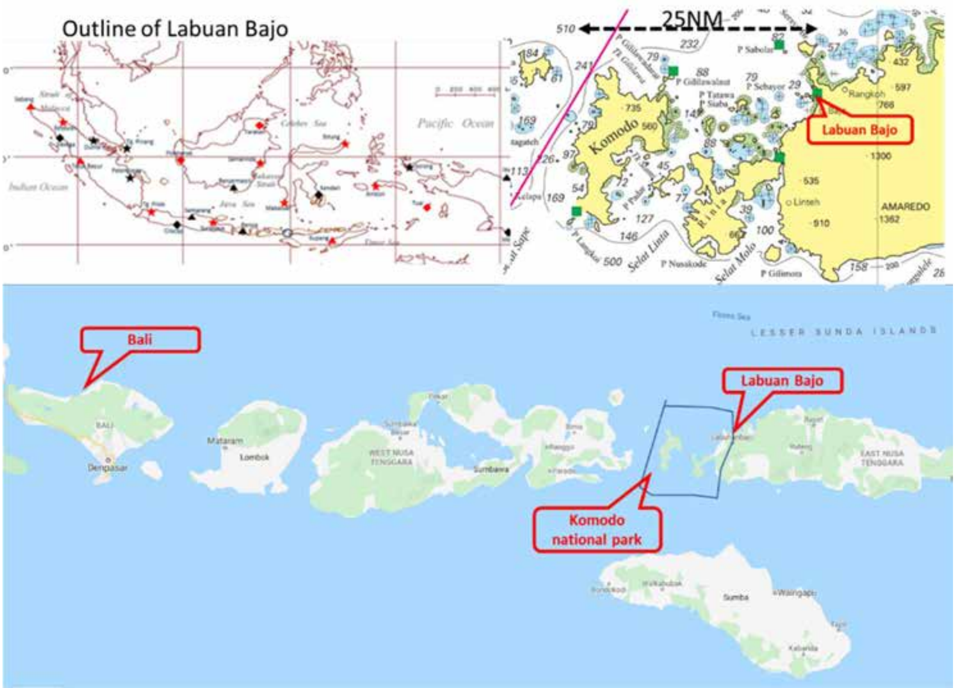


Figure 4.1.14 -1 : Location of DISNAV Labuan Bajo

2) Outline of Labuan Bajo in tourism attraction

Labuan Bajo (representing generally whole Komodo National Park), the small town originally having less than 10,000 populations, is the one of the hottest national tourism spot now. Recently President Joko has announced that Labuan Bajo is the top priority super priority tourism resort to develop and promote internationally following by famous Bali Island success. In 2018, total 160,000 tourists have arrived at this small town from abroad and local.

Sunset of Labuan Bajo bay viewed from hill top. Most of boat anchoring bay inside

Picture 4.1.14 -1 : The Bay of Labuan Bajo

This tourism booming has just began within last few years. This town is located 300 NM east of Bali Island at west end of Flores Island under Nusa Tenggara Timor (NTT) province. Labuan Bajo is the gateway to Komodo national park which is widely well known by Giant Komodo dragon habitat in Komodo Island in long history.

Komodo Island being under restricted condition for entry to keep and protect dragon, there is a huge tourism resources inside national park including numbers of splendid beaches and diving spots, are spread over the national park that is the main attractive point for tourist. Main tourism islands of Komodo, Rinca and other small one off Labuan Bajo are originally generated after the volcano eruption activity consisting of sharp cliff and caldera bay under or half sea water creates unique attractive scenery contrast.

Picture 4.1.14 -2 : Contrast view of sharp cliff and caldera bay, Padar Island

Picture 4.1.14 -3 : Pink beach, South of Komodo Island, Komodo Island main entrance pier

Picture 4.1.14 -4 : Coral and Sand Island appeared in low tide, Giant Komodo dragon

3) Tourism traffic situation

At least 25 diving and tourism spot inside national park spread to whole park area, there are confirmed (registered) 500 passenger boats serving tourist from Labuan Bajo town to every site daily. Unregistered boats are estimated another 200 Nos under operation. All tourists must engage to take boats at Labuan Bajo town mostly in many tour agents existing in town.

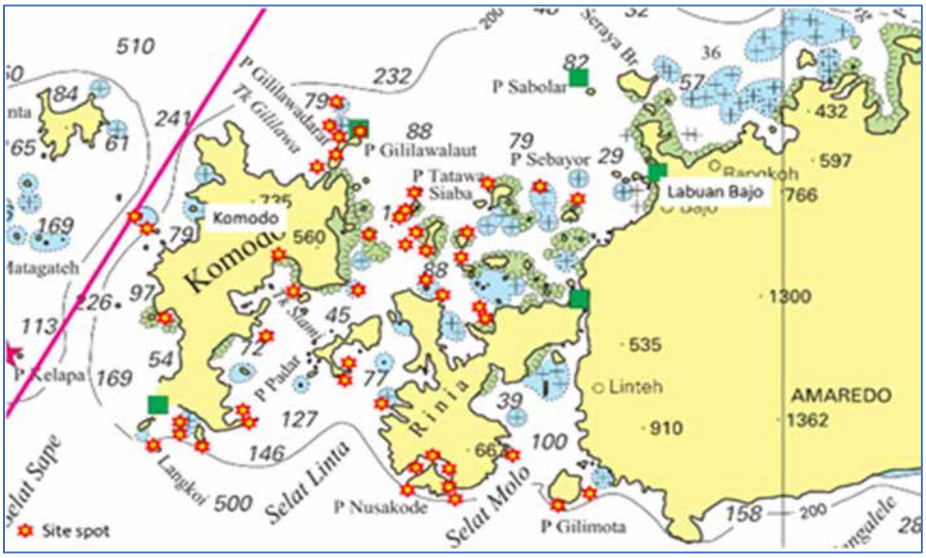


Figure 4.1.14 -2 : Diving Spots

There are 3 categories of passenger boats clarified,

a) Speedboat powered by outboard motor with max 10 passengers below 10GT

b) Conventional passenger boat with max 10 passengers below 30GT
(1 or 2 times for daily trip only)

c) Hotel boat with accommodation and kitchen with max 20 passengers for 50-100GT
(Multi day trip service provided).

Picture 4.1.14 -5 : Speed boat below 10GT, Conventional passenger boat below 30GT

Picture 4.1.14 -6 : Hotel boat 50-100GT

Those traffic movements is neither monitored nor controlled by any authority currently. Just sailing out permission is provided by UPP (Unit Perniangaan Pelabuhan = Port Business Unit) as only one authority to represent of DGST upon submission of boat name and passenger list by boat operator without any itinerary schedule, plan and other details to submit.

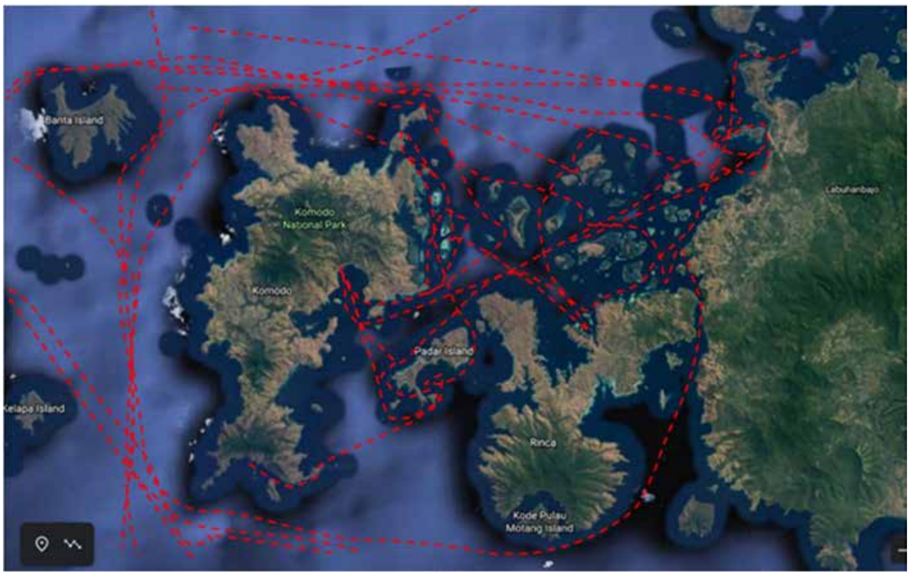


Figure 4.1.14 -3 : AIS Tracking Trace

4) Current Maritime Authority of UPP

As per AIS analysis, tourism boats can run any non-designed route without authority's instruction or acknowledgement. Believed numbers of traffic accident or incident may occurred already however authority do not have any proper radio communication system to monitor such as VHF or AIS but also no proper standard operation program to monitor, control and manage traffic. UPP has original function to control commercial vessels such as cargo or Toll Laut entry into Labuan Bajo port once or less than once per day only. Those tourism boats are not under their principal operation in their original operation work so far.

Picture 4.1.14 -7 : UPP office, Port pier, Lighthouse

Chapter 5

Surveys of Maritime Traffic Flow and Volume

5 Surveys of Maritime Traffic Flow and Volume

Maritime traffic flow and volume survey was conducted with AIS and a portable radar at nice (9) places showing in the Table and the Figure below.

Table 5 -1 : Place and Date of Survey

Maritime Traffic Flow/Volume Survey

No	Location	Means of Collection	Date at Site	AIS DATA
1	Sabang	AIS	Sep. 23 - 24, 2019	9.23~24
2	Tanjung Perak (Surabaya)	AIS, Radar	Oct. 1 - 8, 2019	9.25, 10.~7
3	Kuala Tanjung (Belawan)	AIS	Sept. 18 - 20, 2019	9.18~19
4	Makassar	AIS, Radar	Sept. 1 - 9, 2019	9.2~10
5	Kalukalakuang (Makassar Offshore)	AIS	Sept. 9 - Oct. 6, 2019	8.29~30, 9.4, 9.10~18, 9.29~10.5
6	Labuan Bajo	AIS, Radar	Nov. 1 -7, 2019	11.4~6
7	Kupang	AIS	Oct. 10 - 13, 2019	7.3~4, 11.10~12
8	Tanjung Dehekalano (Ambon)	AIS	Oct. 23 - 28, 2019	10.23~28
9	Merak	AIS	Jan. 8 - 20, 2020	1.8~20

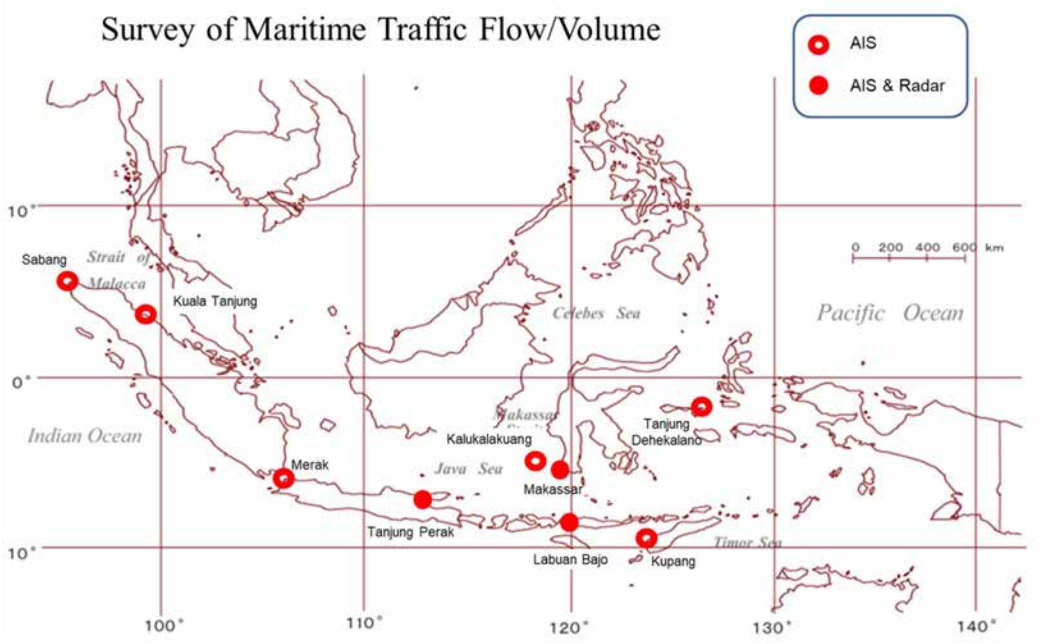


Figure 5 -1 : Location of Maritime Traffic Flow/Volume Survey

In the AIS survey, the equipment and materials, such as an antenna, an AIS/GPS receiver, PC, a power supply and so on, were brought into the sites, and the antenna was installed at a height of 50m or more above sea level (like a radio tower, the rooftop of a building) overlooking the port, and data was collected for at least 2 days.

The data collected was analyzed with software called IWRAP (IALA Waterway Risk Assessment Program).

Picture 5 -1 : AIS Equipment

Picture 5 -2 : Installation of AIS and GPS Antenna

The survey with the radar was conducted at 3 sites. The equipment and materials, such as a radar antenna (6 Feet), Transmitter and Receiver, Control Unit, Power Supply, PC, Recording Device) were brought to 3 sites, each device was set, and radar images were recoded for 2 days.

Picture 5 -3 : Installation of Radar

At the same time, a visual survey was also conducted during the daytime, and the size of a ship, the type of a ship and number of ships by time into view were checked and recorded on a sheet of paper. The criteria for classification of ship size are shown in the Table below.

Table 5 -2 : Classification of Size

Legend

Classification	Visually Observed Size of Vessel		Reference (Grounds of Classification)		
	Gross Tonnage	Reference Length	Navigational Obligation for Traffic	Mandatory Installation of AIS	Obligation to notify of Position Report
S	Less than 30 G/T	Less than 25 m	△	×	×
M	30 G/T ~ 500 G/T	25 m ~ 50 m	△	△	×
L	More than 500 G/T	More than 50 m	○	○	△

For reference, the photos are shown below so that the image of the size of classification can be gotten easily.

The structure image of the survey is shown in the Figure below.

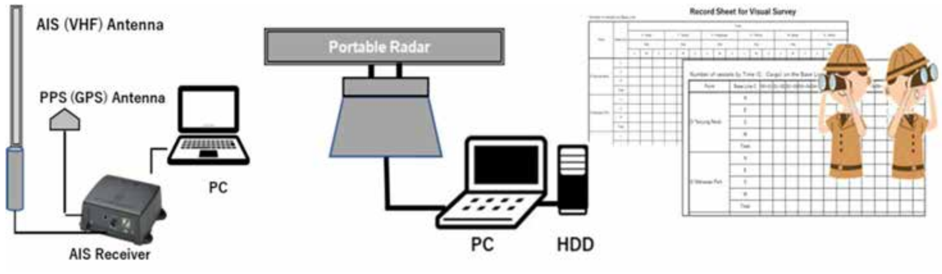


Figure 5 -2 : Image of the Survey

Photographs of the survey places are attached as Appendix 5 -1.

5.1 Sabang

Sabang is located in the northern tip of Sumatra and faces on the western entrance to the Straits of Malacca and Singapore.

AIS was set up here in Sabang in order to get the data on the movement of vessels passing through the Malacca Singapore Strait to the Indian Ocean and vice versa.

The location where AIS base-station was temporarily installed is shown in the Figure below.

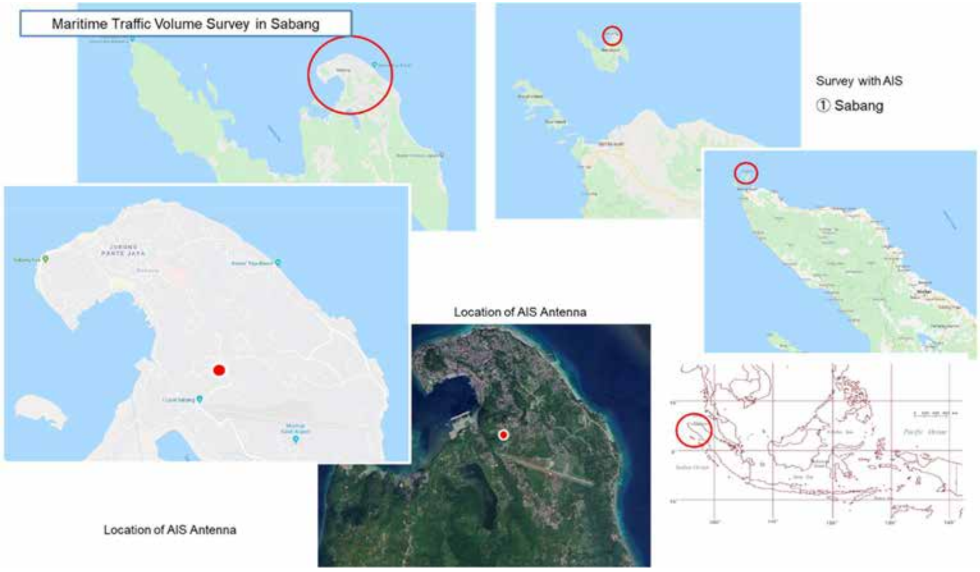


Figure 5.1 -1 : Location of AIS Base-Station

The tracks of the AIS vessels for three days from September 23 to 25, 2019 are shown in the Figure below.

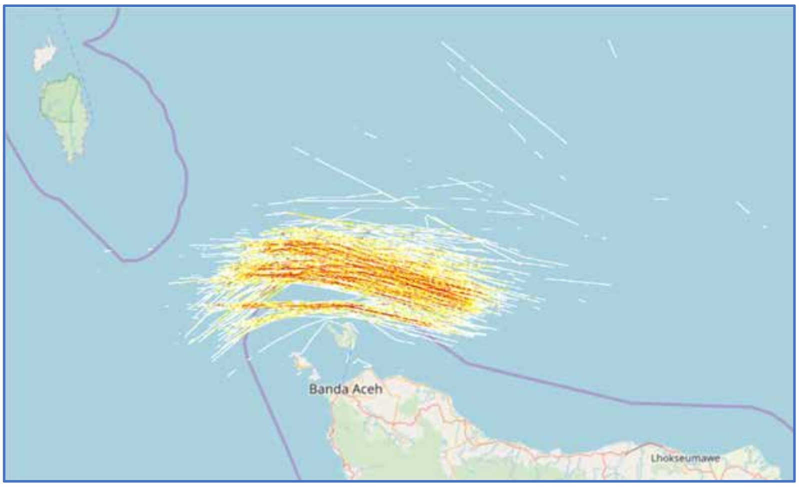


Figure 5.1 -2 : Density Plot of AIS

The total number of vessels confirmed in three days is 310.

The classification as to a type and size is shown at the next page.

Table 5.1 -1 : Type of Vessels

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	0	0	0	2	1	0	0	28	31
51～150m	0	4	6	10	0	0	0	1	21
151～250m	0	0	92	29	0	0	0	4	125
251m以上	0	0	83	50	0	0	0	0	133
Total of ship types	0	4	181	91	1	0	0	33	
Total of all ship types	310								

Most of the vessels sailing in this area are huge and large ships, and most of the ship types are oil tankers and cargo ships.

The density map for each ship type is shown in the Figure below.

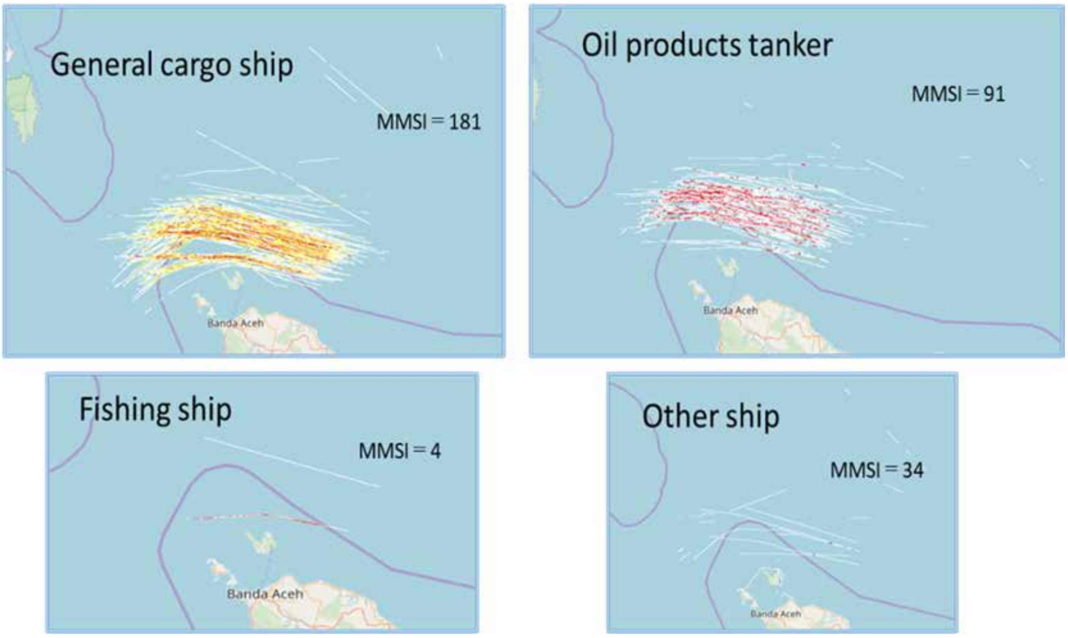


Figure 5.1 -3 : Density Map for each Type

According to the simple calculation from the number of sailing vessels in this area, 100 vessels are passing through a day, and about 35,000 vessels a year. In this connection, about 85% of them are large and huge vessels.

Following the tracks, there are two separation traffic flows.

This two traffic flows are analyzed with IWRAP and the lateral distribution of the traffic volume is plotted as shown in the Figure at the next page.

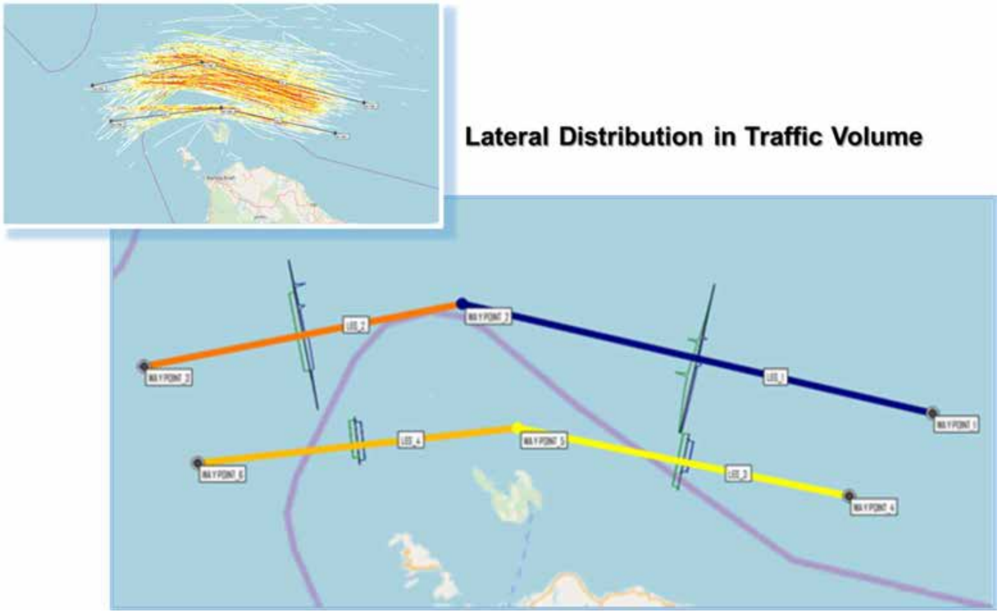


Figure 5.1 -4 : Histogram of Lateral Distribution

From the above, it shows that there are two traffic zones about 25km and 5km wide.

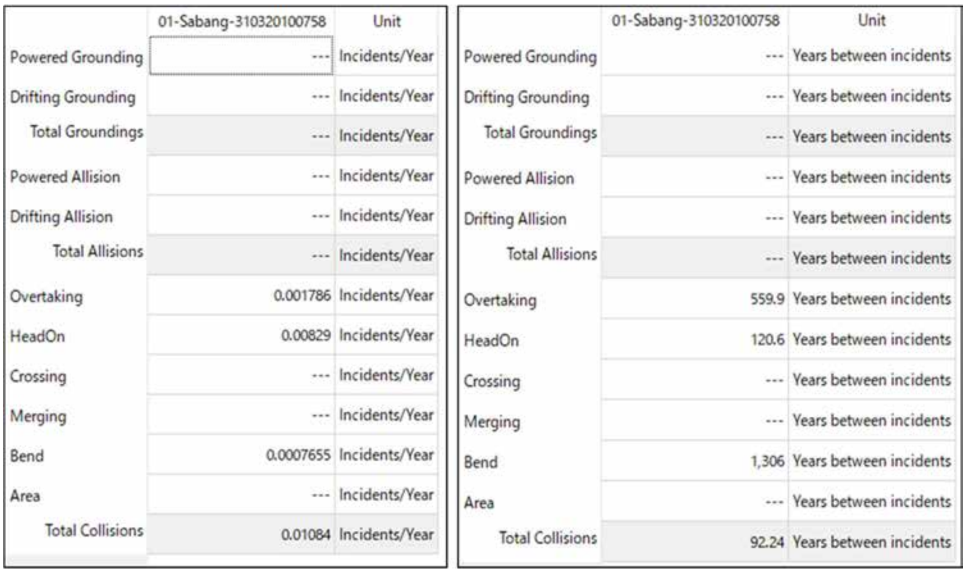
From these histograms, both eastbound vessels and westbound vessels are distributed across the entire width of traffic flow, and there is no clear separation of the traffic.

IWRAP's risk calculation shows that the probability of head-on collision is obviously high, though the number of data is absolutely scarce.

Marine accidents in such area where large vessels, especially huge oil tankers are passing, cause a great deal of damage and environmental destruction often. The setting of the traffic separation zone is one of the safety measures.

The result of the IWRAP calculation is shown in the Table below.

Table 5.1 -2 : Results of IWRAP Calculation



	01-Sabang-310320100758	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.001786	Incidents/Year
HeadOn	0.00829	Incidents/Year
Crossing	---	Incidents/Year
Merging	---	Incidents/Year
Bend	0.0007655	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.01084	Incidents/Year

	01-Sabang-310320100758	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	559.9	Years between incidents
HeadOn	120.6	Years between incidents
Crossing	---	Years between incidents
Merging	---	Years between incidents
Bend	1,306	Years between incidents
Area	---	Years between incidents
Total Collisions	92.24	Years between incidents

In addition, this point is the gateway to the Straits of Malacca and is the best place to manage the movement of vessels.

Based on the destination of the AIS data, 57% of all vessels were East-bound vessels for Singapore, 30% were West-bound for the Middle East, passing through the Bay of Bengal, and 13% were Southwestern for the Indian Ocean to the Cape of Good Hope.

The data is summarized in the Figure and the Graph below.

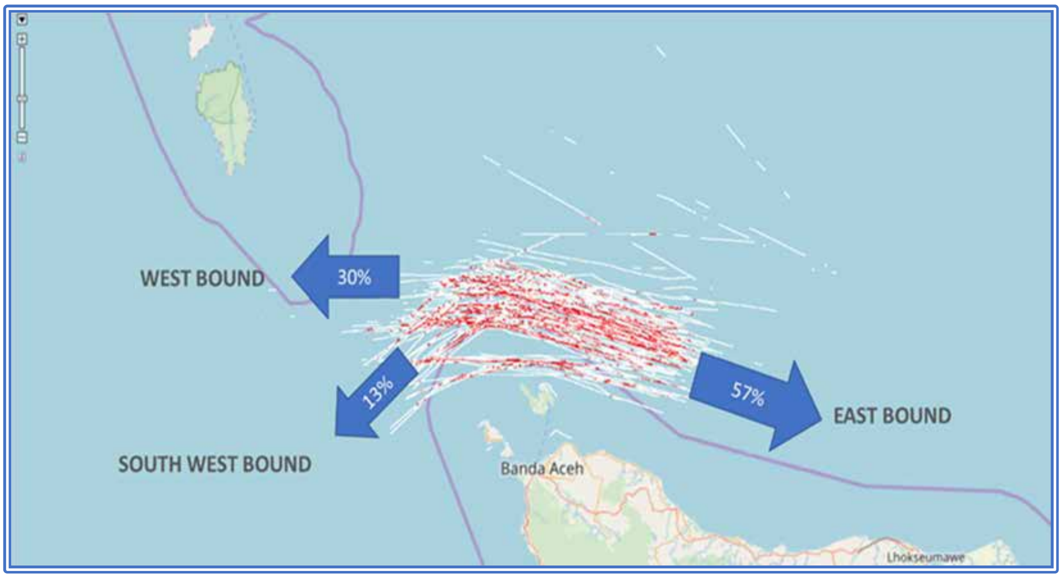
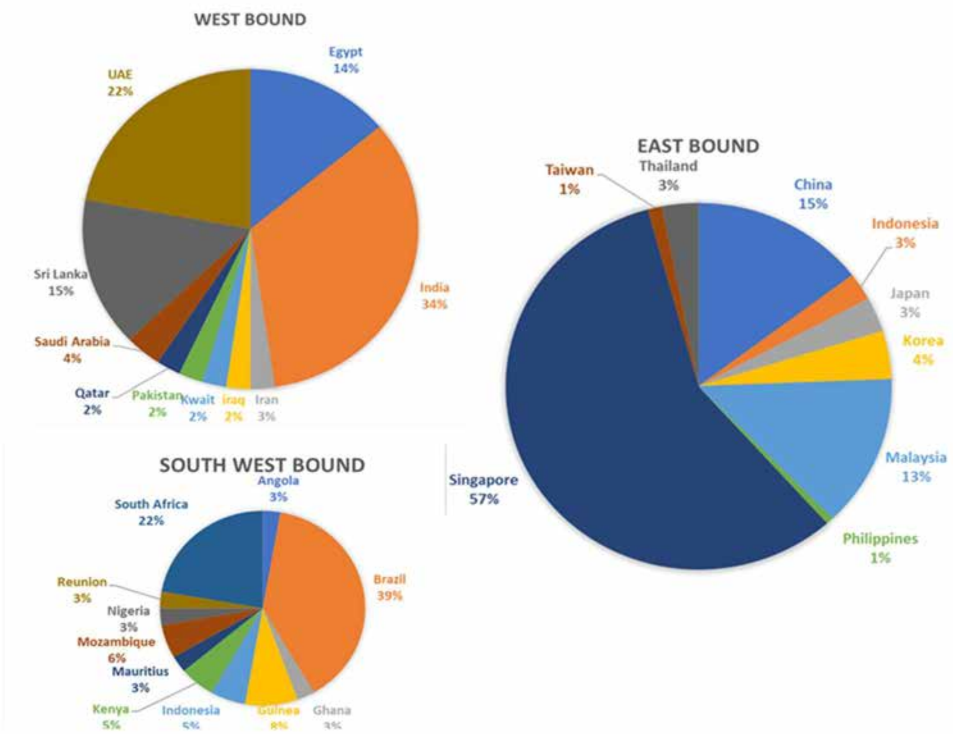


Figure 5.1 -5 : Movement of Vessels



Graph 5.1 -1 : Destination of Vessels

For reference, a density map of AIS vessels in the Bay of Bengal to the Indian Ocean, which was derived from Marine Traffic : Global Ship Tracking Intelligence/AIS Marine Traffic, is attached below.

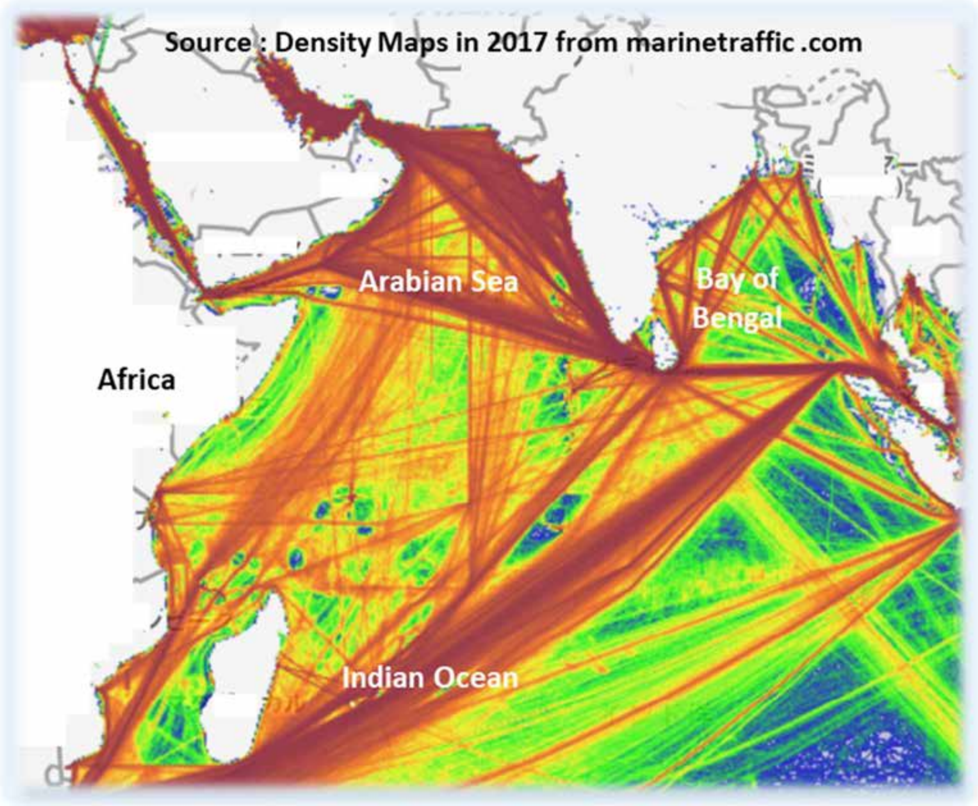


Figure 5.1 -6 : AIS Density Map

5.2 Tanjung Perak (Surabaya)

Port of Tanjung Perak is located at Surabaya, East Java. The port is accessed from the north through the Madura strait, a 25 mile long, 100m wide and 9.5m depth channel between East Java and Madura Island. The location is shown in the Figure below.

Figure 5.2 -1 : Location of Port of Tanjung Perak

An AIS receiver was set up at the port of Gresik, 7 km northwest of the port of Tanjung Perak. Here, radar equipment was also installed and vessel echoes were recorded. The location where the equipment was temporarily installed is shown in the Figure below.

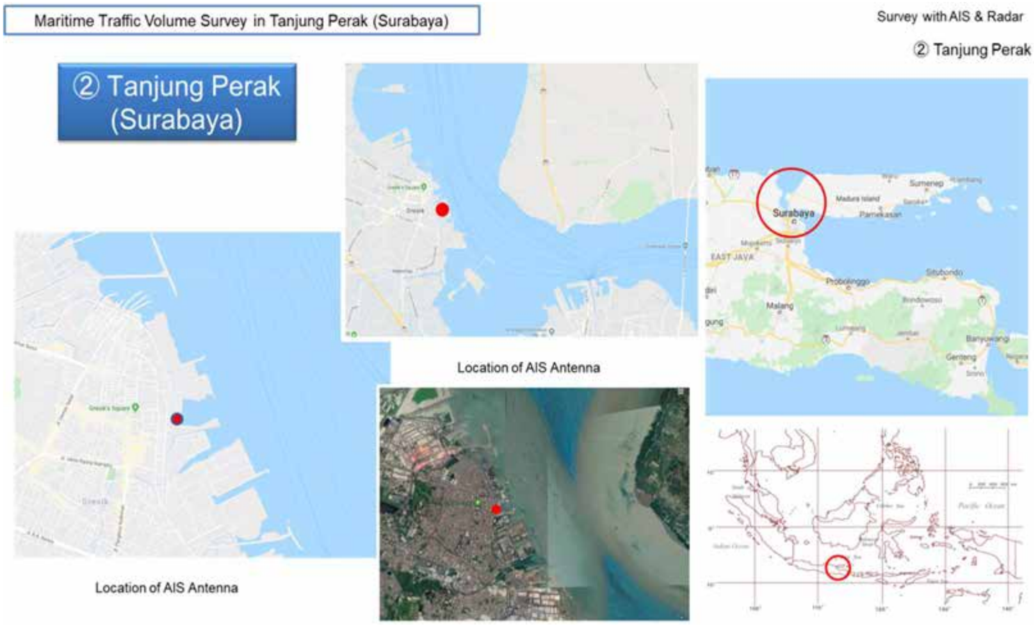


Figure 5.2 -2 : Location of AIS and Radar

The tracks of the AIS vessels and the table of a classification as to a type and size for six days from October 2 to 7, 2019 are shown in the Figure below.

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1~50m	2	0	45	13	14	18	89	71	252
51~150m	0	0	119	41	23	2	5	24	214
151~250m	0	0	46	14	6	0	0	0	66
251m以上	0	0	10	1	0	0	0	1	12
Total of ship types	2	0	220	69	43	20	94	96	
Total of all ship types	544								

Figure 5.2 -3 : AIS Tracks and the Classification Table

As the characteristics of this sea area, vessels have to go through a narrow channel of about 20 nautical miles (36 km) to the Port of Perak. And, the Perak is the second largest passenger port among the five major ports in Indonesia, as shown in Section 2.3, Chapter 2.

The AIS data which was obtained in this survey shows that the total number of vessels equipped with AIS is 544 for 6 days, and this means that about 100 vessels a day.

About 85% of the navigating vessels are medium and small. The reason seems to be that the channel width that a ship can go through is narrow and shallow.

From the AIS data of this survey, the channel width that the vessels actually navigated is calculated as shown in the Figure below.

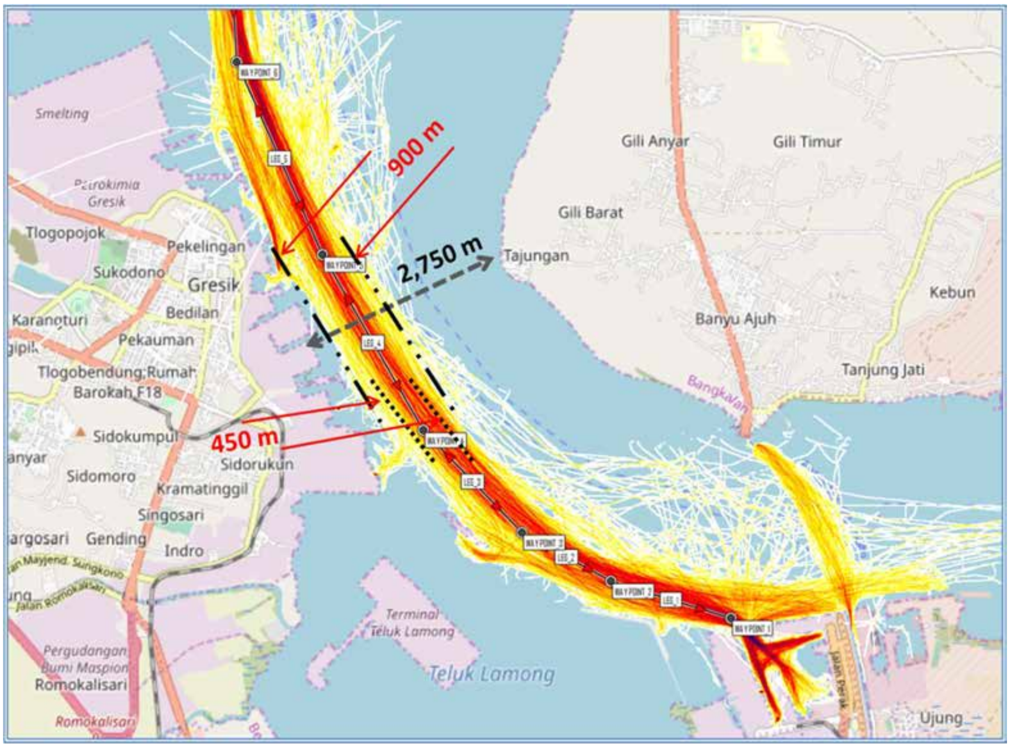
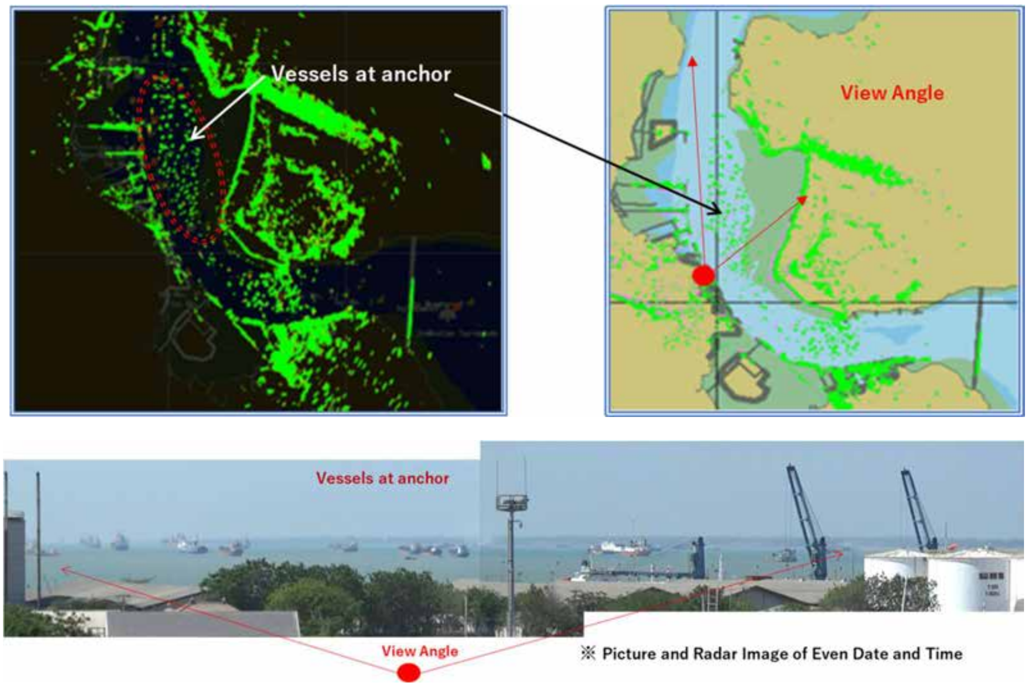


Figure 5.2 -4 : Channel Width

The fairway width that vessels were sailing is about 900m, and the channel width that major vessels were passing is only 450m, though the distance between East Java and Madura Island is 2,750m.

Despite the sufficient navigable water between the Java and the island, the channel width is narrow due to the existence of vessels at anchor, as shown from the radar survey. The radar image and the Picture are shown in the below.



Picture 5.2 -1 : Radar Image and Picture of Vessels at Anchor

It is necessary to take traffic safety measures such as clarifying the traffic route and the anchorage area, ensuring the traffic width and the appointment of a ship's anchor position.

IWRAP analyzed the movement of vessels sailing along the traffic route that extends about 20 NM north and south, and a histogram is shown in the Figure below.

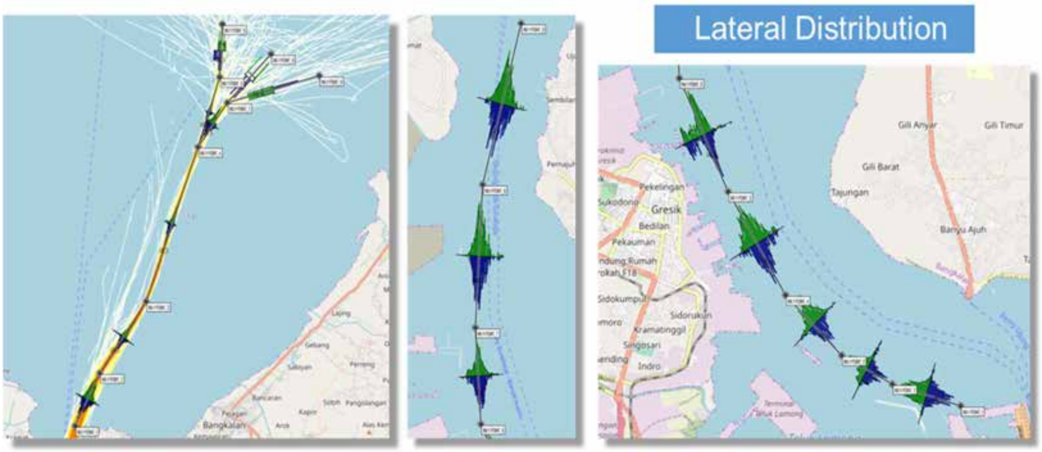


Figure 5.2 -5 : Histogram of Lateral Distribution

As the histogram shows, vessels are sailing quite a long distance in the center of a limited narrow channel, so it is dangerous for vessels to pass each other or overtake in the channel and there is also the risk of getting out of the channel and running aground on side shallows of the channel.

The nautical chart showing the water depth near the approaching channel and the pilot stage and the density map of AIS corresponding to the chart are given in the Figure below.

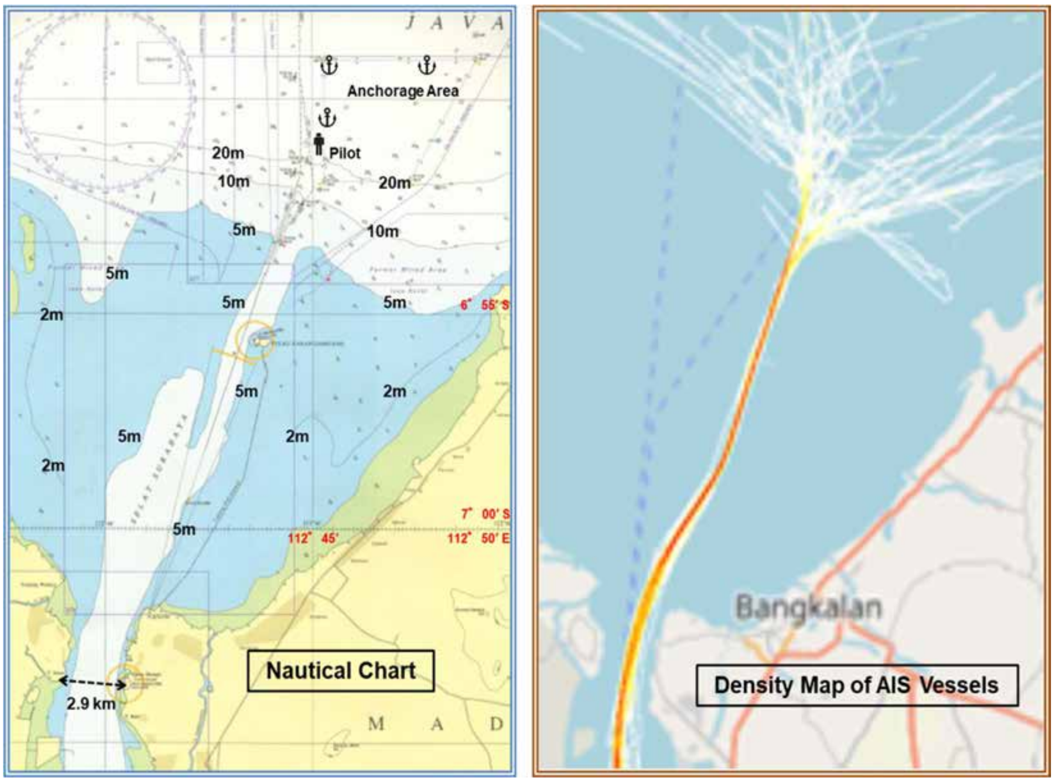


Figure 5.2 -6 : Chart and Density Map

Looking at IWRAP's risk calculation, the probability of overtaking accident and head-on collision is high. Unluckily, since there are no data on the depth of the water in electronic data, the grounding probability had not been calculated.

Then, the grounding incident extracted from the marine accidents report in 2017 was 5 cases a year. (It can be said that the incidence of grounding is abnormally high compared to other marine accidents). The map of the location where the grounding occurred is shown in the Figure at the next page.

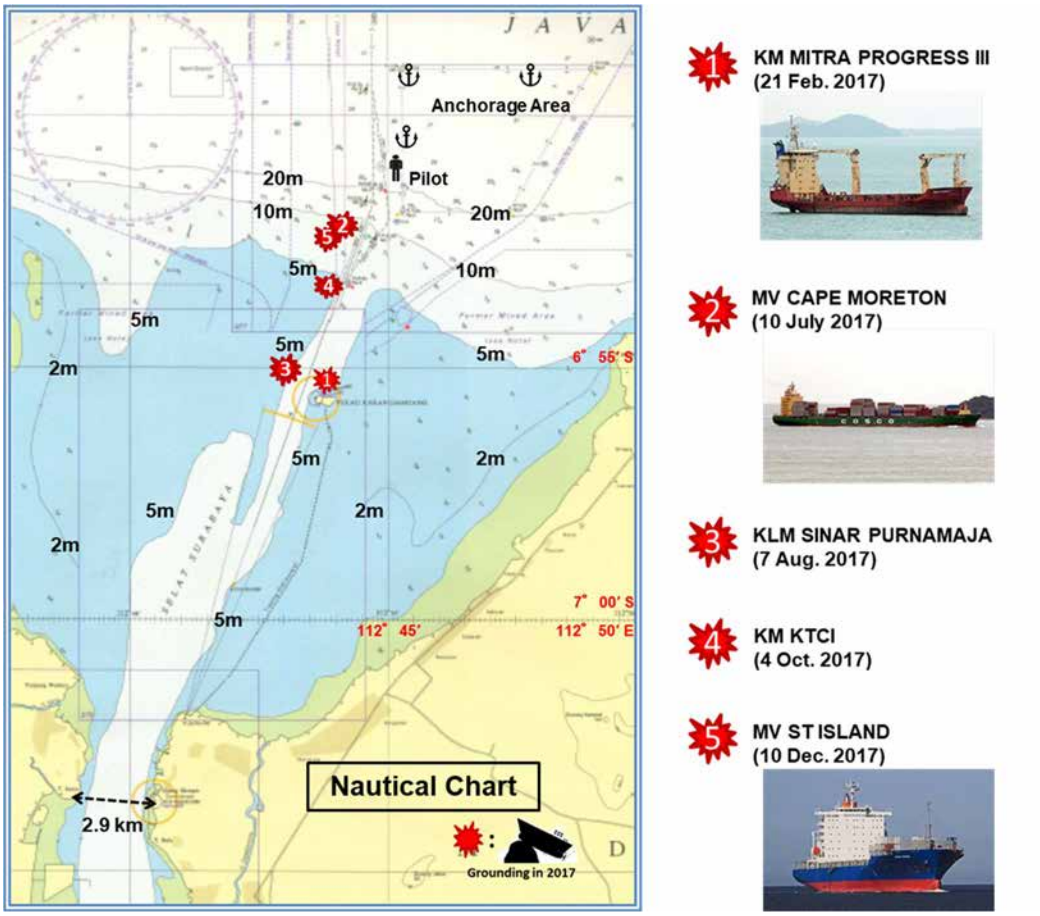
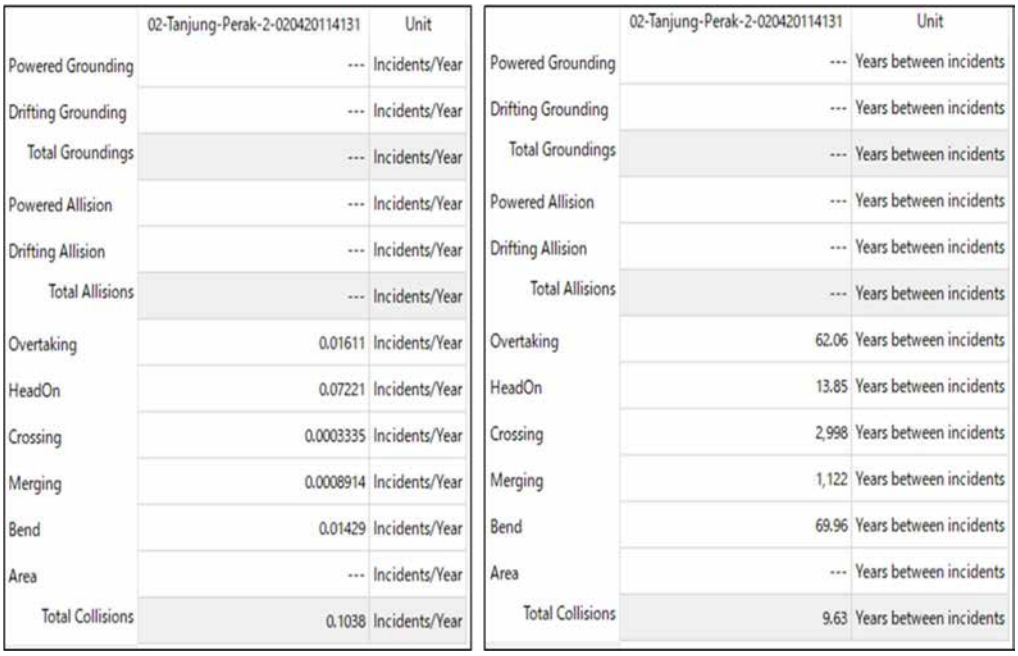


Figure 5.2 -7 : Marine Grounding Map in 2017

The result of the IWRAP calculation is shown in the Table below.

Table 5.2 -1 : Result of IWRAP Calculation



	02-Tanjung-Perak-2-020420114131	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.01611	Incidents/Year
HeadOn	0.07221	Incidents/Year
Crossing	0.0003335	Incidents/Year
Merging	0.0008914	Incidents/Year
Bend	0.01429	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.1038	Incidents/Year

	02-Tanjung-Perak-2-020420114131	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	62.06	Years between incidents
HeadOn	13.85	Years between incidents
Crossing	2,998	Years between incidents
Merging	1,122	Years between incidents
Bend	69.96	Years between incidents
Area	---	Years between incidents
Total Collisions	9.63	Years between incidents

From the viewpoint of the channel width and the maneuvering of the vessel, the navigable width of 450m is the limit (under specific conditions) of the channel width that allows a container ship of 50,000 GT (LOA 300m) and a cargo ship of 1,000 GT (LOA 90m) to pass each other in adequate navigational safety.

There are many factors in setting a channel width and there are some standards incorporating them. The PIANC Guideline is one of them.

> (PIANC, Permanent International Association of Navigation Congresses, is an international professional organization and its mission is to provide expert guidance and technical advice on technical, economic and environmental issues pertaining to waterborne transport infrastructure, including the fields of navigable bodies of waterways, such as canals and rivers, as well as ports and marinas. ---- from Wikipedia)

The following are some of the general concepts of designing a route setting. The elements of channel width are shown in the Figure below.

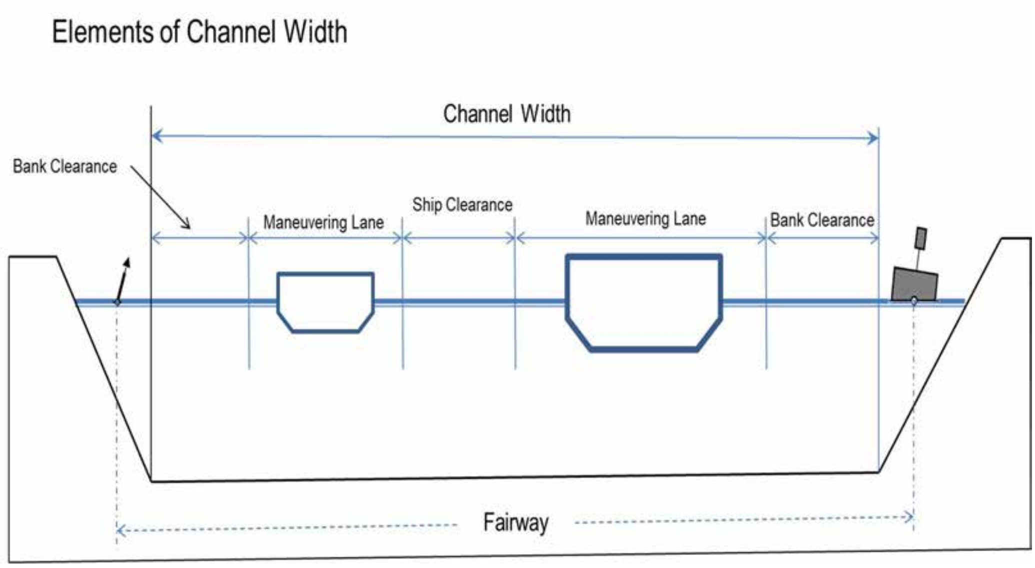


Figure 5.2 -8 : Elements of Channel Width

Assuming a case of a two-way channel in a straight route and an inner traffic (protected water), the channel width with an adequate navigable safety was roughly calculated based on the idea of LANIC Guideline.

When the channel width is set to about 400m, a standard for the size and type of vessels that can pass by one another was estimated. The image of passing each other is shown in the Figure at the next page.

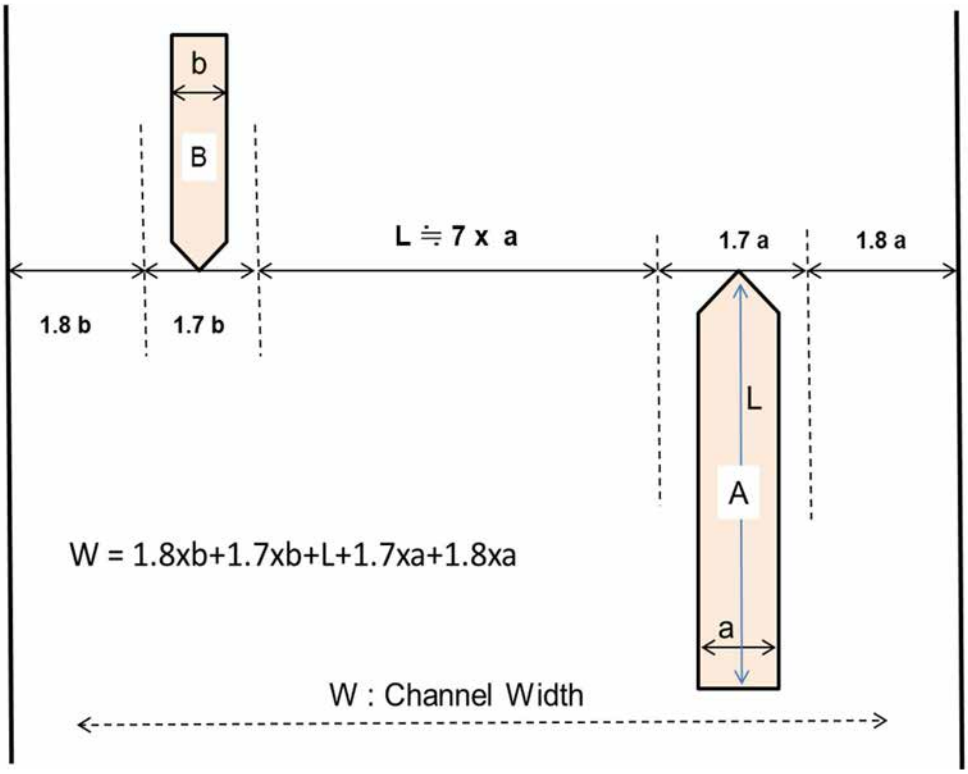


Figure 5.2 -9 : Image of Passing Each Other

The parameters used in this calculation were the safety coefficient that is applied in considering a traffic control in a Japanese port.

A sample of calculation is shown below.

Sample : 1

Vessel A	Container	52,000GT	La :	290m	a : 32m
Vessel B	Cargo	990GT	Lb :	87m	b : 13m

Formula

W (Channel Width) *= 1.8 x b + 1.7x b + La + 1.7 x a + 1.8 x a =* ***447.5m***

Sample : 2

Vessel C	Bulk Carrier	50,000GT	Lc :	210m	c : 37m
Vessel B	Cargo	990GT	Lb :	87m	b : 13m

Formula

W (Channel Width) *= 1.8 x b + 1.7 x b + Lc + 1.7 x c + 1.8 xc =* ***376.4m***

In case of 400m of the channel width, vessels of 1,000GT or more will be subject to control the adjustment of an entry time to the channel or avoidance of passing by controlled ship in the channel, when a container ship of 52,000GT (LOA=290m) or a bulk carrier of 50,000GT is to be controlled vessel.

In order to ensure the safety of vessels on the traffic channel, it is necessary for VTS to carry out such maritime traffic control.

In this area, it can be seen that a cargo ship and an oil tanker are accompanied by Other-Ship and Supporting-Ship by the entrance of the channel.

The density map for each ship type is shown in the Figure below.

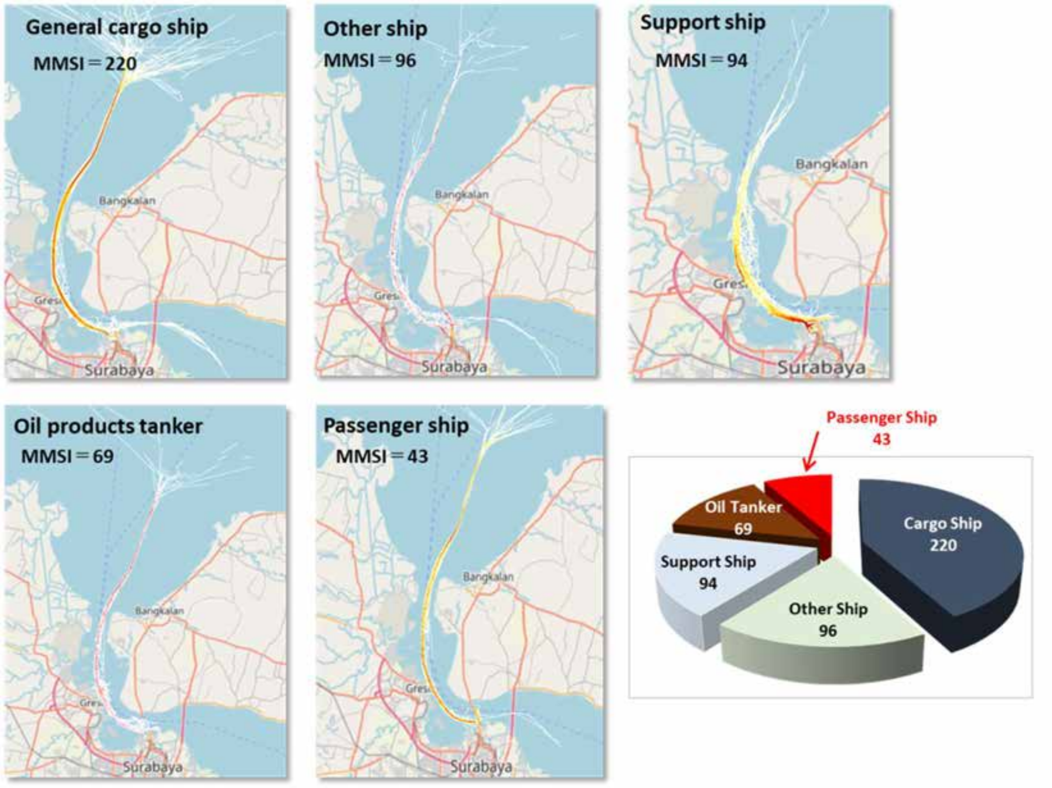


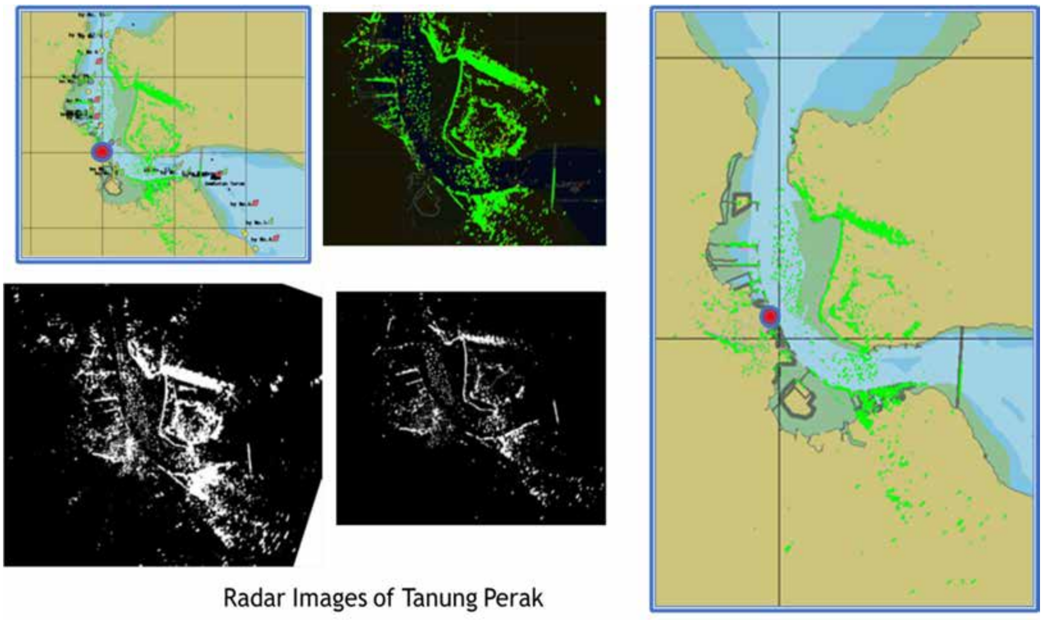
Figure 5.2 -10 : Density Map for Each Type

The radar-based traffic survey in Surabaya was carried out by installing the equipment on the tower of the coastal radio station in GRESIK, as shown below.

Picture 5.2 -2 : Temporary Installation of Radar

The radar survey is to investigate the movement of a ship not equipped with AIS, and conducted together with the visual survey.

The radar images are shown below.



Picture 5.2 -3 : Radar Images

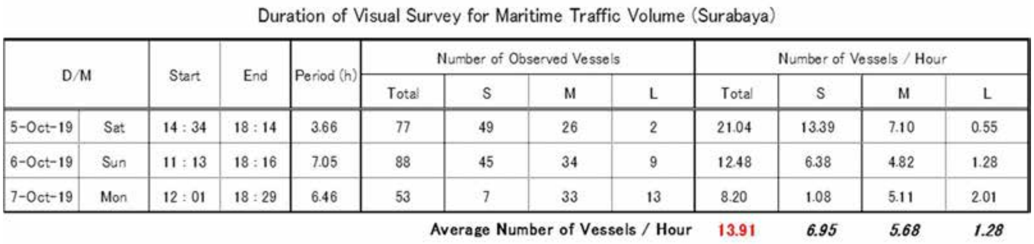
A lot of vessels at anchor in the navigable waters can be seen clearly.

The view from the temporary radar is shown at the next page.

Many small boats are cruising through vessels at anchor.

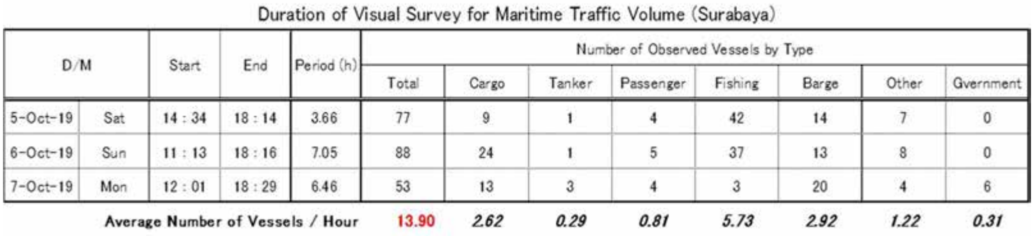
The results of the visual survey are shown in the Table below.

Table 5.2 -2 : Result of Visual Survey



Duration of Visual Survey for Maritime Traffic Volume (Surabaya)

D/M		Start	End	Period (h)	Number of Observed Vessels				Number of Vessels / Hour			
					Total	S	M	L	Total	S	M	L
5-Oct-19	Sat	14 : 34	18 : 14	3.66	77	49	26	2	21.04	13.39	7.10	0.55
6-Oct-19	Sun	11 : 13	18 : 16	7.05	88	45	34	9	12.48	6.38	4.82	1.28
7-Oct-19	Mon	12 : 01	18 : 29	6.46	53	7	33	13	8.20	1.08	5.11	2.01
								Average Number of Vessels / Hour	**13.91**	***6.95***	***5.68***	***1.28***



Duration of Visual Survey for Maritime Traffic Volume (Surabaya)

D/M		Start	End	Period (h)	Number of Observed Vessels by Type							
					Total	Cargo	Tanker	Passenger	Fishing	Barge	Other	Gvernment
5-Oct-19	Sat	14 : 34	18 : 14	3.66	77	9	1	4	42	14	7	0
6-Oct-19	Sun	11 : 13	18 : 16	7.05	88	24	1	5	37	13	8	0
7-Oct-19	Mon	12 : 01	18 : 29	6.46	53	13	3	4	3	20	4	6
Average Number of Vessels / Hour					**13.90**	***2.62***	***0.29***	***0.81***	***5.73***	***2.92***	***1.22***	***0.31***

In Surabaya, the visual survey was conducted for three days in only day time. In total of approximately 17 hours, 218 vessels passed in front of the temporary radar station, namely about 14 vessels are sailing per hour. About half (50%) of them are small vessels (S: 25m or less), and 40% are medium-sized vessels (M: 25-50m). Approximately one (1) large vessel sails in per hour.

Table 5.2 -2 : Index of Classification

Classification	Visually Observed Size of Vessel	
	Gross Tonnage	Reference Length
S	Less than 30 G/T	Less than 25 m
M	30 G/T ～ 500 G/T	25 m ～ 50 m
L	More than 500 G/T	More than 50 m

In the Port of Perak and the Port of Gresik, many small boats sail freely among large vessels and vessels at anchor. The ship types are shown in the Graph below.

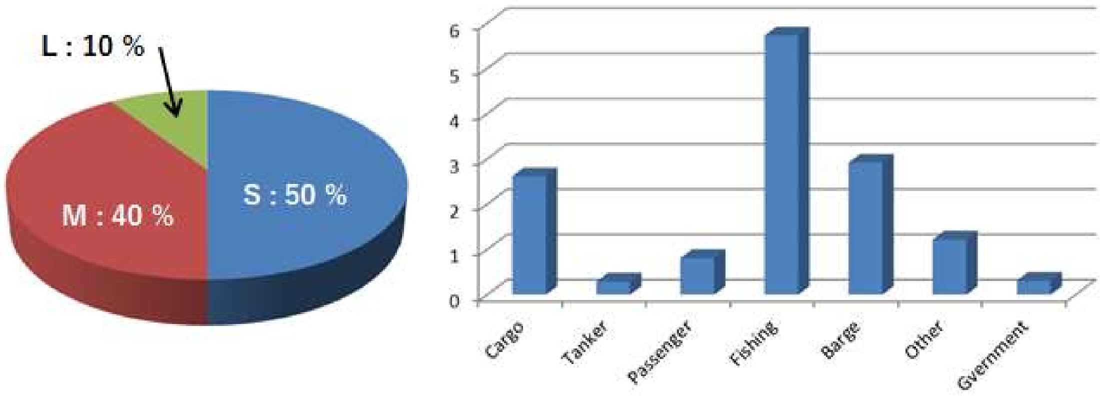


Figure 5.2 -11 : Percentage of Ships Type

5.3 Kuala Tanjung

Kuala Tanjung is located at the middle of Sumatra and south of the Port of Belawan, facing the Strait of Malacca.

AIS was set up here in order to collect the data on the movement of offshore vessels and of vessels sailing around the port.

The location where AIS base-station was temporarily installed is shown in the Figure below.

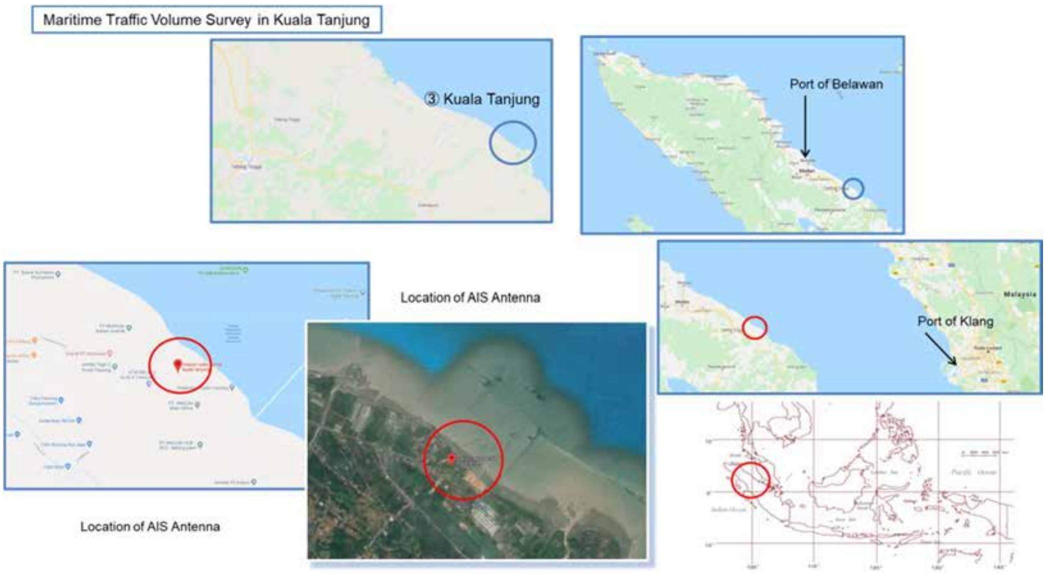


Figure 5.3 -1 : Location of AIS Base-Station

The following pictures show the installation of AIS devices.

Picture 5.3.-1 : Installation of AIS Antenna

The tracks of the AIS vessels for two days from September 18 and 19, 2019 are shown in the Figure at the next page.

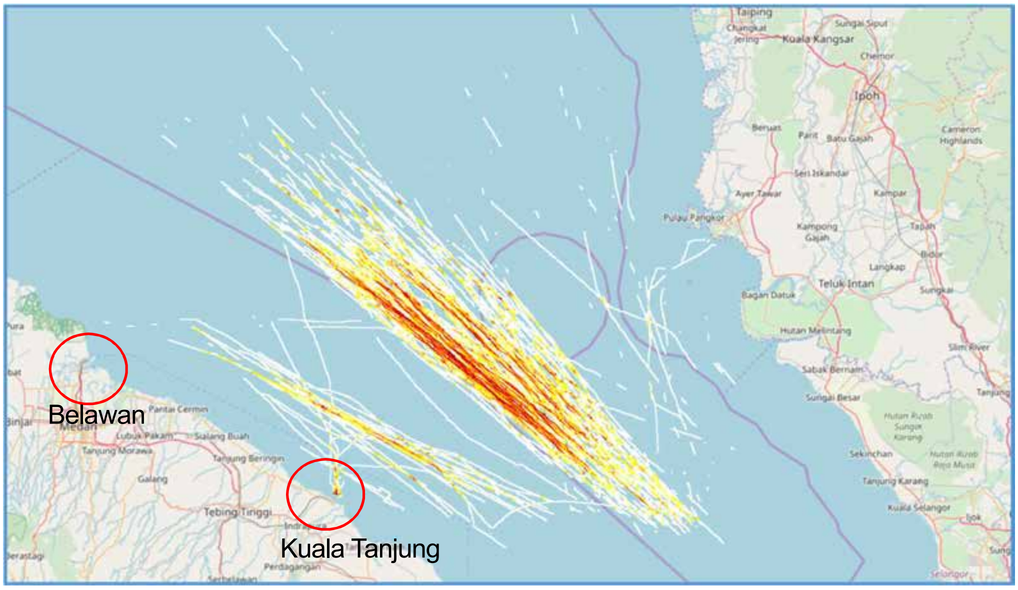


Figure 5.3 -2 : Density Plot of AIS

The total number of vessels confirmed in two days is 406.

Tracks of the north traffic zone in the above figure are vessels passing through the Straits of Malacca and Singapore, and tracks in the south narrow traffic zone are vessels entering and leaving the Port of Belawan.

The port of Kuala Tanjung is currently under construction, and there were few vessels entering the port during the survey period.

The classification as to a type and size is shown in the Table below.

Table 5.3 -1 : Type of Vessels

Ship Type / Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	2	0	45	6	5	3	21	124	206
51～150m	1	0	49	30	12	2	0	10	104
151～250m	0	0	45	9	3	0	0	1	58
251m以上	0	0	36	2	0	0	0	0	38
Total of ship types	3	0	175	47	20	5	21	135	
Total of all ship types	406								

Most of the vessels sailing in the main traffic zone are huge and large ships, and most of the ship types are cargo ships and oil tankers.

The density map for each ship type is shown in the Figure at the next page.

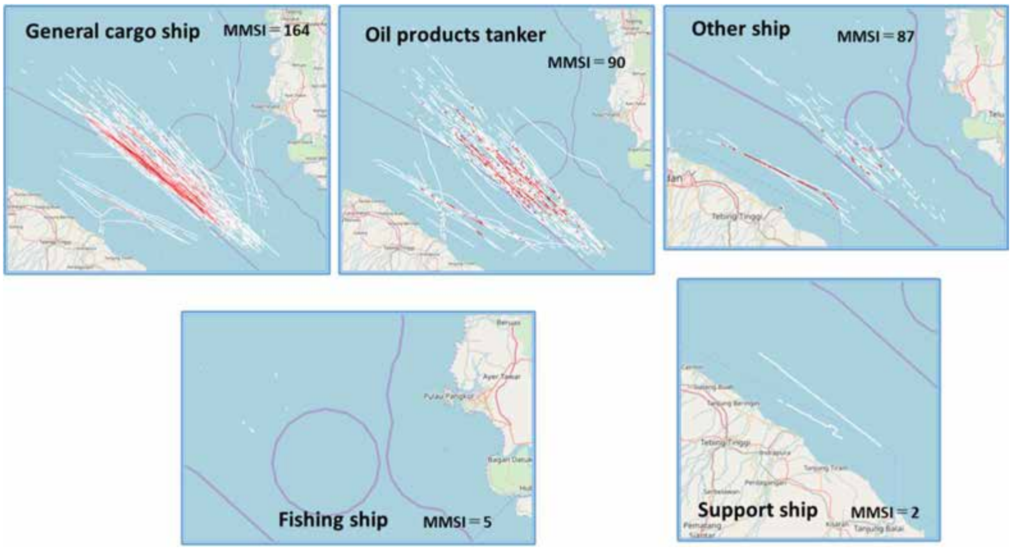


Figure 5.3 -3 : Density Map for each Type

The port of Kuala Tanjung is one of the 24 strategic ports and is positioned as an international hub port, and will become the largest port in Sumatra. Many vessels are expected to enter the port in the future.

When IWRAP analyzes the movement of vessels focused on the southern traffic zone leading to the Port of Belawan, the histogram of the traffic flow is drawn as the Figure below.

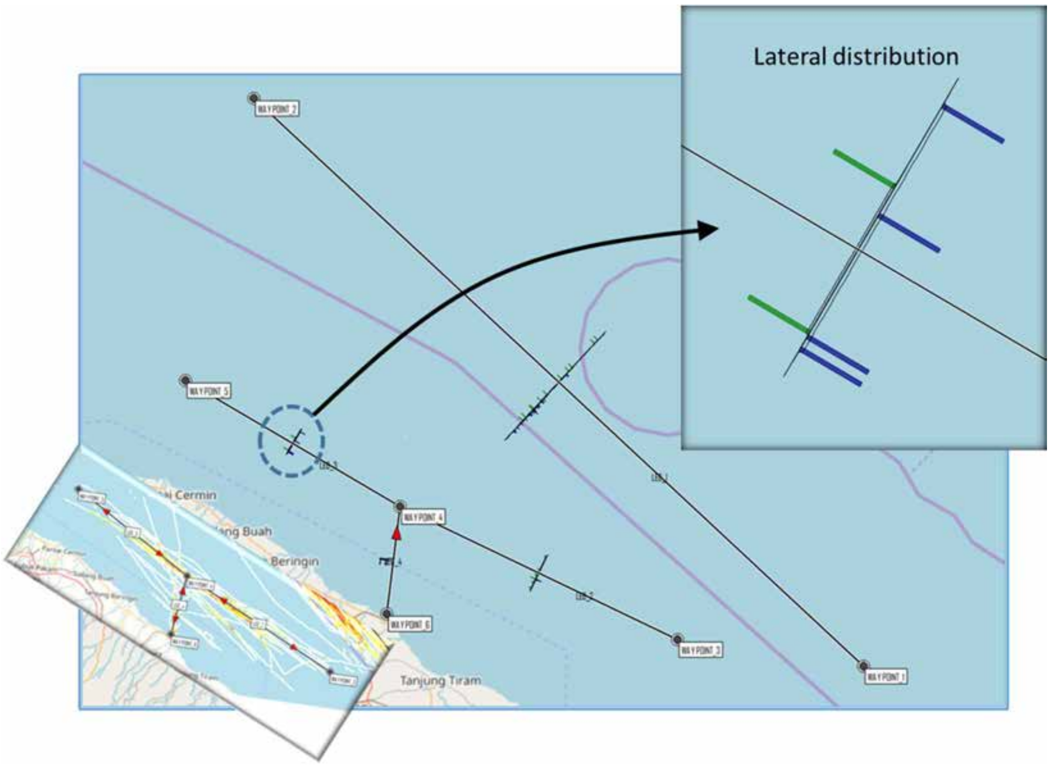


Figure 5.3 -4 : Histogram of Lateral Distribution

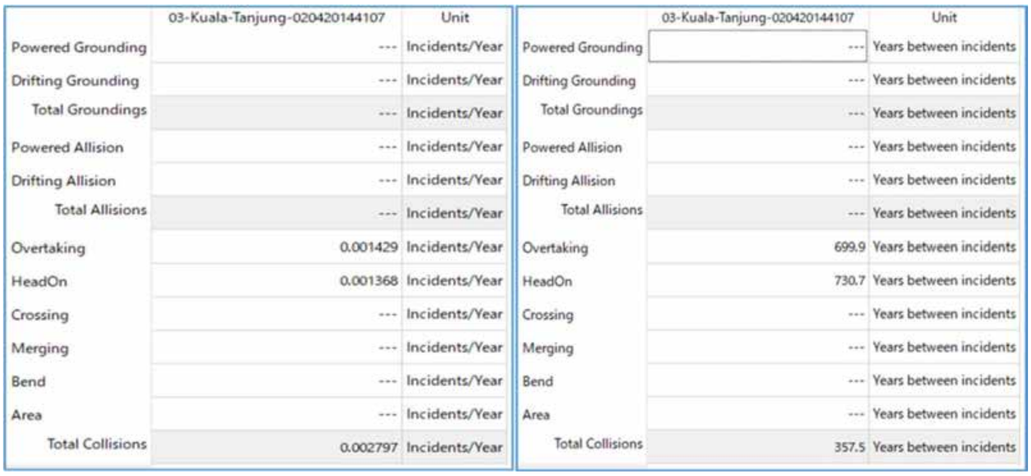
From the histograms, the navigating on the right side of the traffic is kept for now as a main traffic of the Strait of Malacca where the TSS (Traffic Separation Scheme) is established.

In this area where traffic volume is expected to increase in the future, it is necessary to take traffic safety measures in the field of aids to navigation including VTS that meet the situation of port development so that a traffic system will continue.

IWRAP's risk calculation that includes all data in the traffic (including the main zone where TSS is established) shows that the probability of head-on collision is very low compared to Sabang offshore with similar traffic flow.

The result of the IWRAP calculation is shown in the Table below.

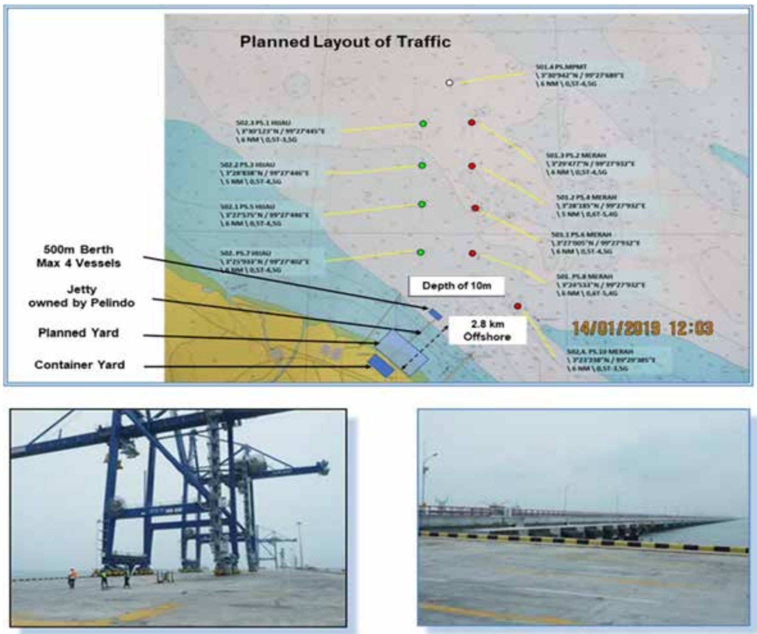
Table 5.3 -2 : Results of IWRAP Calculation



	03-Kuala-Tanjung-020420144107	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.001429	Incidents/Year
HeadOn	0.001368	Incidents/Year
Crossing	---	Incidents/Year
Merging	---	Incidents/Year
Bend	---	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.002797	Incidents/Year

	03-Kuala-Tanjung-020420144107	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	699.9	Years between incidents
HeadOn	730.7	Years between incidents
Crossing	---	Years between incidents
Merging	---	Years between incidents
Bend	---	Years between incidents
Area	---	Years between incidents
Total Collisions	357.5	Years between incidents

The port has a plan for jetty-style that extends over a long distance offshore. Picture below shows the present situation under construction.



Picture 5.3 -2 : Jetty under Construction

5.4 Makassar

Port of Makassar is located at the southwest of Sulawesi, and it has the highest passenger traffic in Indonesian ports, as shown in the Figure 2.2.3 -4. And, Sea-Lane 2 is laid in the north and south off the coast of Makassar.

The AIS was set up here in order to collect the data on the movement of offshore vessels and of vessels sailing around the port.

But, since it is more than 200km away from the port to the Sea-Lane 2, it is difficult for a normal AIS antenna to receive the AIS signals transmitted by vessels navigating along the Sea-Lane 2. Only here, the directional antenna was used on a trial basis. The AIS was installed in Kalukalukuang too, as described in Section 5.5, to collect data on the movement of vessels sailing around the Sea-Lane 2. The location map is shown in the Figure below.

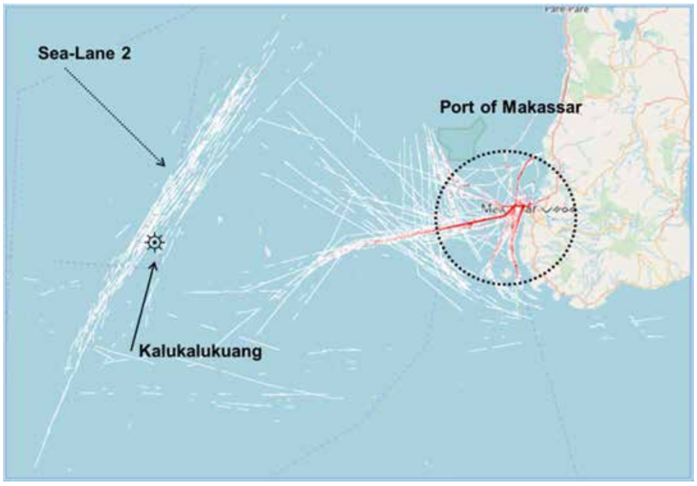


Figure 5.4 -1 : Location of the Port of Makassar and Kalukalukuang

The location where AIS base-station was temporarily installed is shown in the Figure below. And, a radar survey was conducted here.

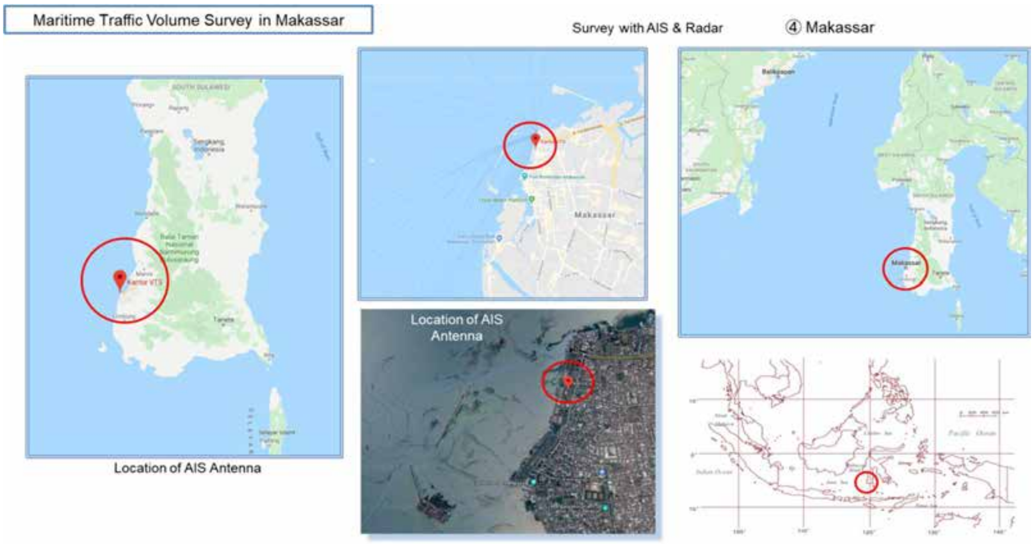


Figure 5.4 -2 : Location of AIS and Radar

AIS data was recorded for 7 days from March 18 to 24, 2020 and compiled into the Table below.

Table 5.4 -1 : Type of Vessel

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	0	**5**	0	0	0	0	**2**	**79**	**86**
51～150m	0	0	**16**	**21**	0	0	0	**2**	**39**
151～250m	0	0	**94**	**37**	0	0	0	**6**	**137**
251m以上	0	0	**54**	**32**	0	0	0	0	**86**
Total of ship types	0	**5**	**164**	**90**	0	0	**2**	**87**	
Total of all ship types	**348**								

The tracks of vessels navigating around the Port of Makassar are shown in the Figure below.

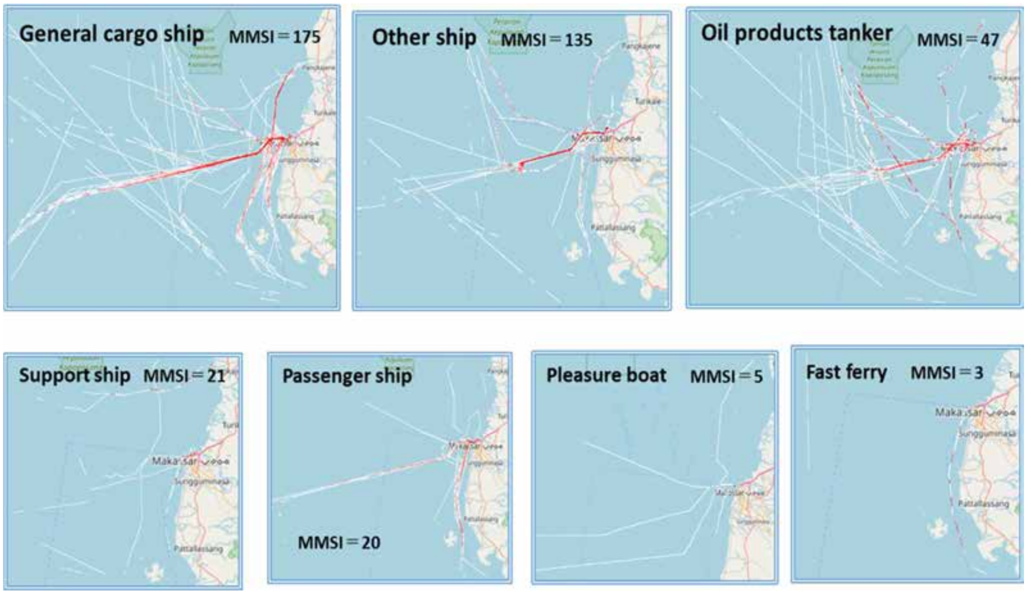


Figure 5.4 -3 : Density Map for each Type

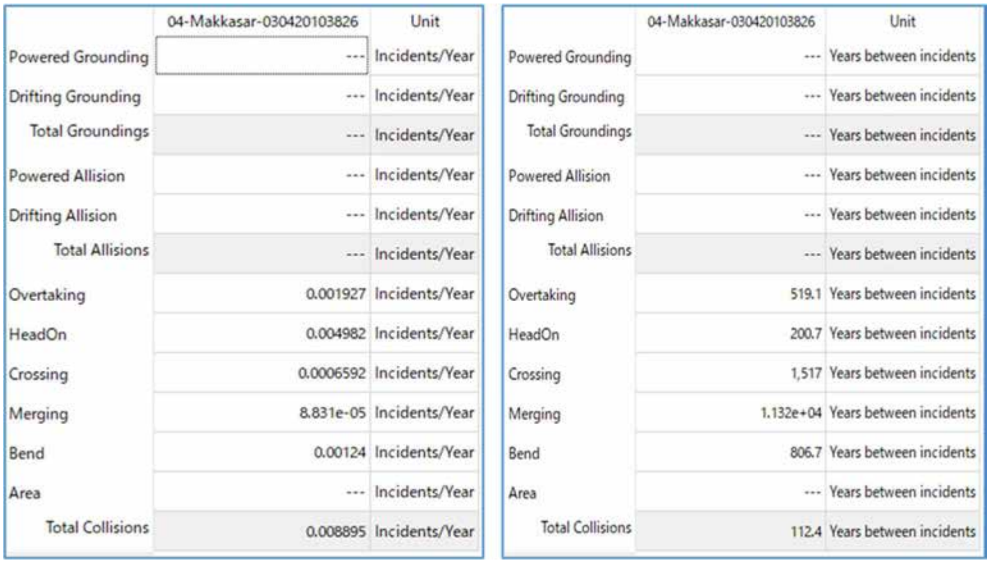
The characteristics of the movement of vessels navigating in this sea area are divided into two tendencies, one is the vessels sailing between the Sea-Lane 2 and the Port of Makassar and two is the vessels sailing in various directions centering on the port.

In other word, vessels are moving each other at right angles, and there is a possibility that the vessels will come across in any sea area.

However, IWRAP analysis did not show any remarkable results due to the large survey area in this survey and the short survey period.

The result of the IWRAP calculation is shown in the Table at the next page.

Table 5.4 -2 : Result of IWRAP Calculation



	04-Makkasar-030420103826	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.001927	Incidents/Year
HeadOn	0.004982	Incidents/Year
Crossing	0.0006592	Incidents/Year
Merging	8.831e-05	Incidents/Year
Bend	0.00124	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.008895	Incidents/Year

	04-Makkasar-030420103826	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	519.1	Years between incidents
HeadOn	200.7	Years between incidents
Crossing	1,517	Years between incidents
Merging	1.132e+04	Years between incidents
Bend	806.7	Years between incidents
Area	---	Years between incidents
Total Collisions	112.4	Years between incidents

The histogram of the lateral distribution by IWRAP is shown in the Figure below.

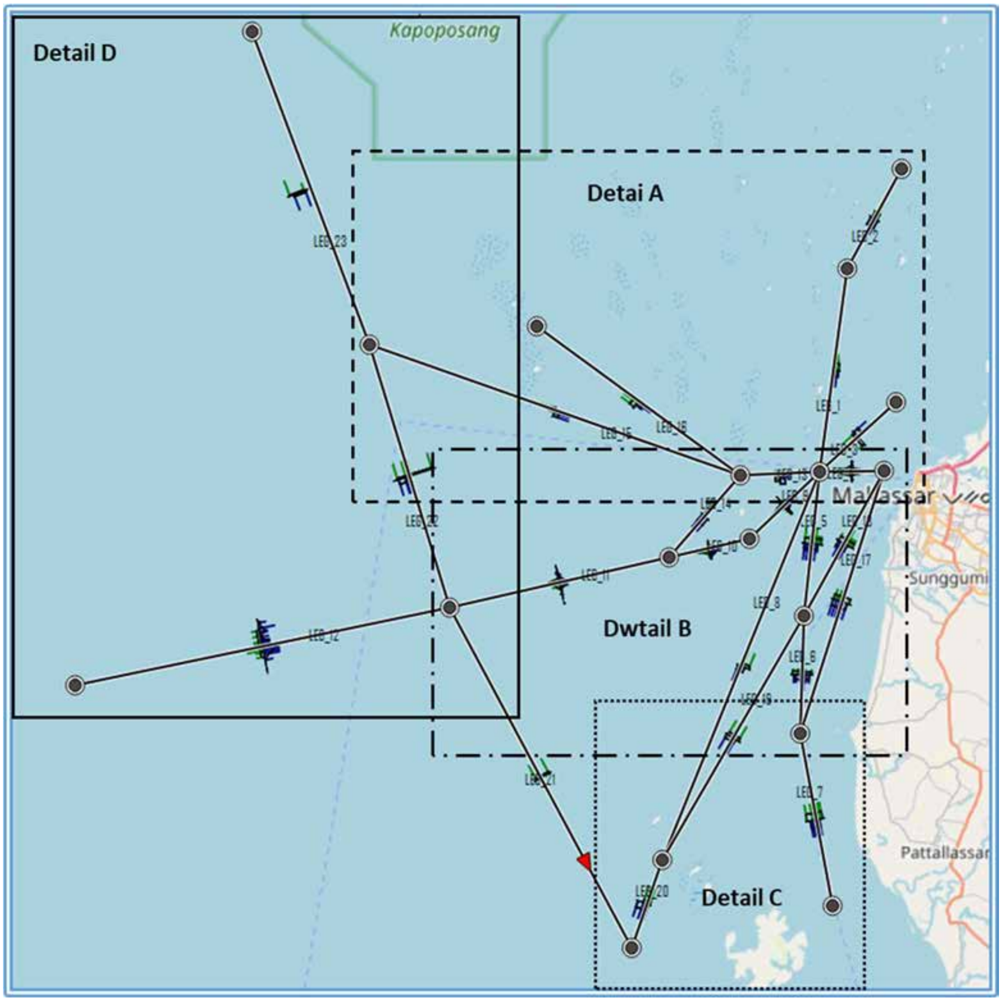


Figure 5.4 -4 : Histogram of Lateral Distribution (1/2)

The detailed map is as follows.

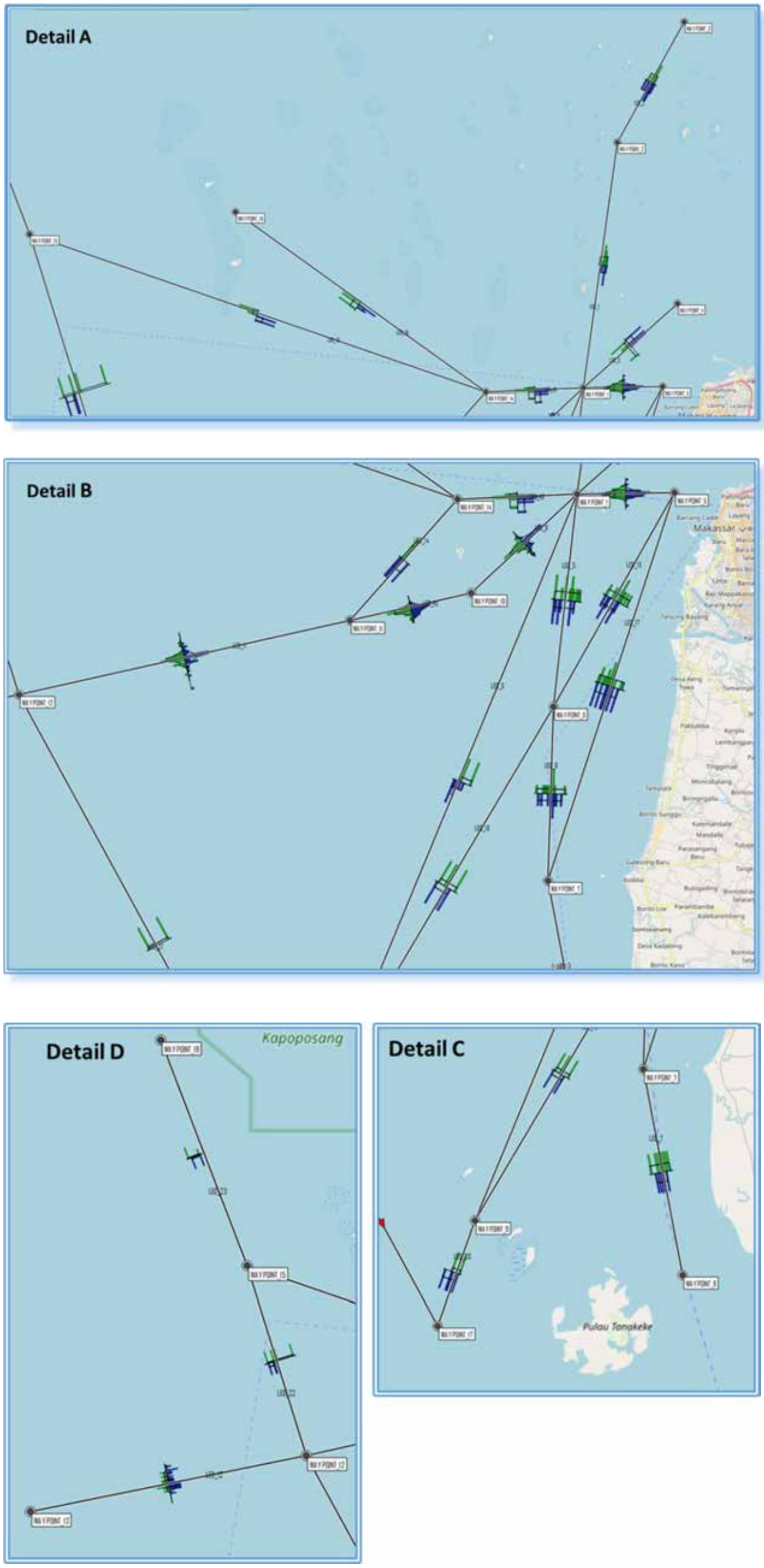


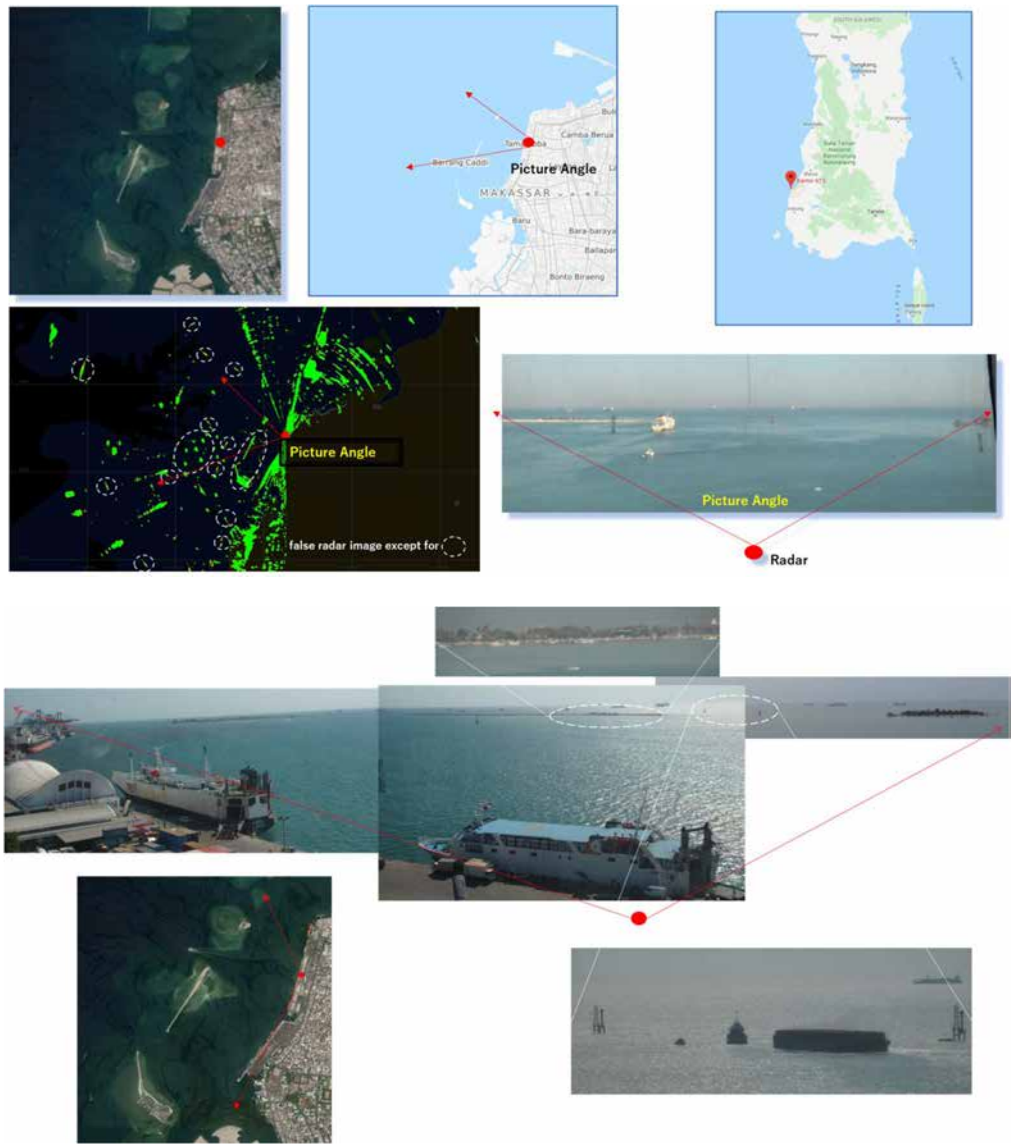
Figure 5.4 -5 : Histogram of Lateral Distribution (2/2)

In this area, there is no fixed traffic route, which is a customary passageway for vessels. Since there are a lot of vessels including large ships passing through the traffic way between the Sea-Lane 2 and the port, it is desirable to continue to watch the movement of such vessels in VTS and it provides appropriate information to the vessels in a timely manner.

In the future, it would be effective to establish a system that provides information on large vessels to small ships around the port by smartphone.

The radar and visual surveys were conducted in this area.

The radar image and the view from the radar are shown in the Picture below.

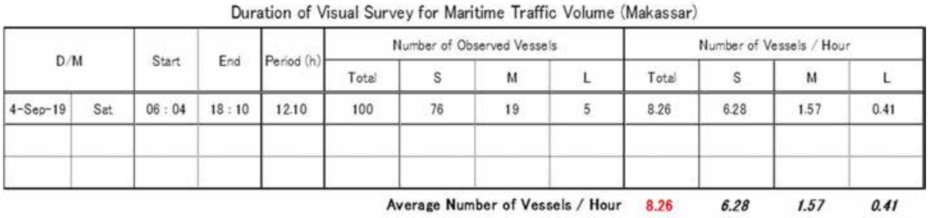


Picture 5.4 -1 : Radar Images and Its view

Many small boats are sailing in and around the port. Radar is effective for obtaining the information on the movement of small boats without AIS, but many false images were confirmed in this survey. The appearance of the false images is related to the location of the radar installed, and further investigation is required before the establishment of the radar.

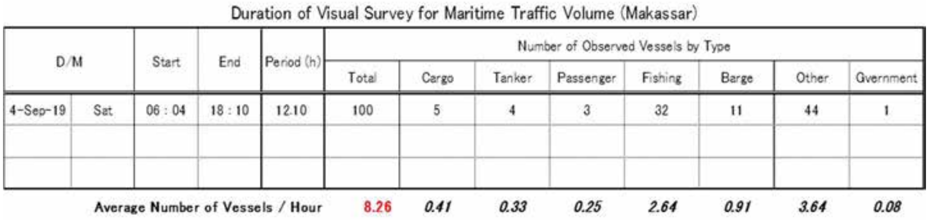
The results of the visual survey are shown in the Table below.

Table 5.4 -3 : Result of Visual Survey



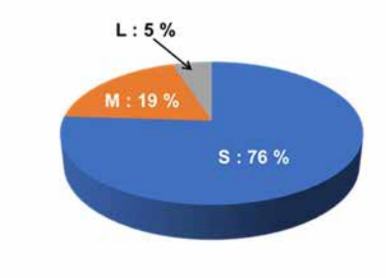
Duration of Visual Survey for Maritime Traffic Volume (Makassar)

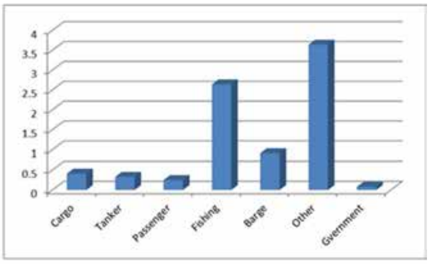
D/M		Start	End	Period (h)	Number of Observed Vessels				Number of Vessels / Hour			
					Total	S	M	L	Total	S	M	L
4-Sep-19	Sat	06 : 04	18 : 10	12.10	100	76	19	5	8.26	6.28	1.57	0.41
								Average Number of Vessels / Hour	8.26	*6.28*	*1.57*	*0.41*



Duration of Visual Survey for Maritime Traffic Volume (Makassar)

D/M		Start	End	Period (h)	Number of Observed Vessels by Type							
					Total	Cargo	Tanker	Passenger	Fishing	Barge	Other	Gvernment
4-Sep-19	Sat	06 : 04	18 : 10	12.10	100	5	4	3	32	11	44	1
Average Number of Vessels / Hour					8.26	*0.41*	*0.33*	*0.25*	*2.64*	*0.91*	*3.64*	*0.08*





The visual survey was conducted from 6 am to 6 pm, and 100 vessels were confirmed during 12 hours. Of these, 76% were small boats. It is possible that a large vessel coming into or out of the port was not confirmed due to the observation for only one day, but there is no doubt that many small boats are sailing inside the port.

Picture 5.4 -2 : Sea dotted with small boats

5.5 Kalukalukuang

Kalukalukuang is a small island, facing the Sea-Lane 2, with a circumference of 13 km located 200 km offshore west of Makassar. AIS was set up here in order to collect data on the movement of vessels passing through the Sea-Lane 2 and its vicinity.

Transportation to here is only by sea from Makassar. Since the island does not have a boat dock, the equipment for AIS was carried on shoulders from the beach.

Picture 5.5 -1 : Carrying AIS Equipment in Island

The location where AIS base-station was temporarily installed is shown in the Figure below.

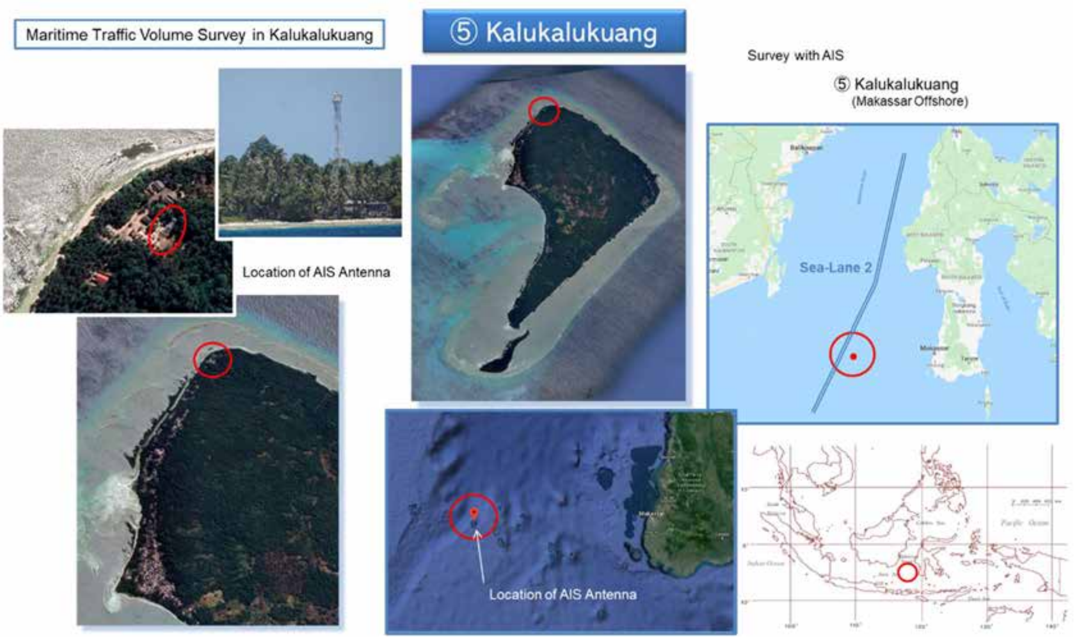


Figure 5.5 -1 : Location of AIS Base-Station

The tracks of the AIS vessels for 19 days in August 29 and 30, in September 4 and September 10 to 18, and from September 29 to October 5, 2019 are shown in the Figure below. The data was recorded intermittently, because the power source for the lighthouse was used as the electricity of AIS devices, which was occasionally switched for maintenance.

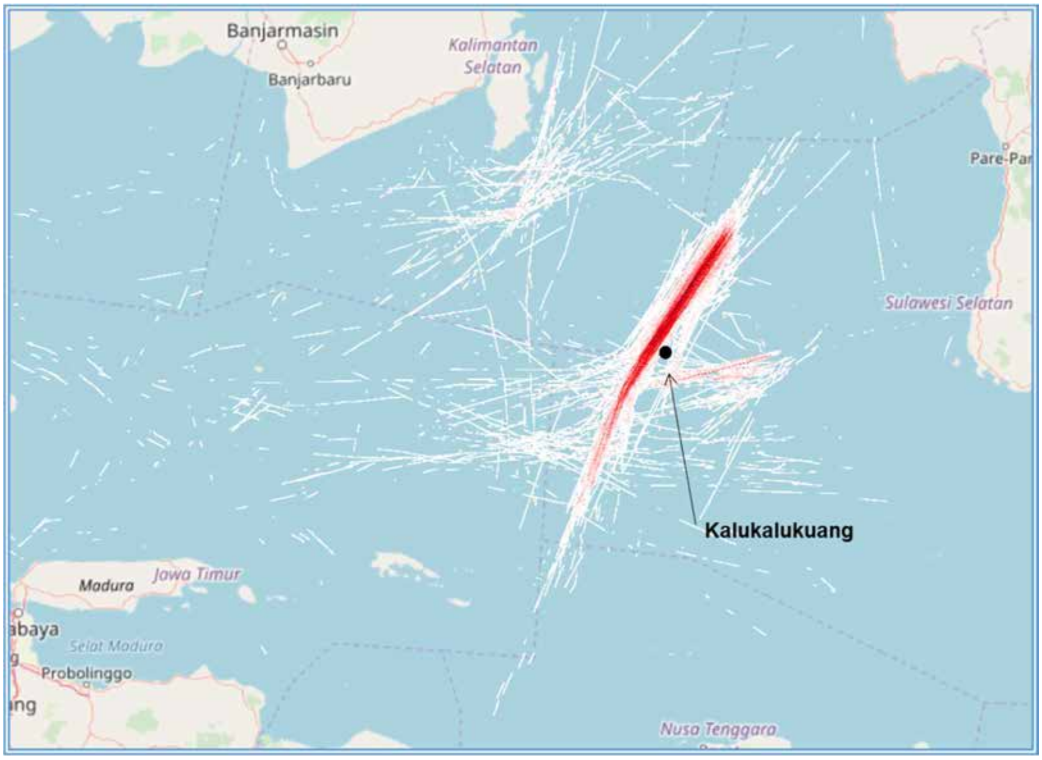


Figure 5.5 -2 : Density Plot of AIS

Most of the vessels recorded during the survey were sailing through the Sea-Lane 2. In addition, this sea area is extensive and deep enough to allow vessels to navigate in any direction.

During this survey (19 days), a total of 1,194 vessels were confirmed. This means that about 63 vessels are sailing a day. However, the actual number of sailing vessels may be a little higher than the count number, because this figures are a count of the number of MMSI detected during this survey, and there is a possibility that the same MMSI ship has navigated a few times this area.

The classification as to a type and size is shown in the Table below.

Table 5.5 -1 : Type of Vessel

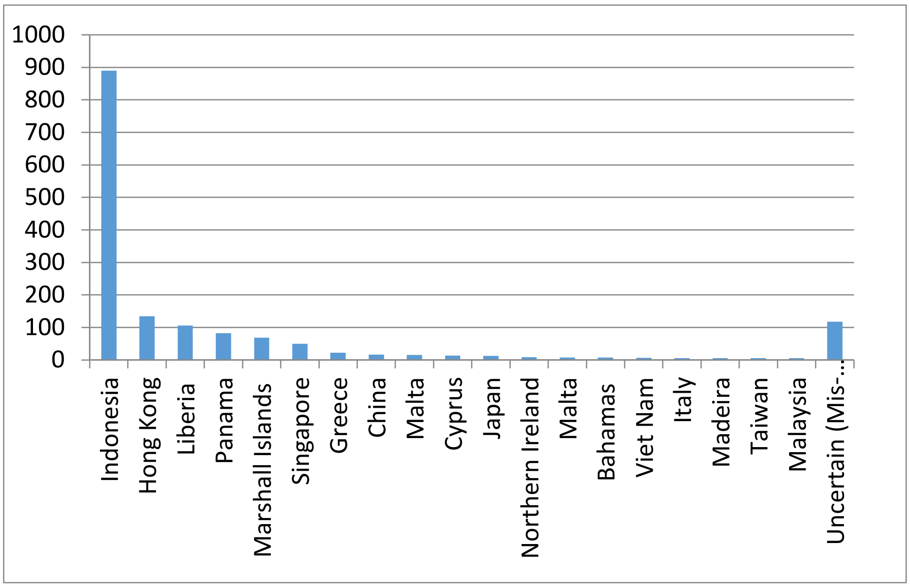
Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	0	0	**17**	**6**	**5**	**1**	**29**	**256**	**314**
51～150m	0	0	**126**	**50**	**11**	**1**	**10**	**28**	**226**
151～250m	0	0	**276**	**58**	**5**	0	**1**	**7**	**347**
251m以上	0	0	**300**	**0**	**1**	0	0	**6**	**307**
Total of ship types	0	0	**719**	**114**	**22**	**2**	**40**	**297**	
Total of all ship types	**1,194**								

In this area, it can be seen that all size of ships are sailing and they are particularly dense on the Sea-Lane 2.

Three Sea-Lane run through the islands of Indonesia from north to south, and not only Indonesia vessels but also many foreign vessels are using this route as the main maritime traffic route. An analysis of AIS's MMSI in this survey revealed that many foreign vessels had navigated through this sea area.

According to the nationality of 1,521 vessels recorded in this survey, Indonesian-flag ships account for about 60 % of them, but foreign-flag ships in 45 countries, including Indonesia, were in service, as shown in the Graph and the Table below.

Graph 5.5 -1 : Vessels by Nationality



In order of nationality, Indonesia, Hong Kong, Liberia, Panama, Malaysia, and Singapore are the major countries, with the exception of Liberia and Panama which are a flag of convenience ship. The number of vessels by all 45 countries is shown in the Table below.

Table 5.5 -2 Vessels by Nationality

1	2	3	4	5	6	7	8	9	10
Indonesia	Hong Kong	Liberia	Panama	Marshall Islands	Singapore	Greece	China	Malta	Cyprus
890	135	106	82	69	50	22	17	16	14
11	12	13	14	15	16	17	18	19	20
Japan	Northern Ireland	Malta	Bahamas	Viet Nam	Italy	Madeira	Taiwan	Malaysia	UK
13	9	8	8	7	6	6	6	6	4
21	22	23	24	25	26	27	28	29	30
Luxembourg	Norway	Korea	Bermuda	Cayman Islands	Tuvalu	Netherlands	Antigua and Barbuda	India	Mongolia
4	4	4	3	3	3	2	2	2	2
31	32	33	34	35	36	37	38	39	40
Niue	Philippines	Thailand	Germany	Spain	Gibraltar	Dominica	US	Saudi Arabia	Pakistan
2	2	2	1	1	1	1	1	1	1
41	42	43	44	45	-----				
Australia	Cambodia	Kiribati	New Caledonia	Togolese Republic	Uncertain (Mis-Input)				
1	1	1	1	1	118				

The fact that vessels from 45 countries are navigating in this area is really an international maritime traffic zone, and the maritime surveillance for the management of vessel's movement will have to be considered.

The density map for each ship type is shown in the Figure below.

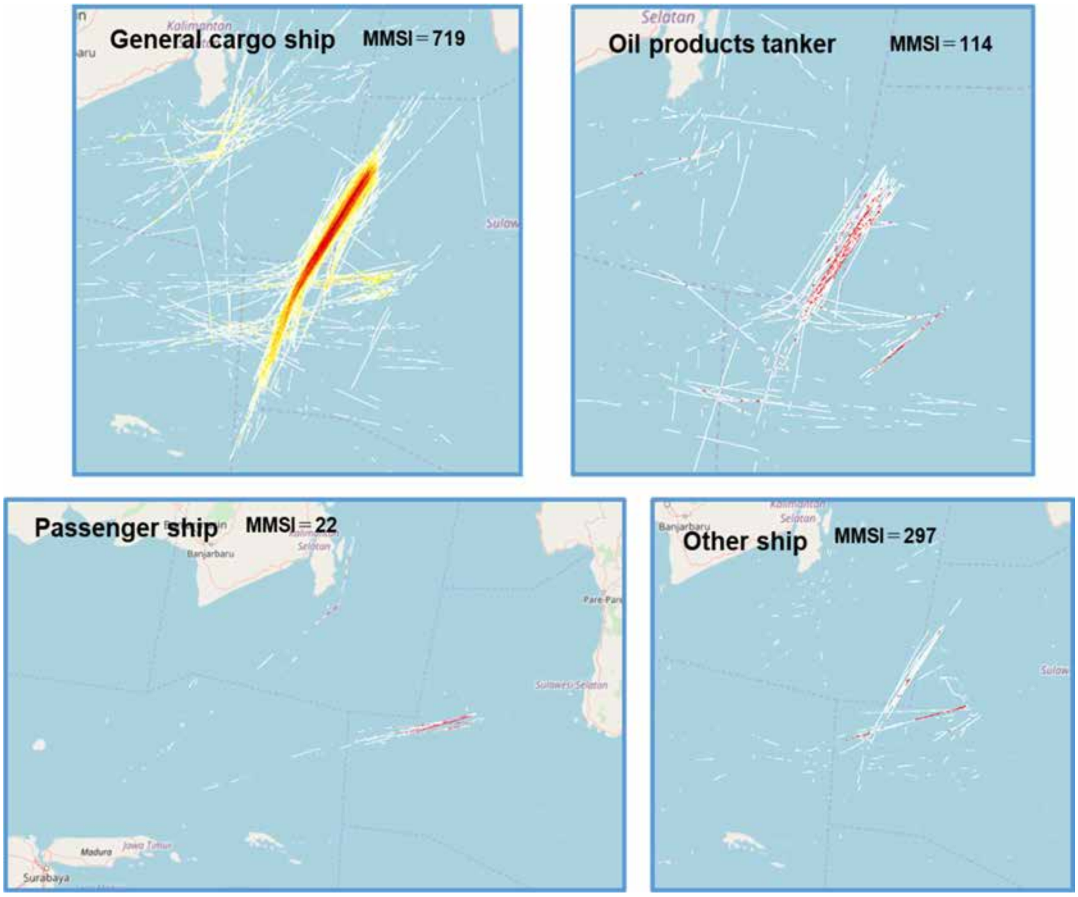


Figure 5.5 -3 : Density for each Type

It can be clearly seen that general cargo ships and oil tankers are sailing in the Sea-Lane 2, and many ships, such as a passenger ship, other ships which are considered domestic ships, are going back and forth between Makassar and Surabaya.

Two traffic routes extending from west to east, which are used by vessels entering Makassar Port, intersect the Sea-Lane 2.

To analyze the risk management by IWRAP, the following lateral distribution map was prepared, as shown in the Figure at next page.

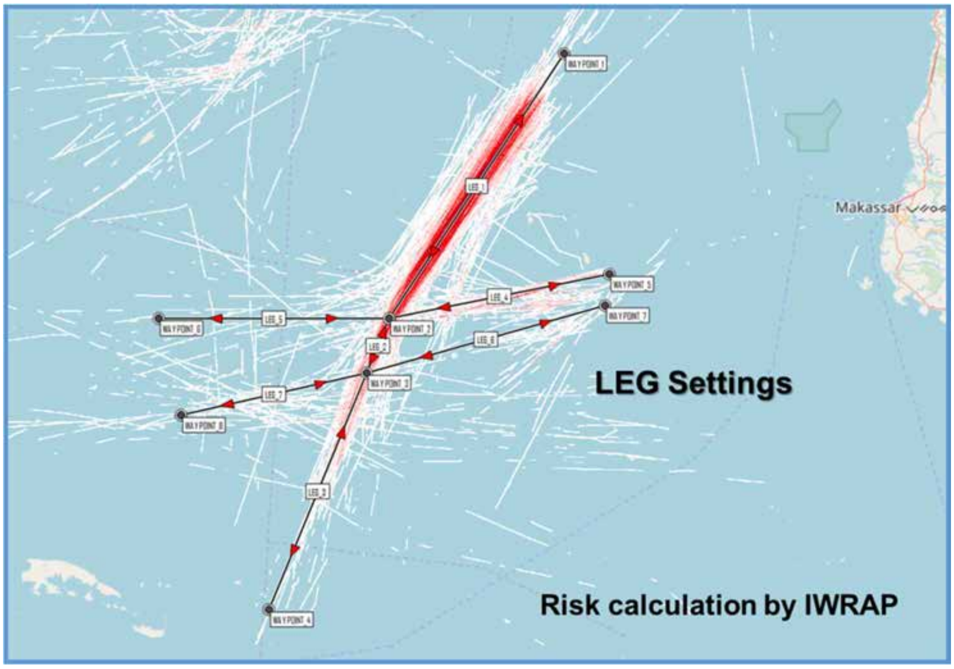


Figure 5.5 -4 : Designation of Leg for Calculation

The vessels are sailing along the route, and it seems that they are navigating with margin space because the sea area is wide enough. The lateral distribution of vessels shows this. The width of each histogram bar is 1 km.

Histograms of each leg for the traffic are shown in the Figure below.

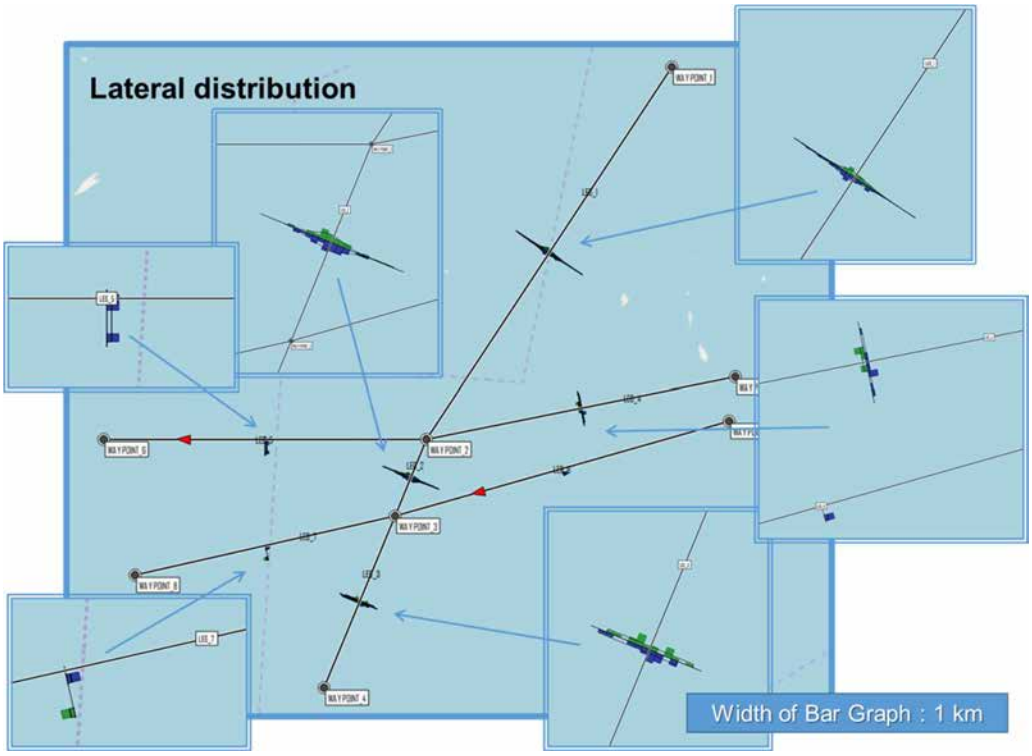
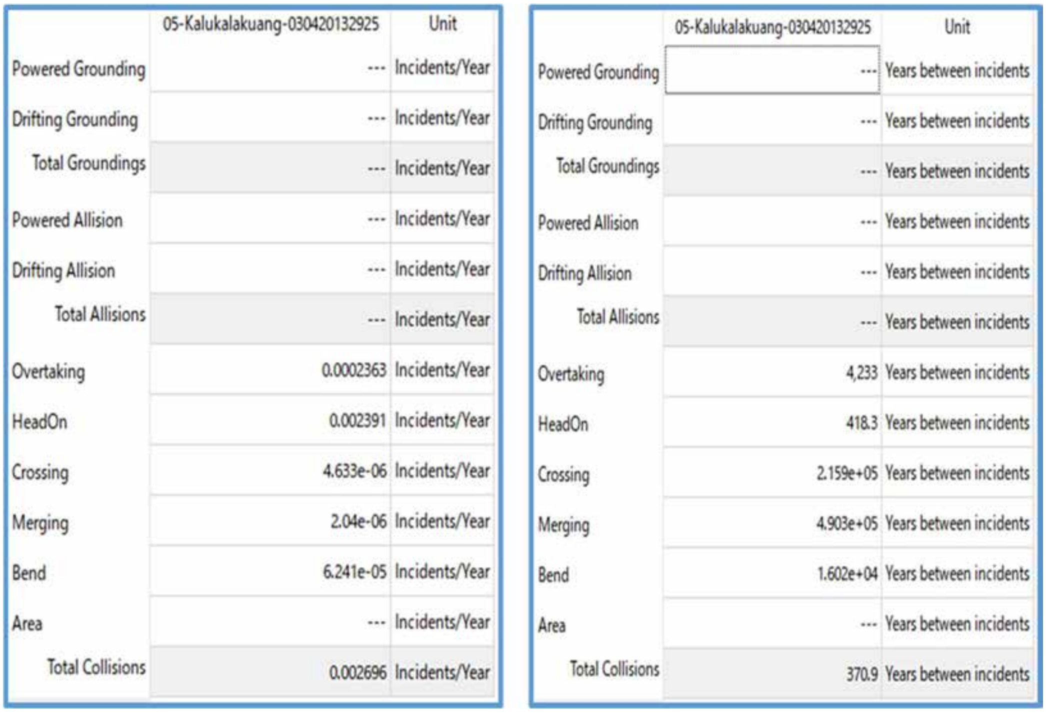


Figure 5.5 -5 : Histogram of Lateral Distribution

The result of the IWRAP calculation is shown in the Table below.

Table 5.5 -3 : Results of IWRAP Calculation



	05-Kalukalakuang-030420132925	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.0002363	Incidents/Year
HeadOn	0.002391	Incidents/Year
Crossing	4.633e-06	Incidents/Year
Merging	2.04e-06	Incidents/Year
Bend	6.241e-05	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.002696	Incidents/Year

	05-Kalukalakuang-030420132925	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	4,233	Years between incidents
HeadOn	418.3	Years between incidents
Crossing	2.159e+05	Years between incidents
Merging	4.903e+05	Years between incidents
Bend	1.602e+04	Years between incidents
Area	---	Years between incidents
Total Collisions	370.9	Years between incidents

Because the navigable area for vessels is wide and the absolute traffic volume is not so large, no remarkable calculation results have been obtained. However, as far as the tracks of vessels are concerned, there are many intersections of vessels in this area, and there is a potential vessel collision.

5.6 Labuan Bajo

Labuan Bajo is located at the western end of the large island of Flores in the Nusa Tenggara region of east Indonesia, and nearby is Komodo National Park. Recently, many facilities to support tourist activities have been developed in the surrounding area, and the number of visitors using the sea is increasing.

The AIS was set up here in order to collect the data on the movement of vessels sailing around Komodo Island.

The location where AIS base-station was temporarily installed is shown in the Figure below. And, a radar survey was conducted here.

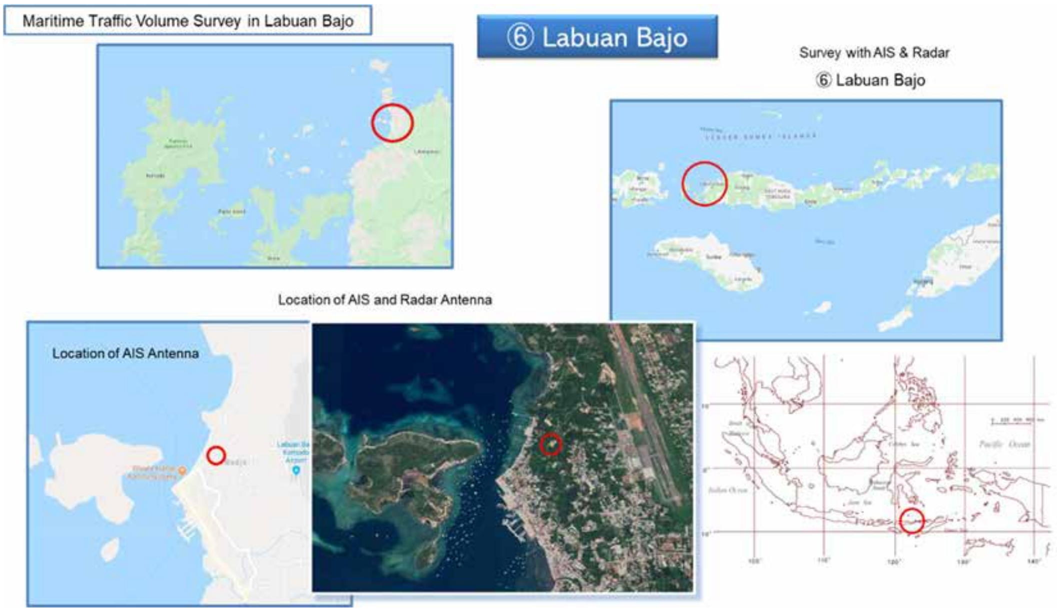


Figure 5.6 -1 : Location of AIS and Radar

The tracks of the AIS vessels for 3 days from November 4 to 6, 2019 are shown in the Figure below.

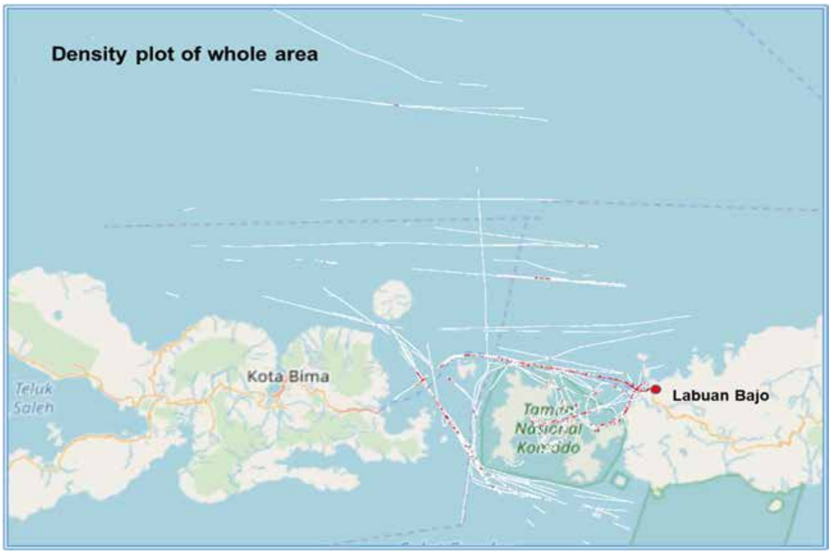


Figure 5.6 -2 : Density Plot of AIS

The total number of vessels equipped with AIS confirmed in three days is 82.

The classification as to a type and size is shown in the Table below.

Table 5.6 -1 : Type of Vessel

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～25m	1	0	0	0	1	8	1	2	13
26～50m	0	0	1	0	5	2	0	18	26
51～150m	0	0	12	8	4	2	1	1	28
151～250m	0	0	4	1	0	0	0	0	5
251m以上	0	0	10	0	0	0	0	0	10
Total of ship types	1	0	27	9	10	12	2	21	
Total of all ship types	82								

The tracks by vessel’s type are shown in the Figure below.

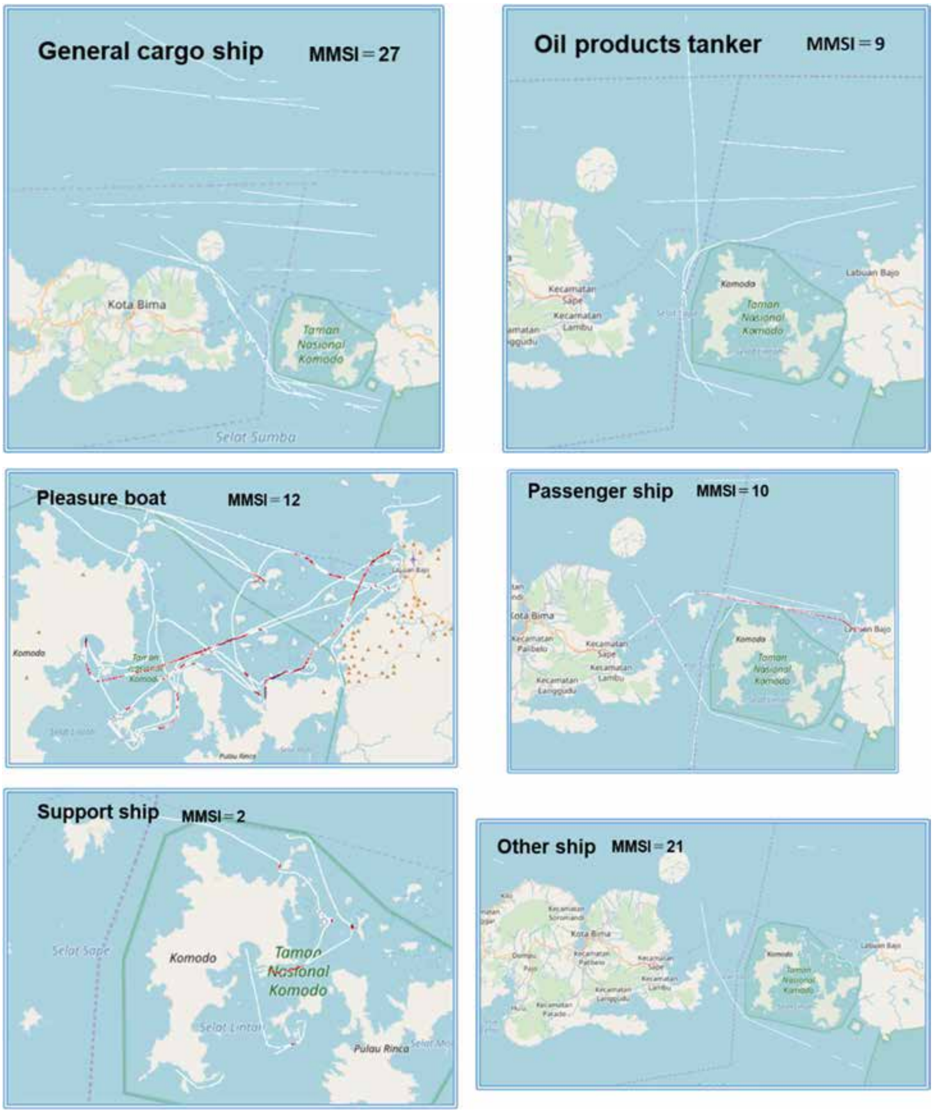


Figure 5.6 -3 : Density Map for each Type

It can be seen that the most of large and medium-sized cargo ships and oil tankers are navigating outside Comodo Island and the port.

Pleasure boats, passenger boats, ant other small boats are cruising within the bay surrounded by Komodo Island and the Port, and they are going back and forth among islands.

In addition, a lot of small boats not equipped with AIS are cruising in the bay. They were confirmed by radar and visual survey this time, and many small boats were anchoring in the bay. The radar devices are installed on the hilltop building temporarily as shown in the phot below.

Picture 5.6 -1 : Installation of Radar

The coverage range of a radar (X-Band Radar) used for maritime surveillance is usually 10 km to 20 km (depending on the height of an antenna), and a few more radar sites must be installed in order to get the movement of small boats cruising in the bay up to Komodo Island.

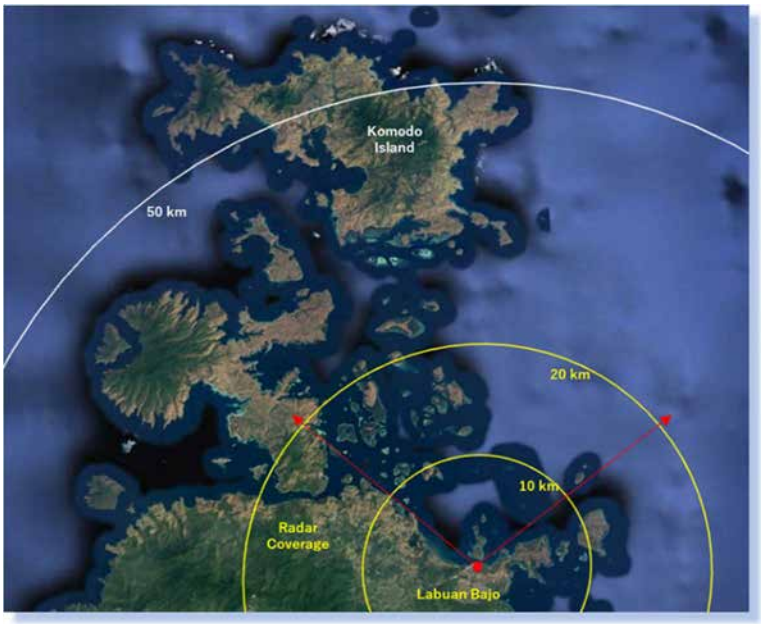


Figure 5.6 -4 : Expected Radar Coverage

The radar images are shown in the Figure below.

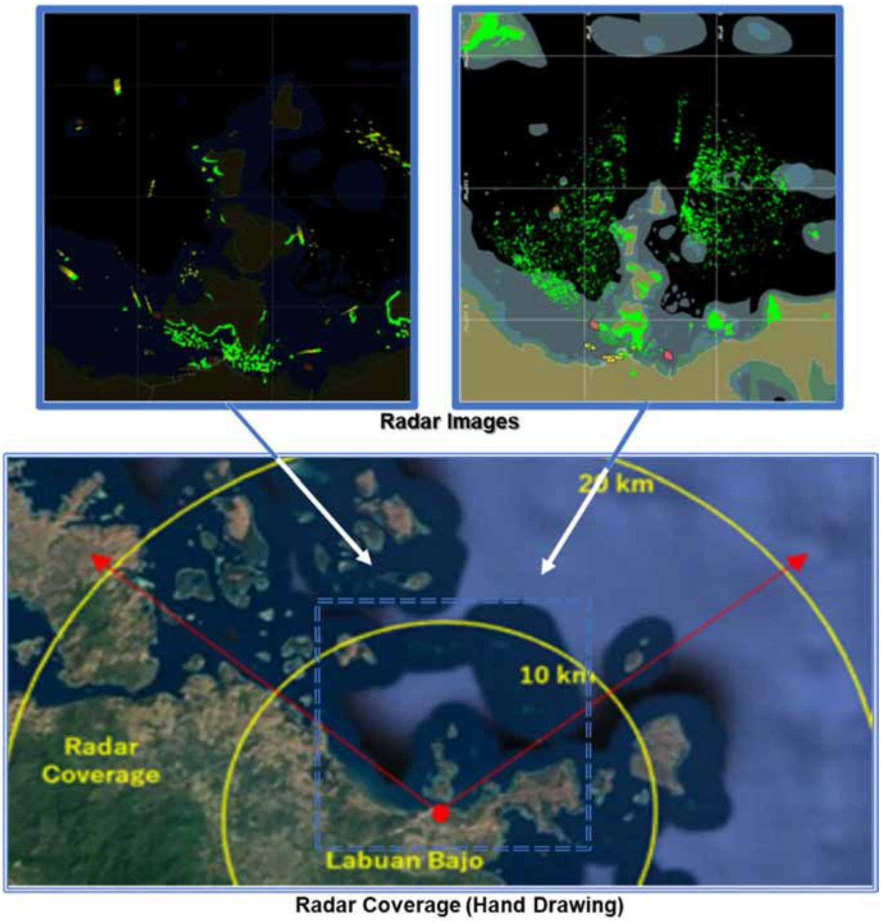
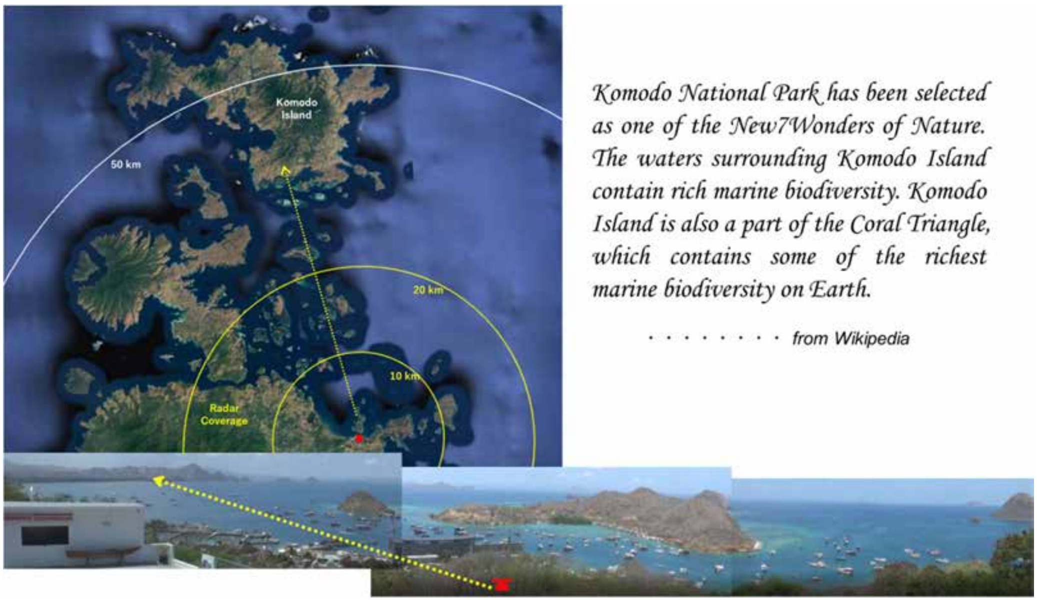


Figure 5.6 -5 : Radar Images in the Port

It can be seen that the bay is studded with many islets and small boats are moored between them. The view in a direction of Komodo Island from the temporary radar site is as follows.



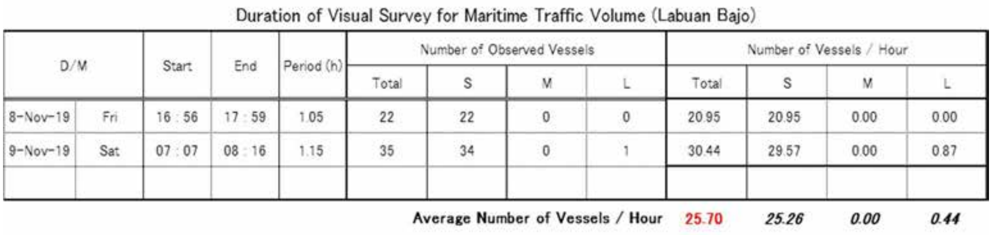
Komodo National Park has been selected as one of the New7Wonders of Nature. The waters surrounding Komodo Island contain rich marine biodiversity. Komodo Island is also a part of the Coral Triangle, which contains some of the richest marine biodiversity on Earth.

. . . . from Wikipedia

Picture 5.6 -2 : View toward Komodo Island

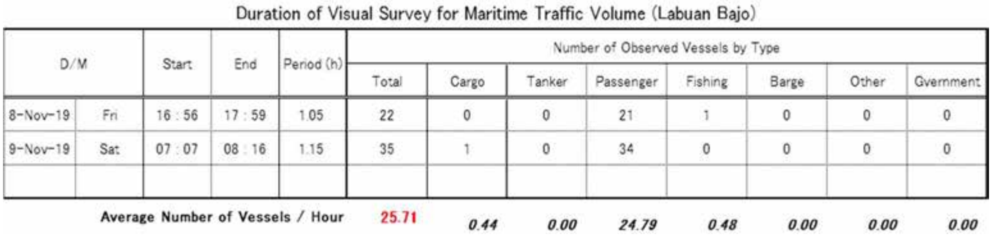
According to the visual survey, the number of vessels crossing the front of the radar site is shown in the Table below.

Table 5.6 -2 : Result of Visual Survey



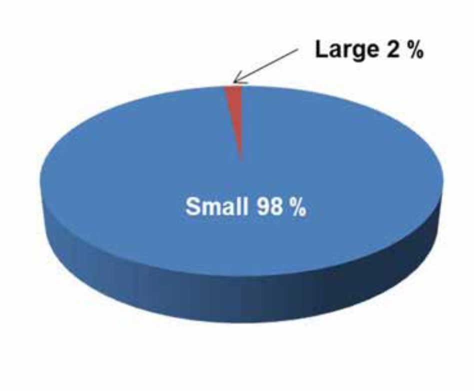
Duration of Visual Survey for Maritime Traffic Volume (Labuan Bajo)

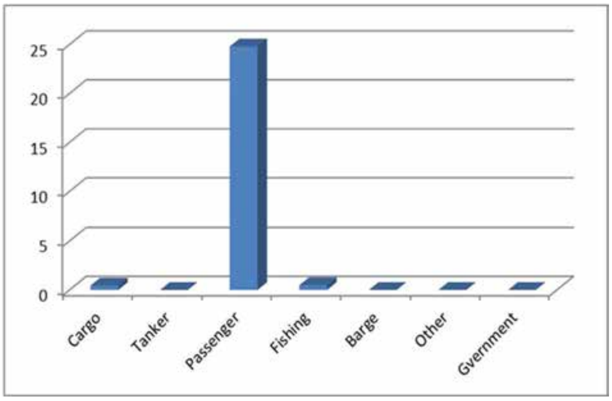
D/M		Start	End	Period (h)	Number of Observed Vessels				Number of Vessels / Hour			
					Total	S	M	L	Total	S	M	L
8-Nov-19	Fri	16 : 56	17 : 59	1.05	22	22	0	0	20.95	20.95	0.00	0.00
9-Nov-19	Sat	07 : 07	08 : 16	1.15	35	34	0	1	30.44	29.57	0.00	0.87
								Average Number of Vessels / Hour	25.70	*25.26*	*0.00*	*0.44*



Duration of Visual Survey for Maritime Traffic Volume (Labuan Bajo)

D/M		Start	End	Period (h)	Number of Observed Vessels by Type							
					Total	Cargo	Tanker	Passenger	Fishing	Barge	Other	Gvernment
8-Nov-19	Fri	16 : 56	17 : 59	1.05	22	0	0	21	1	0	0	0
9-Nov-19	Sat	07 : 07	08 : 16	1.15	35	1	0	34	0	0	0	0
		Average Number of Vessels / Hour			25.71	*0.44*	*0.00*	*24.79*	*0.48*	*0.00*	*0.00*	*0.00*



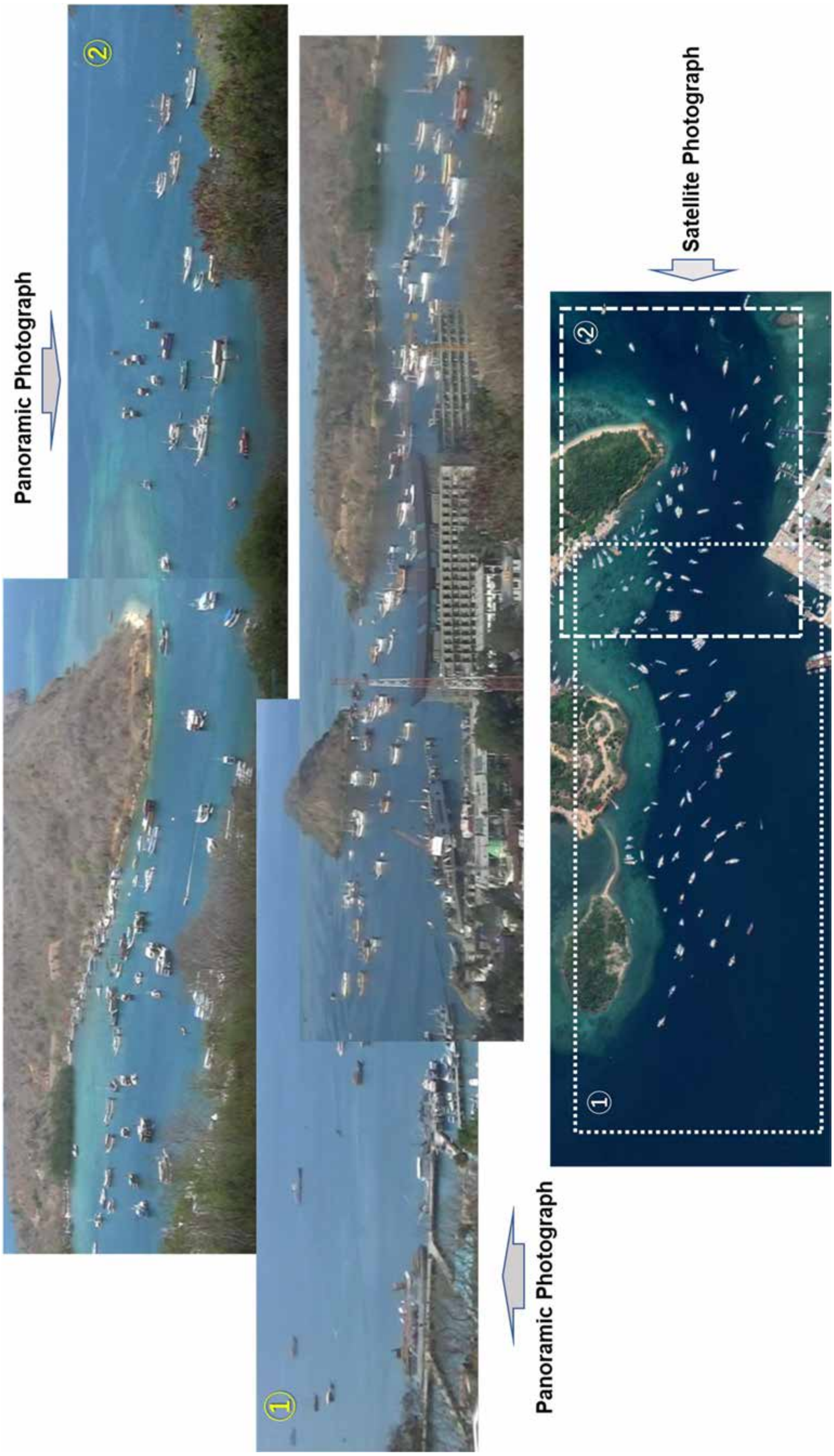


At this time, the visual survey has been conducted only for one hour in the morning and before sunset. However, the movement of small boats was confirmed because they start to move and return to the port during the period of this time.

By the way, it should be noted that there are almost no lighted aids to navigation in such remote sea areas, where becomes a completely black sea at night. Therefore, there is no traffic of a small boat at night.

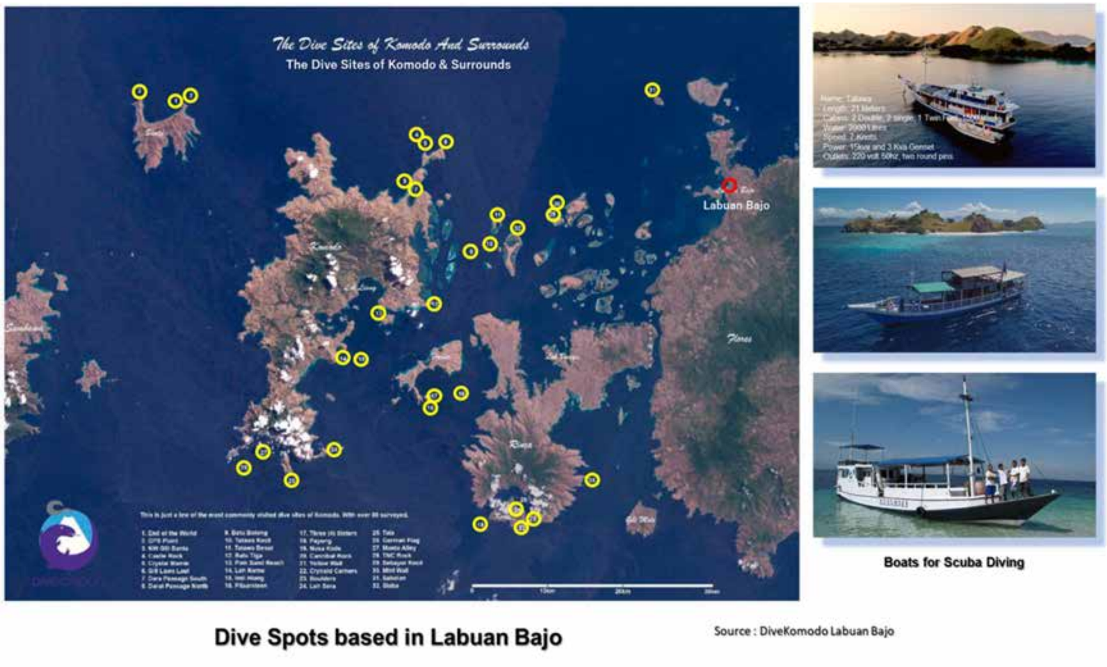
In this survey, the number of vessels passing by one hour was about 25, and most of them were small boats with a length of 25m or less, and 95 % of them are passenger boats.

The satellite photo (Google Earth) at the same angle as the panoramic picture taken from the radar site is as follows (The shooting date and time are different).



Picture 5.6 -3 : View of Labuan Bajo

Labuan Bajo is now a tourist center, and there are numerous snorkeling and diving points in the islands close to Labuan Bajo.



Picture 5.6 -4 : Dive Spots

Tourism is promoted as a national policy, and it is expected that the number of tourists who will be involved in the maritime activities will increase in the future, and the number of large cruiser will increase accordingly. If these ships suffer a human life-related marine accident, it will be a terrible disaster. The maritime safety measures must be taken thoroughly.

Picture 5.6 -5 : Cruise Ship in Labuan Bajo

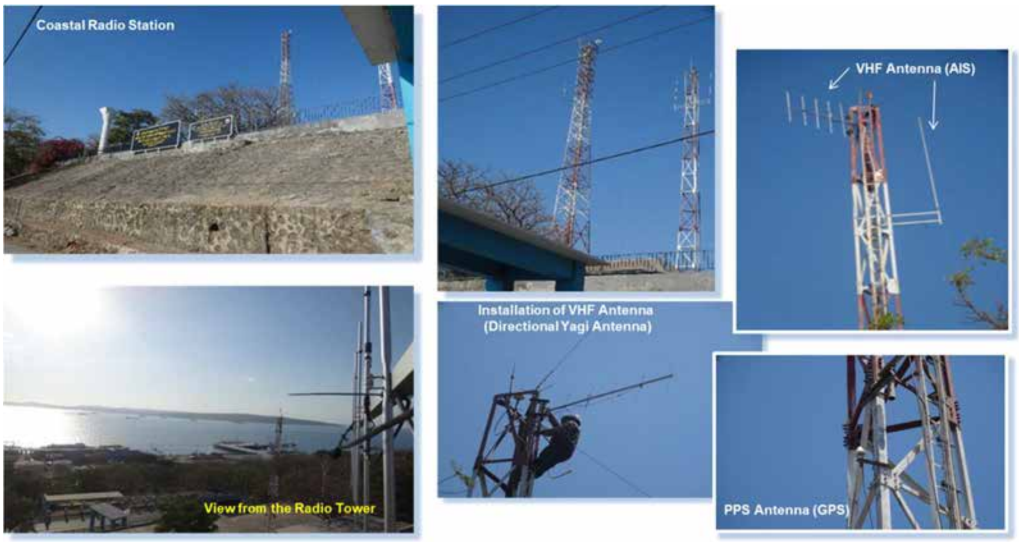
5.7 Kupang

Kupang is a port town located at the west end of Timor Island (West Timor). It is the closest island to Australia.

AIS was set up here in order to collect the data on the movement of vessels sailing around the port. The location where AIS base-station was temporarily installed is shown in the Figure below.

Figure 5.7 -1 : Location of AIS Base-Station

The following pictures show the installation of AIS devices.



Picture 5.7 -1 : Installation of AIS Antenna

The tracks of the AIS vessels for five days from July 3 and 4, and October 10 to 12, 2019 are shown in the Figure at the next page.

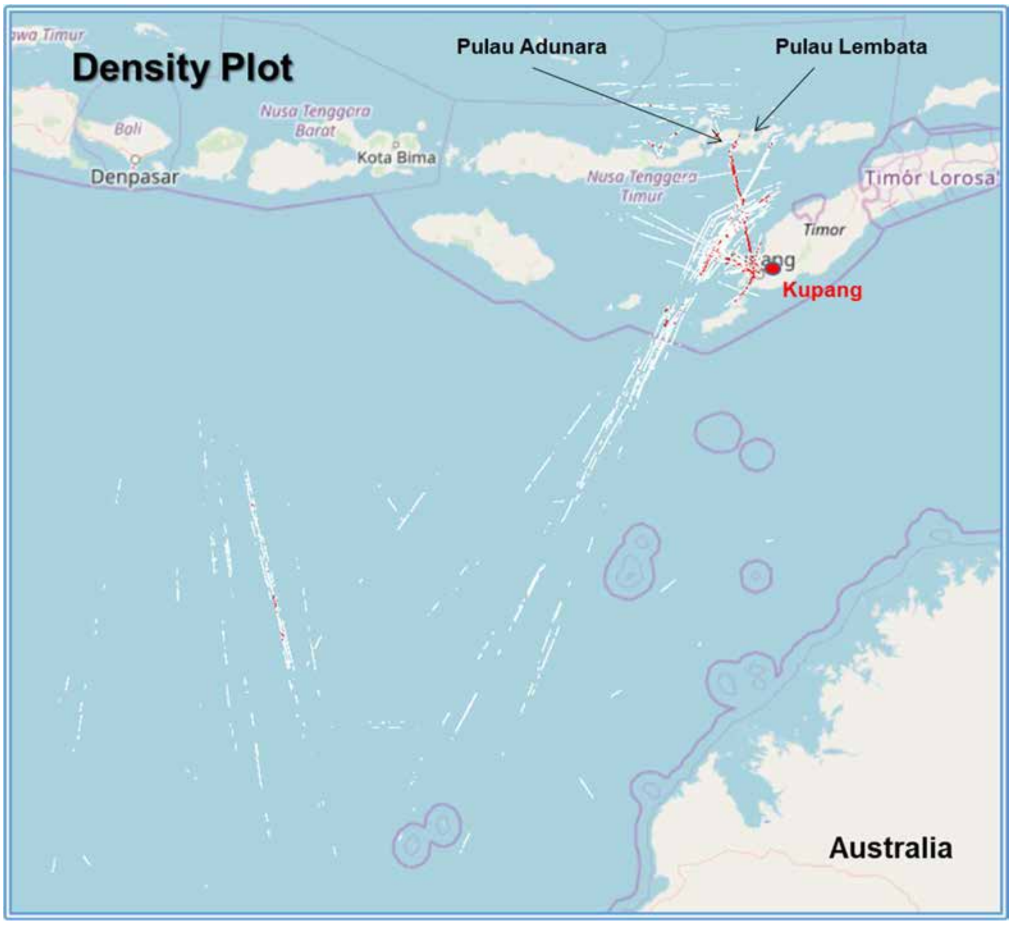


Figure 5.7 -2 : Density Plot of AIS

The total number of vessels confirmed in five days is 209.

Off the coast of Kupang, there is a traffic route that is one of the south gateways of Sea-Lane 3, which is used by vessels mainly going back and forth to Australia. There are quite a few large vessels passing through.

Another feature is that there is a considerable volume of traffic on the other side of Adunara Island and Lembata Island.

The classification as to a type and size is shown in the Table below.

Table 5.7 -1 : Type of Vessels

Ship Type / Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	**1**	**1**	**3**	0	**10**	**4**	**6**	**46**	**71**
51～150m	0	0	**15**	**12**	**8**	0	**1**	**11**	**47**
151～250m	0	0	**13**	**5**	0	0	0	**1**	**19**
251m以上	0	0	**60**	**11**	0	0	0	**1**	**72**
Total of ship types	**1**	**1**	**91**	**28**	**18**	**4**	**7**	**59**	
Total of all ship types	**209**								

Considering the scale of the Port of Kupang, it seems that a huge vessel of 250m or more is sailing in the traffic, namely, Sea-Lane 3. Other vessels are sailing in and around the Kupang, and about 27 vessels are sailing per day in this survey (Excluding 72 huge vessels).

The density map for each ship type is shown in the Figure below.

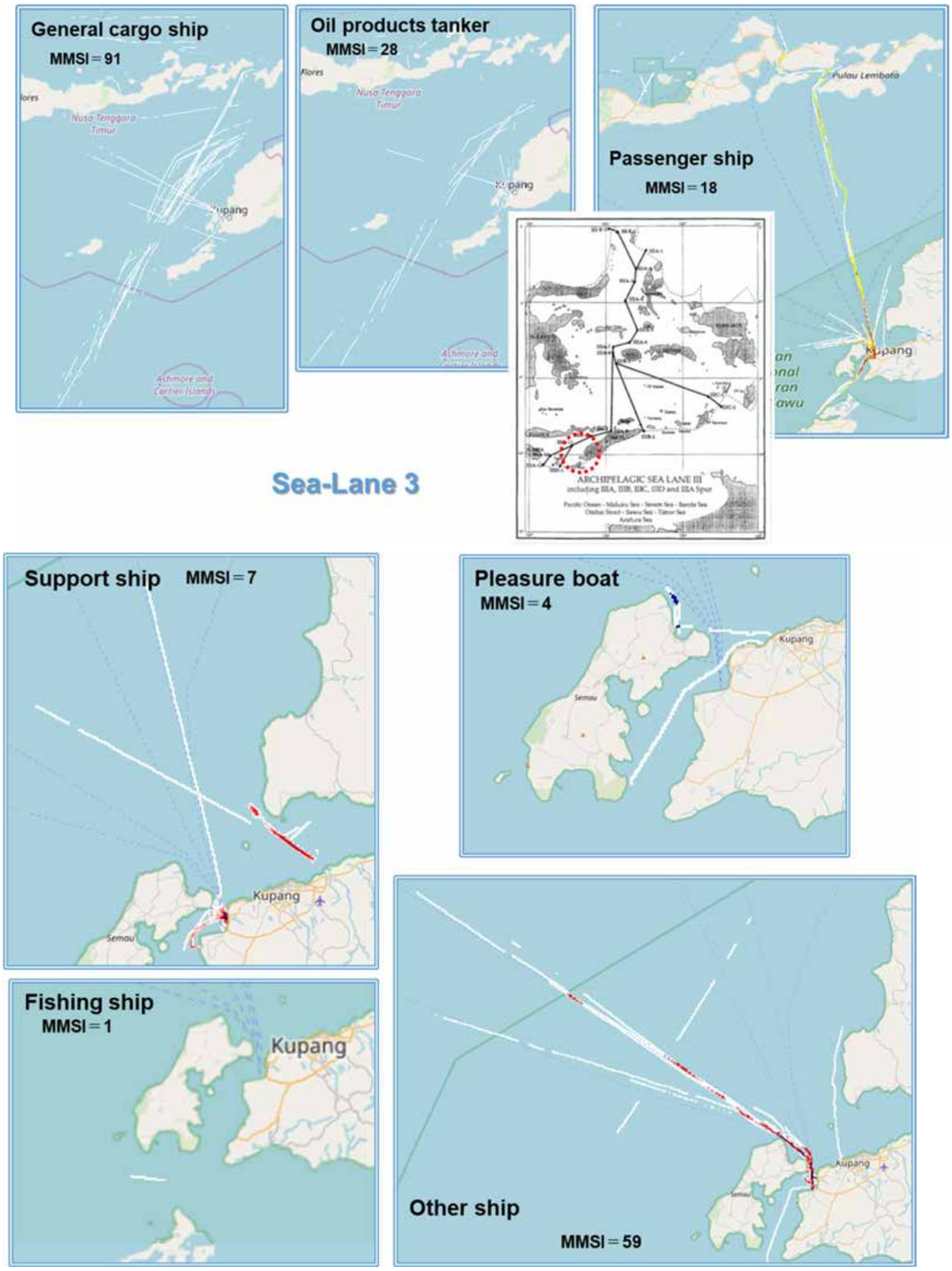


Figure 5.7 -3 : Density Map for each Type

As mentioned above, most of the vessels are sailing on the sea lane, and the main types of vessels are cargo vessels and oil tankers. The second largest number is the passenger boat to the opposite side of islands.

The lateral distribution of vessel's movement around the port, which is analyzed by IWRAP, is shown in the Figure below.

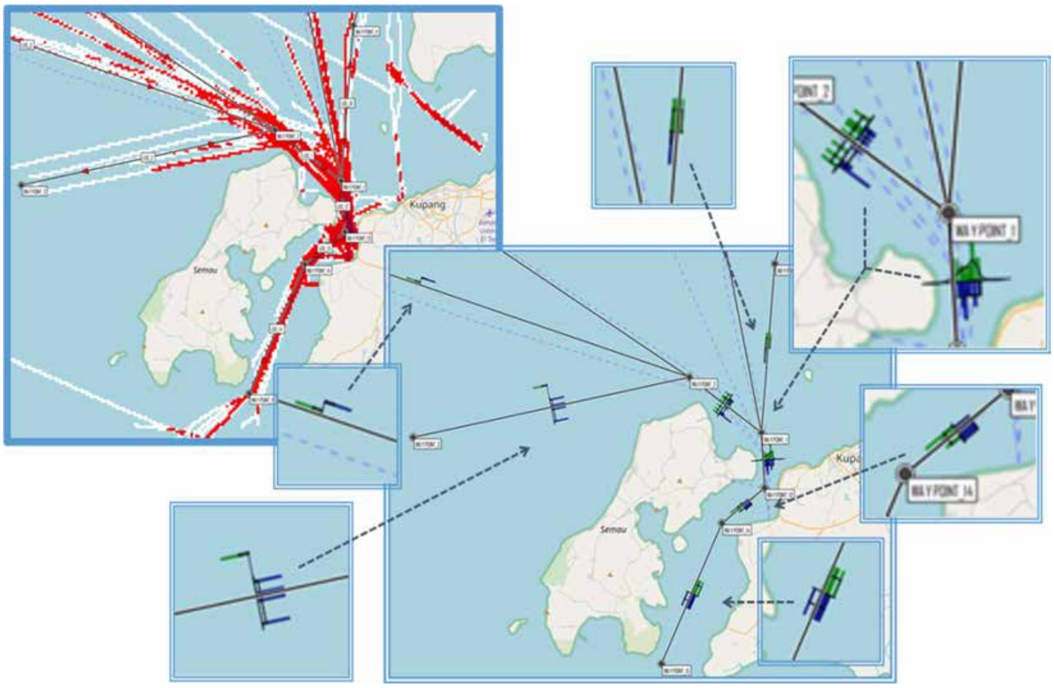


Figure 5.7 -4 : Histogram of Lateral Distribution

Vessels entering from the north are keeping to the right side traffic by sailing on the land side. With regard to departure vessels, the visibility forward is not clear due to the peninsula located in the north, and naturally vessels keep to the right side traffic by sailing off land. Right-hand traffic is generally kept in this area.

5.8 Tanjung Dehekalano

Tanjung Dehekalano is located at the easternmost tip of Pagama Island, where is east of the Sula Islands Regency in North Maluku province, and faces Obi Island on the opposite shore with a distance of 100 km across the sea. Between the two islands, the Sea-Lane 3 extends from north to south.

The location where AIS base-station was temporarily installed is shown in the Figure below.

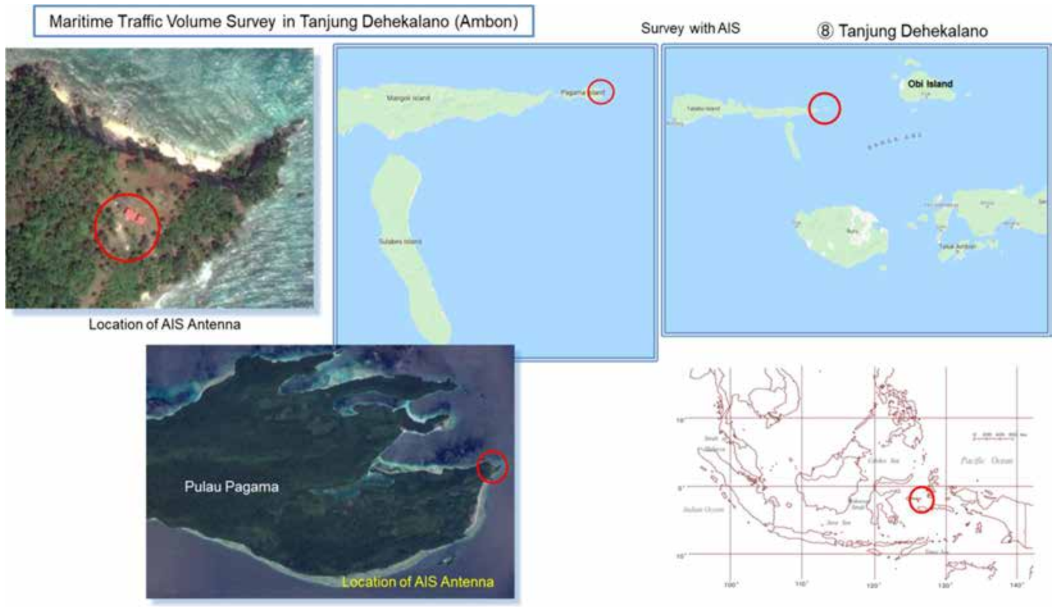


Figure 5.8 -1 : Location of AIS Base-Station

The following pictures show the installation of AIS devices.

Picture 5.8 -1 : Installation of AIS Antenna

The tracks of the AIS vessels for 6 days from October 23 to 28, 2019 are shown in the Figure at the next page.

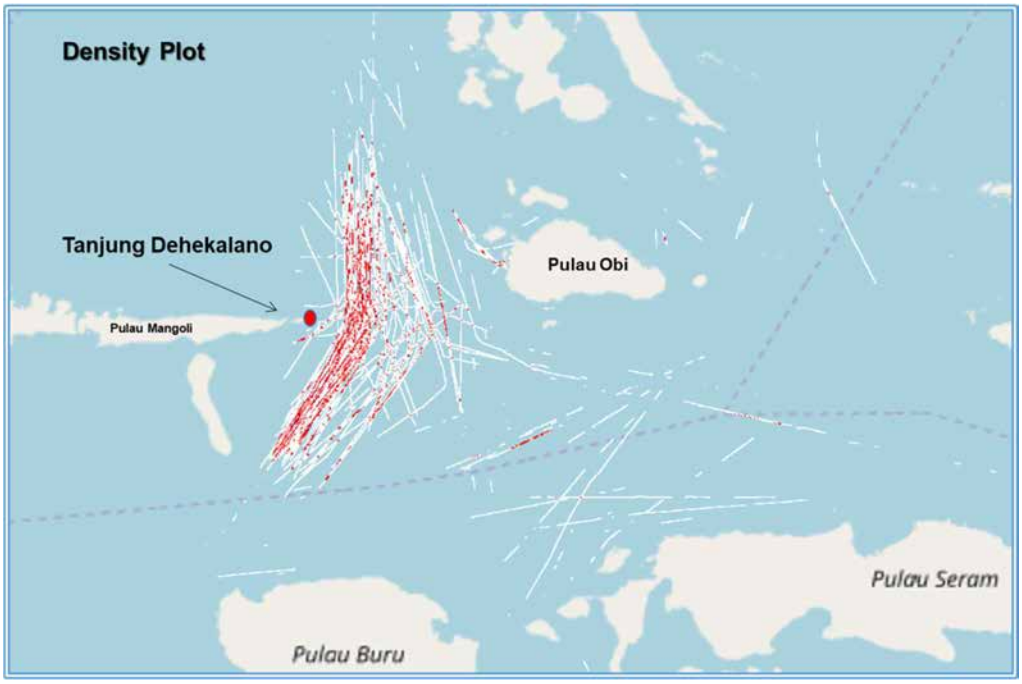
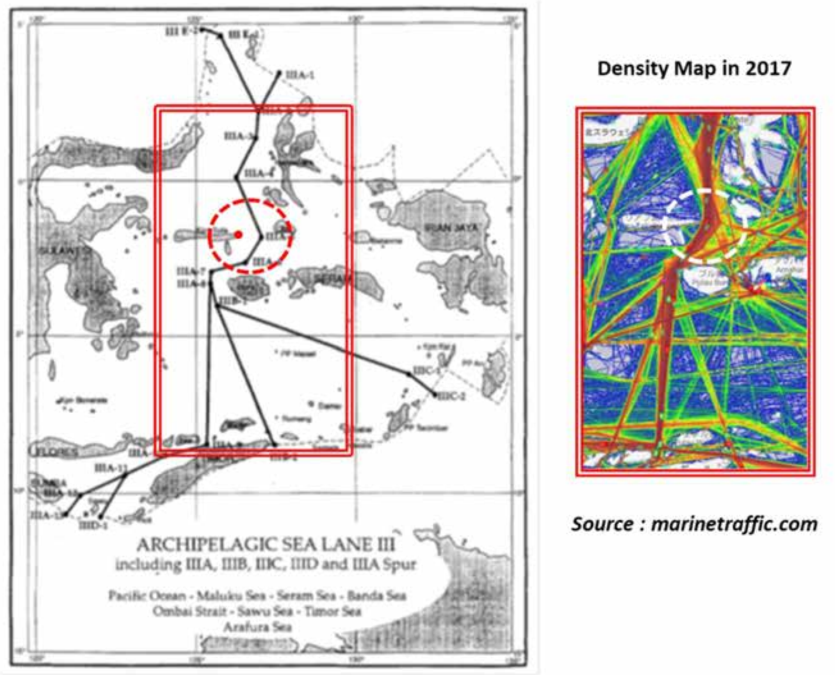


Figure 5.8 -2 : Density Plot of AIS

Total number of vessels confirmed in 6 days is 150. Of these, about 30% (46 vessels) are under the flag of Indonesia, and the others are foreign vessels. (including 15vessels of unknown nationality)

The majority of traffic flow in this area is along the Sea-Lane 3, as shown in the Figure below, and this point is the bottleneck of this sea-lane and is important in terms of the surveillance of vessel traffic.



Source : marinetraffic.com

Figure 5.8 -3 : Traffic Flow of Sea-Lane 3

The classification as to a type and size is shown in the Table below.

Table 5.8 -1 : Type of Vessel

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	0	0	**1**	**1**	**3**	**2**	**10**	**18**	**35**
51～150m	0	0	**11**	**8**	**3**	0	0	**4**	**26**
151～250m	0	0	**26**	0	0	0	0	0	**26**
251m以上	0	0	**38**	**25**	0	0	0	0	**63**
Total of ship types	0	0	**76**	**34**	**6**	**2**	**10**	**22**	
Total of all ship types	**150**								

The density map for each ship type is shown in the Figure below.

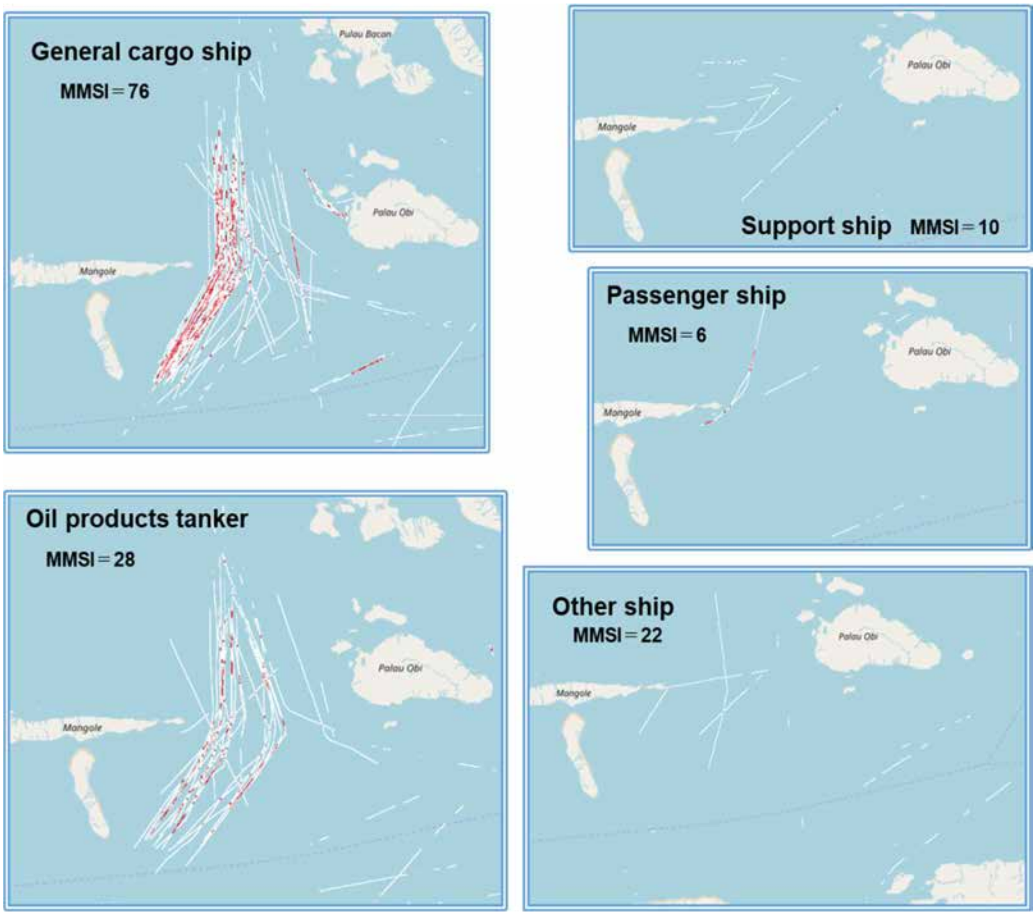


Figure 5.8 -4 : Density Map for each Type

As shown in both figures above, most of vessels passing through this area are a general cargo ship an oil tanker, and the only vessels that are sailing in the vicinity are small vessels such as a support ship, a local passenger boat and other ship.

The navigable width of vessels in this area is very broad, and IWRAP analysis shows that the lateral distribution is shown in the Figure below.

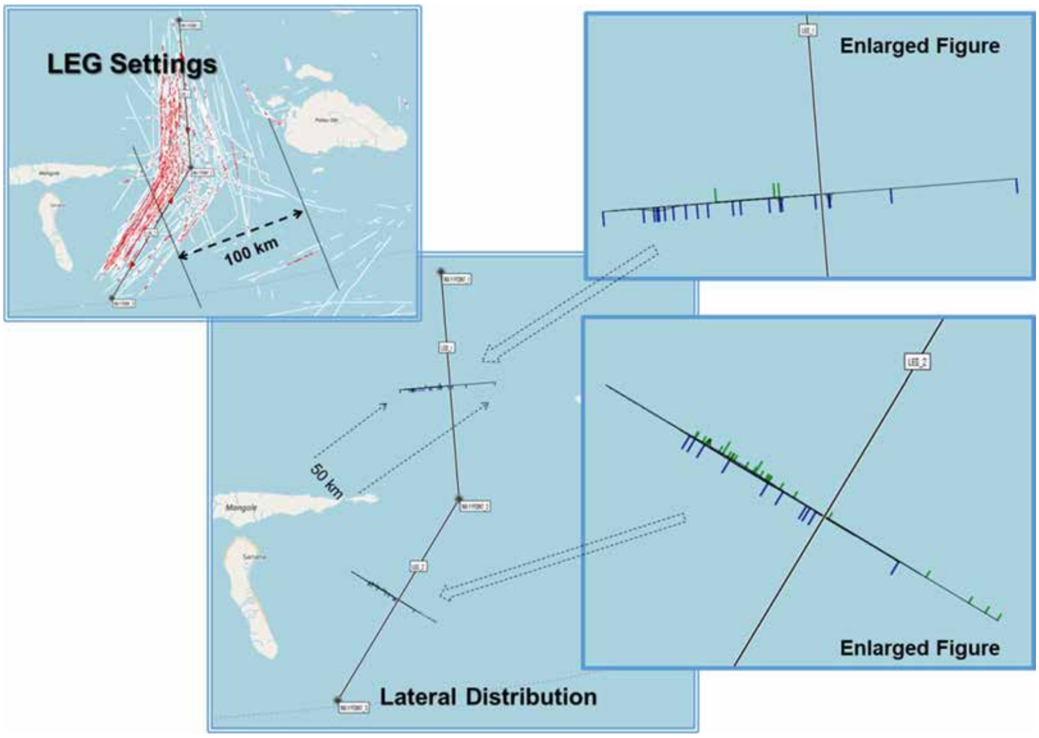
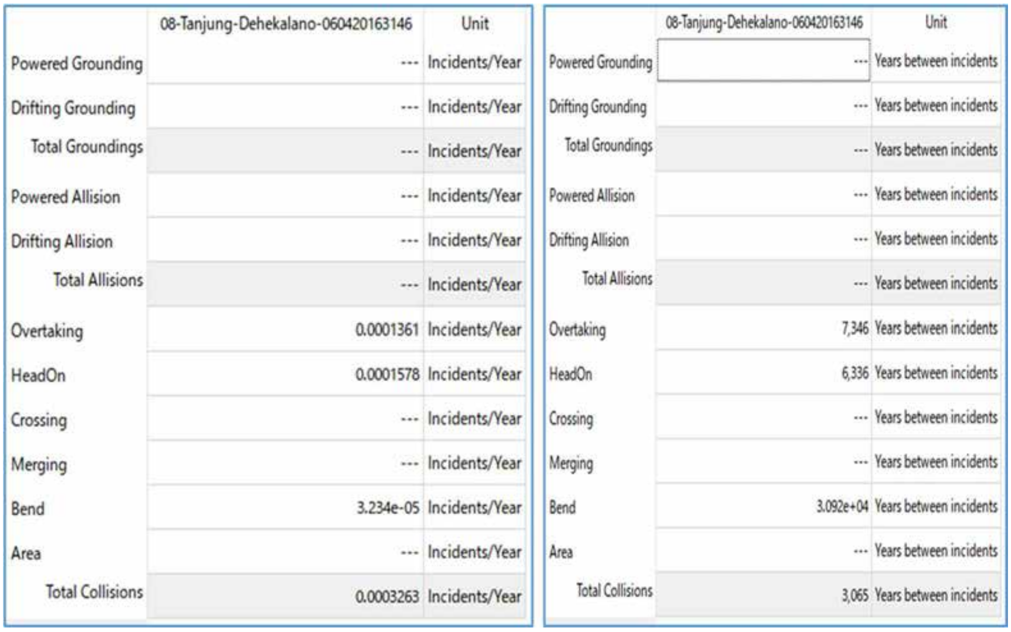


Figure 5.8 -5 : Histogram of Lateral Distribution

As shown the histogram of the lateral distribution, vessels are sailing in a sea area with a width of 50km or more on an average sideways.

In this survey, the number of data may be small, but the IWRAP calculation also shows very small numbers. The calculation results are shown in the Table below for reference.

Table 5.8.-2 : Result of IWRAP Calculation



	08-Tanjung-Dehekalano-060420163146	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.0001361	Incidents/Year
HeadOn	0.0001578	Incidents/Year
Crossing	---	Incidents/Year
Merging	---	Incidents/Year
Bend	3.234e-05	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.0003263	Incidents/Year

	08-Tanjung-Dehekalano-060420163146	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	7,346	Years between incidents
HeadOn	6,336	Years between incidents
Crossing	---	Years between incidents
Merging	---	Years between incidents
Bend	3.092e+04	Years between incidents
Area	---	Years between incidents
Total Collisions	3,065	Years between incidents

5.9 Merak

Merak is located on the northwestern tip of Java, facing the east side of the Sunda Strait, where TSS (Traffic Separation Scheme) will be come into force in the 1st July 2020.

AIS was set up here in order to get the data on the movement of vessels passing through and crossing the strait.

The location where AIS base-statin was temporarily installed is shown in the Figure below.

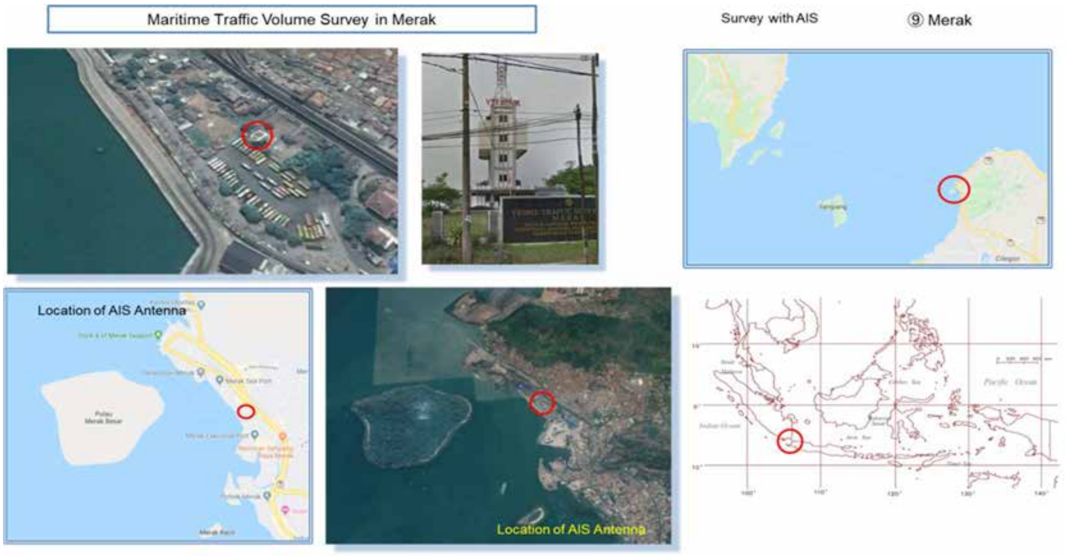


Figure 5.9 -1 : Location of AIS Base-Station

The tracks of the AIS vessels for 21 days from January 8 to 28, 2020 are shown in the Figure below.

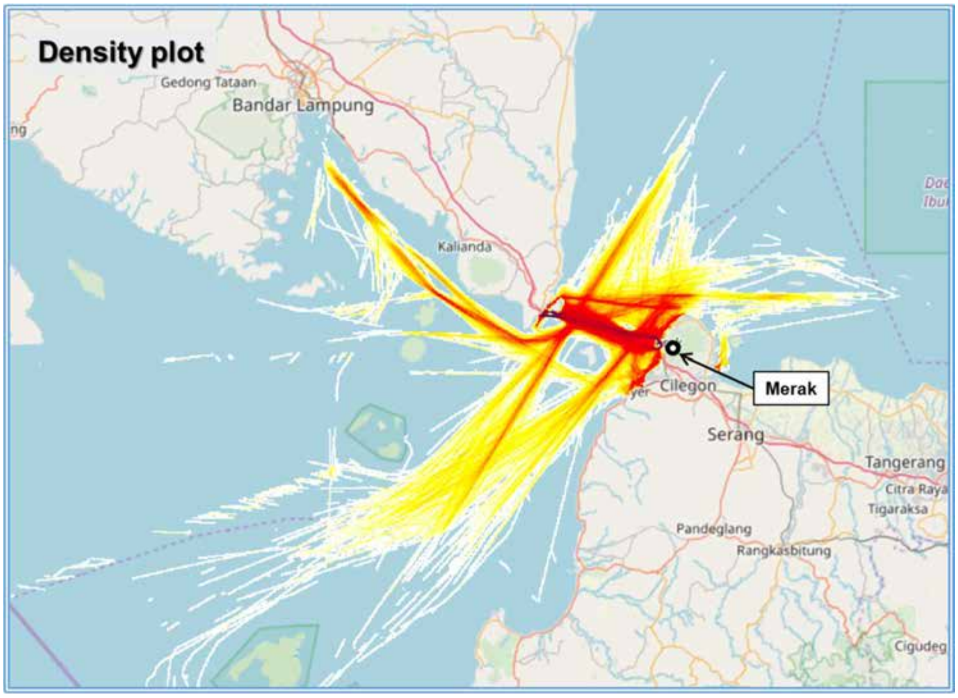


Figure 5.9 -2 : Density Plot of AIS

Merak is a key port for the passenger and commercial ferry traffic between Java and Sumatra across the Sunda Strait, and this strait is one of the three sea-lanes established by Indonesia, as the Sea-Lane 1.

Obviously, it can be seen that many vessels are crossing the strait and passing through the strait.

The total number of vessels confirmed in 21 days is 998. The classification as to a type and size is shown in the Table below.

Table 5.9 -1 : Type of Vessels

Ship Type Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～50m	3	4	15	14	13	10	193	90	342
51～150m	0	0	95	115	53	2	6	24	295
151～250m	0	0	198	75	7	0	1	0	281
251m以上	0	0	67	13	0	0	0	0	80
Total of ship types	3	4	375	217	73	12	200	114	
Total of all ship types	998								

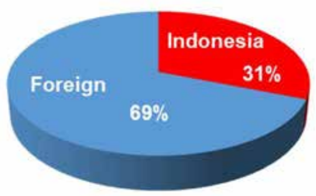
In this survey, the number of vessels equipped with AIS per day is about 50 mathematically, but in the case of the same name of the passenger ferry, the number of vessels sailing is counted as one, no matter how many times she sails. The ferry boat crossing the strait goes back and forth every 20 minutes, and then the actual number of sailing vessels is over 50 a day. (According to the interview at the Merak VTS, the number of vessels sailing in the strait is 120 per day.)

As for the type of a ship, the majority of sailing vessels are a general cargo and an oil tanker, but there are also many support vessels such as tug-boat. And the sizes are widely distributed from a large vessel to a small vessel.

The ratio of Indonesian flagship of these vessels is shown in the Table and Graph below.

Table 5.9 -2 : Ratio of Indonesian Flagship

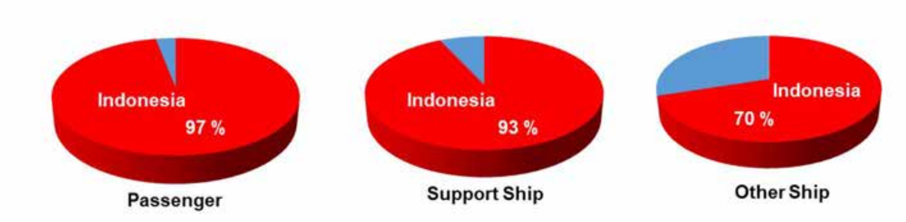
General Cargo		Oil Tanker	
Indonesia	Foreign	Indonesia	Foreign
116	259	118	99
31 %	69 %	54 %	46 %



General Cargo

Oil Tanker

Passenger		Support Ship		Other Ship	
Indonesia	Foreign	Indonesia	Foreign	Indonesia	Foreign
71	2	185	15	80	34
97 %	3 %	93 %	7 %	70 %	30 %



As of February 2020, the number of ferry boats in this area is 73, and the liner is 35 in the strait in service now.

The density map for each type is shown in the Figure below.

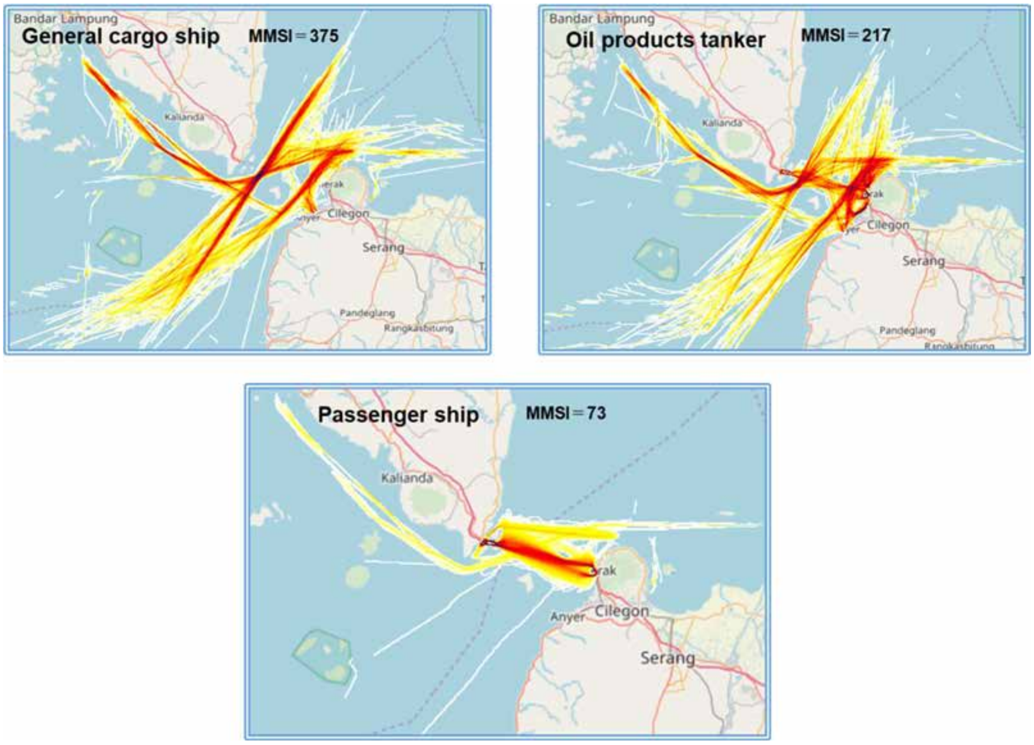


Figure 5.9 -3 : Density Map for each Type

It can be seen that the general cargo ships and oil tankers, which make up the majority of sailing vessels, cross with the passenger ships. In addition, there is a traffic route north-south on the east side of the strait besides the TSS, and the passenger ships crossing the strait will meet vessels passing through the strait two times.

In this sea area, the vessels passing through and crossing the strait, both sides vessels, are faced to be in the cautious ship handling operation.

The movements of small vessels, which are mostly domestic ships, are shown in the Figure below.

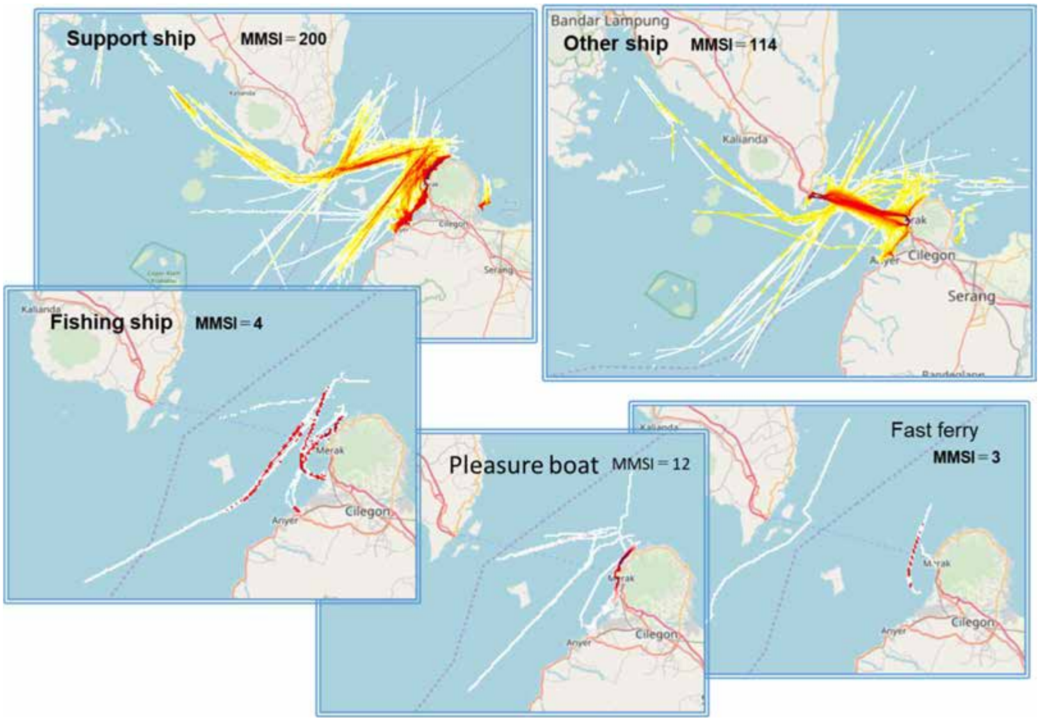


Figure 5.9 -4 : Density Map for each Type

It can be seen that small boats are sailing all over this area.

The movement of the passenger boats crossing the strait is analyzed by IWRAP as shown in the Figure below.

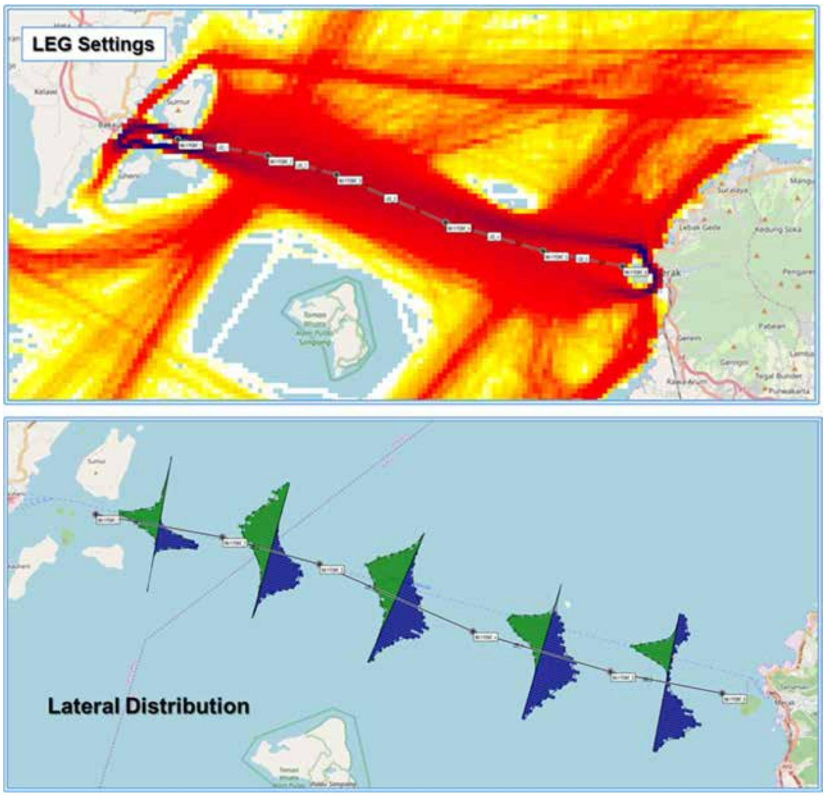


Figure 5.9 -5 : Histogram of Lateral Distribution

As shown in the distribution map above, the vessels crossing the strait are properly keeping on the right side of a ship's course. The results of the probability calculation for marine casualties are shown in the Table below.

Table 5.9 -3 : Results of IWRAP Calculation

	09-Merak-080420140051	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.002033	Incidents/Year
HeadOn	0.005006	Incidents/Year
Crossing	---	Incidents/Year
Merging	---	Incidents/Year
Bend	---	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.00704	Incidents/Year

	09-Merak-080420140051	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	491.8	Years between incidents
HeadOn	199.8	Years between incidents
Crossing	---	Years between incidents
Merging	---	Years between incidents
Bend	---	Years between incidents
Area	---	Years between incidents
Total Collisions	142.1	Years between incidents

Since the above calculation was made only for the vessels crossing the strait, the probability of a crossing accident among these vessels is nil.

Next, the lateral distribution map of the vessels passing through the TSS and the vessels crossing the strait, where cautious maneuvering is required each other, is shown in the Figure below.

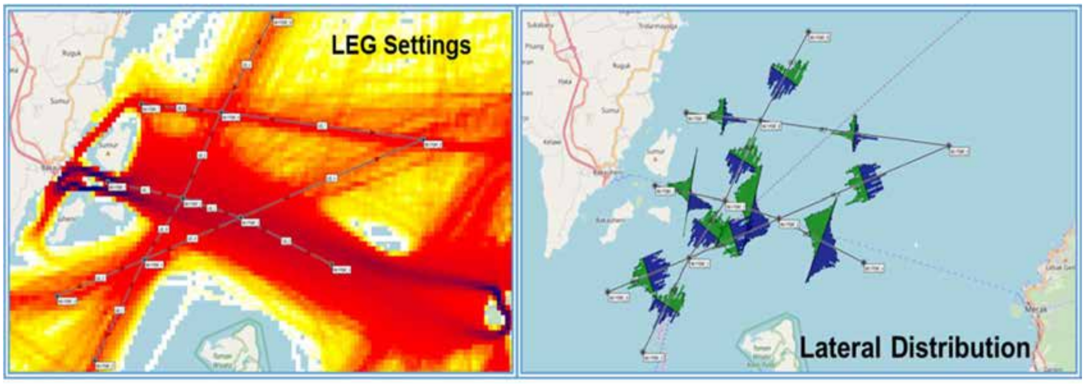
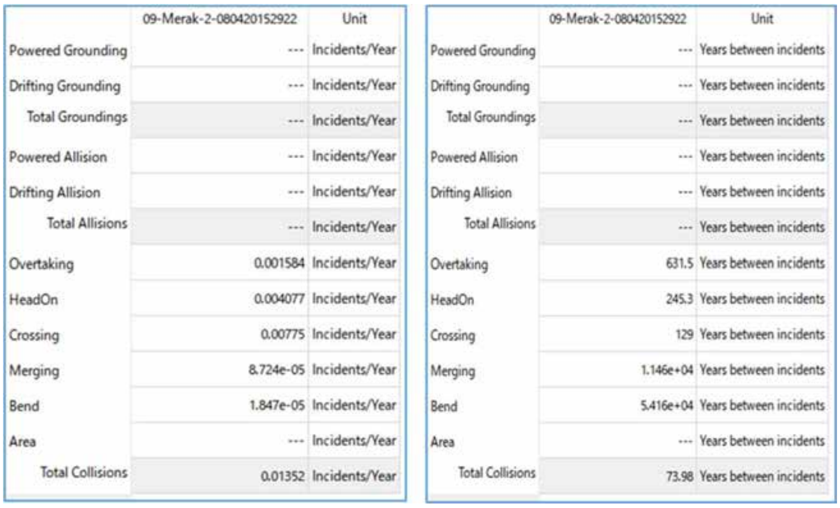


Figure 5.9 -6 : Histogram of Lateral Distribution

In this area, it is required that vessels have to pay attention to the crossing vessels rather than to the vessels facing each other or sailing in the same direction.

The calculation results by IWRAP are shown in the Table at the next page.

Table 5.9 -4 : Results of IWRAP Calculation



	09-Merak-2-080420152922	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.001584	Incidents/Year
HeadOn	0.004077	Incidents/Year
Crossing	0.00775	Incidents/Year
Merging	8.724e-05	Incidents/Year
Bend	1.847e-05	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.01352	Incidents/Year

	09-Merak-2-080420152922	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	631.5	Years between incidents
HeadOn	245.3	Years between incidents
Crossing	129	Years between incidents
Merging	1.146e+04	Years between incidents
Bend	5.416e+04	Years between incidents
Area	---	Years between incidents
Total Collisions	73.98	Years between incidents

The lateral distributions of the traffic zone on the east side of the strait and on the Sumatra side connecting to the Port of Bandar Lampung are shown in the Figure below, and the results of IWRAP calculation are shown in the Table at the next page.

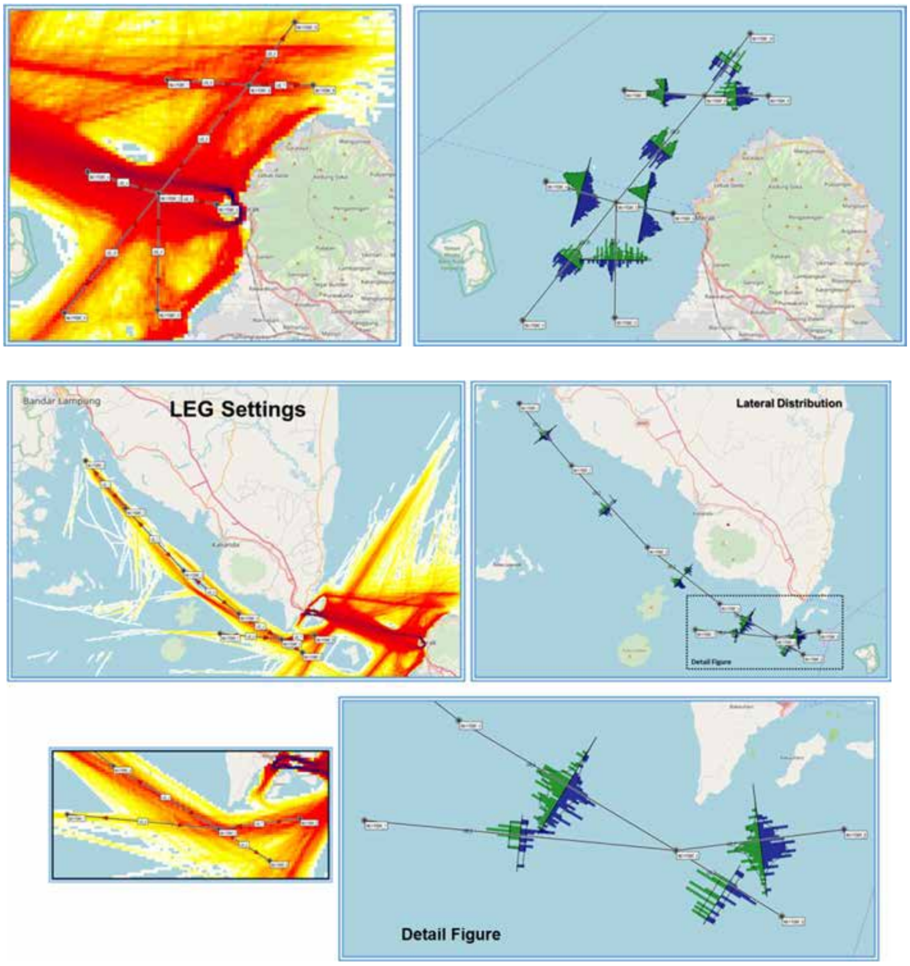
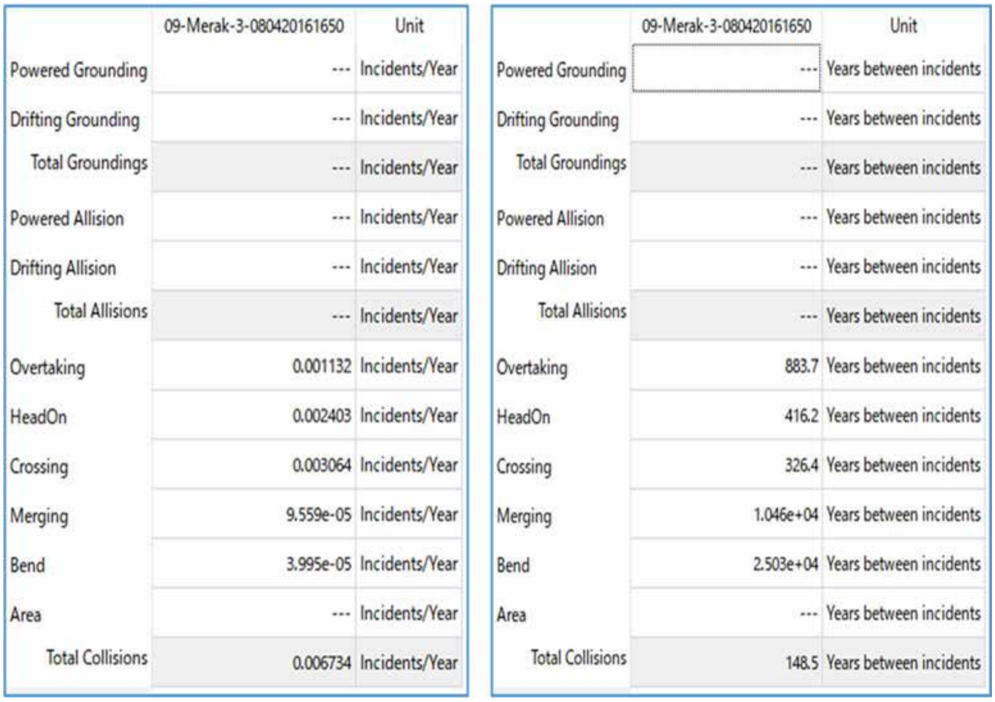


Figure 5.9 -7 : Histogram of Lateral Distribution

Table5.9 -5 : Calculation Results for the East Side Traffic Zone



	09-Merak-3-080420161650	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.001132	Incidents/Year
HeadOn	0.002403	Incidents/Year
Crossing	0.003064	Incidents/Year
Merging	9.559e-05	Incidents/Year
Bend	3.995e-05	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.006734	Incidents/Year

	09-Merak-3-080420161650	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	883.7	Years between incidents
HeadOn	416.2	Years between incidents
Crossing	326.4	Years between incidents
Merging	1.046e+04	Years between incidents
Bend	2.503e+04	Years between incidents
Area	---	Years between incidents
Total Collisions	148.5	Years between incidents

Table5.9 -6 : Calculation Results for the Sumatra Side Traffic Zone

	09-Merak-4-100420090409	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.0003441	Incidents/Year
HeadOn	0.0007843	Incidents/Year
Crossing	8.01e-05	Incidents/Year
Merging	4.156e-05	Incidents/Year
Bend	0.0001283	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.001378	Incidents/Year

	09-Merak-4-100420090409	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	2,906	Years between incidents
HeadOn	1,275	Years between incidents
Crossing	1.248e+04	Years between incidents
Merging	2.406e+04	Years between incidents
Bend	7,795	Years between incidents
Area	---	Years between incidents
Total Collisions	725.5	Years between incidents

Since the TSS in the Sunda Strait will be fully implemented in July, 2020, it is obligatory to receive the position report from a vessel at a certain point, both entering or crossing the TSS and precautionary Area, and to maintain the traffic control and management such as the provision of information on maritime traffic safety and the maintenance of aids to navigation installed for TSS to ensure the safety of navigation.

There is the VTS in Merak, which will perform its duty. As the traffic survey by AIS shows, the movement of vessels sailing in this area is complicated and the traffic is considerably congested.

The TSS is shown in the Figure below.

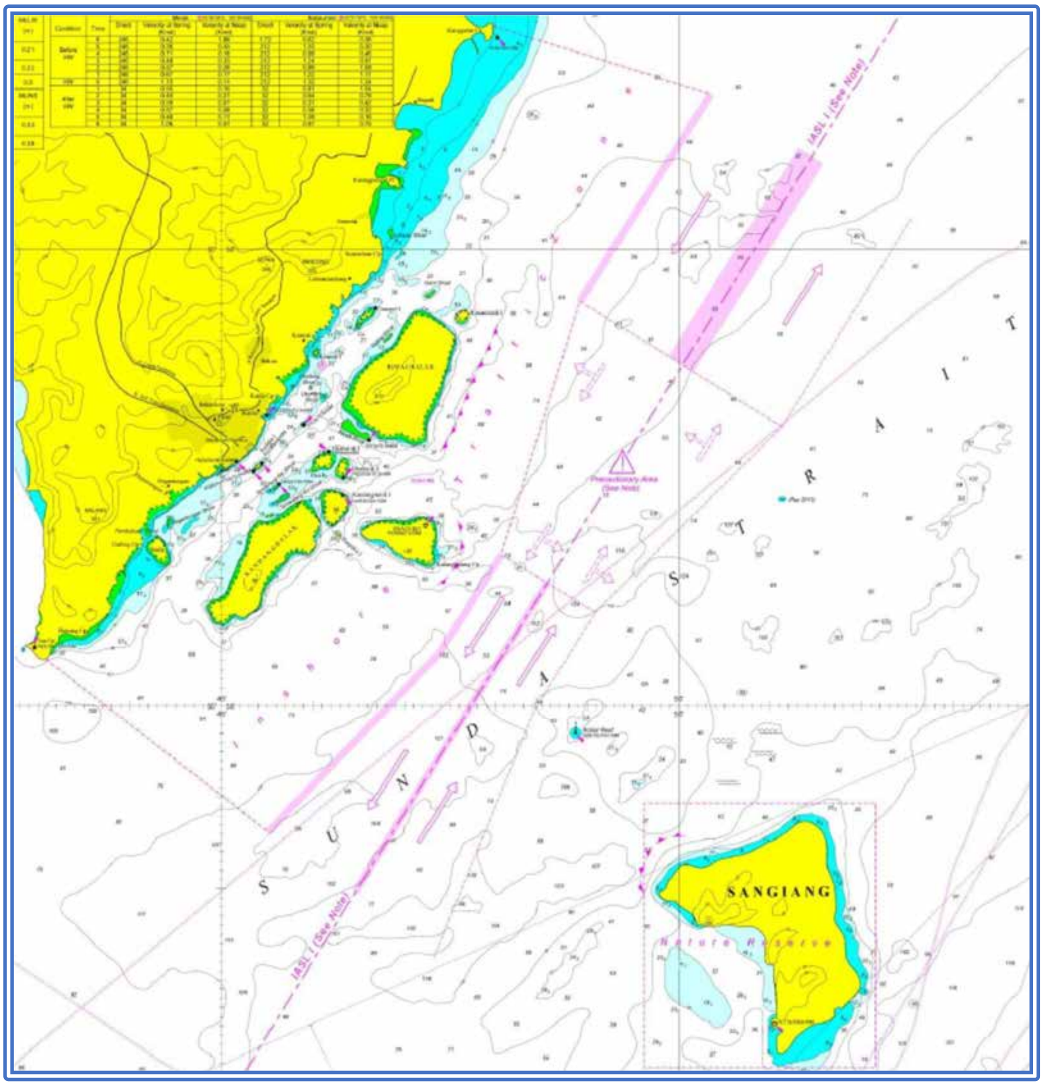


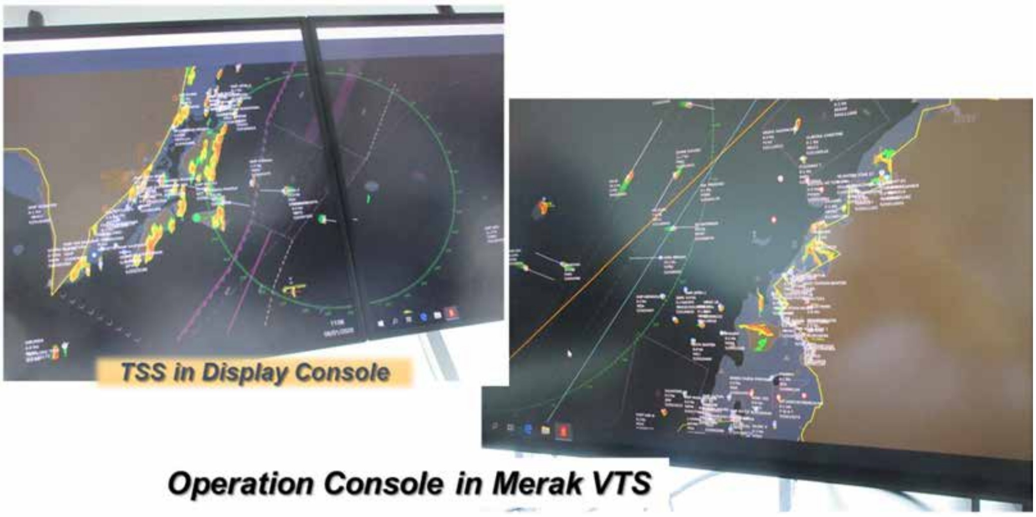
Figure 5.9 -8 : TSS in the Sunda Strait (ID Chart No. 170)

It is to be desired to set up the system that the operational information on ferry boats regularly in service is obtained and such information is provided to large vessels passing through the TSS, and conversely the information on positon reports received from the large vessels is provided to the ferry boats under operation.

The exterior of the Merak VTS building is shown below, which will play that role.

Picture 5.9 -1 : Merak VTS and Radar Tower

Picture 5.9 -2 : Port of Merak (View from the VTS Operation Room)



Picture 5.9 -3 : Digitalized Radar and AIS Images

5.10 Samarinda

Samarinda is located about 40km upstream of the Mahakam River. There is a radar station which has an AIS Base-Station at the mouth of its river.

This time, AIS data was provided by the station, and the movement of vessels sailing around the river mouth was analyzed by IWRAP.

The location of the AIS station is shown in the Figure below.

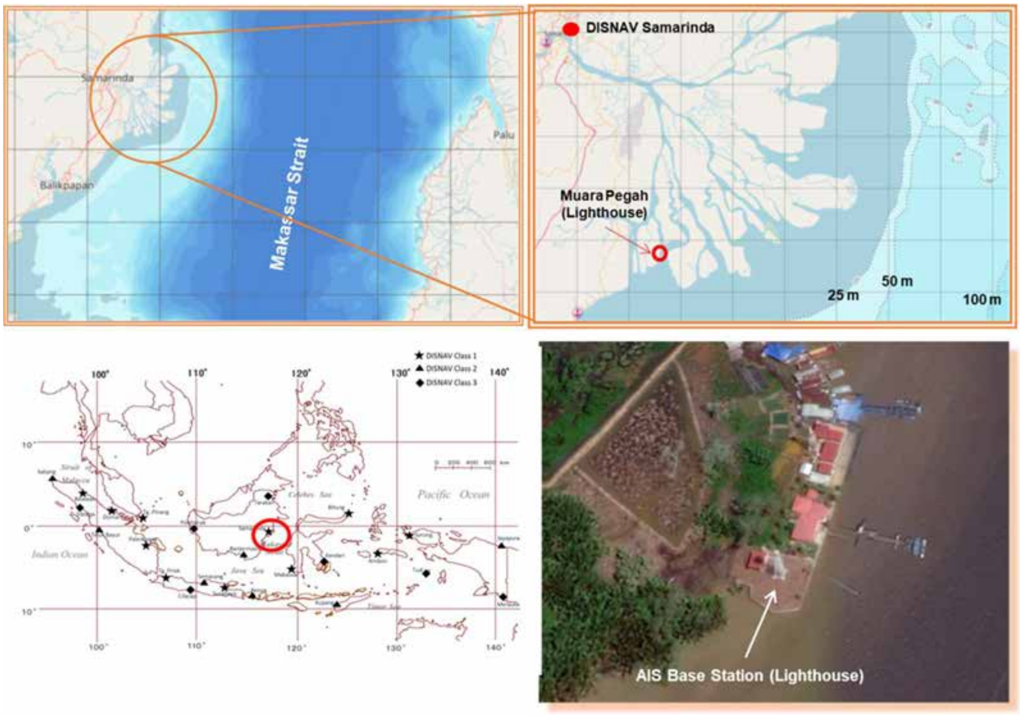


Figure 5.10 -1 : Location of AIS Base-Station

The tracks of the AIS vessels for four days from February 14 to 17, 2020 are shown in the Figure below.

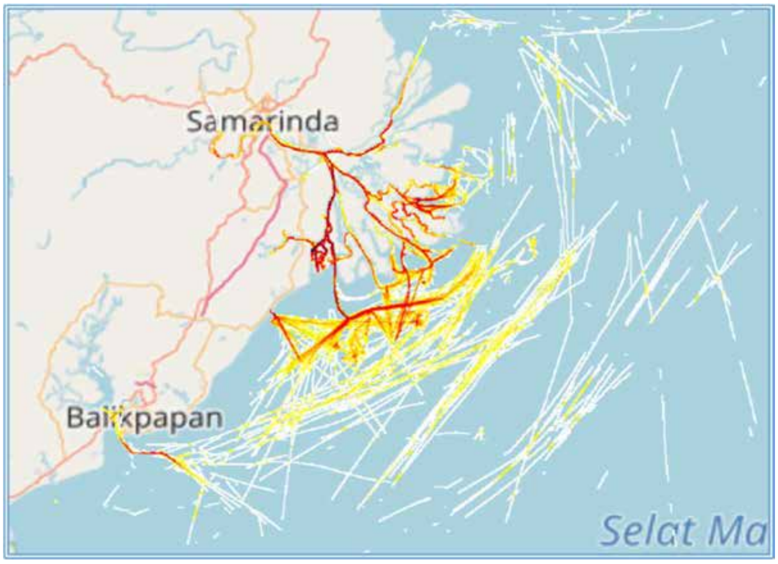


Figure 5.10 -2 : Density Plot of AIS

Since the Port of Samarinda lies on the banks of the Mahakam River, a large ship cannot move up the river due to the restrictions on the draft and navigable width, and the cargo is transferred to smaller vessels near the mouth of the river.

As can be seen from the AIS plot, many vessels are crowded near the coast and in rivers.

The toal number of vessels confirmed in four days is 931. The classification as to a type and size is shown in the Table below.

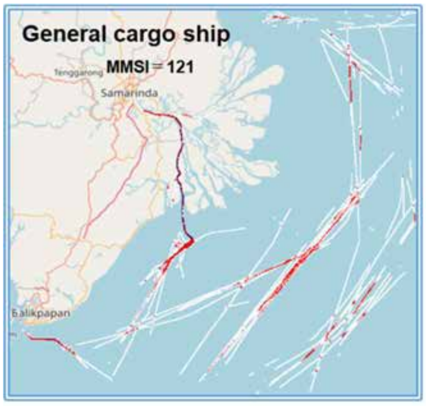
Table 5.10 -1 : Type of Vessels

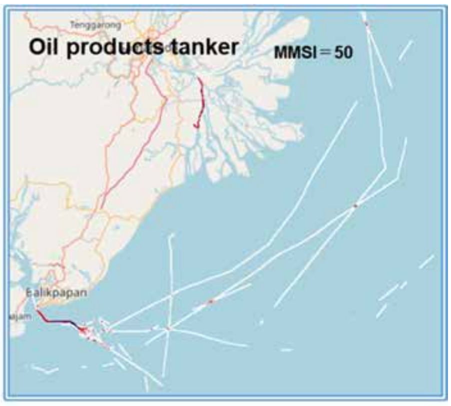
Ship Type / Length	Fast ferry	Fishing ship	General cargo ship	Oil products tanker	Passenger ship	Pleasure boat	Support ship	Other ship	Total
1～25m	0	0	10	0	0	256	116	65	447
26～50m	1	0	2	5	9	4	147	124	292
51～150m	0	0	12	10	2	0	8	14	46
151～250m	0	0	56	29	5	1	0	5	96
251m以上	0	0	41	6	0	0	1	2	50
Total of ship types	1	0	121	50	16	261	272	210	
Total of all ship types	931								

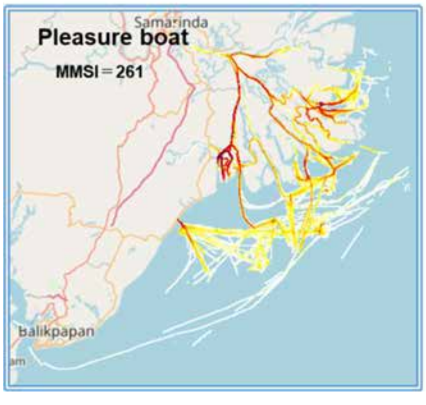
Most of the large vessels are thought to include vessels passing through the Makassar Strait, while most of the smaller vessels seem to be vessels moving up the rivers and their associated vessels.

The simple calculation of small boats from the above Table shows that there are about 700 boats, which is converted into 175 boats per day.

The density map for each type is shown in the Figure below and at the next page.







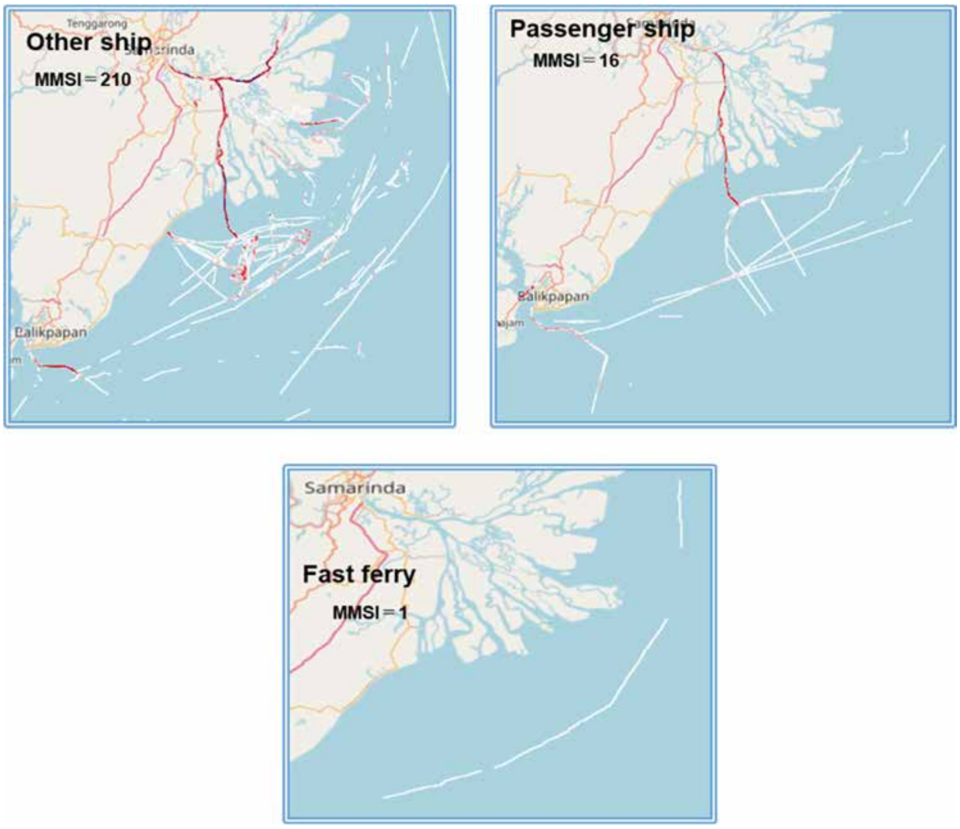


Figure 5.10 -3 : Density Map for each Type

Many of the vessels that go up to the Port of Samarinda use the western waterway of the Delta tributaries. The depth of the water is as shallow as 25m up to 4 nautical miles offshore of the Delta, and the meeting of ships (Ship-to-ship cargo transfer) can be seen offshore.

The lateral distributions of vessels analyzed by IWRAP for vessel sailing off the Delta are shown in the Figure below.

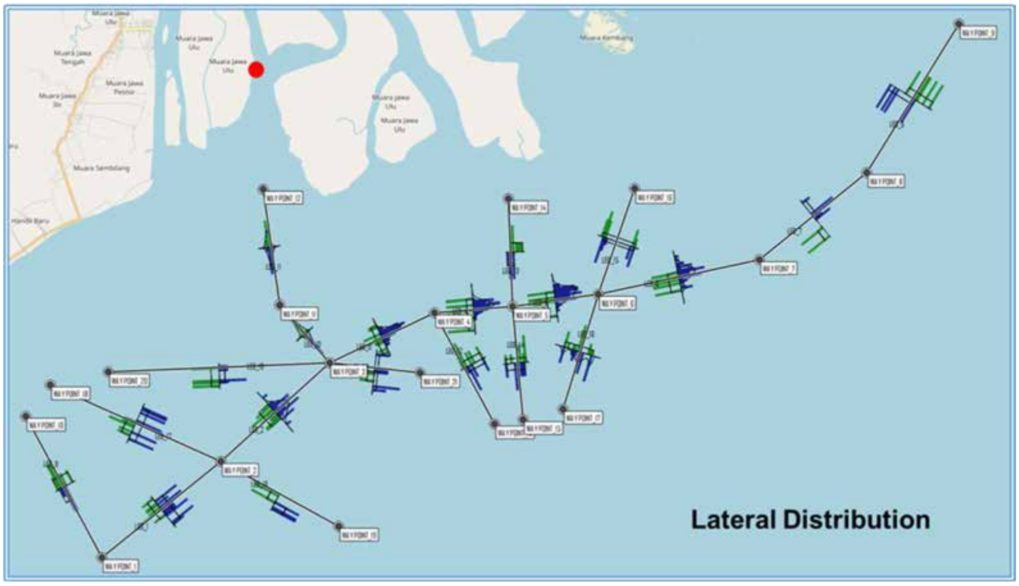
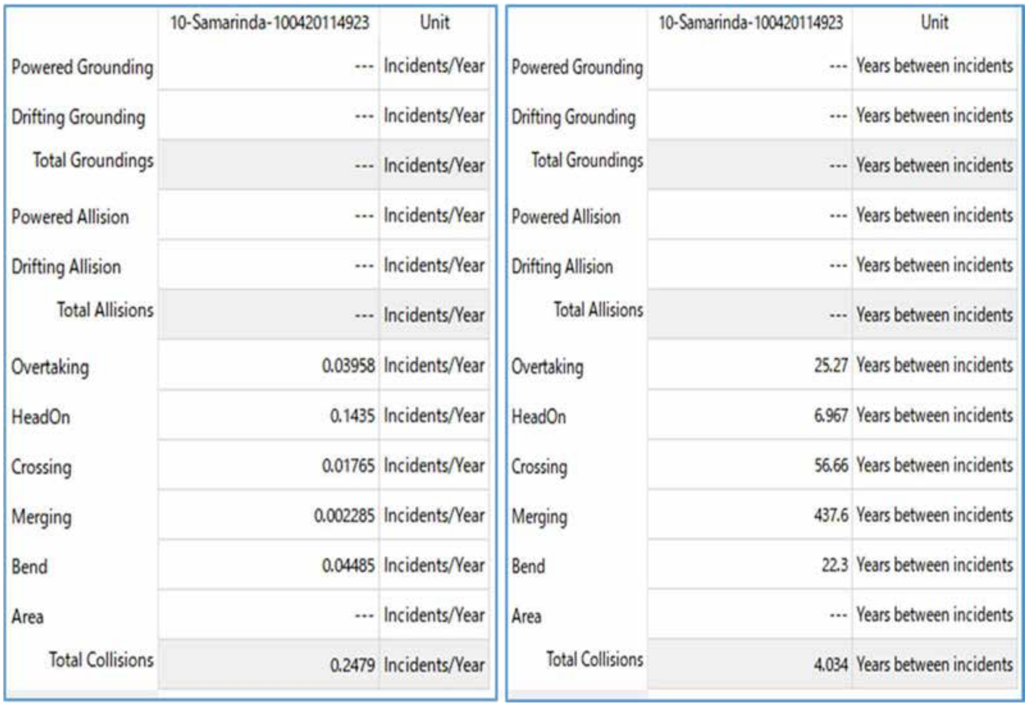


Figure 5.10 -4 : Lateral Distribution

Although it looks like a properly traffic flow, vessels are sailing within a limited navigable width, and the results of the risk calculation shows a fairly high probability as shown in the Table below.

Table 5.10 -2 : Result of IWRAP Calculation



	10-Samarinda-100420114923	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.03958	Incidents/Year
HeadOn	0.1435	Incidents/Year
Crossing	0.01765	Incidents/Year
Merging	0.002285	Incidents/Year
Bend	0.04485	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.2479	Incidents/Year

	10-Samarinda-100420114923	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	25.27	Years between incidents
HeadOn	6.967	Years between incidents
Crossing	56.66	Years between incidents
Merging	437.6	Years between incidents
Bend	22.3	Years between incidents
Area	---	Years between incidents
Total Collisions	4.034	Years between incidents

The lateral distributions of vessels sailing in the Delta tributaries are shown in the Figure below.

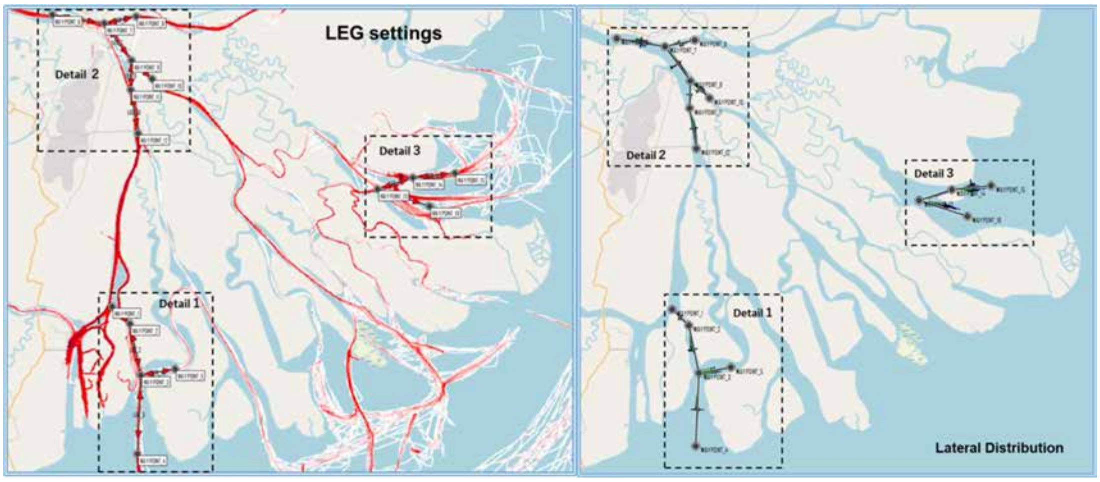


Figure 5.10 -5 : Histogram of Lateral Distribution

The detail figure of each tributary is shown in the Figure below.

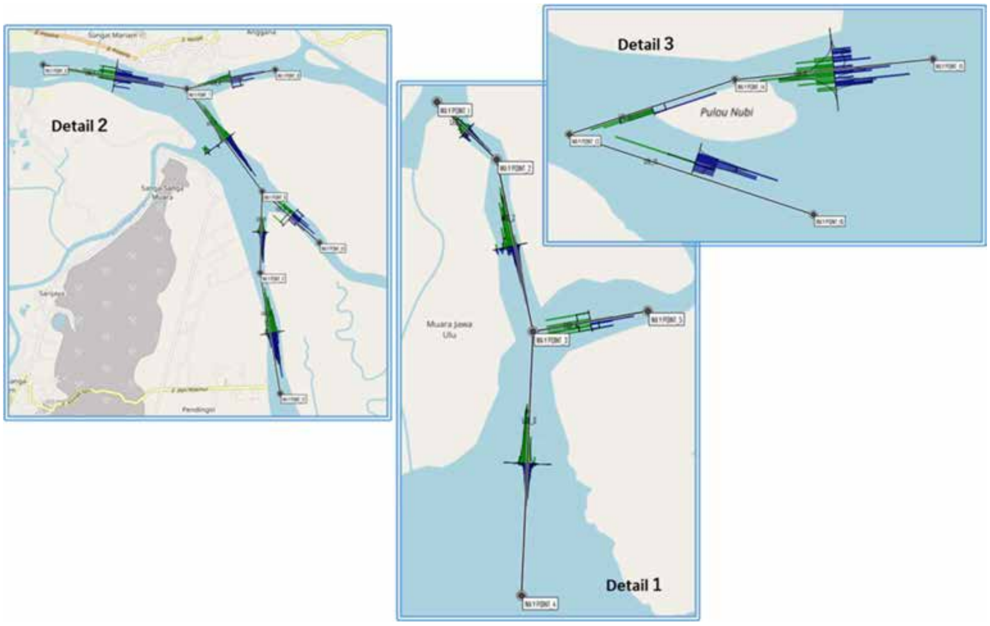


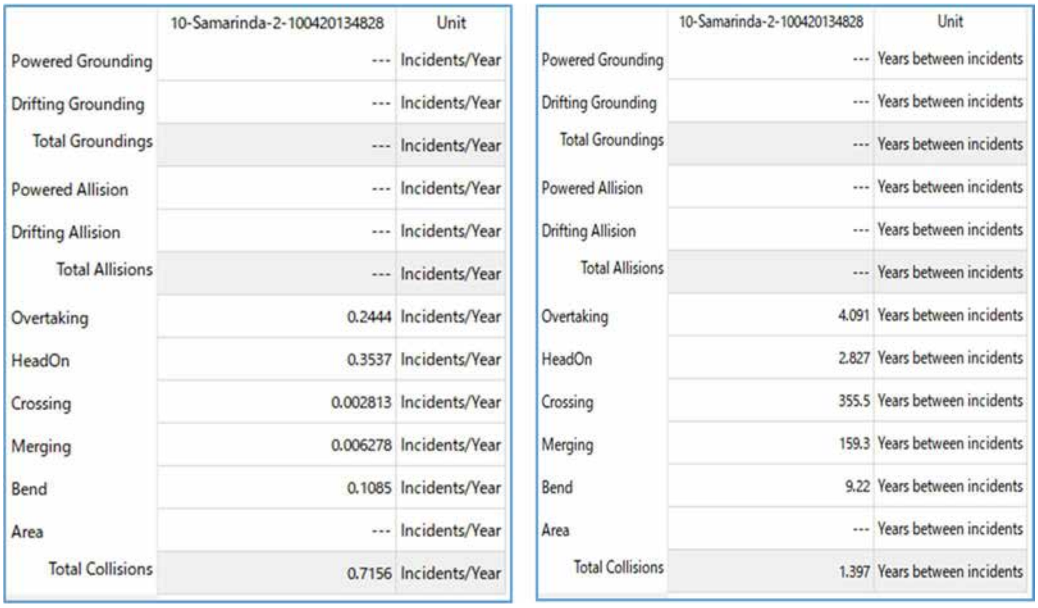
Figure 5.10 -6 : Histogram of Lateral Distribution

The navigable width is about 1,300m near the mouth of the widest river and only 300m in the midstream, which means that vessels have to go through the center of the passage in the river. The histogram bars are also gathered in the center (Not distributed).

The probability in the risk calculation also shows a higher value than the value of the offshore Delta.

The results of the calculation are shown in the Table below.

Table 5.10 -3 : Result of IWRAP Calculation



	10-Samarinda-2-100420134828	Unit
Powered Grounding	---	Incidents/Year
Drifting Grounding	---	Incidents/Year
Total Groundings	---	Incidents/Year
Powered Allision	---	Incidents/Year
Drifting Allision	---	Incidents/Year
Total Allisions	---	Incidents/Year
Overtaking	0.2444	Incidents/Year
HeadOn	0.3537	Incidents/Year
Crossing	0.002813	Incidents/Year
Merging	0.006278	Incidents/Year
Bend	0.1085	Incidents/Year
Area	---	Incidents/Year
Total Collisions	0.7156	Incidents/Year

	10-Samarinda-2-100420134828	Unit
Powered Grounding	---	Years between incidents
Drifting Grounding	---	Years between incidents
Total Groundings	---	Years between incidents
Powered Allision	---	Years between incidents
Drifting Allision	---	Years between incidents
Total Allisions	---	Years between incidents
Overtaking	4.091	Years between incidents
HeadOn	2.827	Years between incidents
Crossing	355.5	Years between incidents
Merging	159.3	Years between incidents
Bend	9.22	Years between incidents
Area	---	Years between incidents
Total Collisions	1.397	Years between incidents

The Port of Balikpapan as well as Samarinda, which is one of the 24 strategic ports, is about 80km southwest of the Delta, and the AIS data of vessels going back and forth to the port were captured, so IWRAP analyzed the movement of such vessels for reference, as shown in the Figure below.

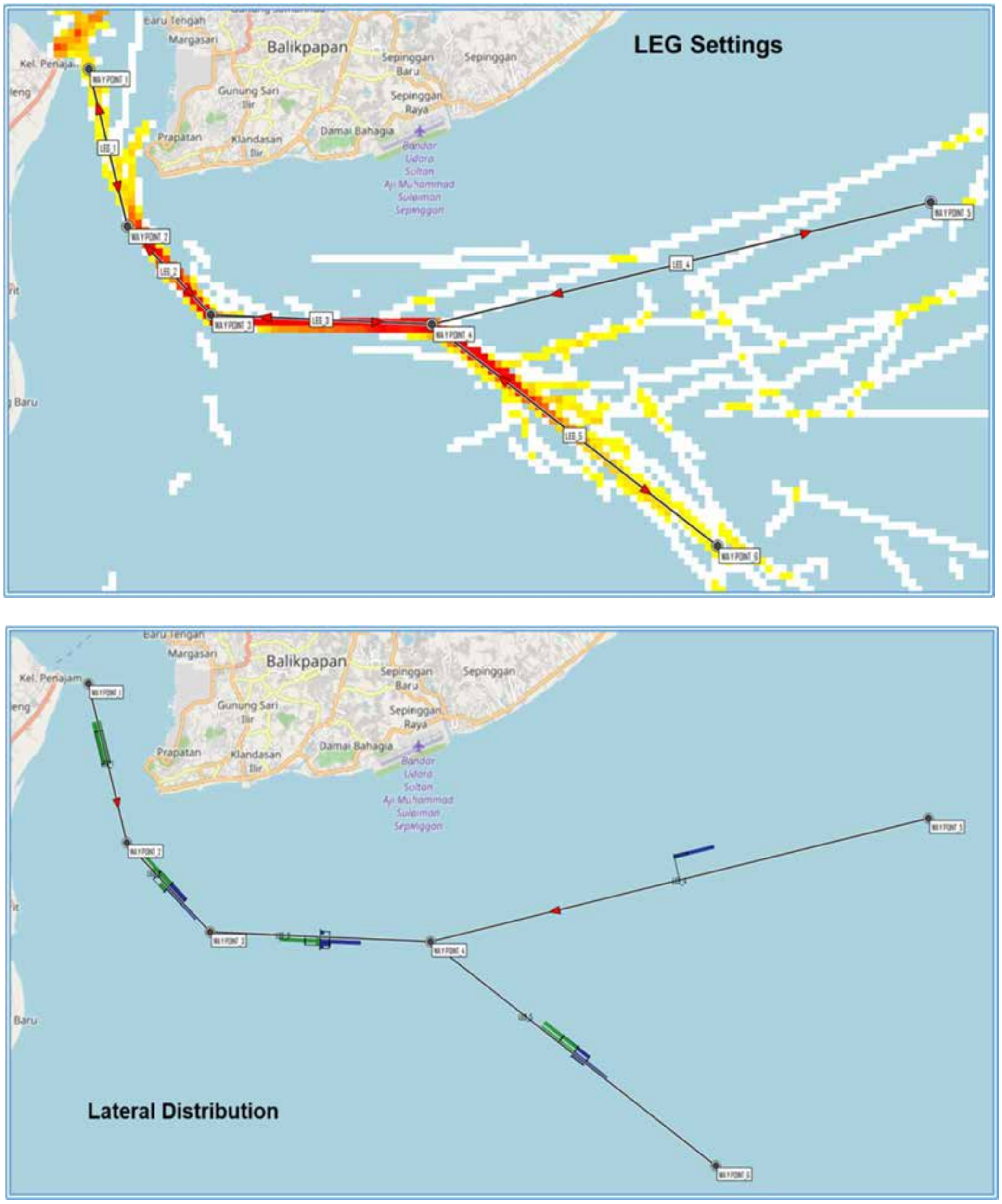


Figure 5.10 -7 : Histogram of Lateral Distribution

Chapter 6

Current Status and Issues in Establishing Development Plan

6 Current Status and Issues in Establishing Development Plan

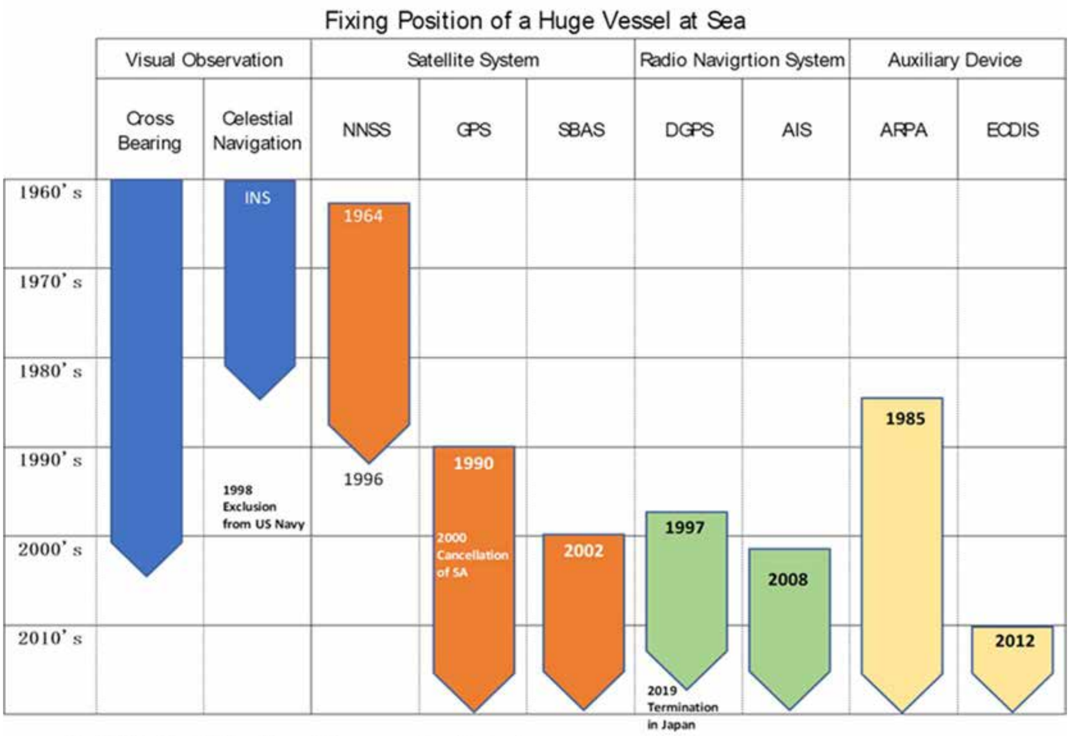
6.1 General Remarks

The present issues for the future development plans for maritime traffic safety services in each field of aids to navigation are shown below, which are derived from the study of the field surveys, such as the interviews with the NAVIGASI staff, the questionnaire survey, and the visit to a DISNAV office, and of the current movement of maritime administration in Indonesia.

In the beginning, the current status of fixing position of vessels, which is directly related to the establishment of aids to navigation and ships routing, will be described, because the positioning of vessels is one of the factors that greatly affect maritime traffic safety measures, and the method of fixing position with GPS, which was not widely used at the time of the previous survey, is now indispensable.

6.2 Fixing Position and Aids to Navigation

The changes in fixing position for large vessels are shown in the Figure below.



※ SBAS (Satellite Based Augmentation System)
※ DGPS (Medium-Frequency Wave)

1940's : Practical installation of Marine Radar

Figure 6.2 -1 : The Change of the Positioning System

In the Age of Exploration (Discovery), voyages were carried out with celestial (astronomical) navigation and visual navigation that landmarks are targeted, but the introduction of radio navigation system such as Radio-Beacon, Loran, Decca, Omega and so on, which enable to fix position even at night or in poor visibility, has greatly changed the method of navigation.

However, the radio navigation systems were still not sufficient for coastal navigation because of a fixing accuracy and a limited coverage, and coastal lighthouses were indispensable for the safety of navigation.

From the end of the 20th century to the beginning of the 21st century, GPS became available anywhere in the world. But the signal available for civilian use was intentionally degraded. In order to correct the GPS accuracy, the differential GPS system was developed and the terrestrial GPS-Correction transmitting stations were established in all places.

Subsequently, the satellite-based augmentation system for GPS, as shown in the Figure below, was developed to transmit the GPS-Correction and the coverage of the differential GPS system was drastically expanded.

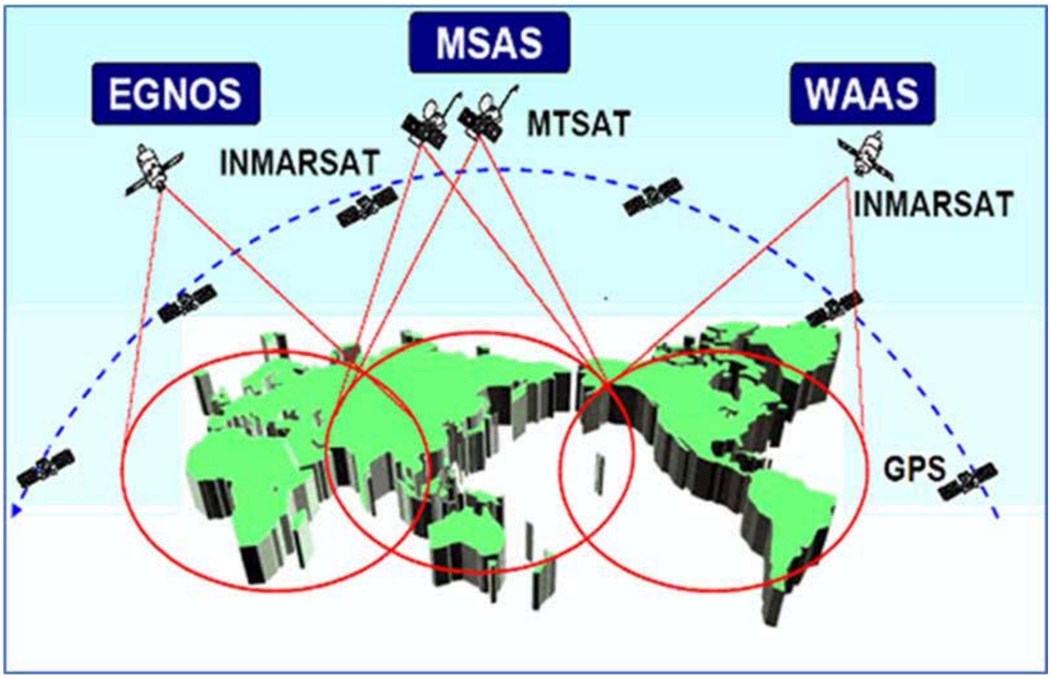


Figure 6.2 -2 : SBAS (Satellite-based Augmentation System)

In 2002, the fixing accuracy of GPS was remarkably improved with the cancellation of SA (Selective Availability).

As a result, the necessity of the terrestrial DGPS and the radio aids to navigation has been reduced substantially, and the operation of these systems has been gradually discontinued worldwide.

Similarly, large coastal lighthouses have changed significantly in the role of visual aids for large vessels equipped with radar, AIS and other state-of-the-art equipment used for navigation. They are rarely used for the fixing position as in the past, except in an emergency such as when a device breaks down.

However, aids to navigation are needed where there is a lack of adequate natural visual leads, especially within a constrained waterway.

They are sorted as follows.

- Directional guidance, i.e. lateral positioning reference in a channel
- Longitudinal positioning reference to a channel
- Warning of possible hazardous areas and objects

6.3 Maritime Traffic Safety Measures and Ships Routing

As described in Chapter 2, Indonesia is focusing on maritime development under national policy with the concepts of a maritime nation, and the promotion of port development and the expansion of marine transportation between the east and the west will make the volume of vessel traffic bigger.

The main sea routes for large vessels and an unspecified large number of vessels in domestic and overseas are already adopted as the Archipelagic Passage, which is called Sea-Lane (see Fig. 2.4 -1 : Sea Lane Map) based on the United Nations Convention on Maritime Law. This does not stipulate any special navigation. Since ocean-going vessels can pass through with the right of innocent passage, they will mainly use these routes and these main routes may run across the traffic of local vessels. In the field survey this time, the traffic crossing was confirmed between Sea-Lane 2 laying offshore Makassar and the flow of vessels navigating to the east and the west, but it is not necessary to take special maritime traffic safety measures due to the small traffic at present as long as the maritime traffic rules (COLREGs : International Regulations for Preventing Collisions at Sea 1972) at the open sea are followed.

TSS (Traffic Separation Scheme), which enforces navigational restriction on vessels based on the international law, has been established in the congested straits of Sunda (Fig. 2.4 -2 TSS Sunda Strait) and Rombok (Fig. 2.4 -3 TSS Rombok Strait), and it has been in effect since July 2020. VTS has already been established in places here, and maritime traffic measures for vessels sailing around these waters are taken by watching compliance of navigation rules and providing maritime information.

The spreading of AIS has become possible to visualize the traffic flow (Fig. 2.5 -1 Density Map of AIS Vessels) of conventional vessels' passage.

Although the number of vessels is expected to increase in the future, most of the vessels that go through between the Pacific Ocean and the Indian Ocean via the archipelago routes will use the Malacca Singapore Strait because this Strait has good geographical conditions. Then, further development of the archipelago route is not expected in the consideration of current traffic volume. Therefore, there are no installation of TSS that require the adoption of IMO.

However, if TSS is to be established on domestic transportation routes, special navigation rules will be enforced, so it will be necessary to prepare some sort of regulations.

On the other hand, the promotion of port development is directly related to the increase in the number of vessels entering and leaving the ports. Depending on the structure and quality of the port, vessels will become larger and speedier and maritime traffic safety measures must be considered individually for each port.

Currently, there are 167 designated ports and about 700 other general ports, ant it generally seems that it is not necessary to establish the traffic route in all these ports like TSS, but it is necessary to prepare the passageway for maritime safety and to discuss the countermeasures as described above with the port authority for each port in order from the designated port. After this, the arrangement and type of aids to navigation, which are sometimes called "Ships Routing", will be decided. These are established after hearing the opinions of many stakeholders, and cannot be done on the desk in an office.

These safety measures will be developed in consideration of port features, regional characteristics, and natural environment around the port. In the case of maritime traffic route designation, the traffic width, the water depth, the length of a channel will be specified, and these design and implementation will be in line with the IMO resolution (SOLAS IMO Resolution A572, 14), and the IALA Guideline and IALA Manual are the standards for the installation of Aids to Navigation. And, the formulation of necessary regulation or legislation will be prepared for these development and operation.

Furthermore, in formulating specific maritime traffic safety measures, it is necessary to consult with related parties such as port authority, ship operators, and fishermen engaging in the vicinity. Regarding the establishment of a passage (a traffic route) and the installation of aids to navigation, its standards and the manuals are needed to have a common understanding with parties concerned. For this purpose, they must be prepared.

6.4 Visual Aids to Navigation

As mentioned in the previous section, the procedure for fixing a ship’s position has changed significantly with advent of GPS. Due to this change, it can be said that the role of a lighthouse marking landfalls for offshore navigation has also changed considerably. Furthermore, the improvement of GPS positioning accuracy and the development of navigational instruments on board, such as ECDIS (Electronic Chart Display and Information System) and ARPA (Automatic Radar Plotting Aids), have brought about a change in the role of a lighthouse.

In particular, the position can be automatically obtained by GPS, and the method of fixing the position by using a cross bearing with lighthouses is almost rarely used now except in the case of equipment failure of on-board GPS or a radar system.

6.4.1 “Adequacy” of Visual Aids to Navigation

In the strategic plan prepared in 2015, DGST has introduced the concept of “Adequacy” of the number of visual aids to navigation for the first time.

This is a conceptual calculation of how many visual aids to navigation need to be established on the coastline of Indonesia, and the ratio (percentage) of an implementation is quantified based on the necessary number. In other words, it indicates the degree of achievement of the goal.

The “Adequacy” calculated by DGST in 2015 is shown in the Figure below.

Figure 6.4.1 -1 : Adequacy of Visual Aids to Navigation

The concept of "Adequacy" is that, assuming that the Indonesian coastline is covered with the light of visual aids to navigation, the maximum required number is calculated from the coastline length and the average range of visual aids (large, medium and small lighthouse, and Light-Beacon), and the ratio of the required number and the established number of visual aids becomes the "Adequacy".

* The average Range of Aids = 12 NM (Nautical Mile)

* Length of Indonesian Coastline = 42,628 NM

*Adequacy Units 42,628 NM / 12 NM = 3,469 Units (Required Number)

A conceptual explanatory diagram is shown in the Figure below.

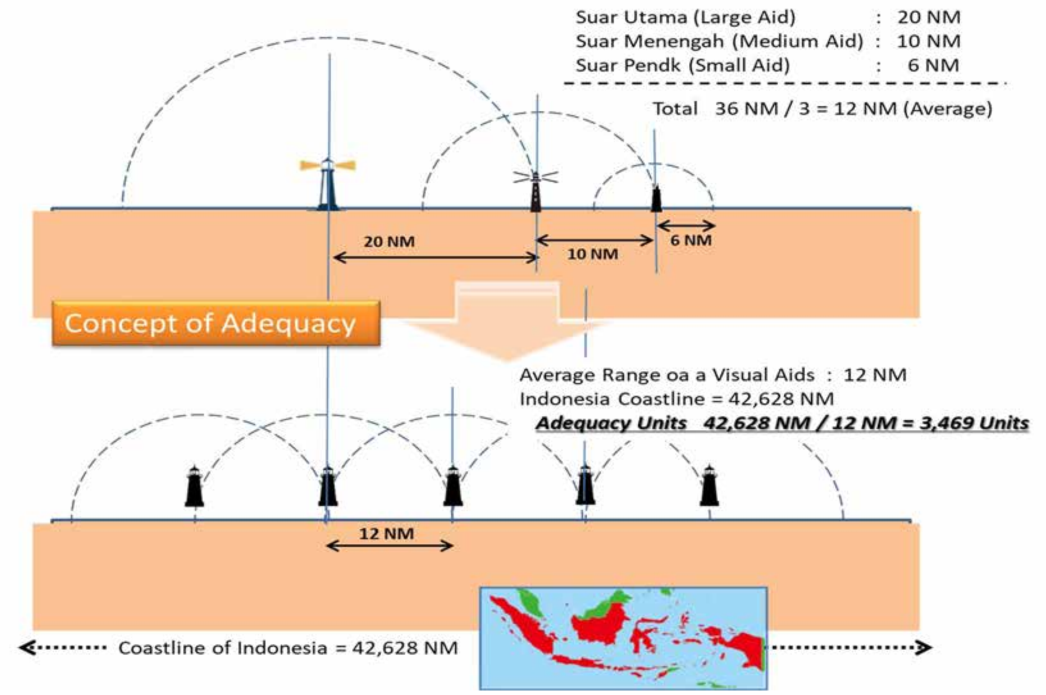


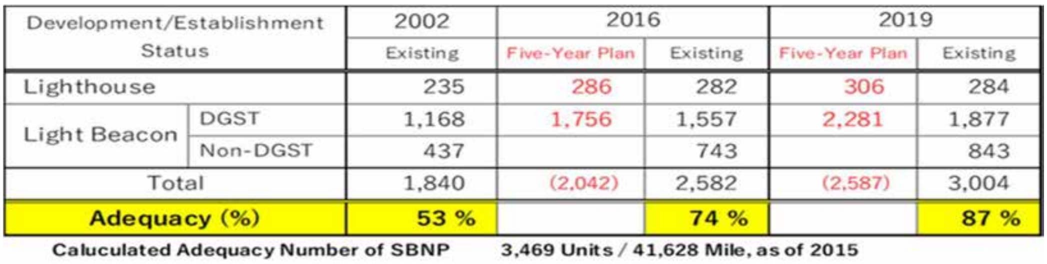
Figure 6.4.1 -2 : Concept of "Adequacy"

1) Ration of **"Adequacy"**

"Adequacy" in 2002, when the previous MP was prepared, was 53 %. By the way, in 2016 when the strategic plan was issued is 74 % and in 2019 at the time of this survey is 87 %.

The data is shown in the Table below.

Table 6.4.1 -1 : "Adequacy" of Visual Aids to Navigation



Development/Establishment Status		2002	2016		2019	
		Existing	Five-Year Plan	Existing	Five-Year Plan	Existing
Lighthouse		235	286	282	306	284
Light Beacon	DGST	1,168	1,756	1,557	2,281	1,877
	Non-DGST	437		743		843
Total		1,840	(2,042)	2,582	(2,587)	3,004
Adequacy (%)		**53 %**		**74 %**		**87 %**

Caluculated Adequacy Number of SBNP 3,469 Units / 41,628 Mile, as of 2015

As of 2019, there are 3,004 units of visual aids, which greatly exceed the target number indicated in the strategic plan in 2015. While, as shown in the Figure 3.1.1 -2 (Transition of Visual Aids to Navigation), comparing the number proposed in the previous MP with the current number, the lighthouse is not exceeded, and the Light-Beacon has increased significantly in number.

Behind these figures, there is the large number of Light-Beacons that have been established by non-DGST in association with port/harbor development.

Hereafter, as the economy grows, port development will also proceed and aids to navigation will be required for the safety navigation around coastal areas and in ports. As a result of this, the number of aids to navigation will be increase accordingly.

However, they are not intended to be established for the fixing position by the cross-bearing. They are aids to navigation indicating the distance and/or direction to the waterway, and dangerous water area as described in Section 6.2, which will be established while hearing an opinion from port development agencies and mariners.

2) **Number of Visual Aids to Navigation**

The types and number of visual aids required for navigation have changed significantly due to the development of onboard navigational instruments, and the future policy of an establishment plan for the coastal lighthouse which is the landfall aid should be considered, given the current situation where the Adequacy has reached nearly 90%, not just to increase the number of aids according to the budget as in the past. The establishment of lighthouses should be reviewed to ensure that they are installed where they are really needed by mariners.

The installation of light-beacons and floating buoys, which serve as visual aids to navigation for harbors and fishing ports, will be also considered, including who will install them, according to the conditions of ships routing and the situation of port development.

In addition, it should be considered to remove the existing aids to navigation that have overlapping coverage of lights in order to reduce the burden of their maintenance in consultation with relevant parties from now on.

6.4.2 Standardization of Establishment for Visual Aids to Navigation

The fact that the Adequacy was close to 90% means that lighthouses and light-beacons were arranged throughout the country and aids to navigation were almost installed on the main traffic routes. As mentioned earlier, it is not necessary to uniformly install navigational aids as in the past due to changes in the method of vessel navigation.

In the future, necessary aids will be installed according to the port development. Maritime traffic safety measures will be promoted by formulating guidelines that will serve as standards for installation of aids to navigation so that the competent authorities who manages and supervises the aids and the parties who involve in port development can have a common understanding for installation and maintenance of aids to navigation.

In making the guidelines, it is necessary to clarify the criteria, buoyage-system direction, standardization of aids, and specification of devices.

1) Formulation of Guideline

The contents of the guideline for the installation and management of Aids to Navigation is shown below.

a. Role of Aids to Navigation

- ✧ Definition of Aids to Navigation
- ✧ Type (Lighthouse, Light-Beacon, Floating Buoy, Leading Light, Sector Light)
- ✧ Buoyage System (Type, Light Character, Buoyage Direction, Light Color, Top Mark)

b. Installation of Aids

- ✧ Installation Model (Breakwater, Reef, Construction Area, Fishing Net, Traffic)
- ✧ Design Criteria

c. Applicable Aids and Application Procedure

- ✧ Scope of Obligation to Installation

  (Government, Other Organization with Permission, Other Organization with Notification)

2) Guidance of Establishment

The future establishment of visual aids to navigation will be decided through consultation with mariners, fishermen and parties of port development, so the establishment guidance will be prepared.

a. Lighthouse

The lighthouse will be individually examined as to what kind of aid is required, when a new offshore traffic route is developed or when mariners request the installation of a lighthouse on an existing traffic route.

b. Light Beacon

Light Beacons are classified into Breakwater Beacon, Obstruction Beacon and Traffic Beacon. These will be installed corresponding to increase in vessels and to activation of traffic volume accompanying the development of ports and fishing ports, and will be installed in consultation with mariners and parties of port development.

Typical Light Beacons are shown in the Figure at the next page.

Break-water Beacons

Obstruction Beacon

Traffic Beacon

Picture 6.4.2 -1 : Typical Light Beacon

c. Floating Light Buoy

Lighted Buoys are installed on the sea and are divided into two types. One is connected to a sinker on the seabed with chains and other is with a shackle directly. These clearly indicate the lateral line of traffic, shallow waters, and obstacles, and the type and installation location will be examined individually for each port in consultation with mariners and fishermen. Typical Floating Light Buoy is shown in the Figure below.

Picture 6.4.2 -2 : Typical Floating Beacon

The installation of these lighted buoys will be planned for each port individually in consultation with mariners and other stakeholders.

It is noted that a minimum requirement of a lighted buoy is that at least one buoy should always be visible (by eye or radar) on either side of the waterway (traffic). With this rule and knowledge of visibility conditions in area of interest, a navigator can calculate maximum distances between the buoys. Therefore, the maximum spacing of the buoys is less than minimum visibility required (The minimum viewing distance from vessels may be recognized as shorter than the actual weather conditions, depending on the size of a vessel, the speed of a vessel, the visibility from the bridge, and the use of on-board electronic devices).

The type that is connected to the sinker of the seabed with a shackle directly is called Spar (Resilient) Buoy, which is less likely to be disturbed by wind and waves than a conventional floating buoy. And, the position of its light above water can be higher than the conventional one generally, that makes it very easy to see the lights. Also, the small floating radius makes it possible to secure a wider navigable route as shown in the Figure below, effectively making the traffic width.

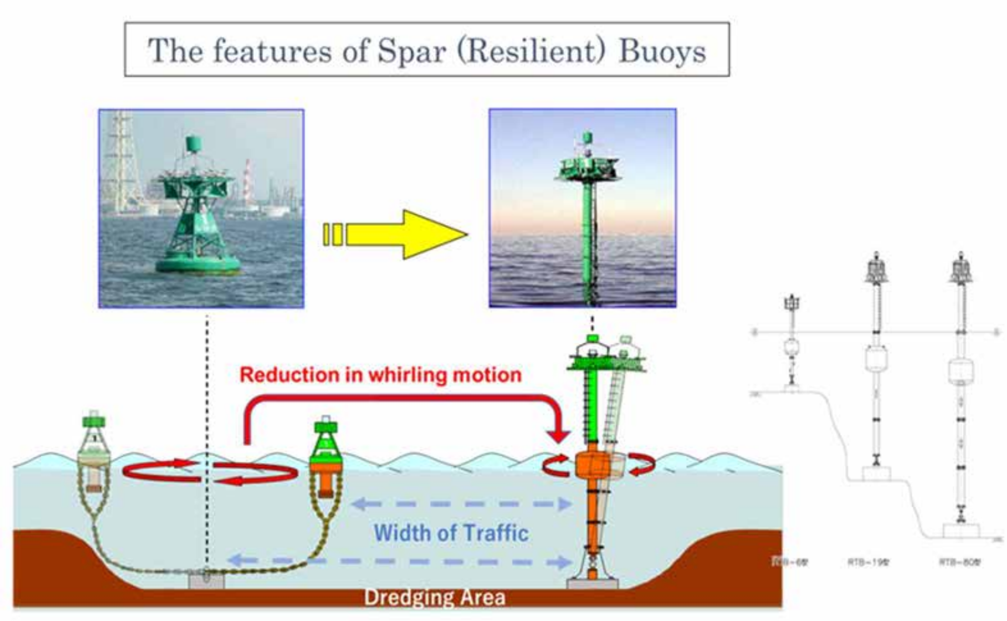
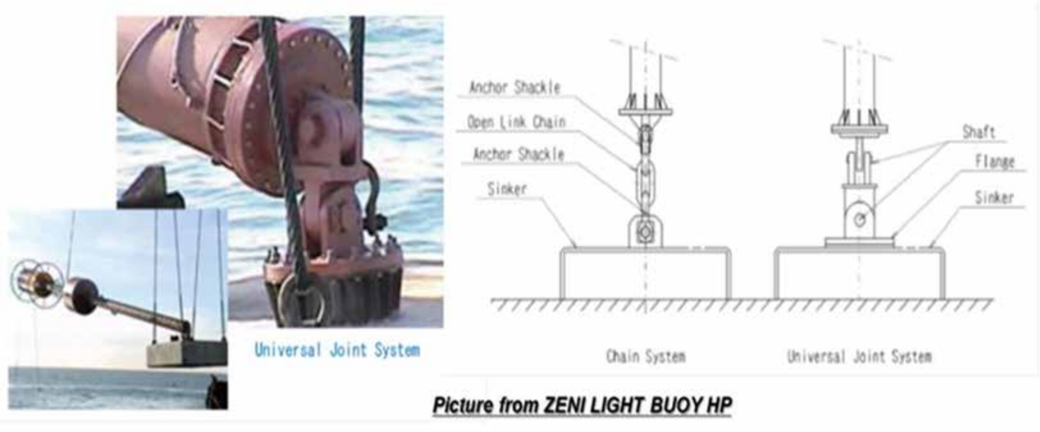


Figure 6.4.2 -1 : Merit of Spar Buoy

The Spar (Resilient) Buoy is suitable for aids that indicate the traffic side line because the movement is controlled to be small due to the connection that the main body and the sinker are linked by a universal joint with the high-tensile shackle or the single chain.

The general connection for the Spar Buoy is shown in the Figure at the next page.



Picture from ZENI LIGHT BUOY HP

Figure 6.4.2 -2 : Connection of Body to Sinker

In addition, the synchronous flashing of their lights makes it easier to recognize the channel, as shown in the Figure below.

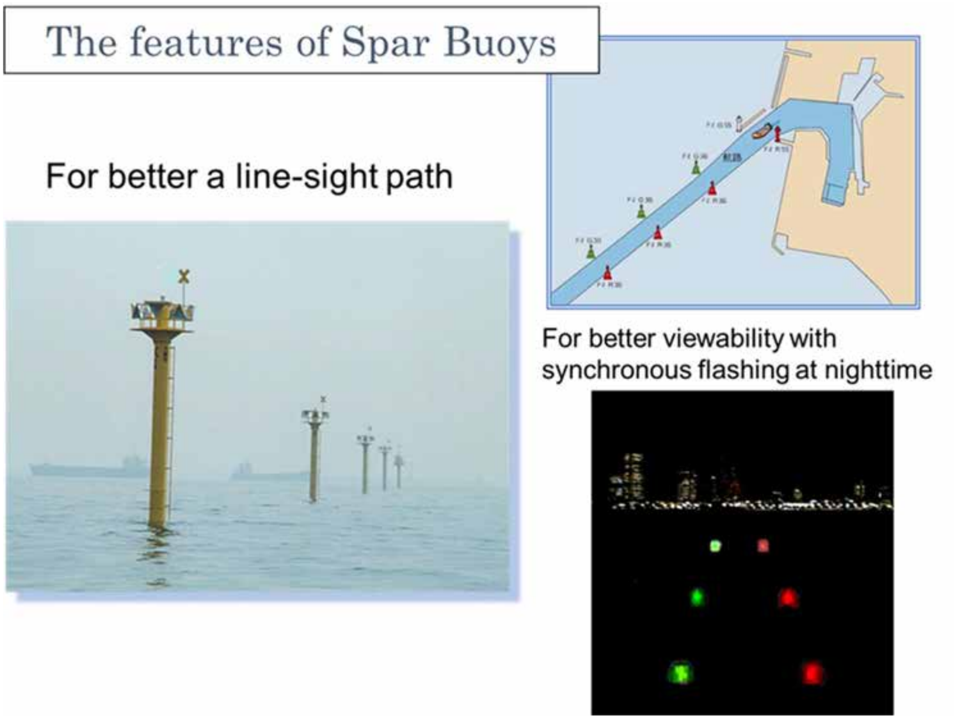


Figure 6.4.2 -3 : Synchronized Flashing ("Region-B")

The Spar Buoy should be individually designed to meet the conditions of the water depth and wave height of the installation area.

Regarding the maintenance, the replacement of a buoy body, which is pulled out to sea, has a longer cycle than the conventional floating buoy.

A new type of buoy (wreck aid) shown in the Figure below has been adopted to identify navigational obstacles in the sea. These will be installed where there are obstacles that hinder marine traffic, such as shallow waters, reefs, sandbars, and wrecked vessels, which were confirmed in hydrographical surveys or reports from navigators, to be known immediately to all concerned.

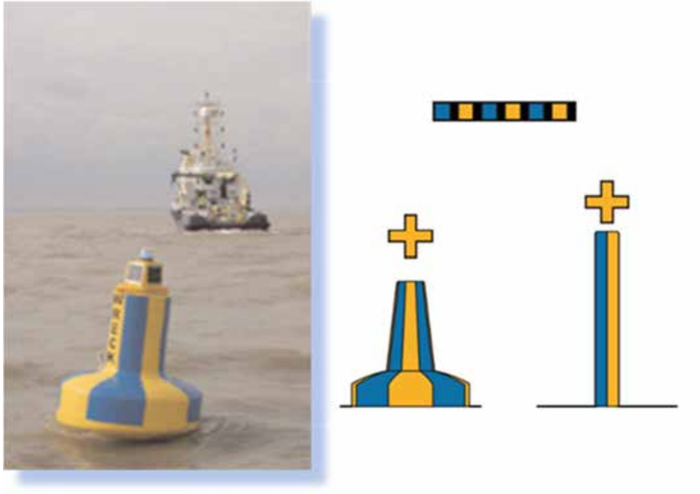


Figure 6.4.2 -4 : Marking New Dangers

d. Leading Light, Sector Light, Projector

Generally, as a typical example of clearly indicating waterways and obstacles on the sea, there are floating buoys installed along the waterways, but these facilities at the sea have a greater burden in terms of maintenance than onshore facilities. If an aid having the same function as a floating buoy can be installed on land, there are many advantages such as inspection ca be performed at any time.

They are Leading Light, Sector Light, and Projector.

The Leading Light plays a role as the function of clearly indicating the center of a traffic route from land as shown in the Figure at the next page, which can provide accurate information on the straight part of the narrow waterway in guiding vessels safely.

Figure 6.4.2 -5 : Leading Light

The Sector Light is often used to guide vessels to approach a dock (a pier) safely in avoiding shallow and hazardous waters.

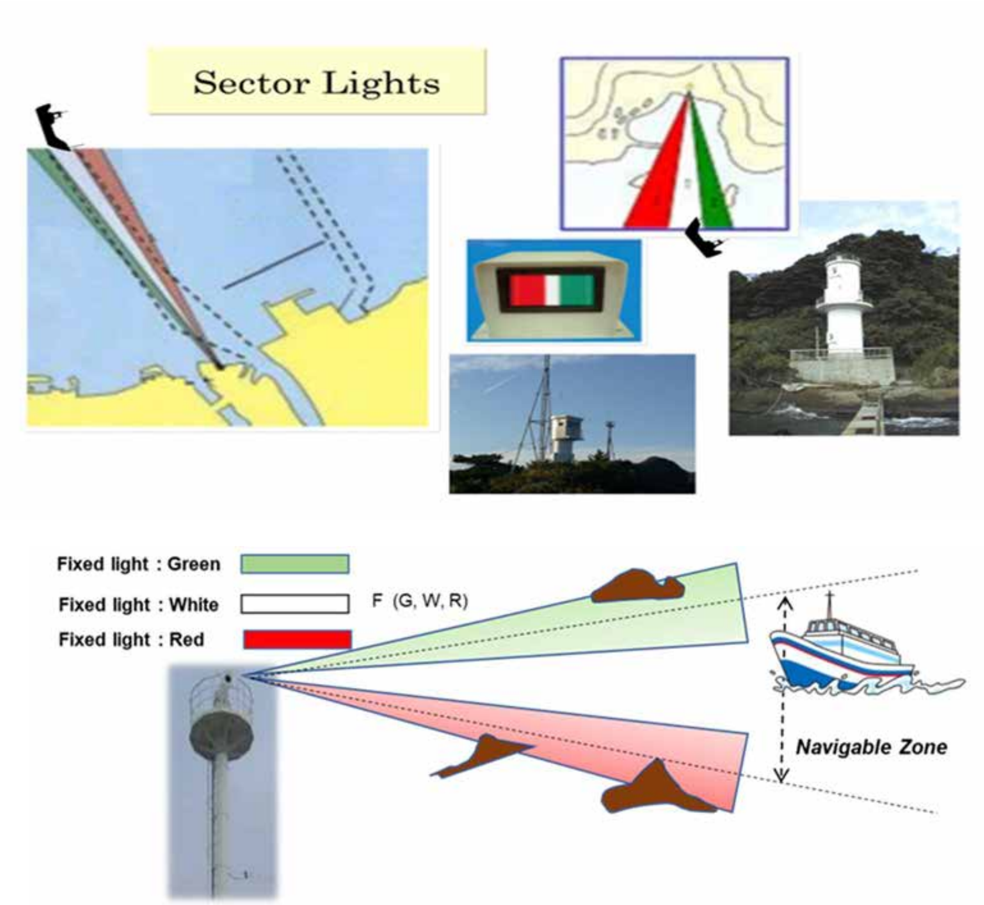


Figure 6.4.2 -6 : Sector Light

This aid is suitable for a location such as rural ports or fishing ports where there is a passage leading the pier in shallow waters.

Figure 6.4.2 -7 : Sector Light at Tip Point of Pier

The `Projector (Irradiation Light) illuminates rocky reefs on the sea where it is difficult to install aids to navigation, which is arranged on land.
The Figure is shown below.

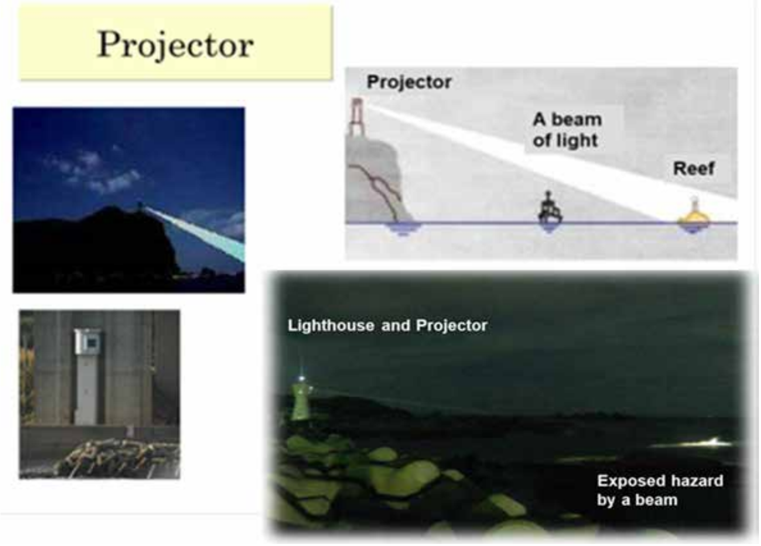


Figure 6.4.2 -8 : Projector

3) International Buoyage System

IALA classifies aids to navigation into 3 categories.

Category-1 is a landfall mark, and a mark indicating primary routes, as the most important marks at sea.

Category-2 is a mark indicating secondary routes and complementarily marking primary routes.

Category-3 is a mark being required for navigation.

In preparing an establishment plan, the aids to navigation proposed can be classified into the categories to determine the priority of establishment.

There are two International Regions of Buoyage Systems, the “Region-A” and the “Region-B”. The only difference between them is the vessel’s lateral marking.

“Region-A” : Combination of cardinal and latera marking (port marks are red)

“Region-B” : Combination of cardinal and lateral marking (port marks are starboard)

Indonesia has adopted the “Region-A”, which is shown in the Figure below.

(In “Region-A”, the direction of buoyage is Red to port-side when entering harbor.)

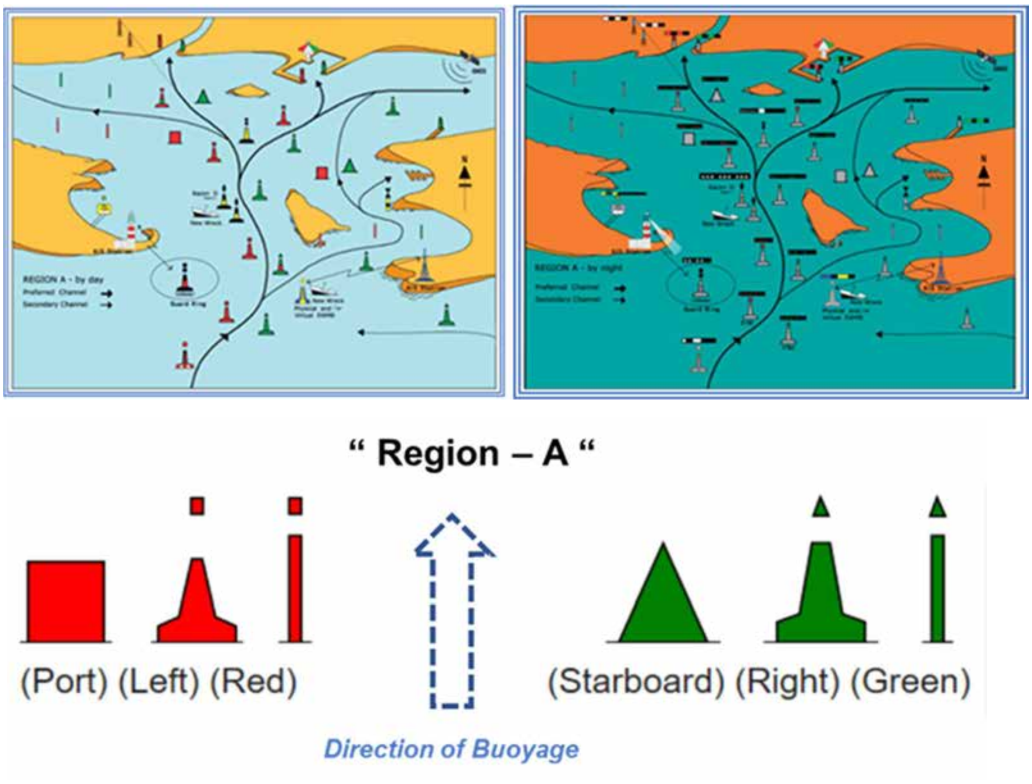
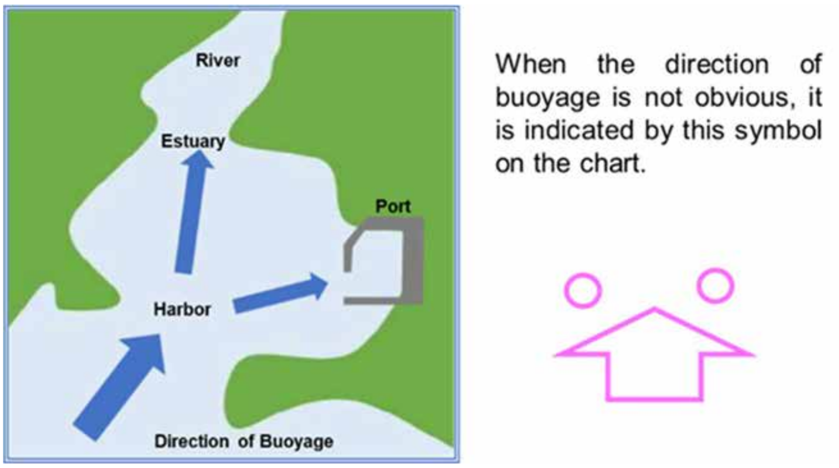


Figure 6.4.2 -9 : IALA Buoyage System (Region A)

In the Buoyage System, the direction of the buoyage is the course of entry into the port, and in the sea areas other than the port, the direction is generally in the clockwise steering. If the direction is unclear, such as a waterway surrounded by islands, a symbol shown in the Figure at the next page must be clearly stated on the nautical chart.

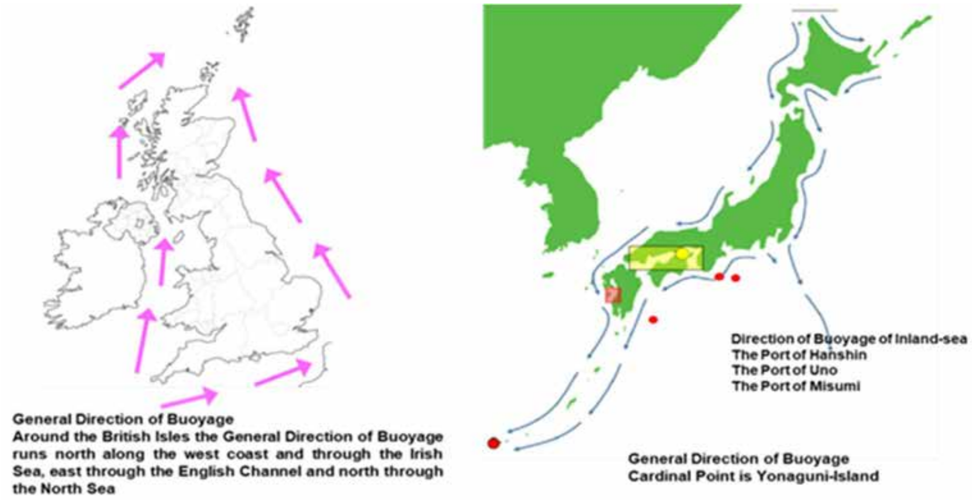


When the direction of buoyage is not obvious, it is indicated by this symbol on the chart.

Figure 6.4.2 -10 : Symbol for Buoyage Direction

The direction of buoyage system has to be determined by the maritime authorities of its country, following the general (conventional) direction taken by the mariner when approaching a harbor, river estuary or other waterway from seaward and in other area, following a clockwise direction around continental land masses.

In the case of island countries surrounded by sea, as an example Japan and England cases are shown in the Figure below.



General Direction of Buoyage
Around the British Isles the General Direction of Buoyage runs north along the west coast and through the Irish Sea, east through the English Channel and north through the North Sea

General Direction of Buoyage
Cardinal Point is Yonaguni-Island

Figure 6.4.2 -11 : Direction of Buoyage

4) Installation Model

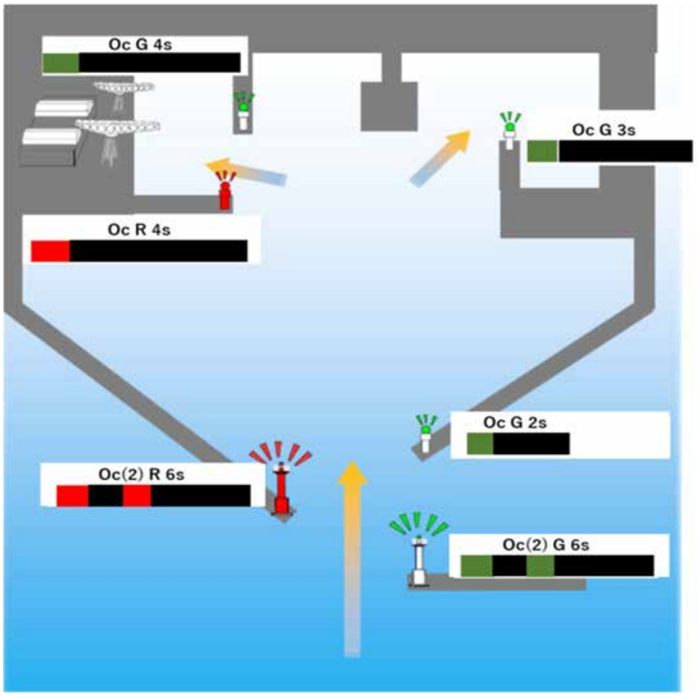
Since the installation of Light Beacon and Floating Light Buoy will take a leading part in the establishment of visual aids to navigation associated with port development, an installation model for standard specification of visual aids, such as Surface Color, Light Character, Luminous Intensity, will be made known to the relevant parties in order to understand the recognition and knowledge about aids to navigation without omission in the maritime traffic safety measures.

The examples of installation on breakwaters, reefs, offshore construction areas, and traffic routes are shown in the Figure at the next pages.

a) Breakwater

Indication of Breakwater

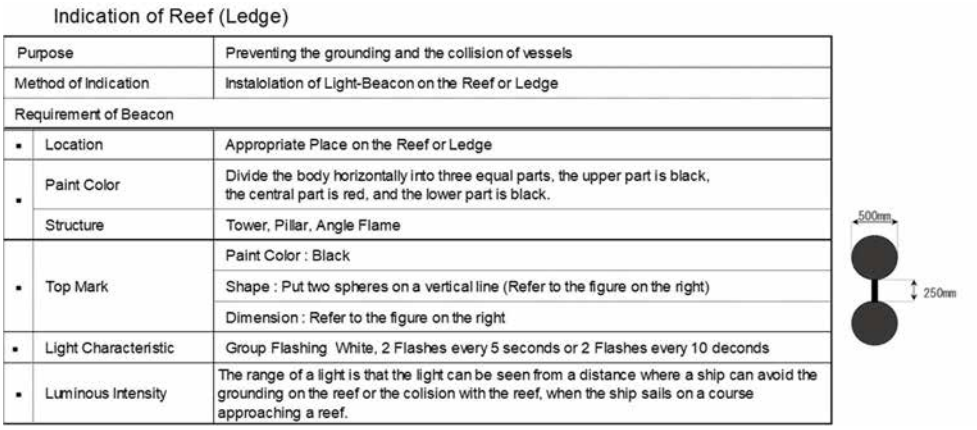
Purpose		Showing the entrance of a harbor, Preventing the collision of vessels			
Method of Indication		Instalolation of Light-Beacon on the Breakwater			
Requirement of Beacon					
■	Location	Tip area or Outer area of Breakwater on Traffic side			
■	Paint Color, Structure	Port Side	Red	Tower, Pillar or Stand Pipe	"Reagion A"
		Starboard Side	White	Tower, Pillar or Stand Pipe	
■	Light Color	Port Side	Red		
		Starboard Side	White		
■	Light Characteristic	Single-Flashing, Group-Flashing, Isophase Light, Single-Occulting, Group-Occulting, Continous Quick-Flashing, Group Quick-Flashing or Fixed Light			
		※ Synchironized flashing, when beacons show the same entrance of a port			
■	Luminous Intensity	The range of a light is that the light can be seen from a distance where a ship can avoid the colision with the breakwater, when the ship approaches the breakwater.			



(Example)

Figure 6.4.2 -12 : Arrangement of Light-Beacon at the Breakwater

b) Reefs (Ledges)



Indication of Reef (Ledge)

Purpose		Preventing the grounding and the collision of vessels
Method of Indication		Instalolation of Light-Beacon on the Reef or Ledge
Requirement of Beacon		
▪	Location	Appropriate Place on the Reef or Ledge
▪	Paint Color	Divide the body horizontally into three equal parts, the upper part is black, the central part is red, and the lower part is black.
	Structure	Tower, Pillar, Angle Flame
▪	Top Mark	Paint Color : Black
		Shape : Put two spheres on a vertical line (Refer to the figure on the right)
		Dimension : Refer to the figure on the right
▪	Light Characteristic	Group Flashing White, 2 Flashes every 5 seconds or 2 Flashes every 10 deconds
▪	Luminous Intensity	The range of a light is that the light can be seen from a distance where a ship can avoid the grounding on the reef or the collision with the reef, when the ship sails on a course approaching a reef.

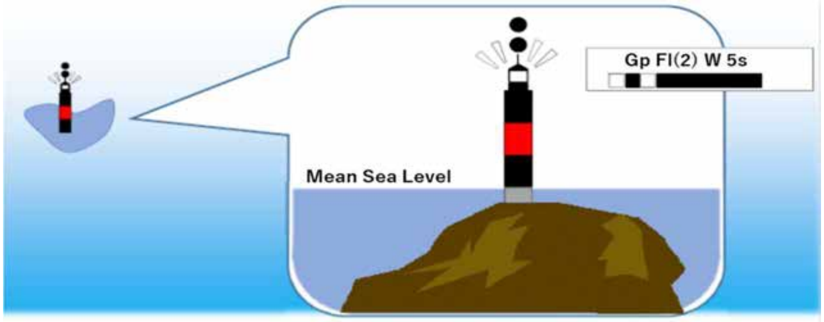
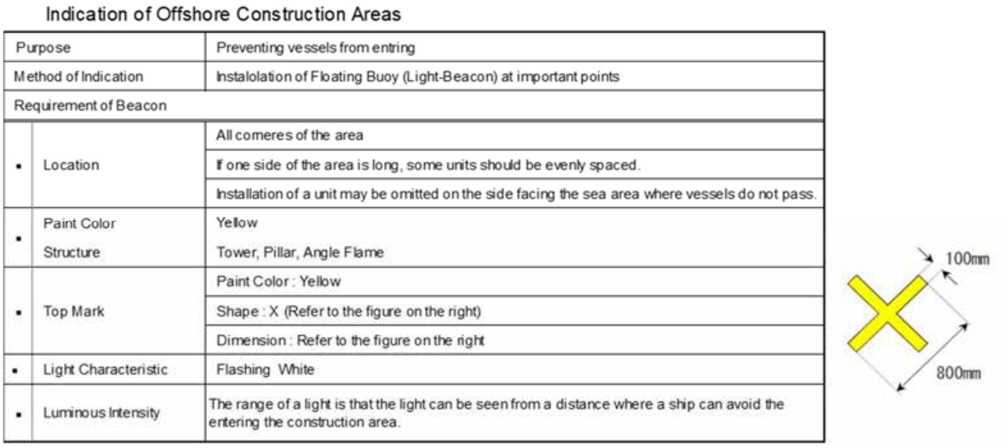


Figure 6.4.2 -13 : Arrangement of Light-Beacon at the Reefs

c) Offshore-Construction Areas



Indication of Offshore Construction Areas

Purpose		Preventing vessels from entring
Method of Indication		Instalolation of Floating Buoy (Light-Beacon) at important points
Requirement of Beacon		
▪	Location	All comeres of the area
		If one side of the area is long, some units should be evenly spaced.
		Installation of a unit may be omitted on the side facing the sea area where vessels do not pass.
▪	Paint Color	Yellow
	Structure	Tower, Pillar, Angle Flame
▪	Top Mark	Paint Color : Yellow
		Shape : X (Refer to the figure on the right)
		Dimension : Refer to the figure on the right
▪	Light Characteristic	Flashing White
▪	Luminous Intensity	The range of a light is that the light can be seen from a distance where a ship can avoid the entering the construction area.

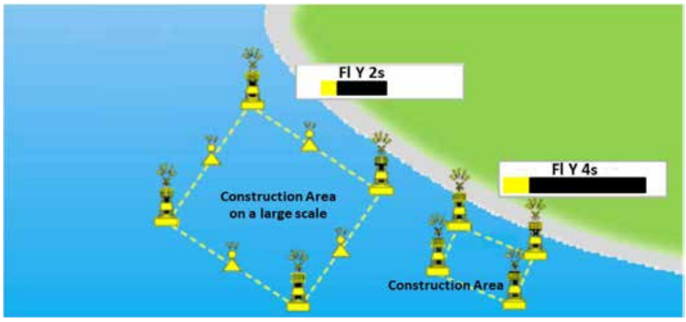
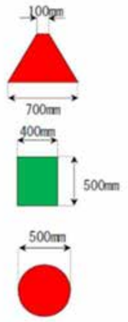


Figure 6.4.2 -14 : Arrangement of Light-Beacon at the Construction Area

d) Traffic Route

Indication of Traffic Route

Purpose		Showing the side-track (lateral line), Regulating traffic		
Method of Indication		Instalolation of Floating Buoy at Light-Beacon at key points		
Requirement of Beacon				
▪	Location	Entrance (Exit) of Traffic Rout, and the bent corner on the line of Traffic Route		
		If the route is long, some units should be evenly spaced.		
		Installation of the unit may be omitted if it interferes with entrance into and leave from Traffic Route.		
▪	Paint Color	Port Side	Red	"Reagion A"
		Starboard Side	Green	
		Center	Red and White vertical stripes (eight equal parts)	Safe Water Marks
▪	Structure	Angle Frame, Pillar		
▪	Top Mark	Port Side	Paint Color : Red	
			Shape : Cone	
		Starboard Side	Paint Color : Green	
			Shape : Cylinder	
		Center	Paint Color : Red	
			Shape : Sphere	
▪	Light Color	Port Side	Red	
		Starboard Side	Green	
		Center	White	
▪	Light Characteristic	Port Side Staraboard Side	①Entrance (Exit) and Bent : Group Flashing, 2 Flashes every 6 seconds	
			Cases other then ① : Singl Flashing, every 2, 3, 4 or 5 seconds	
		Center	①Entrance (Exit) and Bent : Isophase, Light 2 seconds and Darkness 2 seconds (A light in which all the durations of light and darkness are clearly equal.)	
			Cases other then ① : Isophase, Light 2 seconds and Darkness 2 seconds, Long Flashing, 1 long-flashing every 10 seconds or Morse code, A(•—) every 8 seconds	
▪	Luminous Intensity	The range of a light is that the light can be seen from a distance where a ship can avoid the colision with the other vessel, when the ship approaches the traffic route.		



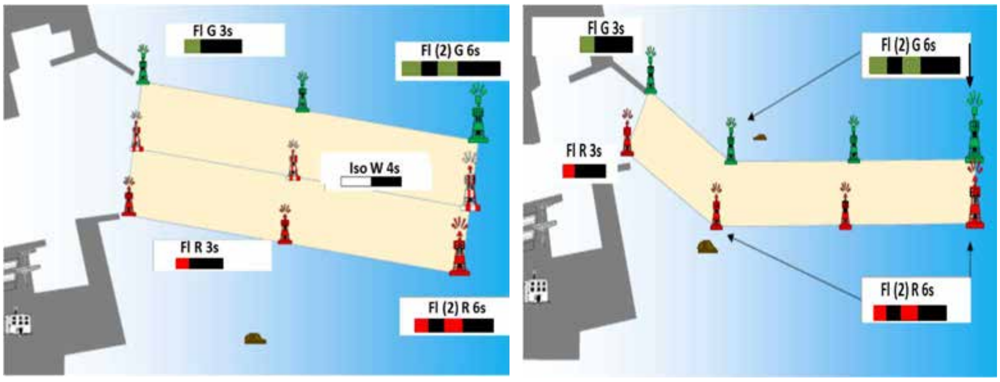


Figure 6.4.2 -15 : Arrangement of Light-Beacon at the Traffic Route

5) Standardization of General Lighted Beacon and Lantern with LED

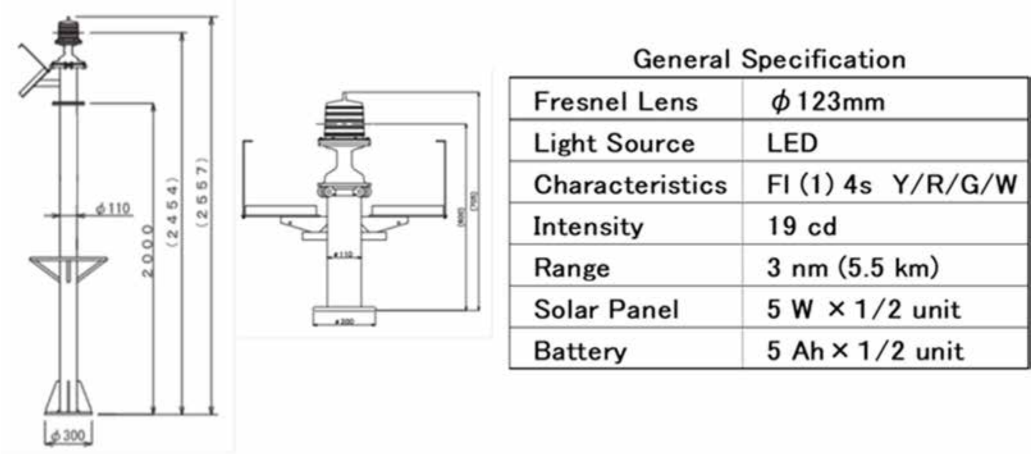
In a local port and a fishing port, there are very few places where a light beacon is installed on the pier that is covered with coral reefs and has a long passage to offshore, because there was a big problem in supplying electric power to the facilities necessary to lay a long power cable.

It is impossible to enter and leave the port at night without aids indicating safety zone, and even in daytime there is always a danger of landing in places where there are no marks showing underwater reefs and vessels cannot even approach the coast.

Especially in small islands where coastlines with few houses continue, it is very difficult to identify the border line at night under darkness and small fishing boats without radar are always forced to sail with possibility of grounding on reefs.

In order to eliminate such unlit water areas, a light beacon consisting of the main body, lantern, power supply (with simple solar power generations) that can be easily installed without worrying about the power supply will be prepared as a standard model.

The sample model is shown in the Figure below.



General Specification

Fresnel Lens	φ 123mm
Light Source	LED
Characteristics	Fl (1) 4s Y/R/G/W
Intensity	19 cd
Range	3 nm (5.5 km)
Solar Panel	5 W × 1/2 unit
Battery	5 Ah × 1/2 unit

Figure 6.4.2 -16 : Standard Model of Small Lighted Beacon

One of the improvements in today's aids to navigation is to use the LED (Light-Emitting Diode) that does not permanently require replacement, instead of an electric bulb-type lamp for light sources.

When the range of a visual aid to navigation needs more than 25 nautical miles, a meta-halide lamp may be used, but with the development of high-luminance LED, bulb-type lamps including a meta-halide type are almost disappearing.

Another big innovation is that the power consumption has been reduced due to the light source being switched to LED, and the power source of aids to navigation is changing from a commercial power or a replaceable storage battery to a solar battery (rechargeable storage type) using solar-cell generator. This means that it is no longer necessary for the vessel to refuel a lighthouse for power generation and to replace storage batteries of a floating buoy.

Due to the configuration of the LED and the solar battery system, there are almost no parts that need to be replaced regularly, and maintenance work is theoretically required only on the functional decline that results from deterioration of parts.

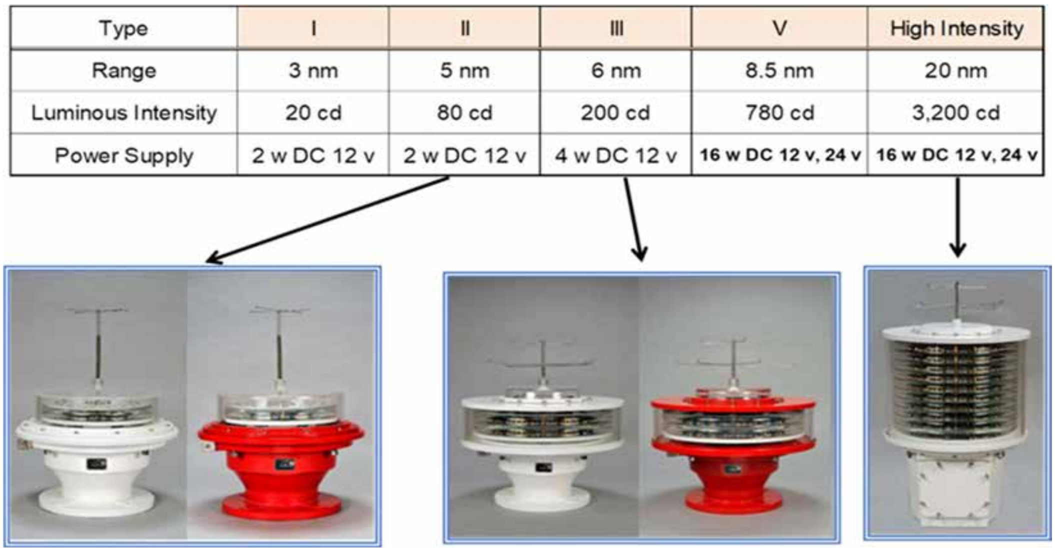
LED Lantern are manufactured by several companies in the world, and each company has its own standards such as large, medium, and small, and those are packaged in each one unit in the market. When a device packaged in this way breaks down, it is common to replace the set of a lantern with a new one prepared as a spare device and bring it back to the workshop for repair.

Actually, several companies' lanterns are used, and each manufacturer's lantern has spare parts. Since they will not be common parts for other companies' lantern, a lot of inventory will remain.

LED Lantern can be classified into short-range type for inside the port, medium-range type for outside the port, and long-range type for coastal aids. Standardized specifications for luminous intensity and power supply according to the range will be decided and procured so that the maintenance can not only be rationalized but also a lot of inventory is unnecessary.

A lantern that uses LED as a light source must be composed of LED, Control Unit, and Optical Switch Unit in one package, and the entire device must be with specifications that can withstand the installation environment.

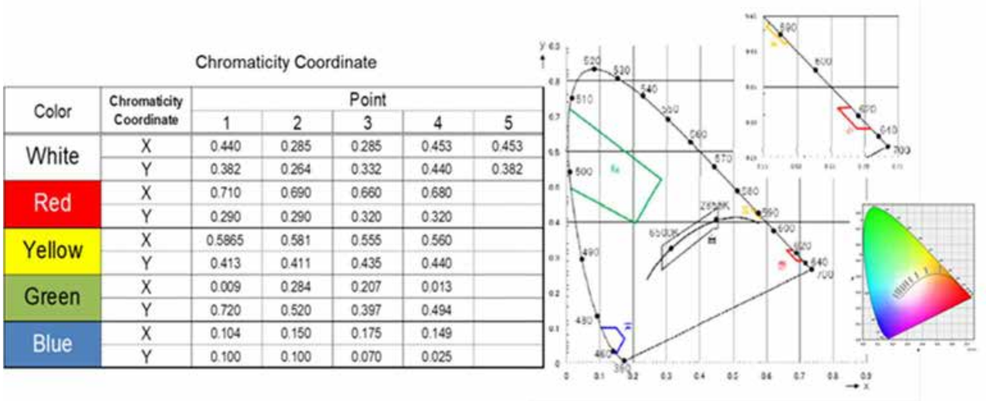
For reference, an example of the specifications (Partial) of the lantern is shown in the Figure below.



Type	I	II	III	V	High Intensity
Range	3 nm	5 nm	6 nm	8.5 nm	20 nm
Luminous Intensity	20 cd	80 cd	200 cd	780 cd	3,200 cd
Power Supply	2 w DC 12 v	2 w DC 12 v	4 w DC 12 v	16 w DC 12 v, 24 v	16 w DC 12 v, 24 v

Figure 6.4.2 -17 : Standard Model of LED Lantern

In determining specifications such as luminosity, the surface color and the light color are definitely indicated in accordance with the IALA standard (White, Red, Yellow, Green or Blue). The chromaticity range of light colors is shown in the Figure below.



Chromaticity Coordinate

Color	Chromaticity Coordinate	Point				
		1	2	3	4	5
White	X	0.440	0.285	0.285	0.453	0.453
	Y	0.382	0.264	0.332	0.440	0.382
Red	X	0.710	0.690	0.660	0.680	
	Y	0.290	0.290	0.320	0.320	
Yellow	X	0.5865	0.581	0.555	0.560	
	Y	0.413	0.411	0.435	0.440	
Green	X	0.009	0.284	0.207	0.013	
	Y	0.720	0.520	0.397	0.494	
Blue	X	0.104	0.150	0.175	0.149	
	Y	0.100	0.100	0.070	0.025	

Figure 6.4.2 -18 : Chromaticity Range for Light Color

6) Applicable Aids and Application Procedure

Aids to Navigation are used by an unspecified large number of mariners and fishermen and have a highly public nature. Furthermore, they are internationally unified and their management and operation must be stringently enforced, because foreign vessels will also be used.

Therefore, many aids to navigation will be managed and operated by the national government, but some of them may be installed under the responsibility of the port authority at the port where only specific vessels enter and leave. Even in such a case, the public nature of aids to navigation may lead to the possibility of use by other vessels or of misunderstanding, so the government needs to manage them as well.

The scopes of applicable aids are classified as follows.

✧ Permitted Aids (installed by other organization)

It shall be an aid that is given permission for installation and operation with the required procedures.

✧ Notified Aids (installed by other organization)

It shall be an aid that has an obligation to notify the installation, that should be very low luminous intensity (e.g. 15 candelas or less) and be unlikely to be mistaken for other aids.

6.4.3 Remote Monitoring System

Aids to Navigation must be constantly monitored for their conditions and the monitoring system must be in place to notify mariners immediately when the light are turned off or something goes wrong in operation which may directly lead to a marine accident.

The light condition of aids to navigation has been confirmed by a lighthouse keeper and residents near the aids, or navigators until now, and they have informed of the abnormality.

Some of the aids are still monitored in this way, but there are many unmanned lighthouses and aids installed at isolated areas, which are out of monitoring conditions. It takes time to inform the concerned people of the light conditions only by the report from the navigator, and the dangerous situation is left for a long time.

It is necessary to reaffirm the importance of monitoring aids to navigation and to consider introducing an automatic monitoring system using current electronic and radio wireless technologies.

There are many restrictions for the monitoring of aids installed at remote places at sea, and it depends largely on the means of communication between the aids and the monitor site. Today, mobile phone networks are widespread throughout Indonesia, and it is possible to set up the monitoring system to some extent by utilizing this communication network.

The Figure below shows the service coverage published by Indonesia Telecom which is a major tele-communication network company in Indonesia.

Source from nPerf.com

Figure 6.4.3 -1 : Coverage of Mobile Phone

The conceptual diagram of the monitoring system for aids to navigation is shown in the Figure below.

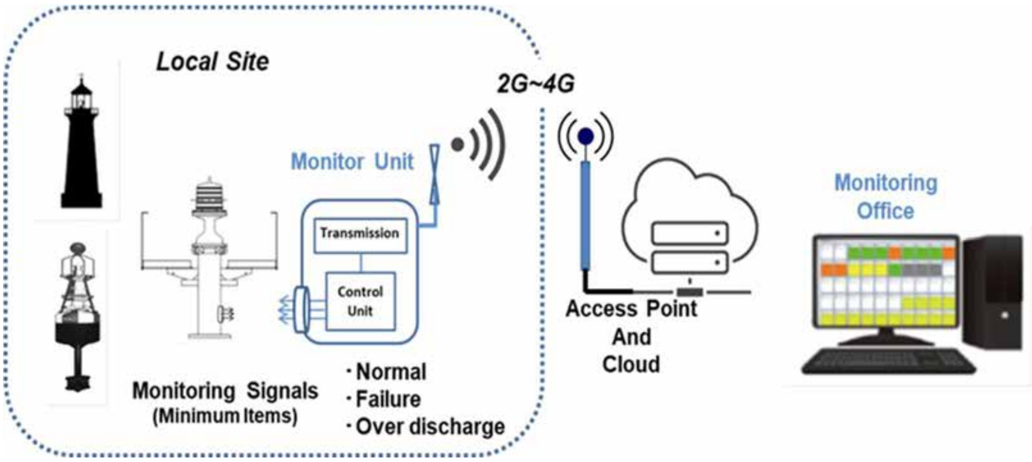


Figure 6.4.3 -2 : Remote Monitoring System

The following monitoring units should be provided at least, when purchasing the lantern.

a) Current Detection Unit

The lantern shall have a function that the voltage proportional to the current flowing through the LED is detected and the signal at the time of lighting is output to Monitor Unit.

b) Lighting Monitoring Unit

The lantern shall have a function that the signal of the non-voltage contact is output to Monitor Unit, when the light is turned offs or the light character becomes abnormal.

c) Overcurrent Prevention Unit

The lantern shall have a function that the charge will be stopped, when the full charge is detected in charging the rechargeable battery with the electric power generated from the solar cell.

The aids to navigation equipped with the units having the above-mentioned functions can be incorporated into a monitoring system by introducing the Monitor Unit.

6.5 Radio Aids to Navigation

As mentioned in Section 6.2.1, the hyperbolic radio navigation system, such as Omega, Loran and Decca, which has been synonymous (as a general term) with Radio Aids to Navigation, is now used only in a limited field for measurement surveying due to the advent of GPS and the improvement of GPS accuracy. The system, which was called Radio Aids to Navigation except GPS, is now obsolete worldwide.

Radar Beacon and Ramark Beacon have been developed and installed all over the world as radio aids to navigation for vessels equipped with radar, but their role has diminished due to the development of GPS and of electronic marine charts, so they have been withdrawn from old ones and the new one is no longer installed.

Only GPS navigation and AtoN AIS (Land-based AIS and Floating-buoy AIS) can be said to be Radio Aids to Navigation.

According to the official announcement by the US government, the accuracy of GPS-enabled smartphone is within a 4.9m. Recent FAA (Federal Aviation Administration) data shows the horizontal accuracy (Single-frequency GPS receiver) is less than 1.891 with a 95% probability error as shown in the Figure below.

(For reference : High-end users boost GPS accuracy with dual-frequency receivers and/or augmentation systems. These can enable real-time positioning within a few centimeters, and long-term measurements at the millimeter level).

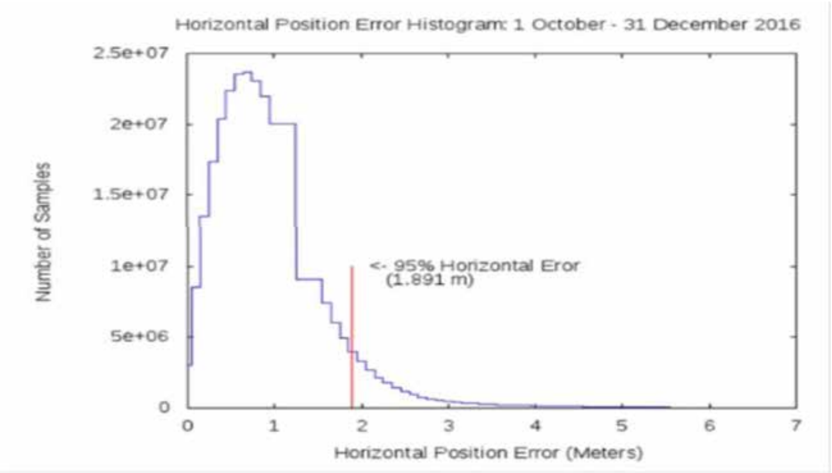


Figure 6.5 -1 : Accuracy of GPS (FAA Report)

6.5.1 AtoN AIS

There are three types of AtoN (Aids to Navigation) AIS.

One of them is the Real AIS, which is installed on an existing aid to navigation and physically exists.

The second one is the Synthetic AIS, which transmits the message of an aid to navigation from a remote AIS base-station.

And, the third one is the Virtual AIS, which transmits information on existence of an aid to navigation in effect though not physical exist. This means that the presence of an aid to navigation is displayed only on electronic chart as if it were real, even though there is no real aid to navigation.

Each of these three types of AtoN AIS has its own features.

✧ Real AIS

It acts like a traditional radar-beacon, and more clearly shows the presence of an aid to navigation with not only a symbol but also static information. When being installed on a floating buoy, the AIS transmits the information on the current position of the buoy, so it would also be known whether or not the buoy is out of position. When used in combination with a meteorological observation device, it is possible to provide real-time weather information, such as a wind speed and a wind direction at its place, by using the broadcasting function of AIS.

✧ Synthetic AIS

It transmits the information on the location of an existing an aid to navigation from another place, and if the position of the actual aid to navigation such as a floating buoy on the sea shifts by some cause, a discrepancy will occur between the actual position and the broadcasting position. Therefore, thorough care must be taken when establishing the Synthetic AIS.

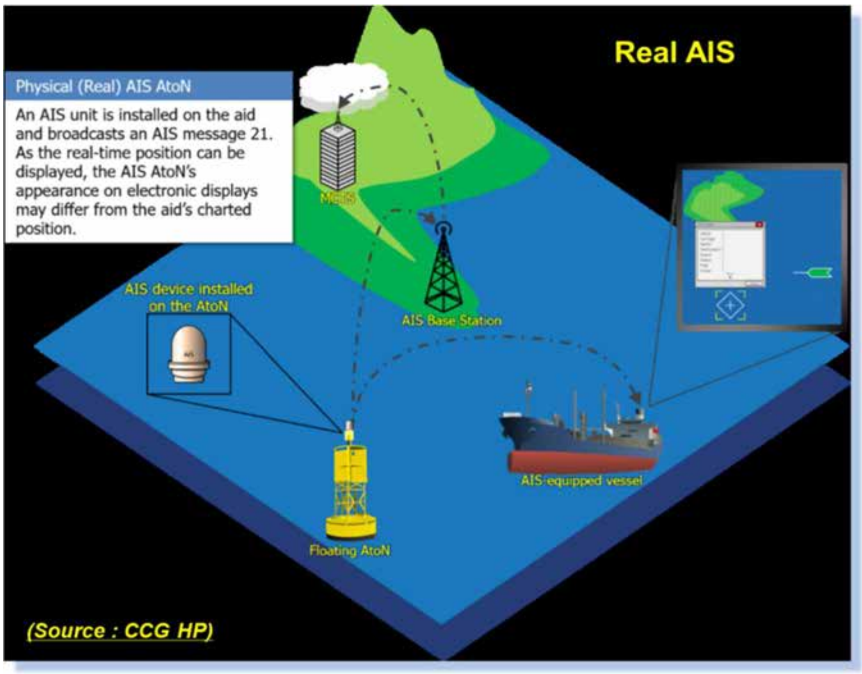
✧ Virtual AIS

The Virtual AIS transmits the information on an aid to navigation in effect though not in actual fact of presence on the sea. In other words, the virtual AIS can be used in places where it is difficult to install the aids to navigation such as deep water and strong currents. In addition, it can be used for indication of immediate wrecks or unexpected hazards.

Vessels not equipped with AIS cannot recognize Virtual AIS signals, which may cause a difference of perception of sea area conditions with vessels equipped with AIS. In planning the installation of Virtual AIS, it is important to inform the people concerned, especially small vessels.

Virtual AIS can be set relatively easily compared to the installation of a light beacon and a floating buoy at sea, due to the only construction work for land facilities, and the maintenance can be easy.

The conceptual illustration of Real AIS and Virtual AIS is shown in the Figure below.

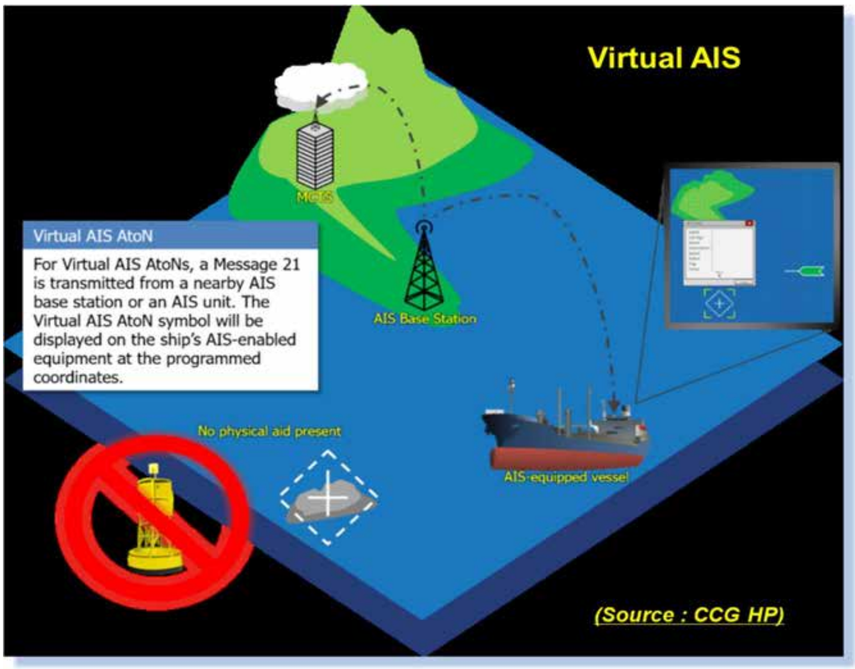


Physical (Real) AIS AtoN

An AIS unit is installed on the aid and broadcasts an AIS message 21. As the real-time position can be displayed, the AIS AtoN's appearance on electronic displays may differ from the aid's charted position.

(Source : CCG HP)

Figure 6.5.1 -1 : Real AIS



Virtual AIS AtoN

For Virtual AIS AtoNs, a Message 21 is transmitted from a nearby AIS base station or an AIS unit. The Virtual AIS AtoN symbol will be displayed on the ship's AIS-enabled equipment at the programmed coordinates.

(Source : CCG HP)

Figure 6.5.1 -2 : Virtual AIS

The Figure at the next page is an example of placing Real AIS and Virtual AIS at the entrance of Tokyo Bay in Japan.

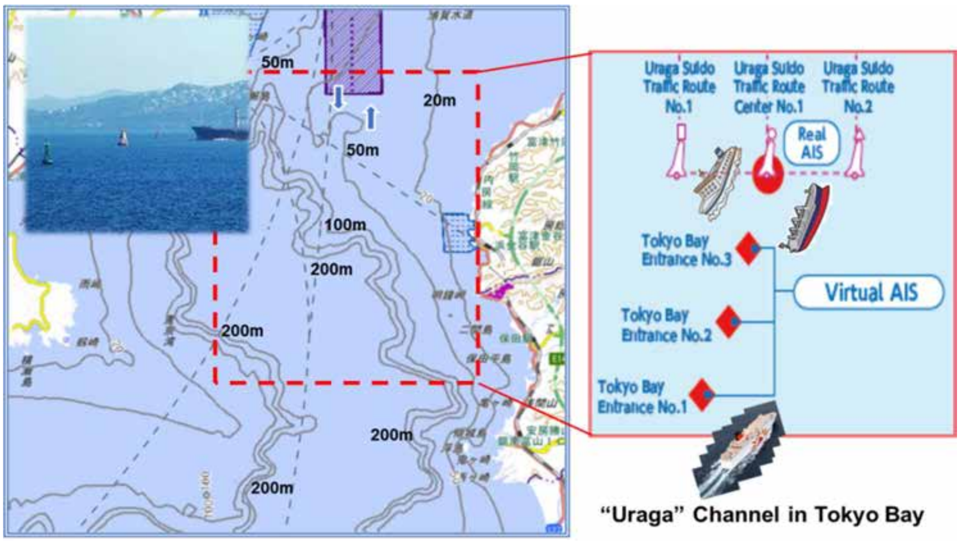
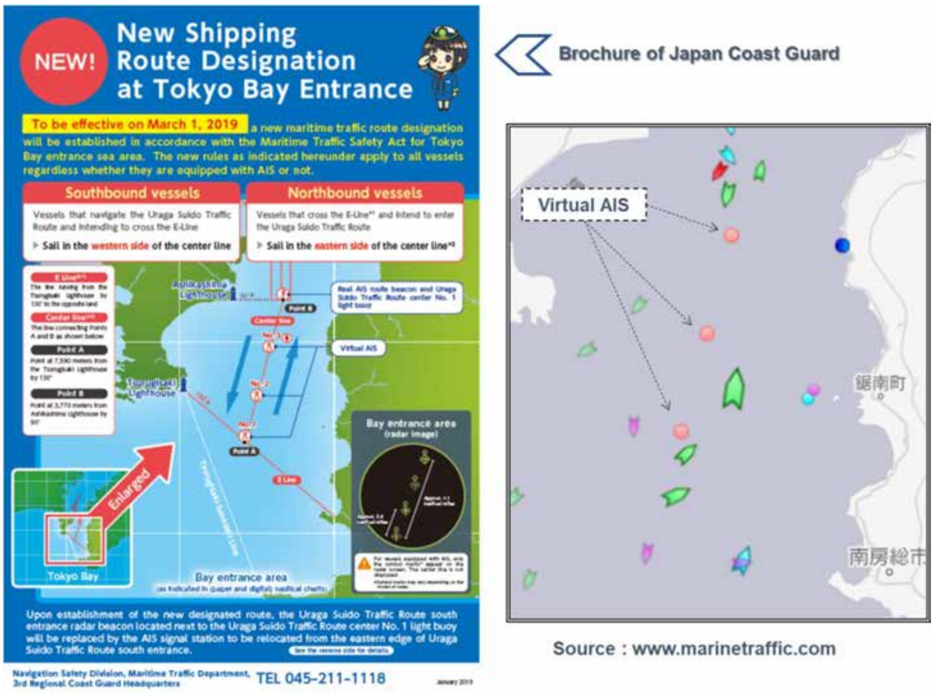


Figure 6.5.1 -3 : Placement of Real and Virtual AIS



Source : www.marinetraffic.com

Figure 6.5.1 -4 : Traffic Flow

In order to make the traffic flow more orderly in the congested area at the entrance of Tokyo Bay, the committee consisting of mariners, fishermen, port authority, and academic exerts was established to study the maritime traffic safety measures, including the analysis with IWRAP. It was concluded that it was necessary to install aids for the separation of the traffic flow, and Virtual AIS was selected because the water depth is too deep in this area to put a floating buoy.

The Virtual AIS signals are transmitted from two sites at the north and south side on land, because vessels sailing from south and north can recognize the signals of Virtual AIS from a distance.

6.6 VTS

The VTS has been developed in major traffic routes and major ports to support maritime management as well as safe and efficient navigation, and the subsequent development will be done in new ports and new ships routings to contribute to the countermeasures for maritime traffic safety.

The system configuration of the VTS will be decided after clarifying the purpose of each respective one in advance. For example, what kind of information should be provided to what kind of vessels, and what kind of traffic management should be done in a sea area where VTS is to be established The VTS should comprise at least an information service and may also include others, such as navigational assistance service or a traffic organization service, or both.

The equipment and their specifications are fixed according to the content of these services.

VTS does not function only by installing equipment, but it will contribute to the safety navigation by conducting the operation and putting the equipment to practical use. And, it will also play a role in the E-Navigation system currently under consideration by IMO, IALA, etc., so the continuous development of VTS can be the cornerstone t of the system.

6.6.1 Function of VTS

The series of tasks as shown in the Figure below should be carried out for full achievement of VTS functions, such as Data Collection related to the movement of vessels and to maritime safety, Data Processing/Storage, Data Analysis, Data Sharing, and Radio Communication with vessels.

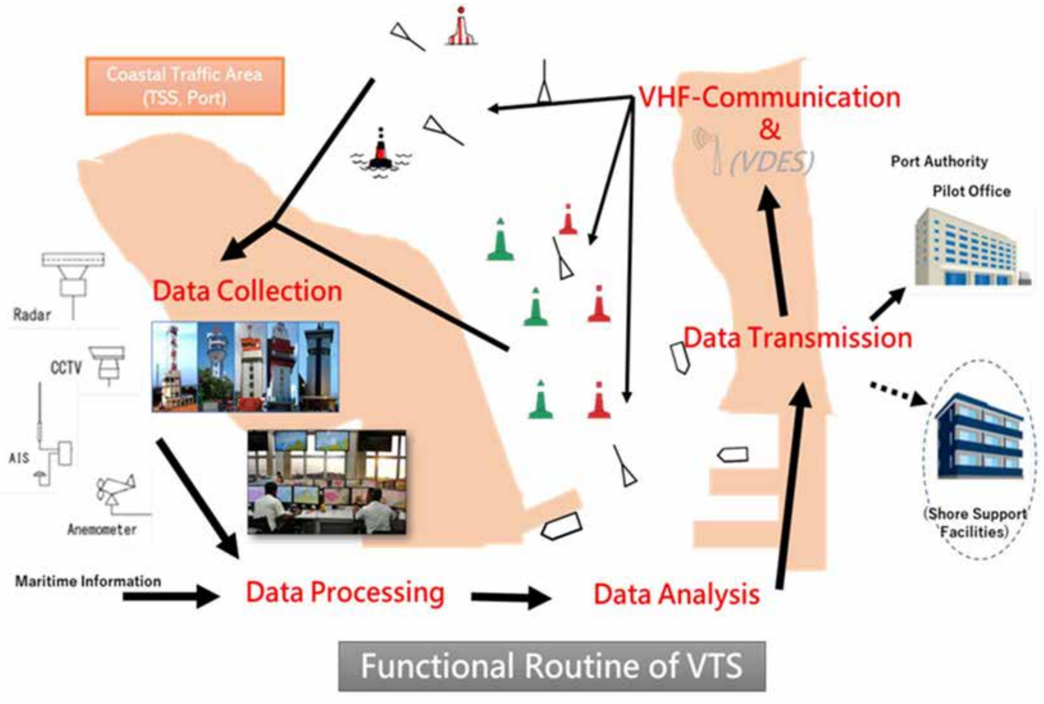


Figure 6.6.1 -1 : Functional Routine of VTS

In providing information, the specific procedures must be established for the contents of the information, such as the type of information, the point where the information is provided vessels, the timing of provision, to avoid the delay in the judgment of the operator or human error, and the confusion for the vessel receiving the information.

It is an operation manual for VTS Operator, and is a user manual for vessels.

✧ Data Collection

There are Radar, AIS and CCTV (Surveillance Camera) as means for obtaining information on the movement of vessels, and they become more sophisticated means of collecting information by exchanging ships' data and by compensating for their lacking functions. These installation places will vary depending on the width of monitoring area where information is collected.

There is information on weather and sea conditions which are indispensable for safety navigation of vessels. It must be real-time data in the vicinity of a vessels navigating as much as possible. As the sensor, an anemometer is generally used. A visibility meter may be installed.

Static information such as vessel registration, ships' schedule known by port authority, and meteorological information issued by the agency are also collected.

✧ Data `Processing and Storage

The information collected from several sensors is subjected to various processes for display and operational forms, and is associated with other information. These (Data) will be saved for statistics and reviews.

✧ Data Analysis

The processed data will be analyzed for grounding prediction, collision prediction, course prediction, etc., and the results will be immediately notified to the VTS operator through the operation console, and they will be provided to vessels by the operator as an information or an alert. The analysis of accumulated data will be used for statistics and policy making.

✧ Data Sharing

The collected information and those processed data will be valuable information not only for providing information to vessels, but also for supervising the movement of vessels by ships' operator and maritime organizations. Then, those data will be shared with those relevant agencies via Internet network.

✧ Information Service

The information will be provided to vessels in a timely and accurately way by VTS operators with International VHF Radio. It is expected that navigational safety information will be automatically transmitted as electronic data by VDES (VHF Data Exchange System).

✧ Operation Manual

The Operation Manual is a procedure text for the VTS Operator that stipulates the handling of information so that the information is not processed or provided at the discretion of the individual. This manual is compiled for each VTS station according to its area, geographical situation, and traffic features. In addition, cooperation service with related organizations may be described in it.

The manual shows specific examples and describes how to collect and provide information, and includes the following contents.

a) Definition of Terms

b) Collection Method of Information (Monitoring target, Purpose, Sea area)

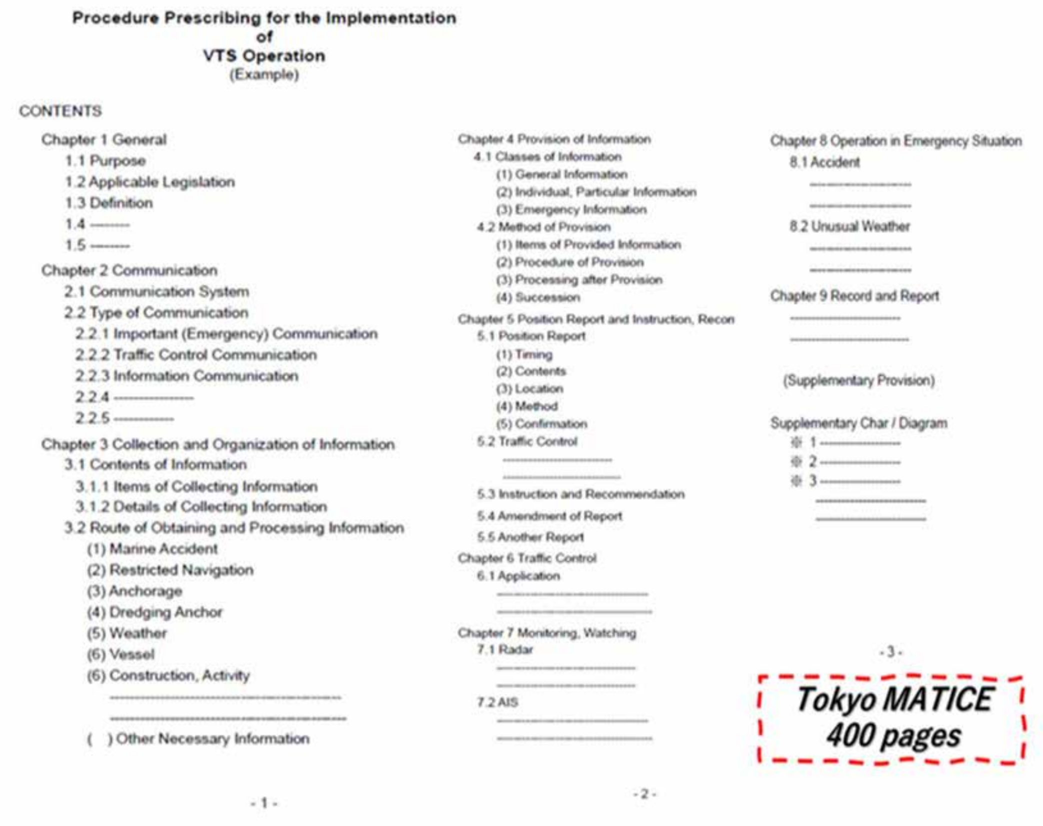
c) Notification and/or Dissemination of Information, Instruction

(Items, Timing, Targets, Means)

d) Arrangement and analysis of information

These are constantly reviewed, corrected, and updated as the situation changes in daily operations.

A brief summary (Contents) of the operation manuals used at the Tokyo Bay VTS (Japan) is shown in the Figure below.



Procedure Prescribing for the Implementation
of
VTS Operation
(Example)

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    - (5) Weather
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    - (6) Construction, Activity
    - ------------------------------
    - ------------------------------
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- 1 -

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  - 4.1 Classes of Information
    - (1) General Information
    - (2) Individual, Particular Information
    - (3) Emergency Information
  - 4.2 Method of Provision
    - (1) Items of Provided Information
    - (2) Procedure of Provision
    - (3) Processing after Provision
    - (4) Succession
- Chapter 5 Position Report and Instruction, Recon
  - 5.1 Position Report
    - (1) Timing
    - (2) Contents
    - (3) Location
    - (4) Method
    - (5) Confirmation
  - 5.2 Traffic Control
    - ------------------
    - ------------------
  - 5.3 Instruction and Recommendation
  - 5.4 Amendment of Report
  - 5.5 Another Report
- Chapter 6 Traffic Control
  - 6.1 Application
    - ------------------
    - ------------------
- Chapter 7 Monitoring, Watching
  - 7.1 Radar
    - ------------------
    - ------------------
  - 7.2 AIS
    - ------------------
    - ------------------

- 2 -

- Chapter 8 Operation in Emergency Situation
  - 8.1 Accident
    - ------------------
    - ------------------
  - 8.2 Unusual Weather
    - ------------------
    - ------------------
- Chapter 9 Record and Report
  - ------------------
  - ------------------

(Supplementary Provision)

Supplementary Char / Diagram
※ 1 ------------
※ 2 ------------
※ 3 ------------

- 3 -

Tokyo MATICE
400 pages

Figure 6.6.1 -2 : Contents of Operation Manual (Example)

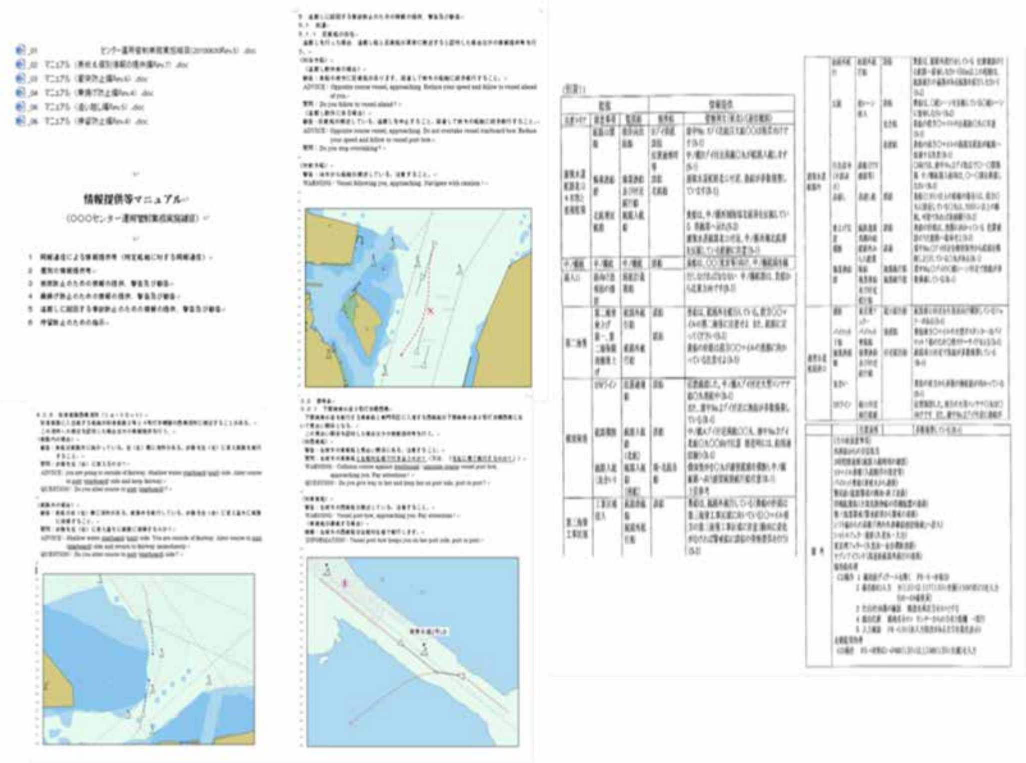


Figure 6.6.1 -3 : Copy of Operation Manual (in Japanese)

✧ User Manual

The user manual is the information book for vessels navigator that contains information for safe navigation in the specific area. Vessels can know the prescribed navigation method and compliance rules, which is in line with the service of VTS.

The Tokyo Bay User Manual shown below is attached as Appendix 6.6.1 -1.

Picture 6.6.1 -1 : Cover of the User Manual

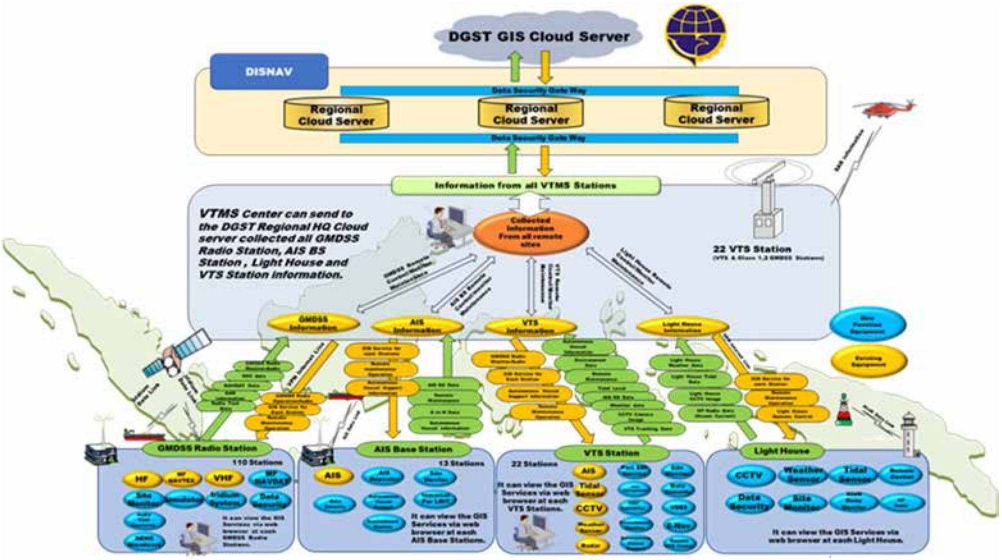
6.6.2 Developmental Role of VTS

Each VTS is now working in its own system. But, if the data which held by each VTS is integrated, the total monitoring for a wide area, the creation of new services, the sharing of information (Data) with other organizations will be possible. And, the current services of each VTS will be enhanced and VTS will be able to form a part of future E-Navigation.

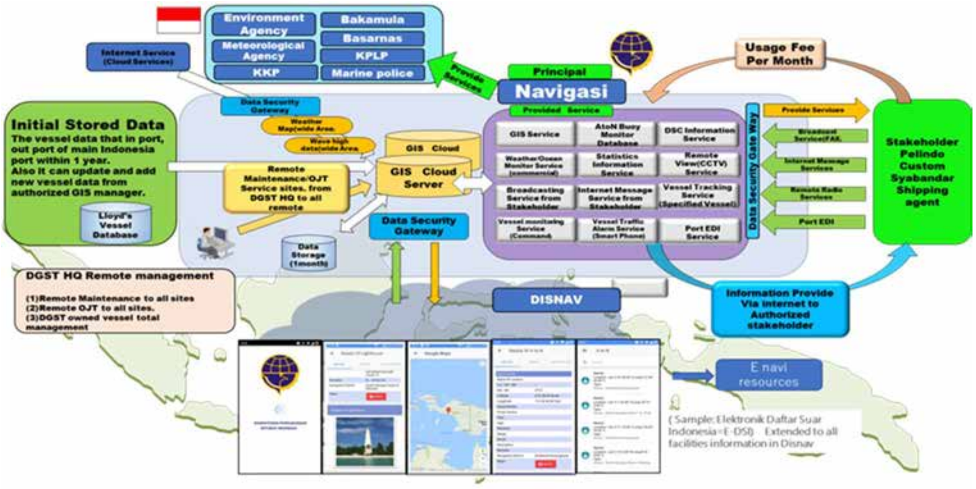
The concept of E-Navigation being considered by IMO/IALA is well known as follows.

> "E-Navigation is the harmonized collection, integration, exchange, presentation, and analysis of marine information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the maritime environment." (IMO MSC85, 2007)

The specific system configuration and conceptual function is shown in the Figure below.



INDONESIA DGST GIS Information Service Concept(1/2)



INDONESIA DGST GIS Information Service Concept(2/2)

Figure 6.6.2 -1 : Integrated Information System

This system is based on the image of the land-side of E-Navigation, and on the integrated functions of VTS, the vessels and the shore support facilities (such as a company-based fleet operation center). The functions playing a central role of VTS are summarized as below.

a) Database of information collected from the sea, the land (Radar, AIS, and Weather Sensor)

b) Database of information collected from meteorological providers and maritime authorities

c) Customized Display Console for operation

d) Building Portal-site of Common Maritime Information

When considering the maritime search and rescue system that utilizes a new network using the cloud system of consolidated VTS and CRS in DGST, the following system shown in the Figure below could be created as an extended network system.

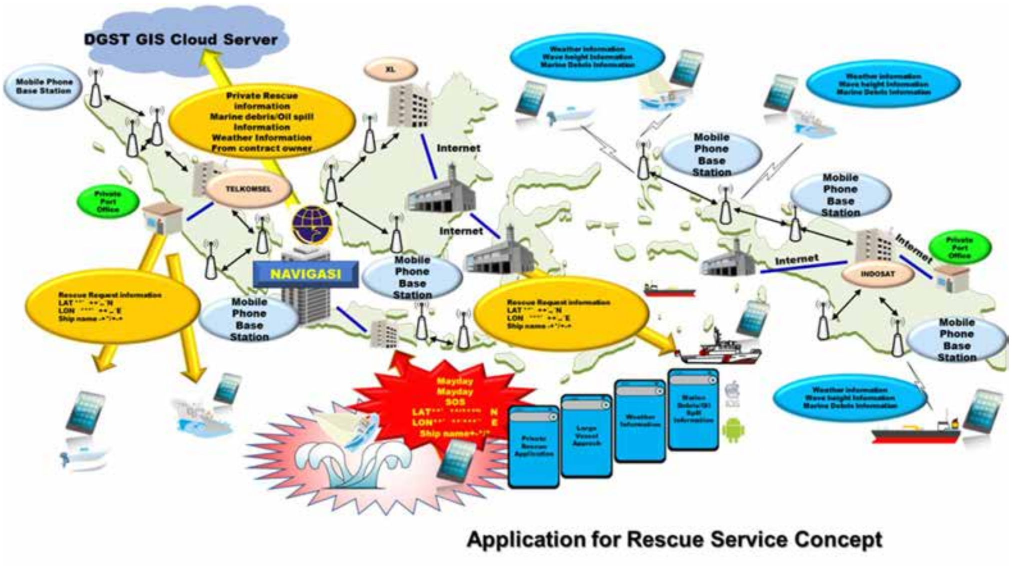


Figure 6.6.2 -2 : Extended Search and Rescue Network System

6.7 Supporting Facilities for Aids to Navigation

A lot of aids to navigation are in remote areas and are installed at the places under severe conditions to access there, as shown in the Picture below.

Picture 6.7 -1 : Aids to Navigation installed under severe conditions

In order to operate these aids properly, it is necessary to carryout the regular maintenance patrols for facilities and equipment. To support this task, a buoy base with a workshop, a warehouse is set up on the shore.

Picture 6.7 -2 : Workshop and Warehouse (Buoy-base)

The buoys on the ocean need to be replaced regularly to prevent sinking due to the adhesion of shellfish and replacing due to deterioration of the iron chains in the sea. These work is conducted by the special vessel as shown in the Picture below.

Picture 6.7 -3 : Replacement of a Floating-buoy by Buoy-Tender

6.7.1 Buoy Base Station

A typical buoy base station in Japan is shown in the Picture below.

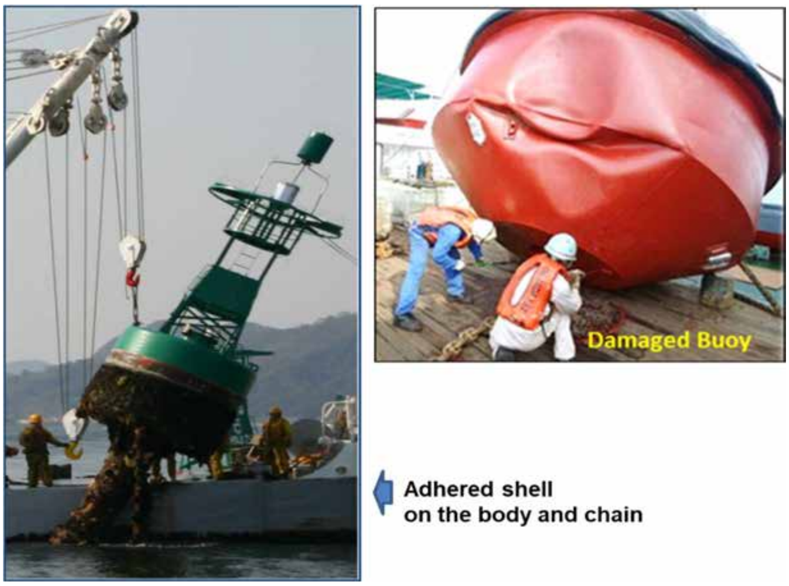
Picture 6.7.1 -1 : Buoy Base Station in Japan

The buoy base station is a facility including an open space for mooring chains and sinkers to maintain and repair floating buoys and related equipment, which consists of facilities shown in the picture above.

The workshop is very important facility to repair, adjust, measure, and improve the equipment brought back from the site of aids to navigation. Machine tools, woodwork machines, hand tools and so on should be provided to the workshop. And, measurement equipment such as intensity meter, oscilloscope and other apparatus should be kept in good condition.

And, the station requires some working open space. The buoy is floating in water for a long time and shellfish adhere to the underwater part of a buoy body, which causes the corrosion of the buoy. Therefore, a buoy has to be pulled up from seawater periodically and transported to the buoy base station for maintenance work on land.

Sometimes, a floating buoy is damaged by collision with a vessel. In such a case, the damaged buoy body, equipment, and superstructure are transported to the station, and they are repaired and replaced one by one after a completion of maintenance work on land.



Picture 6.7.1 -2 : Floating Buoy for Maintenance

Several spare buoy bodies are provided to a buoy base, and replaced one by one after finishing of maintenance work. As the buoy body is relatively large, so the buoy base station should have wide-open area for repairing and other maintenance work and storage area for the buoy body, mooring chains, and sinkers.

Picture 6.7.1 -3 : Spare Body, Sinker, Chain

An example of a functional facilities layout of the buoy base is shown in the Figure below.

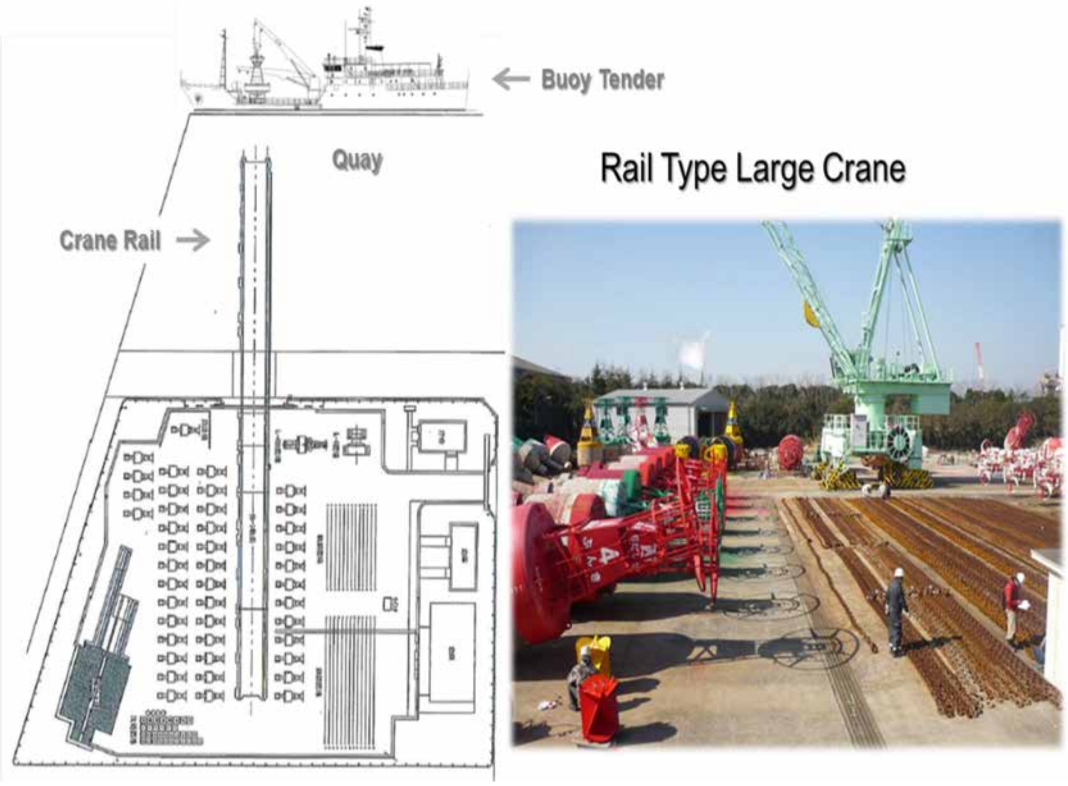


Figure 6.7.1 -1 : Layout of the Buoy Base

And, vessels for aids to navigation, such as a buoy tender, an aid tender and an inspection boat are required in order to carry out the periodical maintenance and inspection works (patrol) for aids to navigation facilities, and to supply the goods to lighthouses, such as fuel oil for lighthouse, daily living necessities for lighthouse keepers.

For these vessels, as well as a warehouse, a jetty and some certain space are necessary as facilities for smooth and prompt loading and unloading works between a vessel and land facilities.

All offices of DISNAV have a workshop, and its space is increase as shown in the "Table 3.1.3 - 1: Area of Workshop and Buoy-Base" in comparison between 2001 and 2019. However, there are spaces with only 80 m^2, and not all offices have sufficient areas.

6.8 Vessel for Aids to Navigation

As described in Section 4.2.1, there are three types of vessels for maintenance of aids to navigation, such as Buoy Tender, Aids Tender and Inspection Boat, and a total of 71 vessels are enrolled.

Nearly half of the vessels have been built for more than 30 years, and they are very old. The composition of vessel age is as shown in the Figure below.

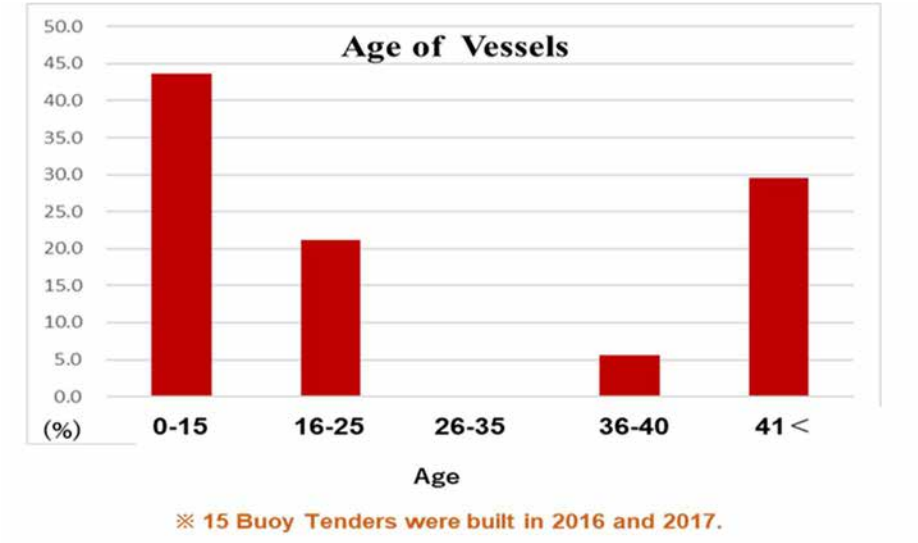


Figure 6.8 -1 : Age of Vessels

About 60 % of all vessels are below the standard technical conditions that indicate the technical requirements of a vessel, even though about 30 % (19 vessels) of vessels were built within the last 5 years.

Vessels over 20 years old are generally considered for scrap and build, but it is necessary to check the condition of relatively new vessels that had problems as confirmed in this survey and of more than half of subject vessels. It is difficult to judge the scrap and build of these vessels without the specialized investigation by a shipbuilding expert.

Recently, the work of supplying lighthouses with fuel and goods and of replacing storage batteries by the vessels have should be reduced due to unmanned lighthouses and LED Lanterns of floating buoys. The number of vessels that are truly needed for the work is calculated from the amount of days required to supply goods and to replace buoys, so that today’s workload must be understood accurately.

Vessels with worse technical conditions and vessels that are relatively young but defective will be selected from among the vessels that have significantly exceeded their life span. Scrap-and-build discrimination is performed from among them, and judgment by shipbuilding experts is indispensable. At the same time, the next establishment plan cannot be made unless the current workload is known in order to the type and number of appropriate vessels.

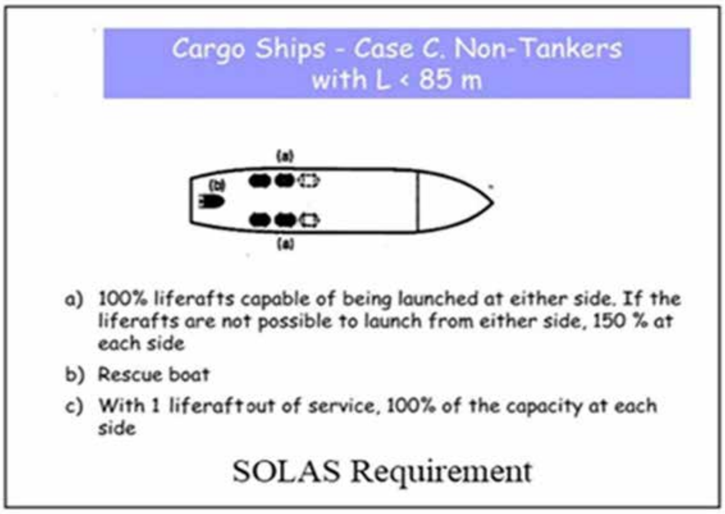
The following many issues are able to be pointed out from this survey as well.

6.8.1 Newly Built Ship

Fifteen Buoy Tenders were newly designed and built in 2016 and 2017, but the following problems have been brought up.

a) Life Boat and Rescue Boat

For life-saving appliances and arrangements required by SOLAS, not life boat but rescue boat with life rafts must be arranged as shown in the Figure below.



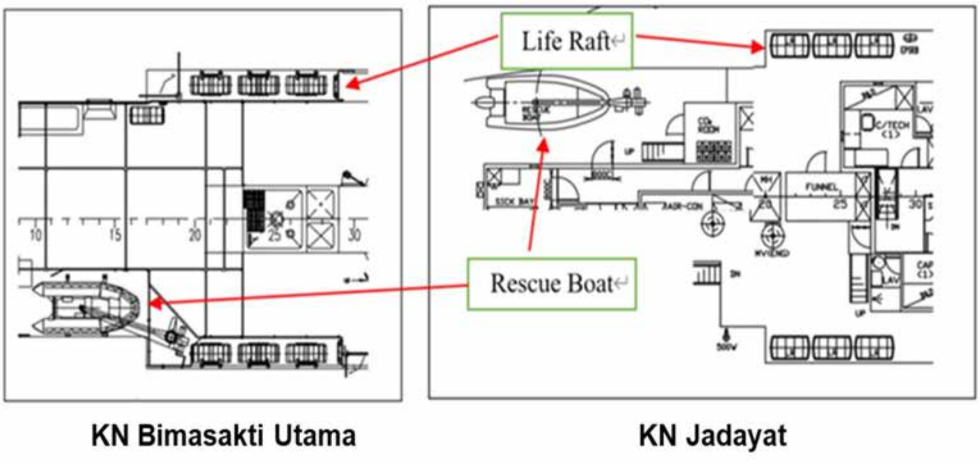
Cargo Ships - Case C. Non-Tankers with L < 85 m

a) 100% liferafts capable of being launched at either side. If the liferafts are not possible to launch from either side, 150 % at each side
b) Rescue boat
c) With 1 liferaftout of service, 100% of the capacity at each side

SOLAS Requirement

Figure 6.8.1 -1 : SOLAS Requirement

For KN Bimasakti Utama designed by DAMAEN and KN Jadayat designed by Niigata, one rescue boat and life rafts are arranged as shown in the Figure below.

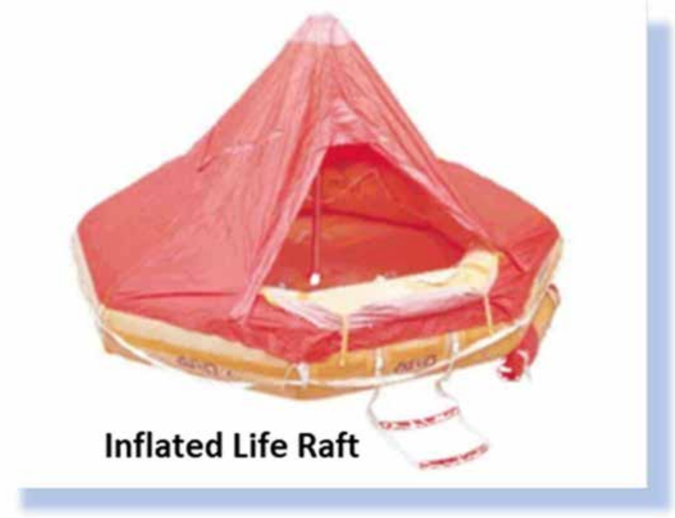


KN Bimasakti Utama **KN Jadayat**

Figure 6.8.1 -2 : Life Raft and Rescue Boat

After evacuation from the vessel and getting in the inflated life rafts under marine accident, rescue boat is required to work gathering each life raft and tie up them by rope.

An inflated life raft is shown in the picture at the next page.



Picture 6.8.1 -1 : Inflated Life Raft

Enclosed life boat is not easy to carry out such duties. In addition to above, life boat is cost effective for building and maintenance of the ship.


Life Boat
Rescue Boat

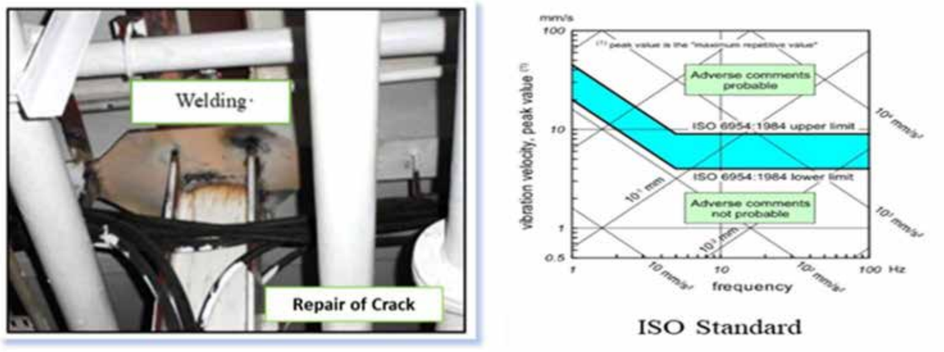
Picture 6.8.1 -2 : Life Boat and Rescue Boat

b) Hull Vibration

According to the interview with officers of KN Edam and KN De Brill, the vessel can't run on more than 50% load of main engine due to hull vibration. Vibration is not partial, but whole of the ship. During onboard survey at KN De Brill, the crack areas caused by hull vibrations were being repaired by welding.

The sister ships from No. 1 to No. 5, each ship has two main engines of 970 kW (1,300 PS), while the ships from No. 6 to No. 15, each one has two main engines of 1,920 kW (2,610 PS). It is questionable whether the hull structure design was reviewed when the power of the main engine was increased from 970kW to 1,920kW (almost double).

Usually, the measurements of hull vibration are made in a sea trial before delivery of a ship, and if unacceptable vibrations are detected in comparison to ISO standards, appropriate measures will be taken.



Picture 6.8.1 -3 : Area of Crack and Allowance Graph

c) High Power Engine

The new buoy tenders designed and built in Indonesia have high power engines. Engine power of KN Maratua is almost double compared with KN Jadayat and KN Bimasakti Utama. Moreover, engine power of KN Edam is quadruple as shown in the Table below.

Table 6.8.1 -1 : Power and Number of Cylinder of Buoy Tenders

Name of Buoy Tender	Designed by	Main Engine	No. of Cylinder
KN Jadayat	NIIGATA	1 set x 735kW x 390rpm	In-line 6
KN Bimasakti Utam	DAMEN	1 set x 1,020kW x 900rpm	In-line 6
KN Maratua	Indonesia	2 sets x 970kW x 1,800rpm	V type 12
KN Edam	Indonesia	2 sets x 1,920kW x 750rpm	In-line 6

The building cost, the running cost and the maintenance cost are higher. For KN Maratua, 24 cylinders (12 × 2) must be pulled out when engines are overhauled

One of the design target/concept of KN Jadayat was low maintenance and low running cost (low fuel consumption). Main engine of KN Jadayat is low speed (revolution) engine without reduction gear while reduction gears are required for other vessels listed above because of middle or high speed engine. This means that KN Jadayat is the vessel of low maintenance/running costs. In general, life time of low speed engine is longer than middle speed engine (KN Edam) and high speed engine (KN Maratua).

d) Buoy Handling Crane

The following problems have been pointed out in the crane system for buoy handling

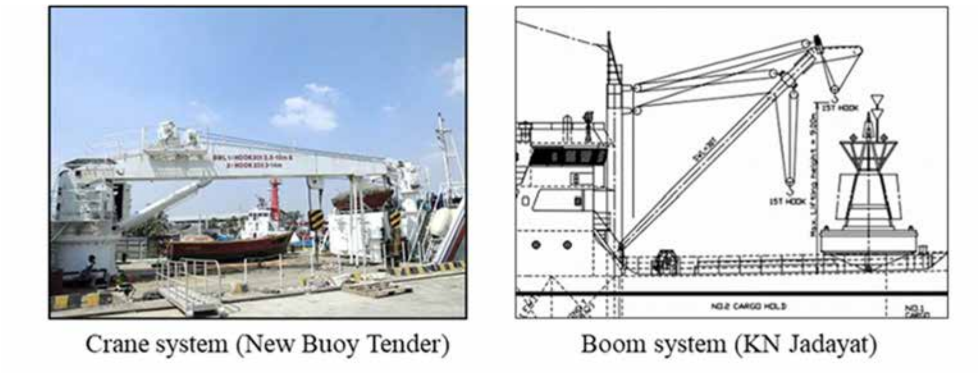
a : Lowering and lifting speed of cargo hook is too slow

b : The crane disturbs the visibility from the wheelhouse to the working deck.

c : It is difficult to use the current crane models, because if the buoy is lifted up higher, it would hit the crane operator room. The buoy chain would have to be inserted into the stopper. The visibility from the wheel house is shown below.

Picture 6.8.1 -4 : View of Fore-Part

The boom system for a buoy tender is preferable to crane system as buoy handling gear. Two types of buoy handling gear are shown in the Figure below.



Crane system (New Buoy Tender) Boom system (KN Jadayat)

Figure 6.8.1 -3 : Buoy Handling Gear

e) Shaft Bearing

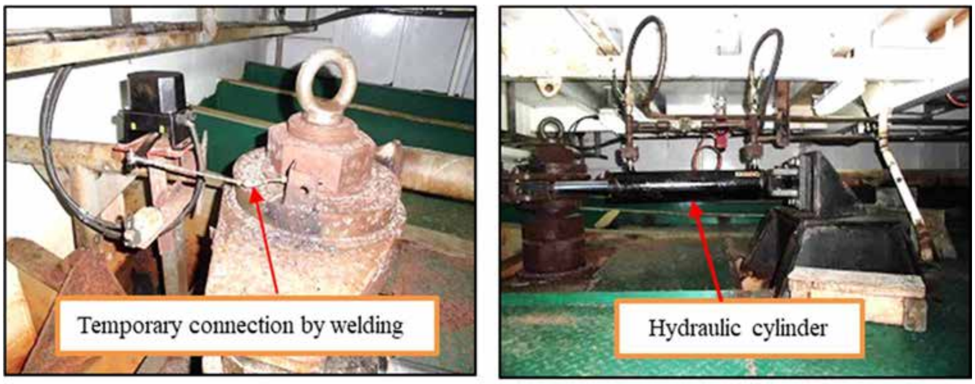
The bearings on both sides of propeller shafts of KN Bacan had broken just after the invalidate warranty, and it is suspected that the shaft is not well aligned and this may be one of the causes of hull vibration.

Picture 6.8.1 -5 : Shaft Bearing

f) Auto Pilot

The rod for an auto pilot limiter had broken. It was too slim and easy to be broken. The rust of the steering gear and the floor of its room are terrible for the age of two years.

The hydraulic cylinder for the steering gear seems to be small considering engine power, and it is questionable that steering torque is sufficient or not.

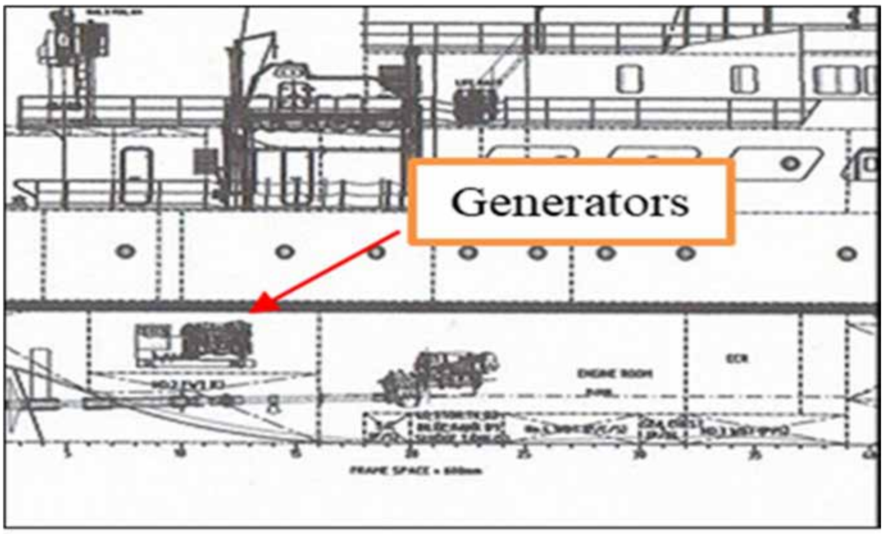


Rudder Shaft **Hydraulic Cylinder**

Picture 6.8.1 -6 : Rudder Shaft and Cylinder

g) Position Generator Engines

The sea water cooling does not flow properly; because the generator engine is positioned too high that drives the cooling pump.



Generator Engine

Figure 6.8.1 -4 : Generator

h) High Sea Chest

Only the bottom sea chests are installed and the high sea chests are not done. Ships often pass through shallow waters and the bottom sea chests easily suck seabed mud with seawater cooling.

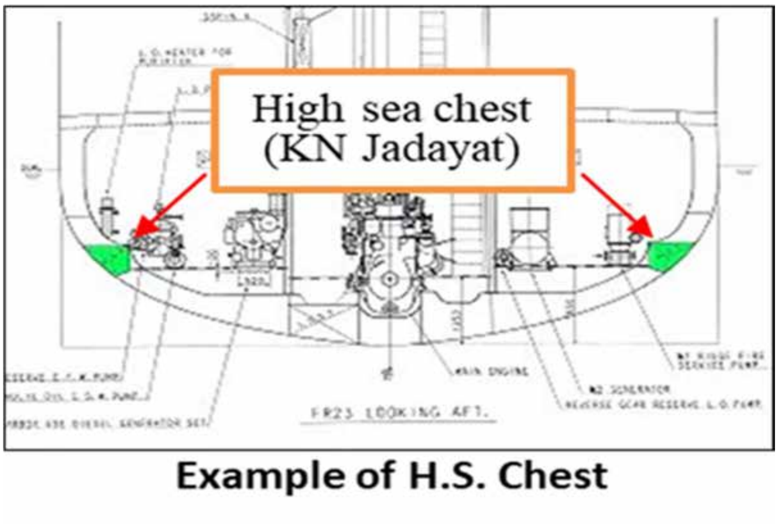


Figure 6.8.1 -5 : Sea Chest

i) Others

The bow thruster, ECDIS, INMARSAT and the speed log are out of work and under repair list.

6.8.2 Biodiesel (BDF)

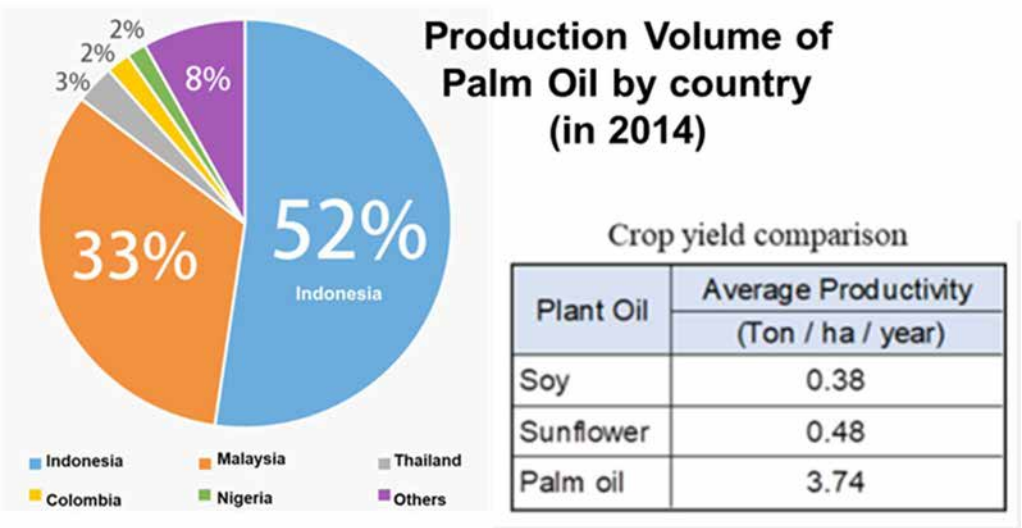
Indonesian Government has issued a ministerial ordinance on the Palm Oil Plantation Fund to mandate the use of BDF B20 as fuel for diesel engines and to promote the supply and use of biodiesel fuel.

a) Background

As shown in the Figure at the next page, Indonesia is the world 's best producer of palm oil, and the biofuel part of BDF is made from fatty acid methyl ester (Fatty Acid Methyl Esters: FAME) from palm oil. In Indonesia twenty-six companies including major companies such as Sinar Mas Group, Wilmar and Musim Mas, are producing FAME.

Also, the yield per unit area is 380 kg for soybean oil and 480 kg for sunflower oil, whereas palm oil has high productivity of 3,740 kg.

In addition, recently Indonesia has imported 400,000 barrels of crude oil and almost the same amount of refined petroleum each day, which was about $ 11.8 billion in trade surplus in 2017 but they got into the red of about $ 8 billion in 2018.



Production Volume of Palm Oil by country (in 2014)

Crop yield comparison

Plant Oil	Average Productivity
	(Ton / ha / year)
Soy	0.38
Sunflower	0.48
Palm oil	3.74

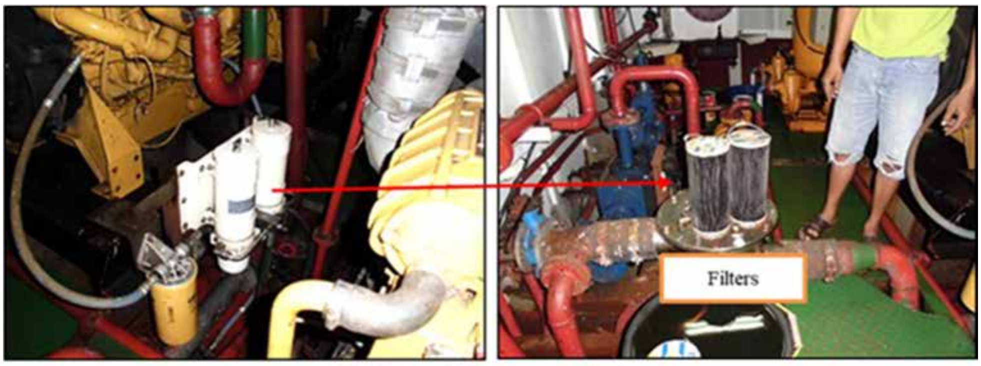
Figure 6.8.2 -1 : Production of Palm Oil

b) Actual Circumstance at Buoy Tender

In general, BDF is mixed with light oil at a certain ratio and B20 is composed of 20% (volume) biodiesel and 80% light oil. B 100 is 100% biodiesel. In Indonesia, using B20 is compulsory now.

The filter for generator engine must be exchanged every week, and the filter for main engine have to be exchanged every 200 hours operation.

While under using conventional diesel oil, generator engine maker is recommending the replacement of FO and LO filters every 600 hours (or every 2 months).



FO Filters of Generator Engine

Picture 6.8.2 -1 : FO Filter

6.8.3 Life Extension Repair

As the life extension repair, main engines of KN Mahkota, KN Mina and KN Mithuna were replaced, and they are belonging to DISNAV Tual, Kupang and Samarinda respectively.

a) KN Mahkota and KN Mina (Aids Tender : KBP)

In 1996 and 1997, 7 Aids Tenders, as a series or vessels, were built at PT DOK DAN PERKAPALAN SURABAYA under technical assistant by Niigata Shipyard. This assistant is so called “Package Deal” supplying basic and detail design, equipment and machinery.

KN Mahkota and KN Mina are 2 of these series vessels.

In 2018, main engine of KN Mahkota was replaced from Inline type of 6 cylinders (Niigata) to V type of 12 cylinders at PT DOK & PERKAPALAN KODJA BAHARI.

This means that maintenance work and cost are higher than heretofore because 12 cylinders (Baudouin) must be pulled out instead of 6 ones when overhauling and 12 maintenance parts such as O-ring are required instead of 6 parts.

Replaced Engine **Original Engine**

Picture 6.8.3 -1 : Main Engine

The main engine of KN Mina was replaced from Inline type of 6 cylinders (Niigata) to Inline type of 8 cylinders (Dresser-Rand’s Guascor, Spanish) in 2017.

The engine maker has no agent in Asia and repair parts have to be ordered to Spain, but in the pamphlet, the regional headquarter “Dresser-Rand Asia Pacific Sdn Bhd” is supposed to be in Kuala Lumpur, Malaysia.

b) KN Mithuna (Buoy Tender : KIP)

6 Buoy Tenders were built about 40 years ago at Niigata Shipyard, and KN Mithuna is one of them.

In 2014, the main engine was replaced from low speed engine to high speed engine and engine power increased from 850 PS to 1,500 PS.

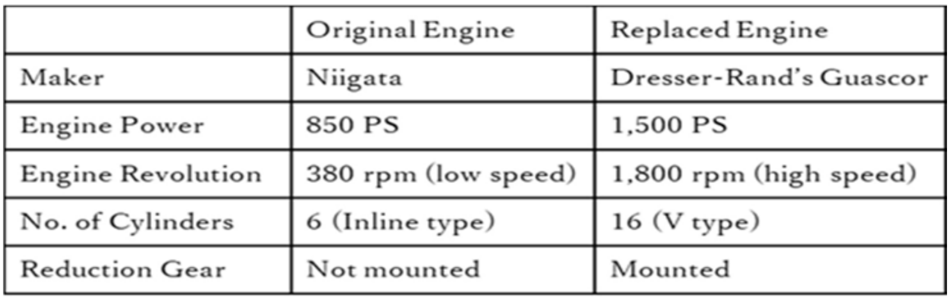
Replaced engine(KN Mina)

Picture 6.8.3 -1 : Main Engine

In general, fuel oil consumption (FOC) changes depending on an engine type shown in the Table below.

For a low speed engine, reduction gears are not required and it is unnecessary to make the maintenance work on it. In general, the life time of a low speed engine is longer than a middle speed and a high-speed engine because the movement of rotating and moving parts is slow.

Table 6.8.3 -1 : Comparison between Original Engine and Replaced Engine

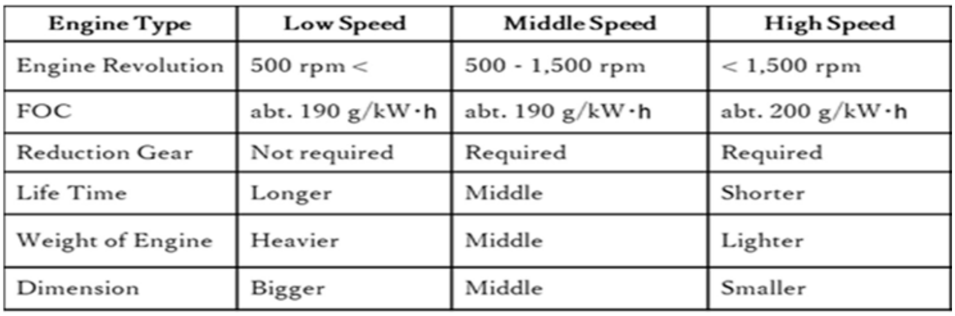


	Original Engine	Replaced Engine
Maker	Niigata	Dresser-Rand's Guascor
Engine Power	850 PS	1,500 PS
Engine Revolution	380 rpm (low speed)	1,800 rpm (high speed)
No. of Cylinders	6 (Inline type)	16 (V type)
Reduction Gear	Not mounted	Mounted

Considering above, there are issues on the impact of hull structure as increasing engine power and FOC from the point of running and maintenance cost.

The Table below shows the parameters of an engine type by the speed of engine rotation.

Table 6.8.3 -2 : Engine Type by Speed



Engine Type	Low Speed	Middle Speed	High Speed
Engine Revolution	500 rpm <	500 - 1,500 rpm	< 1,500 rpm
FOC	abt. 190 g/kW·h	abt. 190 g/kW·h	abt. 200 g/kW·h
Reduction Gear	Not required	Required	Required
Life Time	Longer	Middle	Shorter
Weight of Engine	Heavier	Middle	Lighter
Dimension	Bigger	Middle	Smaller

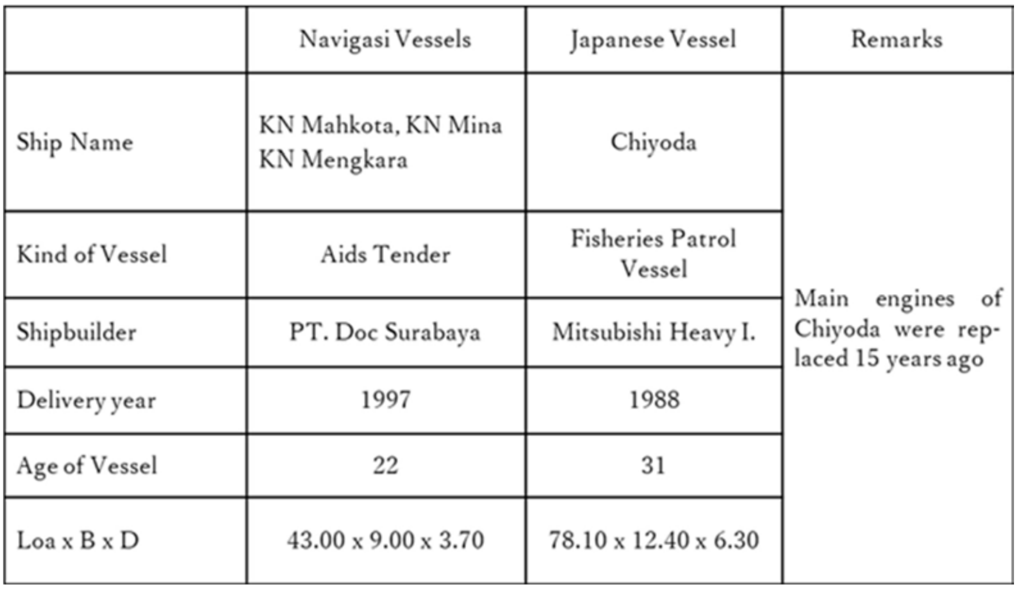
6.8.4 Maintenance of the Vessels

In 2001, the IACS (International Association of Classification Societies) published requirements for Planned Maintenance systems on board. Further, ISM Code (International Safety Management Code) was adopted at IMO as resolution A.741(18), and in the Code, Part A, section 10, the requirement titled "MAINTENANCE OF THE SHIP AND EQUIPMENT" is being mentioned. This code has been incorporated in SOLAS (Safety of Life at Sea) at Chapter IX.

SOLAS is not applied to the vessels operated by Navigasi which are non-international voyage, but the maintenance is imperative element of vessel's routine operation and the similar type of maintenance standards has to be established. In Japan, the similar type of certification system as ISM Code has been implemented by the requirement from the owners of coastal vessels.

As an example, the comparison between the vessels of Navigasi and Japanese vessels is shown in the Table and Picture below.

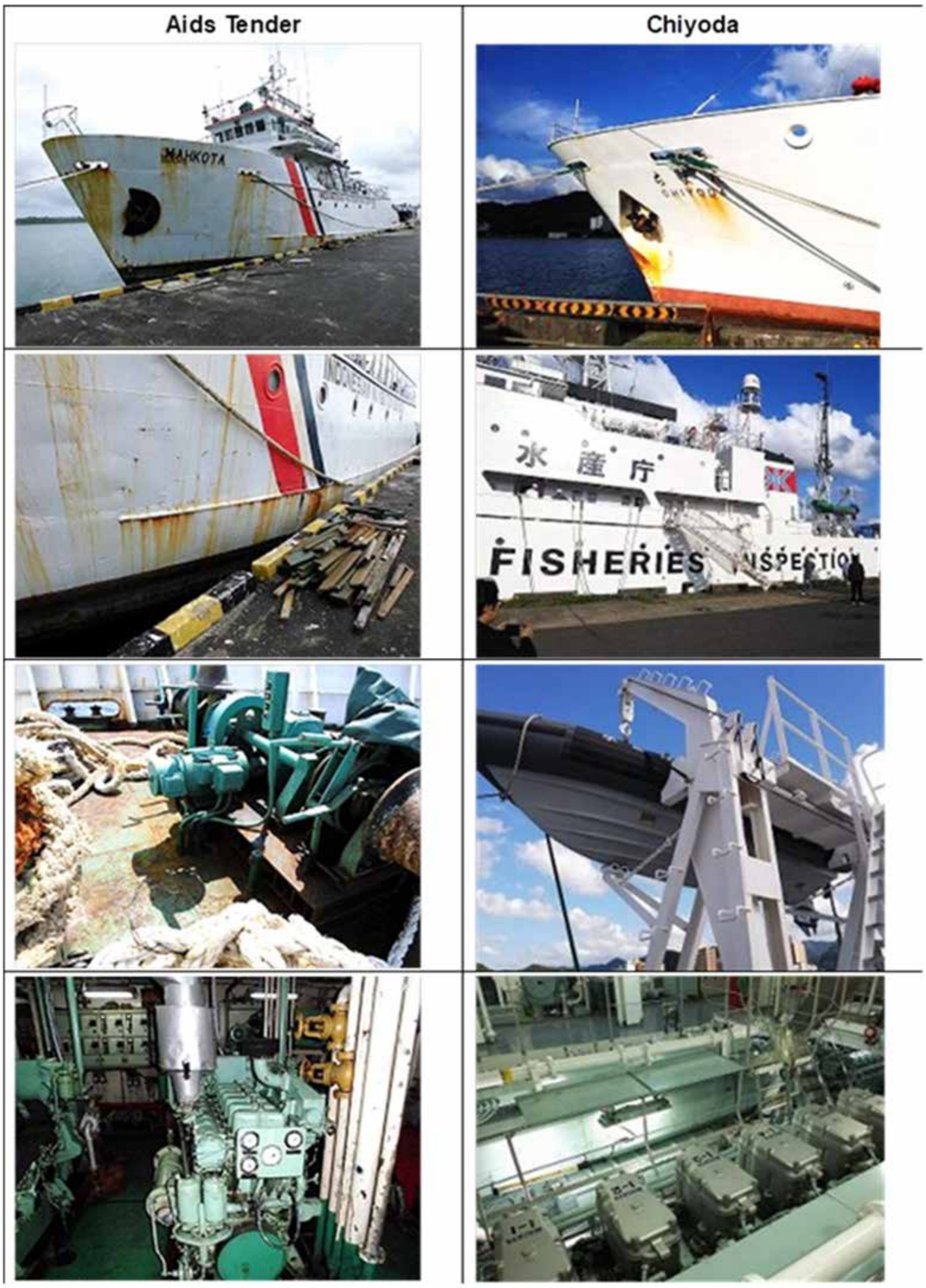
Table 6.8.4 -1 : Comparison between Navigasi Vessels and Japanese Vessel



	Navigasi Vessels	Japanese Vessel	Remarks
Ship Name	KN Mahkota, KN Mina KN Mengkara	Chiyoda	Main engines of Chiyoda were replaced 15 years ago
Kind of Vessel	Aids Tender	Fisheries Patrol Vessel	
Shipbuilder	PT. Doc Surabaya	Mitsubishi Heavy I.	
Delivery year	1997	1988	
Age of Vessel	22	31	
Loa x B x D	43.00 x 9.00 x 3.70	78.10 x 12.40 x 6.30	

The external appearance of the hull, the engine and other external parts are shown in the Picture at the next page.

An age of Japanese vessel is over 30 years old and 10 years older than the Aids Tenders.



Picture 6.8.4 -1 : Comparison by Pictures between Aids Tender and Chiyoda

The paint on exposed decks and ladders (steps) is prone to be worn, so the maintenance of coating is important to protect the inside structure from surface rust and dirt. But, as shown in the pictures below, the maintenance work is not well done.

It is necessary to consider whether the hulls under these conditions can be maintained by the crew as an onboard maintenance (OBM).

Picture 6.8.4 -2 : Surface of Floor and Step of Aids Tender

6.8.5 Issues to be addressed

The following basic design for Buoy Tender can be proposed.

a) The vessel shall be designed as coasting service vessel (not international voyage but domestic voyage).

b) The working deck area shall be kept to load 6 buoys with 2.2 m diameter for the buoy replace trip.

c) Principal dimensions shall be decided considering such as necessary working deck area, accommodation arrangement, engine room arrangement, stability, etc.

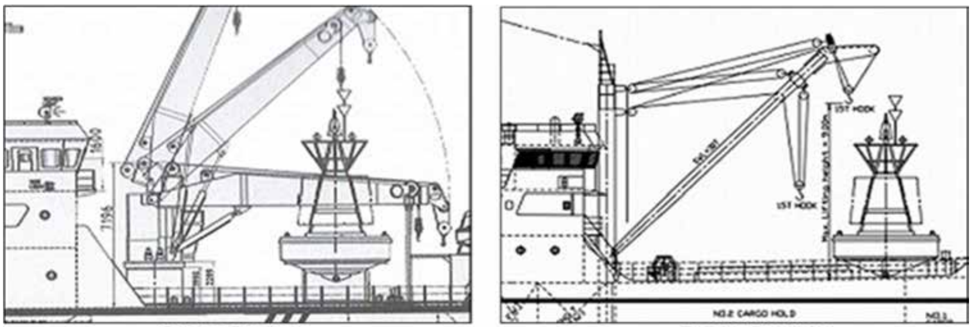
d) Superstructure including main hull above water line shall be small as much as possible to reduce the hull rolling motion when subjected to lateral wind

e) Fore end position of bilge keel shall be decided to avoid the damage from chain at buoy replacement/maintenance work.

f) Buoy handling crane or boom shall have 2 sets of cargo hooks for alternative use of chain lifting work.

g) Considering that most sinkers weight is 5 tons and the maximum sinker weight is 12 tons, SWL (safe working load) of each hook shall be of 15 tons and SWL of crane/boom shall be of 30 tons for simultaneous use of 2 hooks. The simultaneous use is effective when lifting sinker from muddy sea bed.

h) The selection of crane type or boom type shall be decided after detail study at specific project for detail design of buoy tender.



Crane System

Boom System

Figure 6.8.5 -1 : Type of Crane

i) The following machinery shall be arranged in the workshop for buoy maintenance onboard and small hatch shall be arranged between engine room and workshop for common use between engine part and deck part.

Electric bench grinder and vise (a holding device) on work bench

Electric drilling machine and air compressor

Lathe and rotary band sawing machine

Electric welder, gas welder and high-pressure washing machine

j) Considering the requirement of high maneuverability at low speed and buoy handling work, high performance rudder (called fish tail rudder or schilling rudder) shall be fitted. This rudder can be steered up to 70 degrees on one side while steering angle of conventional rudder is 35 degrees. Almost parallel movement can be made by combination with bow-thruster when berthing / leaving.

k) The endurance (sailing range) of the vessel shall be of more than 2,000 nautical miles.

l) One set of low revolution main engine shall be adopted.

m) To avoid pipe corrosion due to seawater in engine room, adoption of central cooling system shall be studied.

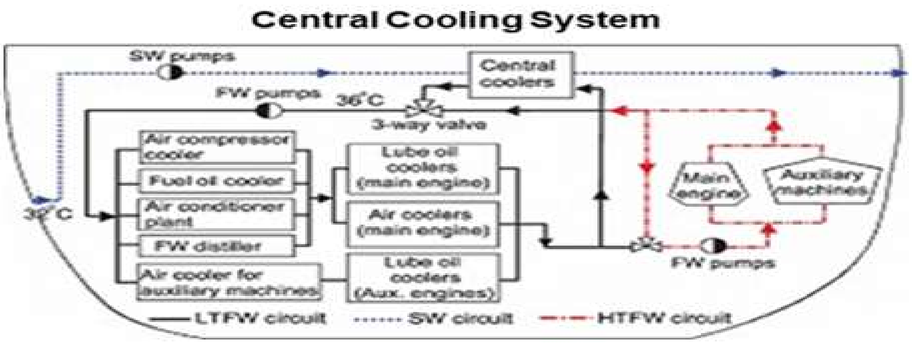


Figure 6.8.5 -2 : Central Cooling System

n) One (1) cabin of 8 persons for lighthouse keepers shall be arranged.

o) Pray room shall be arranged.

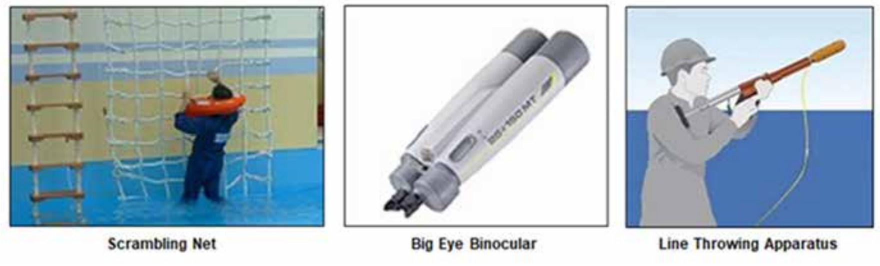
p) Considering the operation area GMDSS sea area shall be of "A1 + A2"

q) For S-band radar, solid state type shall be selected for low maintenance compared with conventional magnetron type.

r) As the multi-function vessel, the following equipment for SAR (Search and Rescue) operation shall be fitted.

Scrambling net, Line throwing apparatus, Parachute flare, Grapnel

Big eye binocular, Night scope binocular (monocular)


Scrambling Net
Big Eye Binocular
Line Throwing Apparatus

Picture 6.8.5 -1 : Applicable Equipment

VHF air band transceiver for communication between ship and air craft

VHF hand-held radio transceiver (floating type) and UHF hand-held radio transceiver

6.9 GMDSS

GMDSS is established in 112 stations of the 151 Coastal Radio Stations throughout Indonesia. Recently, there has been almost no signal reception record, and some devices are not operating.

Indonesia has a large sea area and so many coastal radio stations are deployed throughout the country. But, considering the today's telecommunications network in Indonesia, it is a little bit inefficient to have the manned office of 155 stations decentralized. (The number of the classified stations is shown in the Table 3.1.5 -1 and the position map of them is in the Figure 3.1.5 -1.)

A lot of 3rd Class and 4th Class stations operated by small number of staff are located at remote areas, and such radio stations should be consolidated into the 1st Class and the 2nd Class stations attached to the regional headquarters in urban areas because of reduction of the burden on the staff and efficient operation.

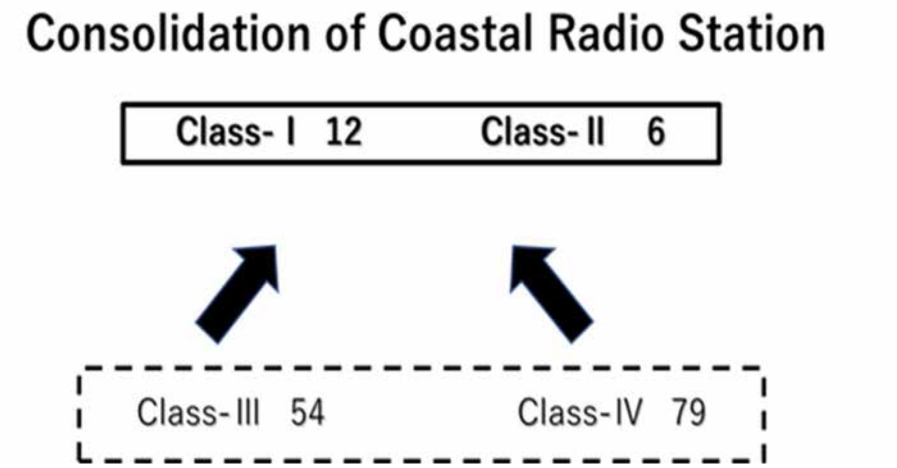


Figure 6.9 -1 : Consolidation of CRS

However, since most of the devices have aged and do not support remote control, it may be necessary to replace all the equipment at the time of consolidation.

In addition, since it is difficult to obtain the spare parts for MF (Medium Frequency) NAVTEX as well as aging, there is a movement in some countries to terminate the broadcasting of NAVTEX with MF and shift to satellite broadcasting.

On the other hand, the modernization of GMDSS is under discussion in IMO and the final report is being adopted soon. According to the draft, the functional requirements are almost the same as the current ones. The enhancement of satellite use and the adoption of E-Navigation (VDES : VHF Data Exchange System) have been studied.

The conceptual configuration of the new GMDSS is shown in the Figure at the next page.

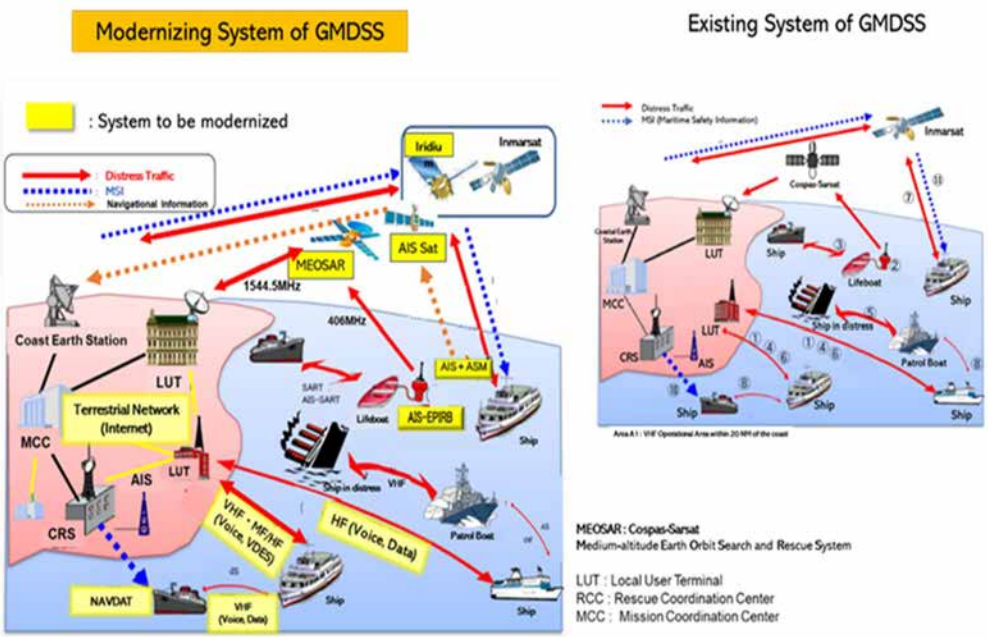


Figure 6.9 -2 : Conceptual Diagram of New GMDSS

In planning the consolidation of radio coastal stations operating GMDSS, it is necessary to consider a comprehensive system that takes into consideration the technical issues, the placement of organizations and manning of operators, and the integration with AIS, VTS, etc.

6.10 Capacity Building and Training

The necessary training courses to execute the aids to navigation service are well prepared, and the organization and training programs are institutionalized.

6.10.1 Education and Training Programs on Maritime Traffic Safety Service

The Sea Transportation Education and Training Center (BPPTL), Jakarta has prepared the following 14 programs of the functional technical training for Sea Transportation staff in 2014.

Training Courses

1 BASIC LEVEL TECHNICAL TRAINING OF AID TO NAVIGATION
2 AIDS TO NAVIGATION TECHNICAL TRAINING SKILLED LEVEL
3 TECHNICAL TRAINING OF MARINE INSPECTOR RADIO
4 VESSEL TRAFFIC SYSTEM TECHNICAL TRAINING (BASIC)
5 VESSEL TRAFFIC SYSTEM OPERATOR TECHNICAL TRAINING
6 VESSEL TRAFFIC SYSTEM SUPERVISOR TECHNICAL TRAINING
7 VESSEL TRAFFIC SYSTEM ON THE JOB TRAINING (OJT)
8 VESSEL TRAFFIC SYSTEM (OJT INSTRUCTURE)
9 SHIP TELECOMMUNICATION TECHNICAL TRAINING LEVEL III
10 ELECTRONICA CERTIFICATE TRAINING LEVEL II
11 GENERAL OPERATOR GMDSS TRAINING
12 TECHNICAL SURVEYOR HYDROGRAPHY TRAINING
13 CARTOGRAPHY TECHNICAL TRAINING
14 MARITIME ENGLISH TRAINING

A syllabus/curriculum and its lesson hour, and the requirements of attendees for each program are provided methodically.

The requirements for the VTS Basic course are as follows.

REQUIREMENTS

1. *Minimum education equivalent to high school*
2. *Civil Service Employee minimal group II / a with 2 years of work period*
3. *Already have an ORU certificate and, or ANT-IV (nautical competence)*
4. *Have completed the Maritime English Education and Training at BPPTL*
5. *Active and proficient in English at least TOEFL 320*
6. *Preferably working as a VTS operator / prospective operator*
7. *Healthy body certified by doctor's recommendation letter*
8. *Maximum age of 50 years*

The syllabus / curriculum for VTS Basic Training Course are shown in the Table below.

Table 6.10.1 -1 : Syllabus of VTS Basic Training Course

SYLLABUS CURRICULUM OF VESSEL TRAFFIC SYSTEM (BASIC) TRAINING
(SEA TRANSPORTATION FUNCTIONAL TECHNICAL TRAINING)

Program : VESSEL TRAFFIC SYSTEM TECHNICAL TRAINING (BASIC)
Program Objective : Participants have the ability and skill of Vessel Traffic Service equipment
Curricular Objective : Participants are expected to know and understand Vessel Traffic Service equipment
Study Period : 28 days
Study Load : 155 lesson hours
Legal Basis : 1. Law No.17 of 2008, concerning Shipping
2. Government Regulation No. 5 of 2010 concerning Navigation
3. Minister of Transportation Regulation No. PM 26 of 2011 concerning Shipping Telecommunications
4. International of Association of Lighthouse Authorities (IALA)

(155 lesson hours / 28 days)

GROUP	SUBJECT		LESSON HOUR		
	SUBJECT MATTER	SUB SUBJECT MATTER	T	P	TOTAL
Personality Development Course *(Personality)*	1. Discretion Discourse Sub Sector of Sea Transportation	a. Discretion of DGST	5	-	5
		b. Discretion of Human Resources Development Agency and Center of Sea Transportation	10	-	10
		c. Discretion of Head of Sea Transportation Education and Training Center (BPPTL)	5	-	5
	2. Character Building	a. Personality of Civil Service Employee b. Cooperation c. Employee Discipline d. Employee Development	10	-	10
	3. Basic Military Regulation	a. Line-up regulation b. Military Ceremonies c. Military Respect Regulations d. Attitude and Discipline	-	10	10
	4. English	a. Grammar b. Making VTS news c. Standard sentence for ship communication d. Information Collection	10	-	10
SUB TOTAL I			**40**	**10**	**50**
Science and Skill Course *(Know how and why)*	1. Traffic Management	a. Requirements according to regulations b. Duties and responsibilities c. VTS environment d. The principle of flow and management of traffic e. Traffic arrangements and organization	10	-	10
	2. Equipment	a. Telecommunication b. Vessel Taffic Management (Management of ship traffic) c. Radar, Audio, Video and other sensors d. VHF / Direction Finding (VHF / DF) e. Tracking System (automatic searching system) f. Technology Development	10		10
	3. Nautical Knowledge	a. Chart Work	5	5	10
		b. COLREG	5	5	10
		c. Aid to Navigation	5	5	10
		d. Shipboard knowledge	5	5	10
		e. Port Operation and Other Allied Services	5	5	10
	4. Communication Coordination	a. General communication skill b. Communication procedure c. Log and Record Keeping	10	-	10
	5. VHF Radio Operator Communication Practice and Procedure	a. Radio operator activities and procedures b. VHF radio system and its use in VTS c. Operation of radio equipment d. Communication procedures include SAR		10	10
	6. Personal Skill	a. Diplomacy b. Interaction c. Emergency management d. Management attributes e. Reliability	5		5
	7. Emergency Situation	a. International, National, Regional, and Local regulations; b. Internal and external emergencies c. Responses to contingencies d. Enforcement of priorities and responses to the circumstances e. Coordination, and support for shared services (with other institutions) f. Recording activities in an emergency situation g. Maintain the security of the flow in an emergency situation	10		10
SUB TOTAL II			**70**	**35**	**105**
Social Living Course	1. Field Work Practice	a. Field survey b. Data / information collection c. Question and Answer / Discussion	Paket	-	Paket
(Able to live together)	2. Evaluation	a. Manuscript making b. Participant exams c. Supervision of examinations d. Test correction e. Assessment	Paket	-	Paket
SUB TOTAL III			**-**	**-**	**-**
TOTAL AMOUNT			**110**	**45**	**155**

Remarks :
Practice can be interpreted as a demonstration in the laboratory / simulator, counting exercises, or field explanations during field study to the port / to the ship
T : Theory
P: Practical

6.10.2 Development of the System

Each course of Sea Transportation Training is based on the minimum basic knowledge of marine and maritime, and if trainees have no these knowledges, they will not be able to understand and follow this course, even basic course.

Each course required to be attended is equivalent to the academic ability of a high school, but the specialized field such as marine and maritime is little treated at the high school level.

As a result, although trainees attended the course, it is unlikely that they had completed the course with enough understanding, and it is quite possible that the certification had been issued as a matter of form.

In order to improve the implementation of the training, all staff engaged in Sea Transportation, whether or not they are trained, must have a minimum basic knowledge of maritime affaires.

It is recommended to establish a system which all employees can acquire the basic knowledge when recruiting staff, or set up a new training course with an opportunity to gain access to basic knowledge before taking an existing training course.

In addition, although there are OJT training course in the existing programs, OJT on the desk cannot be expected to be very effective, and OJT suitable for the actual situation should be carried out at each site.

6.10.3 Reference

The requirements for VTS operators, as clearly stated in IALA V-103, are to master the eight modules (Language, Traffic Management, Equipment, Nautical Knowledge, Communication Coordination, VHF Radio, Personal Attributes and Emergency Situations). And then, the candidates are required to be a VTS experience or a port services experience, to have maritime qualifications or English knowledge certified by an authority.

Considering this matter, there is no other choice but to establish an institution dedicated to education and training for VTS operators to meet the requirements as an organization with hundreds of the operators. The Japan Coast Guard also has a two-year specialized VTS Operator course at the JCG Training School as well as seafarer training course.

For reference, the curriculums for Information Course and VTS Operator Course are shown in the Table 7.2.6 -2.

A copy of the cover page of the brochure of the “Sea Transportation Training and Education Center (BPPTL : Balai Pendidikan dan Pelatihan Transportasi Laut)”, which is one of the eight technical implementation units (UPT : Unit Pelaksana Teknis) of marine training owned by the Ministry of Transportation, is shown on the next page.

The syllabus / curriculum of other training courses on aids to navigation conducted at this Center and the training schedule planned in 2019 are respectively attached as Appendix 6.10.3 -1 and Appendix 6.10.3 -2.

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Picture 6.10.3 -1 : Cover Page of the Brochure

Chapter 7

Development Plan for Maritime Traffic Safety System

7 Development Plan for Maritime Traffic Safety System

7.1 General

In the process of verifying the previous MP and of conducting the field survey of the current situation, the issues described in the Chapter 6 became clear. In considering maritime traffic safety measures, the items to be considered with the views to the future in the fields of Aids to Navigation, AIS, Coastal Radio Station, VTS, Vessels for Aids to Navigation, Integrated Information System and Capacity Building, are summarized as Long-Term Plan and the items to be dealt with soon are noted as Priority Project.

The schedule up to 2040 is shown in the Figure 7.1 -1 (Appendix 7.1 -1) and Figure 7.1 -2 (Appendix 7.1 -2). A bar graph in the figures shows the expected year of implementation as a project that can be carried out as soon as the financial and policy priorities permit. Each plan is not a stand-alone project like the conventional projects, but it closely related to the development of social infrastructure and other projects, and will be promoted in taking into account the progress of each project.

Priority projects are to be implemented by 2025, with an annual roadmap and a breakdown of estimated costs.

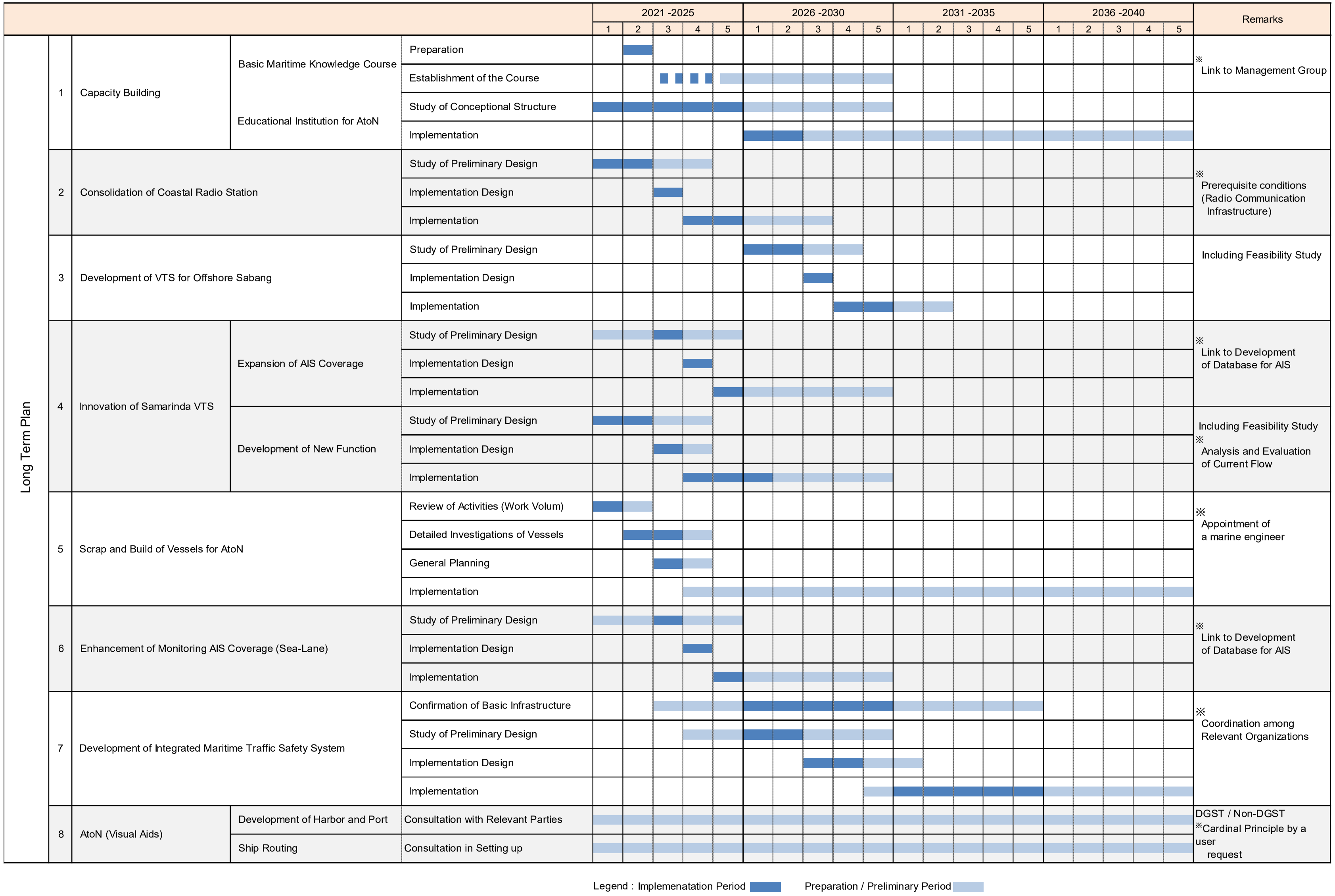
In addition, Ships' Routing shown in the guidelines of IMO, as described in Section 6.3, contributes to safety of life at sea, safety and efficient of navigation and protection of the marine environment on an international level, which includes Traffic separation schemes (TSS), Two-way routes, Deep water routes as well as other ships' routing measures. These impose obligations on all vessels, certain categories of vessels or vessels carrying certain cargoes for the purpose of preventing maritime accidents in most of the heavily congested shipping areas. Therefore, in making the establishment plan, the long-term survey on trends in the traffic flow, traffic volume, vessel types and the nationality (registration) of a vessel will be conducted, and the analysis will be done with data collected in the survey, using evaluation tool called IWRAP which is recommended by IALA. And then, a direction for safety measures will be determined, which has a lot to do with national policy and social situation. Coordination with related organizations will also be required.

The establishment plan, even when for general port/harbor, will not be made uniformly on the desk as in the past, because navigational method for vessels has changed significantly from the time when the MP was prepared last time. All of the system will be developed based on the places where voyagers really demands. In this way, safety measures will be more effective and budgets will be used more efficiently. In order to do so, it is important to hear opinions and requests related to vessel traffic from those who use the port/harbor and from organizations that are familiar with the region, and it is necessary to set up this establishing process.

For vessels navigating offshore, the establishment of aids to navigation is now entering a new era in which lighthouses are installed only where the navigators really want, because a lot of vessels are now using GPS and electronic navigation devices to navigate, which have changed the role of coastal lighthouses. Again, the establishing process for maritime safety measures to regularly (periodically) hear opinions from stakeholders is prioritized over making the plan on the desk.

The flowchart of the establishing-process for Undeveloped Port/arbor, Existing Port/Harbor, New Port/Harbor and Ships' Routing Measures is shown in the Figure 7.1 -3, Figure 7.1 -4, Figure 7.1 -5 and Figure 7.1 -6 respectively.

Development Plan for Maritime Traffic Safety System (Long-Term Plan)

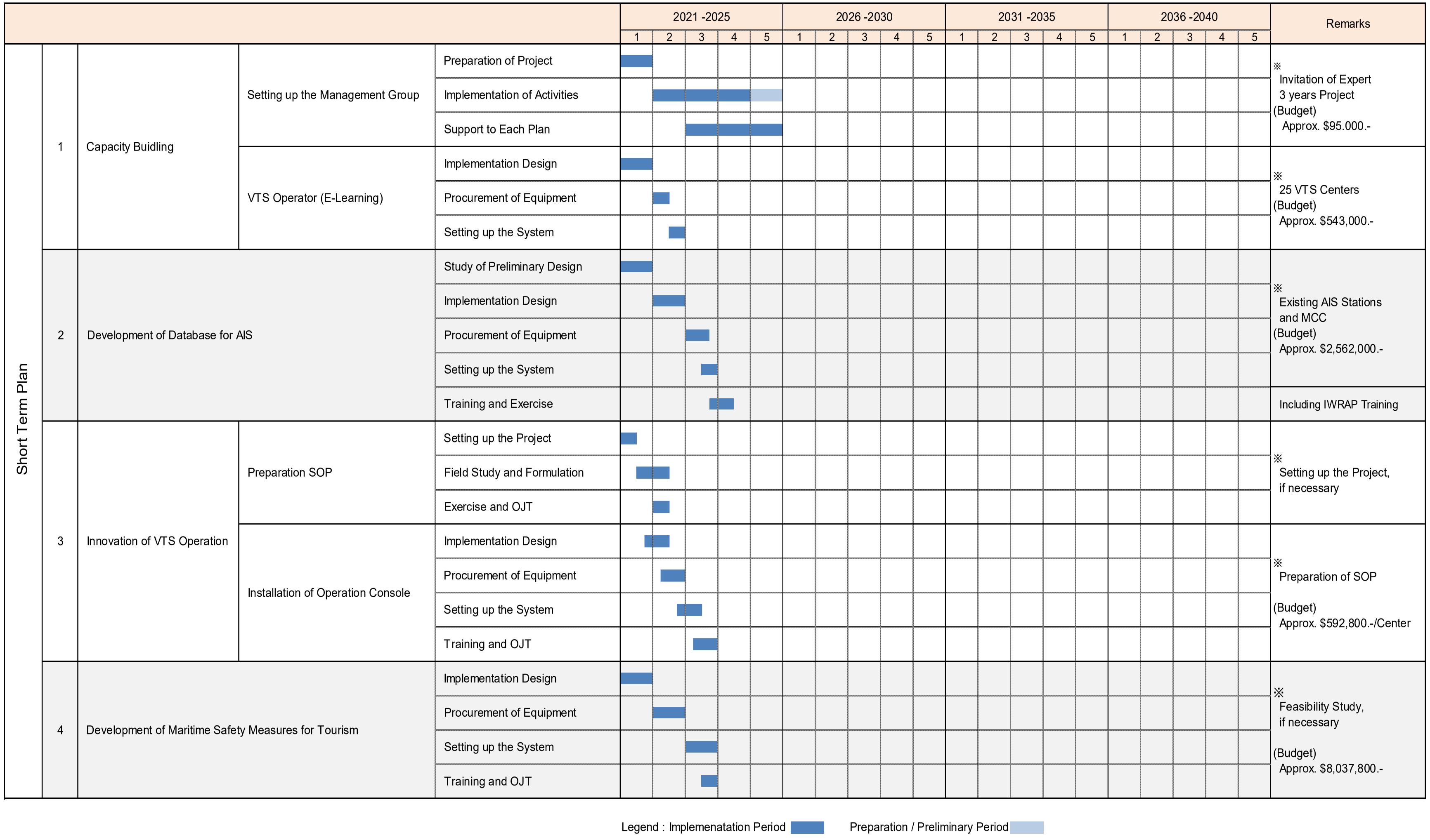


					2021 -2025					2026 -2030					2031 -2035					2036 -2040					Remarks
					1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Long Term Plan	1	Capacity Building	Basic Maritime Knowledge Course	Preparation		■																			※ Link to Management Group
				Establishment of the Course			■	■	□	□	□	□	□	□											
			Educational Institution for AtoN	Study of Conceptional Structure	■	■	■	■	■	□	□	□	□	□											
				Implementation						■	■	□	□	□	□	□	□	□	□	□	□	□	□	□	
	2	Consolidation of Coastal Radio Station		Study of Preliminary Design	■	■	□	□																	※ Prerequisite conditions (Radio Communication Infrastructure)
				Implementation Design			■																		
				Implementation				■	■	□	□	□													
	3	Development of VTS for Offshore Sabang		Study of Preliminary Design						■	■	□	□												Including Feasibility Study
				Implementation Design								■													
				Implementation									■	■	□	□									
	4	Innovation of Samarinda VTS	Expansion of AIS Coverage	Study of Preliminary Design	□	□	■	□	□																※ Link to Development of Database for AIS
				Implementation Design				■																	
				Implementation					■	□	□	□	□	□											
			Development of New Function	Study of Preliminary Design	■	■	□	□																	Including Feasibility Study ※ Analysis and Evaluation of Current Flow
				Implementation Design			■	□																	
				Implementation				■	■	■	□	□	□	□											
	5	Scrap and Build of Vessels for AtoN		Review of Activities (Work Volum)	■	□																			※ Appointment of a marine engineer
				Detailed Investigations of Vessels		■	■	□																	
				General Planning			■	□																	
				Implementation				□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	
	6	Enhancement of Monitoring AIS Coverage (Sea-Lane)		Study of Preliminary Design	□	□	■	□	□																※ Link to Development of Database for AIS
				Implementation Design				■																	
				Implementation					■	□	□	□	□	□											
	7	Development of Integrated Maritime Traffic Safety System		Confirmation of Basic Infrastructure			□	□	□	■	■	■	■	■	□	□	□	□	□						※ Coordination among Relevant Organizations
				Study of Preliminary Design				□	□	■	■	□	□	□											
				Implementation Design								■	■	□	□										
				Implementation										□	■	■	■	■	■	□	□	□	□	□	
	8	AtoN (Visual Aids)	Development of Harbor and Port	Consultation with Relevant Parties	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	DGST / Non-DGST ※Cardinal Principle by a user request
			Ship Routing	Consultation in Setting up	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	

Legend : Implemenatation Period ■ Preparation / Preliminary Period □

Figure 7.1 -1 Establishment Plan

Development Plan for Maritime Traffic Safety System (Short-Term Plan)



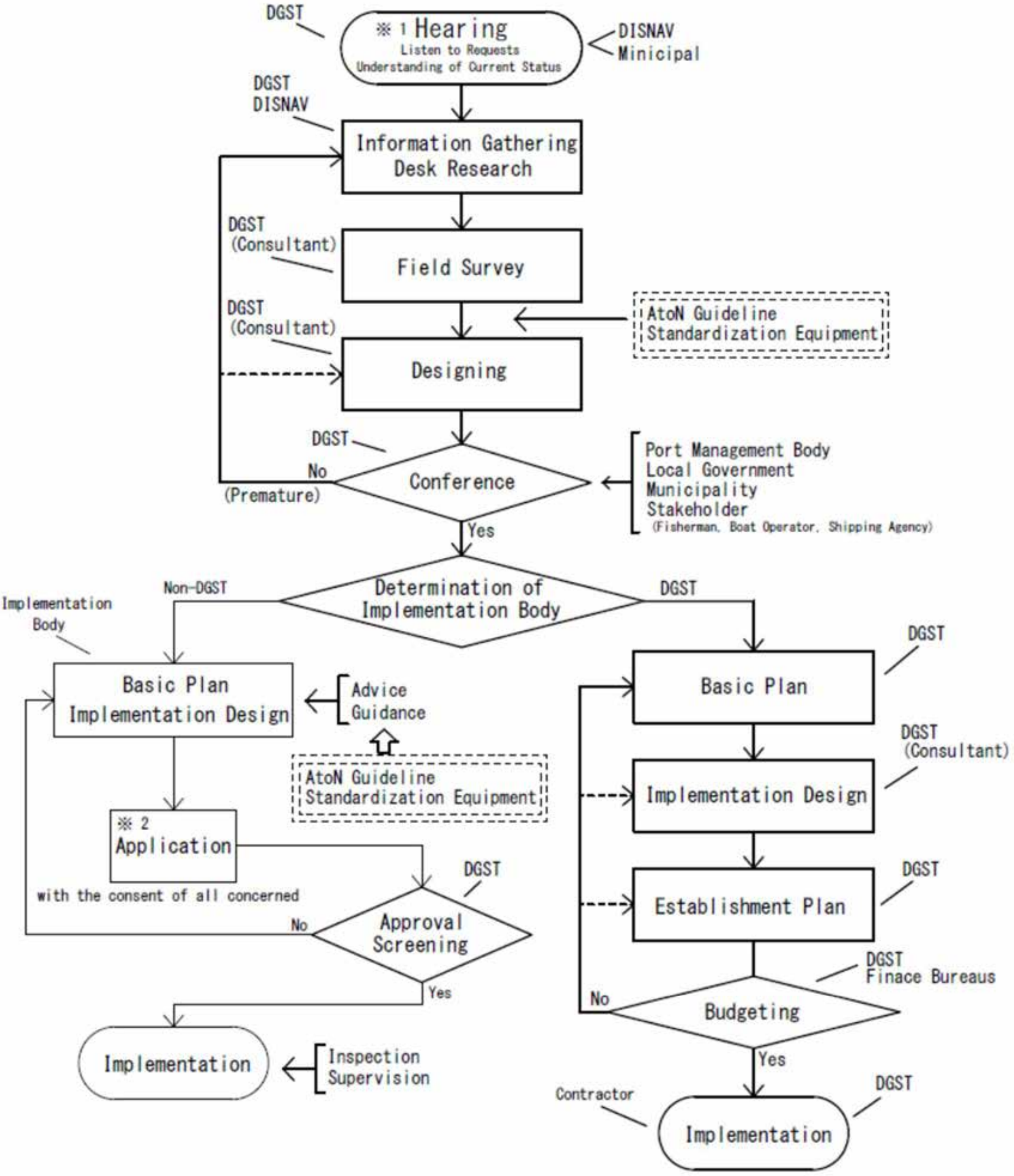
					2021 -2025					2026 -2030					2031 -2035					2036 -2040					Remarks
					1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Short Term Plan	1	Capacity Buidling	Setting up the Management Group	Preparation of Project	■																				※ Invitation of Expert 3 years Project (Budget) Approx. $95.000.-
				Implementation of Activities		■	■	■	□																
				Support to Each Plan			■	■	■																
			VTS Operator (E-Learning)	Implementation Design	■																				※ 25 VTS Centers (Budget) Approx. $543,000.-
				Procurement of Equipment		■																			
				Setting up the System		■																			
	2	Development of Database for AIS		Study of Preliminary Design	■																				※ Existing AIS Stations and MCC (Budget) Approx. $2,562,000.-
				Implementation Design		■																			
				Procurement of Equipment			■																		
				Setting up the System			■																		
				Training and Exercise			■	■																	Including IWRAP Training
	3	Innovation of VTS Operation	Preparation SOP	Setting up the Project	■																				※ Setting up the Project, if necessary
				Field Study and Formulation	■	■																			
				Exercise and OJT		■																			
			Installation of Operation Console	Implementation Design	■	■																			※ Preparation of SOP (Budget) Approx. $592,800.-/Center
				Procurement of Equipment		■																			
				Setting up the System		■	■																		
				Training and OJT			■																		
	4	Development of Maritime Safety Measures for Tourism		Implementation Design	■																				※ Feasibility Study, if necessary (Budget) Approx. $8,037,800.-
				Procurement of Equipment		■																			
				Setting up the System			■																		
				Training and OJT			■																		

Legend : Implemenatation Period ■ Preparation / Preliminary Period □

Figure 7.1 -2 Priority Project

Maritime Traffic Safety Measures
- establishing Process

Undeveloped Port/Harbor

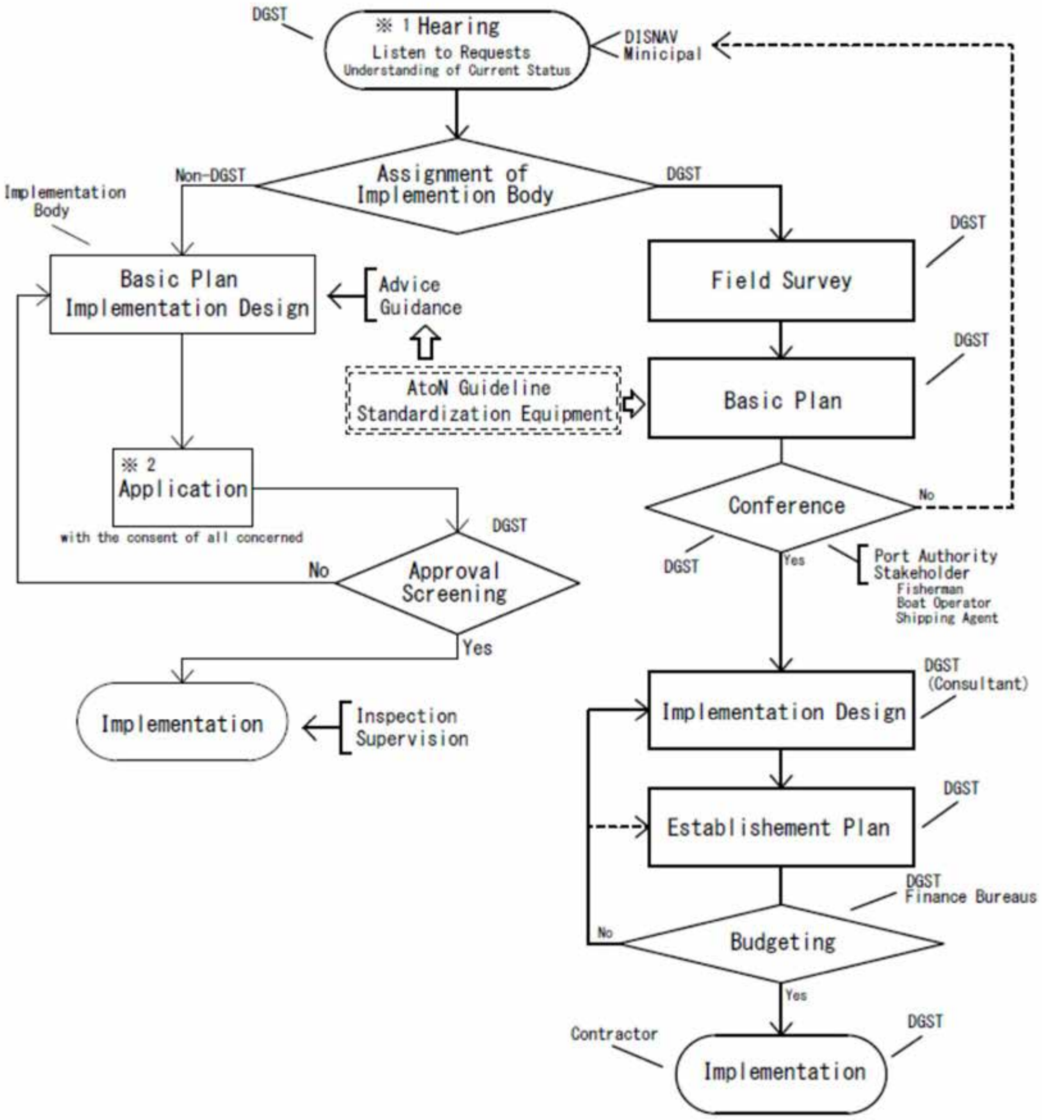


※1 Hearing will be held as needed (as necessity requires).
※2 The application is made under the appropriate laws or regulations.

Figure 7.1 -3 Undeveloped Port/Harbor

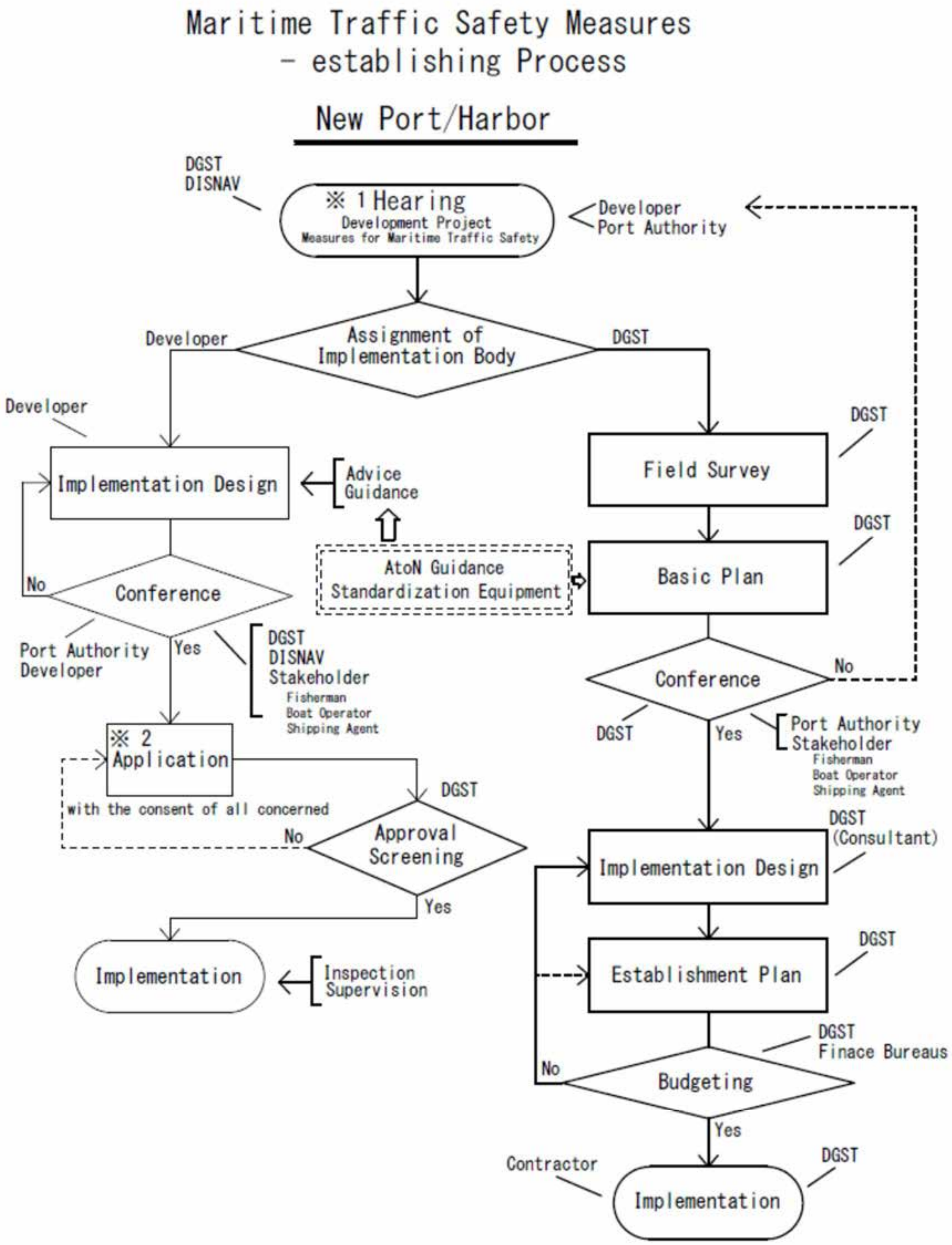
Maritime Traffic Safety Measures
- establishing Process

Existing Port/Harbor



※ 1 Hearing will be held once a year at DISNAV.
※ 2 The application is made under the appropriate laws or regulations.

Figure 7.1 -4 Existing Port/Harbor



※ 1 Hearing will be held when development plans for the most part have been made.

※ 2 The application is made under the appropriate laws or regulations.

Figure 7.1 -5 New Port/Harbor

Ships' Routeing Measures
- establishing Process

including
- Traffic Separation Schemes (TSS)
- Two-way Routes
- Recommended Tracks (Routes)
- Deep Water Routes
- Precautionary Areas
- Area to be avoide
- Sea Lanes (in a broad sense)

These are established in most of the heavily congested shipping areas.

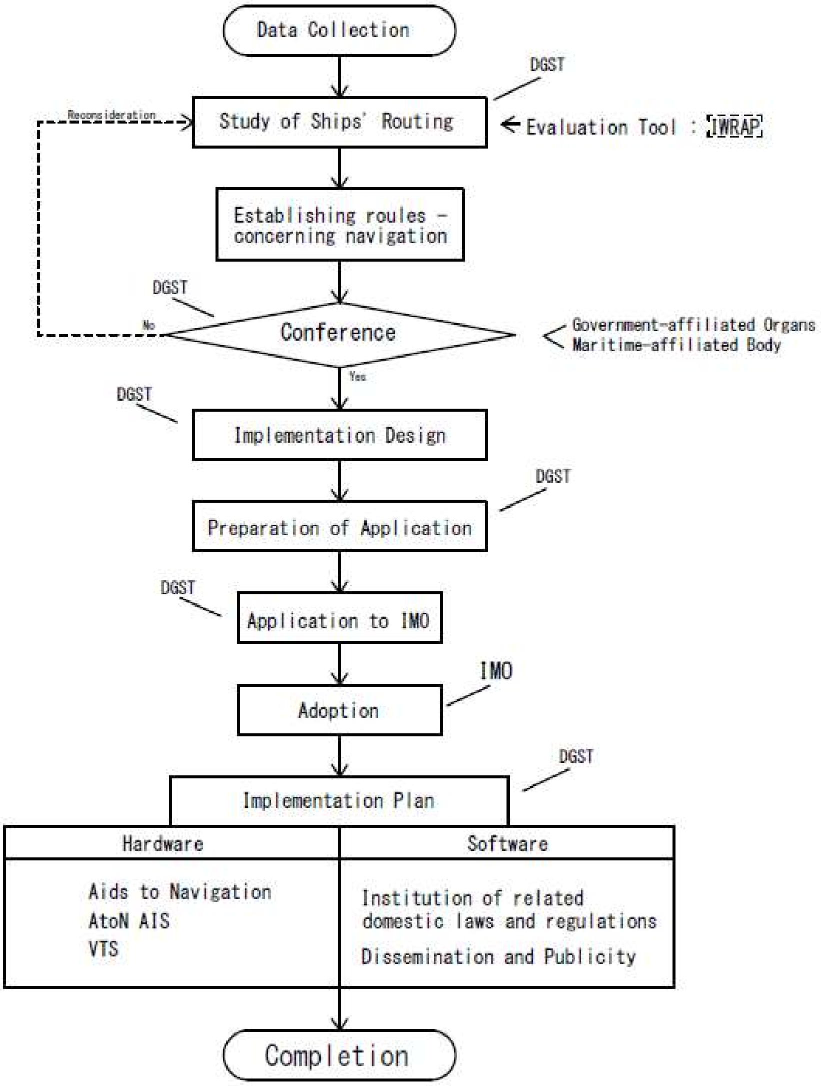


Figure 7.1 -6 Ships' Routing Port/Harbor

7.2 Long-Term Plan

This Master Plan is supposed to be examined with insight on 2040, but in the field of maritime traffic safety measures including Aids to Navigation, new technologies will take the lead in cooperation with the development of electronic technology as seen in GPS and AIS. It is difficult to foresee ahead 20 years from now.

However, the operation and maintenance of maritime traffic safety system will continue forever, and the securing and training human resources for these missions is a top priority in considering the future development of the system. One of the means for a stable supply of human resources is to build an institutional education system according to needs.

From the perspective of future policies, efficient and rational systems and structures are required, and they must be conforming to a high quality age. In other words, it is the introduction of new technology, and the creation of an integrated system that takes advantage of the social infrastructure can be considered.

Regarding the introduction of new technologies in the maritime sector, it is important to build a system that can respond to any time while watching trends in E-Navigation. It is also essential to build a wide-area information network system that utilizes communication infrastructure and to introduce new technologies with IT.

In looking at the long-term plan from these perspectives, the following items are observed; the arrangement of aids to navigation guidelines, the development of AIS data-base and expansion of AIS coverage, the consolidation of coastal radio stations, the innovation of VTS operation, the scrap and build of aids to navigation vessels, and the development of capacity building.

And, the development of VTS for offshore Sabang is proposed as related to VTS (Section 7.2.4). The VTS is expected to prevent maritime accidents and to manage the vessels' traffic in the offshore area of Sabang by placing the traffic flow under surveillance, and could be preparatory steps for setting up the future TSS.

Furthermore, the development of VTS functions and the expansion of AIS coverage at Samarinda will also contribute to the study of new traffic routes by monitoring the complex traffic flow in the area for ship-to-ship cargo transfer off the Mahakam River delta.

7.2.1 Aids to Navigation

Visual aids of Aids to Navigation, as described in the Current Situation and Issues, will be established in response to the requirement from users who really need from now on, rather than having uniformly developed lighthouses and light beacons. And, the installation and management of those aids will be sorted out whether the government or the other parties such as port authorities conduct.

Therefore, the conventional method of deciding the year and the number of units such as lighthouses, light beacons does not suit the current situation and the times. The formulation of guidelines for the installation and of standardization for the equipment should be done.

The establishment of AtoN AIS, as a radio aid to navigation, will be planned, but it will play a role as a complement to the visual aids. Therefore, it can be understood as part of the establishment of visual aids to navigation.

7.2.2 Data-base of AIS and Expansion of AIS Coverage

The AIS monitoring station is established as part of means to collect information on vessels movement at VTS, and the collected information is used only by VTS and is not shared with other parties.

Today, AIS information is extremely useful for maritime organizations that supervise vessel's movement and operation as well as VTS. If the AIS information is compiled into a database and shared, it will be useful in each field.

The AIS Data-base should be considered as a priority project (Refer to Paragragh 7.3.2 : Development of DATA Base for AIS), because it is feasible to make database by utilizing the current communication infrastructure, which ought to be an issue to take.

If the information on AIS can be obtained from a wider area in the creation of the database, the monitoring of vessel's movement can be centralized. It is very useful for obtaining the information of maritime traffic flow and for conducting the search and rescue operation. And, if the current traffic flow and the communication network require for the establishment of AIS monitoring stations are considered, the AIS monitoring area will be able to be expanded to the sea area along Sea-lane 2.

The outline is as follows.

◆Expansion of AIS Monitoring Area : Lombok – Makassar Route

Maritime Safety Commission (MSC 72), IMO held in May1998 adopted archipelago sea lanes in three locations in Indonesia. One of them, Sea-lane 2, is an alternative route to the Malacca-Singapore Strait that connects the Indian Ocean and the Pacific Ocean, and it is important to ensure the safety and efficient navigation of vessels sailing this lane. This means that it is also essential to monitor the movement of vessels.

The location map of the Sea-lane 2 is shown in the Figure at the next page.

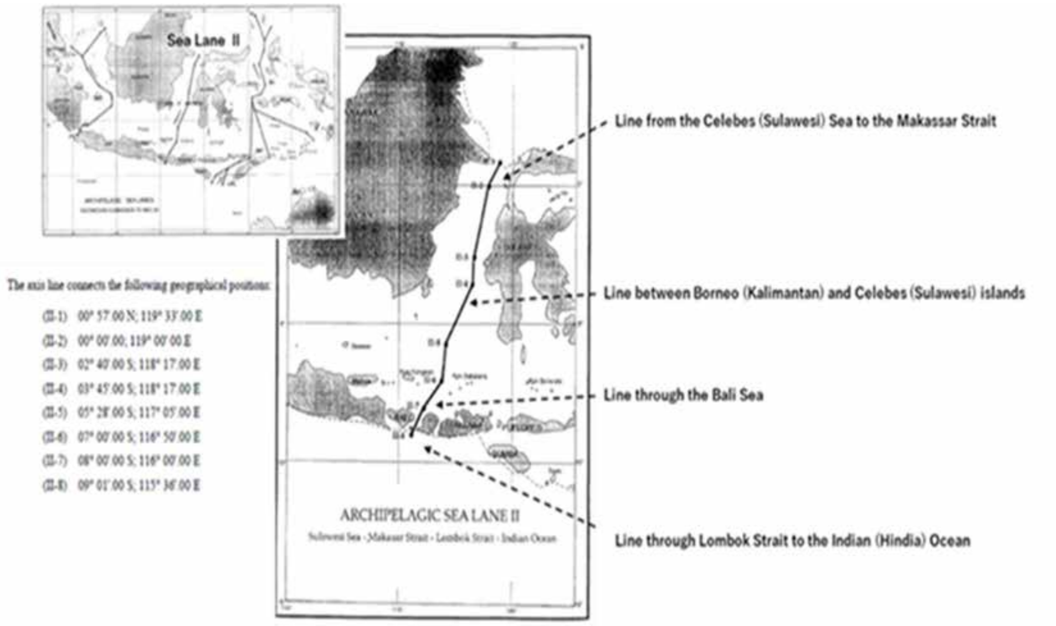


Figure 7.2.2 -1 Location of Sea-lane 2

The VTS (VTS Benoa) is installed in the Lombok Strait which is one of the gateways for Sea-lane 2 to monitor the movement of vessels passing through the strait, and AIS stations also are installed at Makassar and Samarinda to monitor the offshore where vessels are navigating.

However, the entire Sea lane is an extensive area, and existing monitoring facilities are insufficient to monitor the whole area.

As described in the traffic flow surveys in Section 5.4 and 5.5, it was found that the vessels navigating in this area were showing multifarious movements and many vessels were a foreign flag ship.

The key point to strengthen and expand the monitoring system is to secure communication lines such as the Internet network which is expanding to rural areas.

The major marine accidents in this area from 2012 to 2017 are shown below.

Source : KNKT

(Data based on statistics of the National Transportation Safety Board of Indonesia)

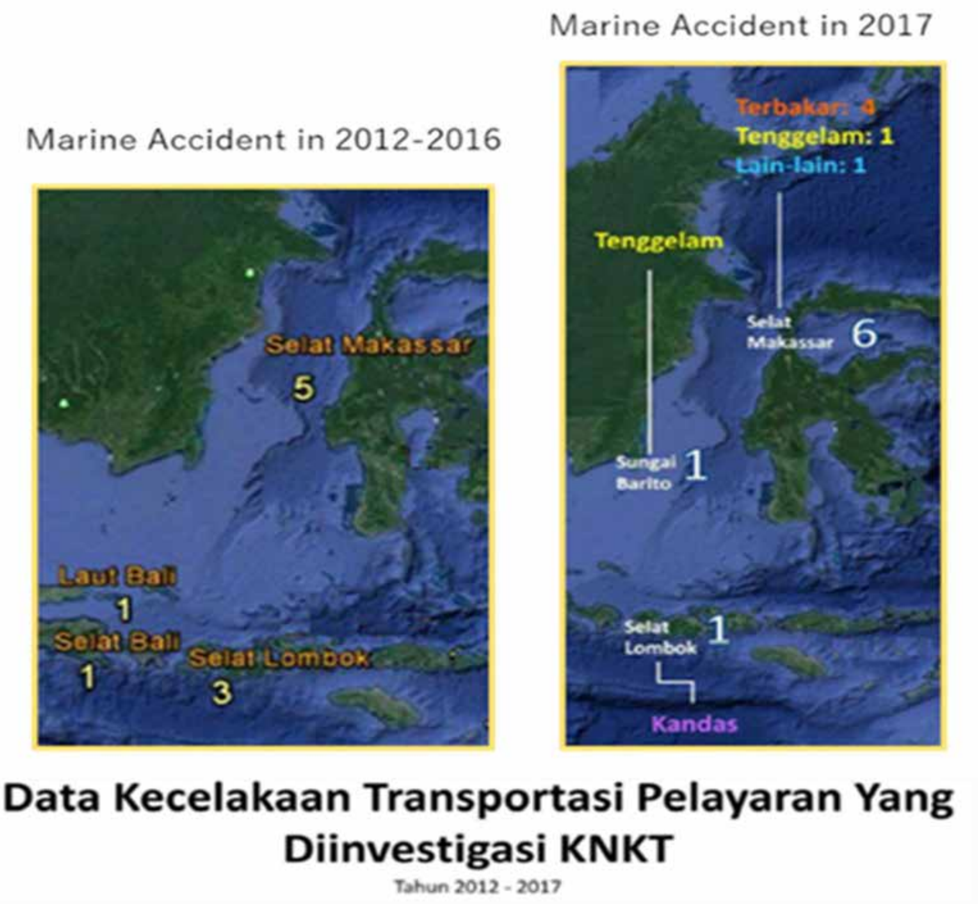


Figure 7.2.2 -2 Location of Marine Accident

When a marine accident occurs, it is necessary to establish a prompt response and search and rescue system, and for that purpose it is important to monitor the movement of vessels over a wide area by AIS.

Along with the data integration of AIS stations nationwide, it is proposed to strengthen the monitoring system for vessels passing through the Makassar Strait, which is an important area.

The outline of establishment is as follows.

In order to support the safe and efficient navigation of vessels in this sea area, it is necessary to cooperate with the relevant VTS stations, to share information among these VTS stations, and to provide wide-ranging and preliminary information to vessels.

Therefore, AIS stations will be added to eliminate the dead zone of AIS coverage and the AIS network will be made even more.

As a proposed location for an AIS station, lighthouses are nominated on the west coast of Sulawesi Island where electro power is supplied stably and mobile communication network is available. The feasibility study will be carried out to confirm the conditions of communication network and the altitude above sea level around the candidate installation place.

The Sea-lane where the vessel navigates is located 50 to 100 km offshore from the coast, and the directional YAGI antenna with a highly sensitive range will be considered to reliably detect the AIS signal transmitted from vessels.

The location of the main lighthouses and the candidate sites are shown in the Figure below, and their coverages. (For reference : 3G/4G Telkomsel Coverage is attached.)

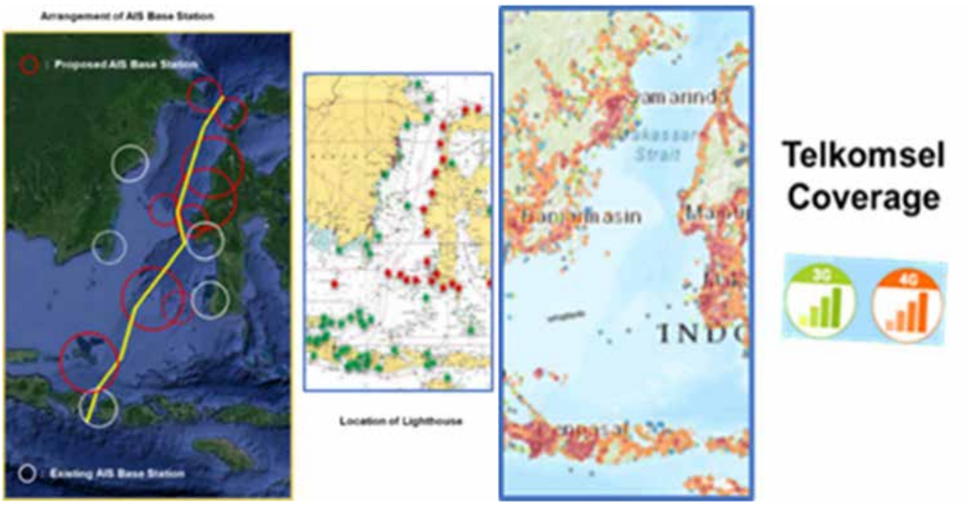


Figure 7.2.2 -3 : Location of Lighthouse and AIS Coverage

The existing VTS arranged along Sea-lane 2 are shown in the Figure below

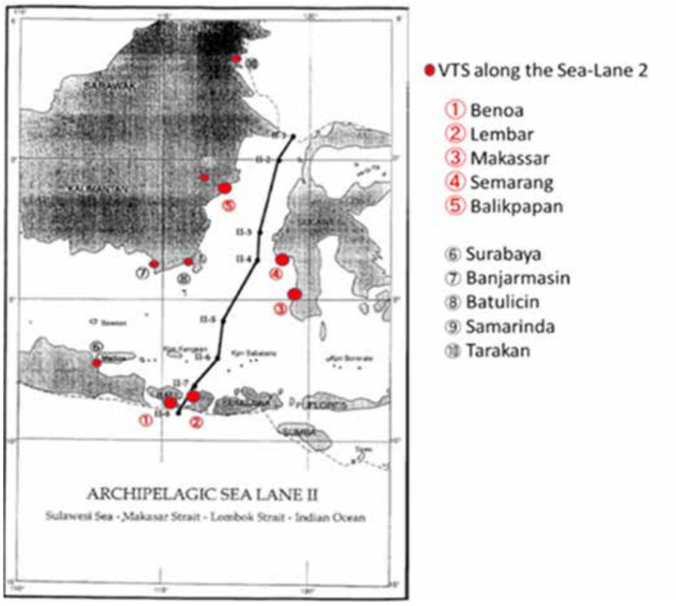


Figure 7.2.2 -4 : Location of VTS

The system configuration diagram is shown in the Figure below.

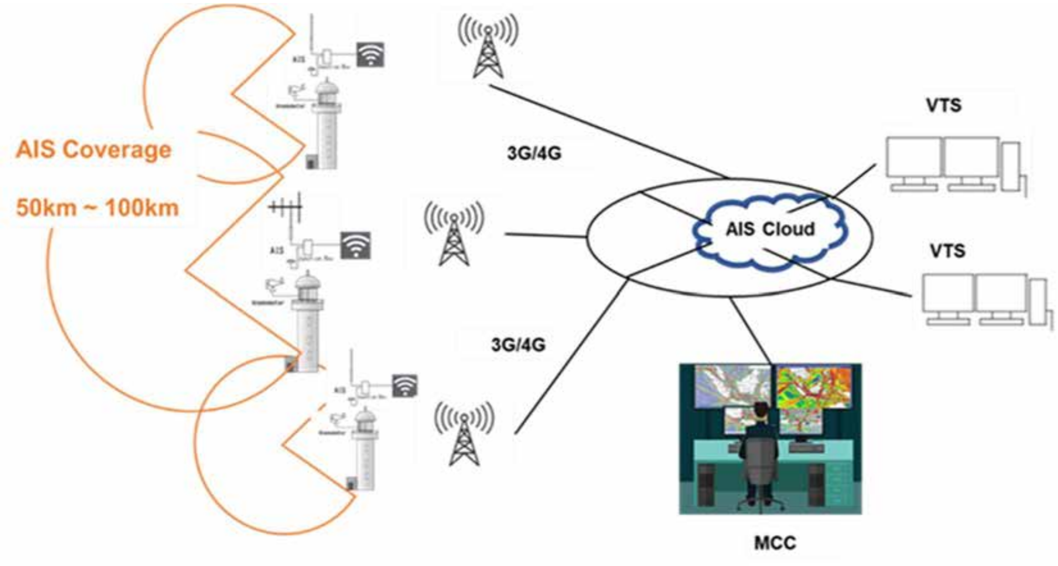


Figure 7.2.2 -5 : System Configuration of AIS

7.2.3 Consolidation of Coastal Radio Station

The replacement of aging equipment and the introduction of remote monitoring and control system for coastal radio stations after renovation of the equipment should be prioritized to promote the efficient operation the radio station including GMDSS, but implementation of this project has some issues on the consolidation of small stations. These projects must be considered at the same time.

There are a total of 151 coastal radio stations, which are classified into four classes from 1st to 4th Class. The 1st Class is 12 stations, the 2nd is 6, the 3rd is 54, and the 4th is 79. The 3rd and the 4th Class stations are relatively located at remote areas, and they will be consolidated into the 1st and the 2nd one.

The replacement of ageing equipment with new one with remote control functions and the consolidation of stations will make the operation improve efficiently, the 3rd/4th grad station unmanned easy and the working conditions improved sufficiently, since DSC (Digital Selective Calling) signals have been received only a few times a year and the equipment has become old.

Therefore, it is not just a matter of the replacement of hardware, and there is no urgency about the operation, so institutional action should be considered first. The process and the roughly estimated budget for simply replacing and consolidating equipment are shown in the next "Action".

Regarding the modernization of GMDSS, there is no concrete improvement action so far. Therefore, it is not necessary to cope with the modernization immediately, but the specification of replacement equipment for radio stations must be given the consideration of the modernization.

◆ Replacement of Equipment and Consolidation of Stations

It is recommended that the 1st and the 2nd Class stations are rearranged as a manned key station (total 18 stations), and the 3rd and the 4th Class stations are integrated into the 1st and the 2nd ones as an unmanned station (133 stations). Where to integrate a small-scale station will be determined based on the status of the communication line including internet network and the relevance to the operations.

For example, if the connection is planned to link each station with its own communication line by using a microwave radio line or a satellite line as in the past, it takes a huge budget and the time for establishment. Today's Internet connections are getting better and ensuring the quality of communication, and it is rational to use this Internet line and the budget can be reduced. Therefore, it is necessary to pay careful attention to the deployment of the Internet network as a social infrastructure in preparing the establishment plan.

Besides, the radio-station equipment installed at present was manufactured before 2015 and has not been adapted to IP (Internet Protocol), so most of them need to be replaced or modified for consolidation of the stations.

Picture 7.2.3 -1 : GMDSS Equipment in Operation

Since almost all the stations are under the environment where the Internet network can be used, all information is digitized and the information is exchanged through this network. The information from each station can be accessed from anywhere via the server on premise or the external server, and the reformation of manned stations will be possible. The consolidation of the coastal radio stations is related to the progress of the telecommunication network, which will have a significant impact on the operation and the welfare of the staff.

a. Reduction of the on-duty hours (One at a time)
b. Efficient and proper operation
c. Expansion of operating capacity and ability
d. As the office organization becomes larger and is located in urban areas, it leads to the improvement in the lives of staff.

The basic configuration of the system and the roughly schedule/estimated coast for replacement of all equipment are shown in the Figure at next page. A feasibility study should be conducted before the preparation of a detailed plan.

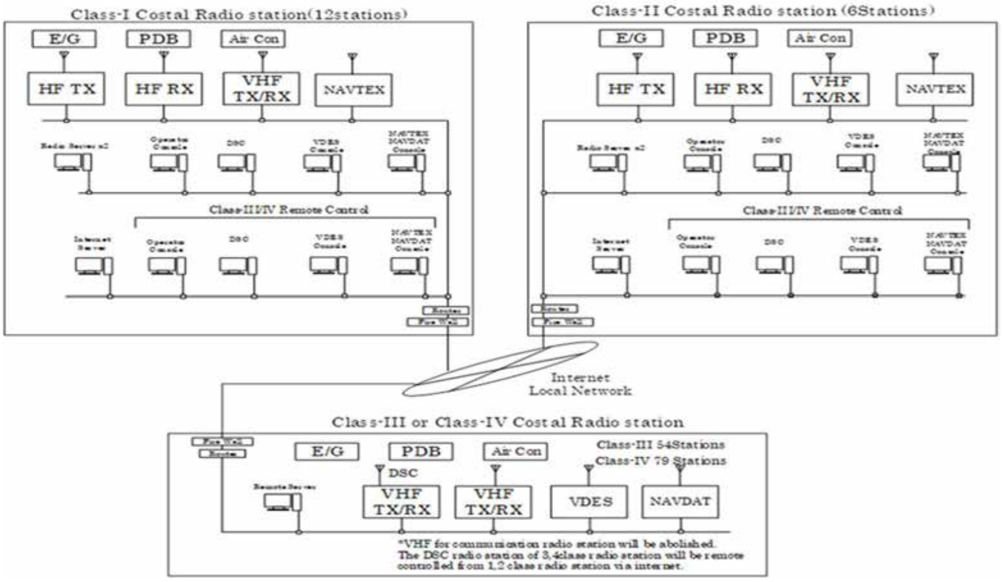
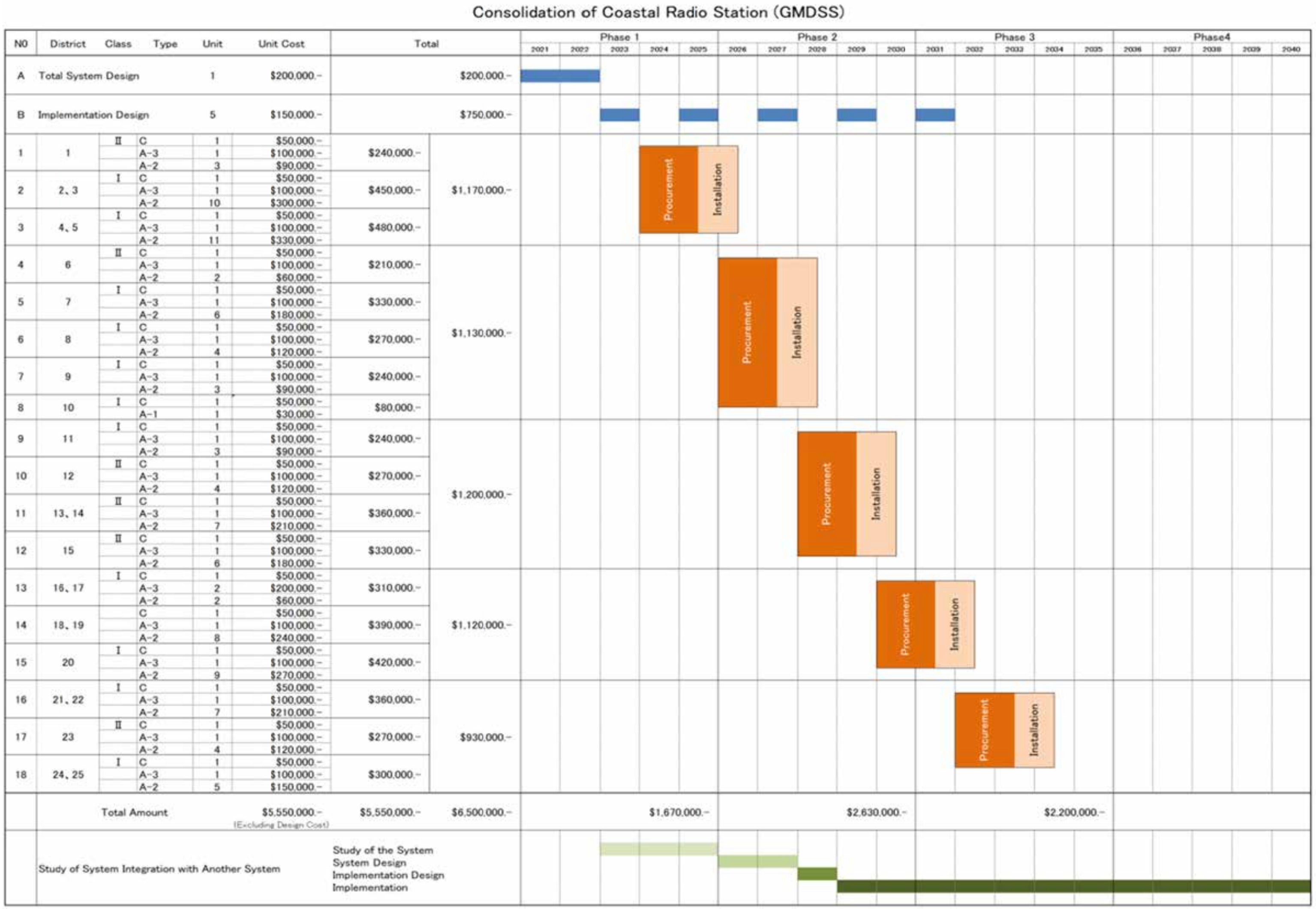


Figure 7.2.3 -1 : Configuration of the System



NO	District	Class	Type	Unit	Unit Cost	Total	
A	Total System Design			1	$200,000.-		$200,000.-
B	Implementation Design			5	$150,000.-		$750,000.-
1	1	II	C	1	$50,000.-	$240,000.-	$1,170,000.-
			A-3	1	$100,000.-		
			A-2	3	$90,000.-		
2	2、3	I	C	1	$50,000.-	$450,000.-	
			A-3	1	$100,000.-		
			A-2	10	$300,000.-		
3	4、5	I	C	1	$50,000.-	$480,000.-	
			A-3	1	$100,000.-		
			A-2	11	$330,000.-		
4	6	II	C	1	$50,000.-	$210,000.-	$1,130,000.-
			A-3	1	$100,000.-		
			A-2	2	$60,000.-		
5	7	I	C	1	$50,000.-	$330,000.-	
			A-3	1	$100,000.-		
			A-2	6	$180,000.-		
6	8	I	C	1	$50,000.-	$270,000.-	
			A-3	1	$100,000.-		
			A-2	4	$120,000.-		
7	9	I	C	1	$50,000.-	$240,000.-	
			A-3	1	$100,000.-		
			A-2	3	$90,000.-		
8	10	I	C	1	$50,000.-	$80,000.-	
			A-1	1	$30,000.-		
9	11	I	C	1	$50,000.-	$240,000.-	$1,200,000.-
			A-3	1	$100,000.-		
			A-2	3	$90,000.-		
10	12	II	C	1	$50,000.-	$270,000.-	
			A-3	1	$100,000.-		
			A-2	4	$120,000.-		
11	13、14	II	C	1	$50,000.-	$360,000.-	
			A-3	1	$100,000.-		
			A-2	7	$210,000.-		
12	15	II	C	1	$50,000.-	$330,000.-	
			A-3	1	$100,000.-		
			A-2	6	$180,000.-		
13	16、17	I	C	1	$50,000.-	$310,000.-	$1,120,000.-
			A-3	2	$200,000.-		
			A-2	2	$60,000.-		
14	18、19		C	1	$50,000.-	$390,000.-	
			A-3	1	$100,000.-		
			A-2	8	$240,000.-		
15	20	I	C	1	$50,000.-	$420,000.-	
			A-3	1	$100,000.-		
			A-2	9	$270,000.-		
16	21、22	I	C	1	$50,000.-	$360,000.-	$930,000.-
			A-3	1	$100,000.-		
			A-2	7	$210,000.-		
17	23	II	C	1	$50,000.-	$270,000.-	
			A-3	1	$100,000.-		
			A-2	4	$120,000.-		
18	24、25	I	C	1	$50,000.-	$300,000.-	
			A-3	1	$100,000.-		
			A-2	5	$150,000.-		
	Total Amount				$5,550,000.- (Excluding Design Cost)	$5,550,000.-	$6,500,000.-
	Study of System Integration with Another System					Study of the System System Design Implementation Design Implementation	

Figure 7.2.3 -2 : Schedule and Cost for Replacement of Equipment

7.2.4 VTS

The innovation of VTS operation should be prioritized to maximize the functions given to VTS, which means that operation manuals for the VTS operator and user manuals for navigator must be prepared, the customized operation console must be established, and the training of the operators is required.

The development of the operation console and the training operator, which have a close relationship, must be considered as a priority project to be performed together as soon as possible. (Refer to Paragragh 7.3.2 : Capacity Building and Innovation of VTS Operation)

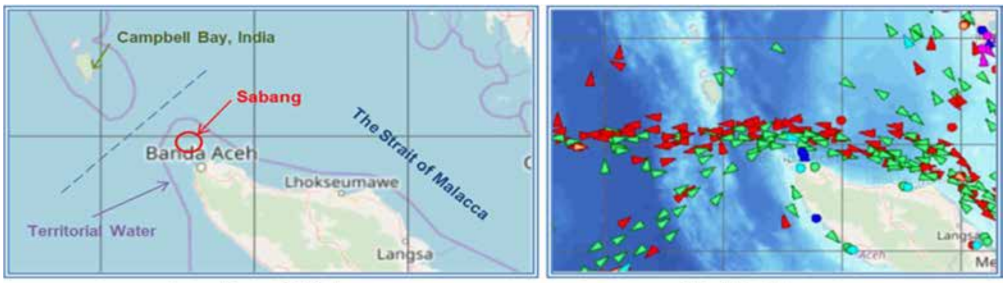
New establishment plan of VTS will be considered after these renewals are implemented, and the VTS will become mainly port-type in the future. Therefore, since the establishment of VTS will be part of the development of aids to navigation in the ports, it must be planned in consultation with relevant parties.

However, for the coastal and strait types, it is proposed to establish the VTS in Sabang, which is located at the northern end of Sumatra, as a west-end gateway that will be a pair of Batam VTS which is functioning as the eastern-end gateway of the Strait of Malacca and Singapore. This will greatly contribute to the provision of information in maritime emergencies such as traffic restriction, weather warning for many vessels including Japanese huge vessels passing through the strait.

As an unique VTS, the Samarinda VTS installed in the river area is proposed to have new functions that are not only the monitoring of vessels and the provision of information by radio, but also the provision of signal information by display boards using sensing technology. In narrow passage like river way where navigation is restricted, efficient operation of barges can be expected as well as the safety navigation.

◆ Development of VTS for Offshore Sabang

Sabang is the city at the northern tip of the Island where is located about 30 km offshore from the northwestern of Sumatra Island (Pulau Sumatera), facing the gateway of the Strait of Malacca which is a narrow and 550NM (890km) stretch of water between the Peninsular Malaysia and the Indonesian island of Sumatera. And it is a border town that separates India with the sea.



Location of Sabang

Traffic Flow

Figure 7.2.4 -1 : Location and Traffic Flow of Offshore Sabang

The Strait of Malacca is a major maritime traffic route between the Indian Ocean and the South China Sea, and it is the world's busiest sea area.

The annual number of vessels navigating through this traffic exceeds 85,000 (2018), including huge vessels, such as tankers and container ships, carrying important goods.

Sabang is an ideal place to monitor and manage the movement of vessels, because offshore Sabang is the veering point and the concentrated area for vessels coming from the Arabian Sea and the Middle East for the Straits of Malacca to prevent marine accident. The traffic flow off Sabang is described in Section 5.1.

On the other hand, the Batam VTS is located on the eastern side of the Singapore Strait and have a role to monitor the eastern entrance of the Strait, where is in the opposite position to Sabang. Therefore, if the movement of vessels can be obtained in Sabang, vessels which are passing through the Straits of Malacca and Singapore can be tracked consistently. It will be important for monitoring and managing vessels statistically.

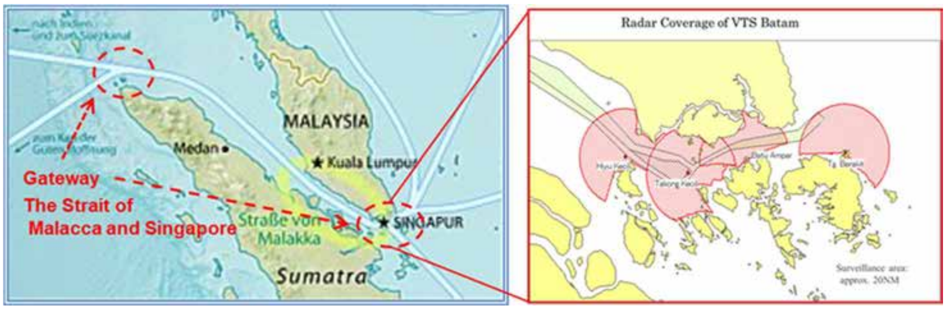


Figure 7.2.4 -2 : Gateways of the Straits of Malacca and Singapore

In designing a system of VTS, it is necessary to carry out a detailed survey for the selection of construction sites and for the determination of equipment specifications, and the feasibility study including an environmental assessment is required in advance.

The basic VTS configuration is shown in the Figure below.

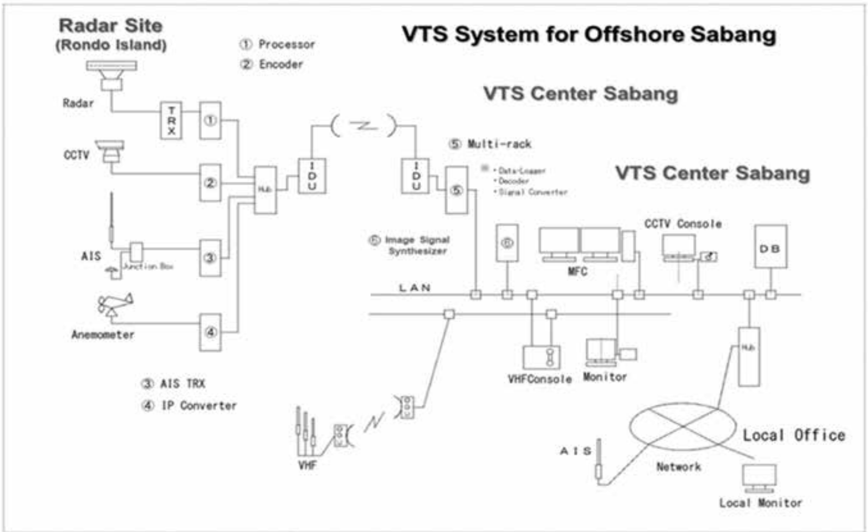


Figure 7.2.4 -3 : Fundamental Configuration of VTS

The sensor station of Radar and AIS will be installed in Rondo Island, where is located 12 NM north of Sabang, to monitor vessels coming and leaving the west exit of the Strait of Malacca, which will be equipped with meteorological observation devices and CCTV to observe the surrounding weather conditions. An international VHF radio will also be installed to receive the position report from vessels and to communicate with vessels.

In the VTS operation room, the multifunction operation console that can display radar images, AIS information, and ship's profile will be installed, so that VTS operators can obtain the information on the vessel's movement in real time and provide appropriate maritime traffic information to vessels. Also, a server system for data storage and data sharing will be installed.

The data collected at Sabang VTS will be transferred to Batam VTS and Dumai VTS via Internet Network to share the movement of vessels passing through the Strait of Malacca and Singapore.

Rondo Island located at the northernmost tip of Indonesia is on the reference line that determines the territorial waters and the contiguous zone, and can be said to be a strategic point for border surveillance.

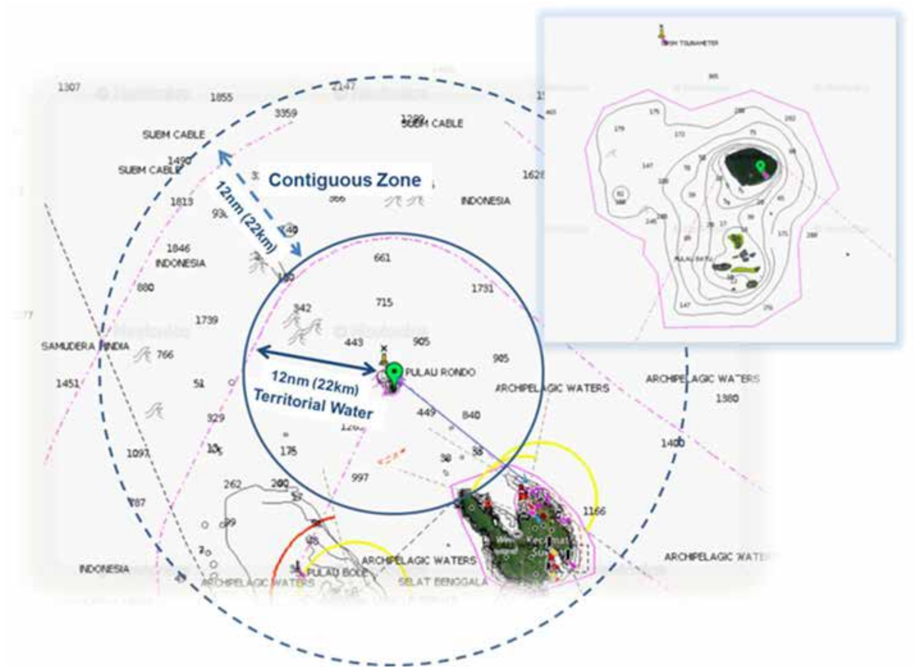


Figure 7.2.4 -4 : Territorial Water and Contiguous Zone

The effective coverage of Radar and AIS in the case of their installation at Rondo Island is shown in the Figure at the next page.

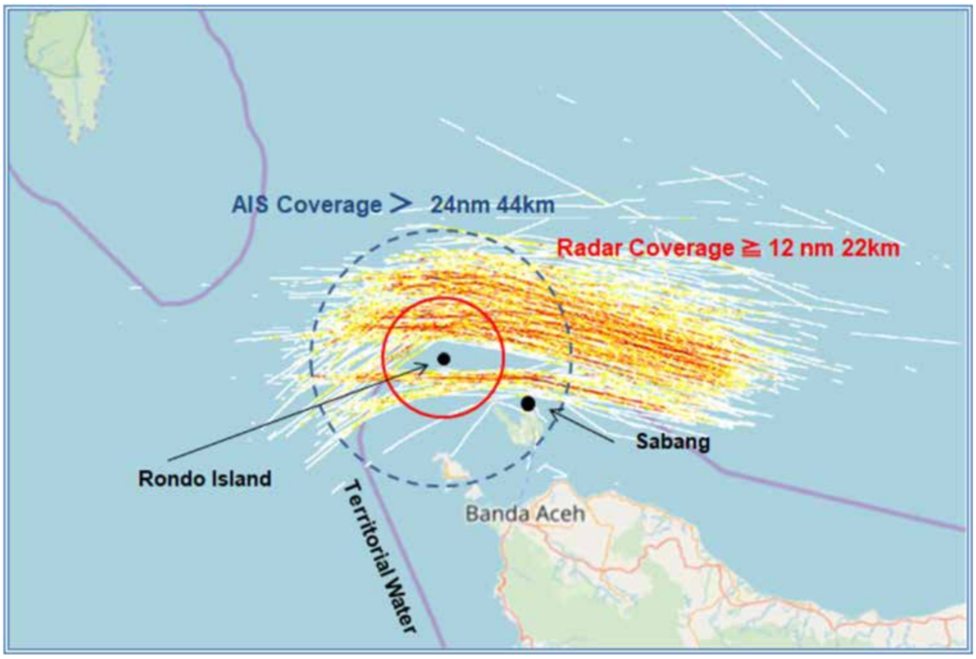


Figure 7.2.4 -5 : Coverage of Radar and AIS

The following effects can be expected by establishing VTS in Sabang.

a. The movement of vessels passing through the Straits of Malacca and Singapore can be checked with the VTS Sabang and the VTS Batam (Tanjung Berakit Radar Sensor Station) which are located at the gateway on the west side and the east side of the straits respectively, and the traffic volume (by Type, Size, Nationality, etc.) can be obtained statistically.

b. The VTS operators can instantly provide vessels with information about unusual or distressed situations that have occurred in the strait.

c. Provision of regular weather information greatly contributes to the navigational safety and efficient operation of vessels passing through the strait.

d. By collecting the actual conditions of traffic flow, it is possible to take appropriate measures such as rectifying the traffic flow.

In particularly, the offshore Sabang is an area where large vessels heading eastward from the Arabian Sea and the Indian Ocean meet, and where there is a small island in the center of those traffic flows, which makes the traffic flow more complicated.

The collecting data can be valuable when the analysis with IWRAP is conducted to consider the installation of virtual AIS.

◆ Development of VTS Functions and Expansion of AIS Coverage in Samarinda

As mentioned about the outline of Samarinda Port in the Paragragh 4.1.5, the characteristics of this port are along the river, and vessels navigating here are mainly barges and tug boats. In the river, there are the piers of a bridge over the Mahakam River, and accidents contacting with the bridge pier have occurred frequently.

Furthermore, the velocity of flow especially during the rainy season is fast and the difference of tidal levels is large, which makes it difficult to load and unload cargo onto a vessel and restricts traffic under the bridge.

The Figure below show that there are piers in the river and the river is narrow and shallow.

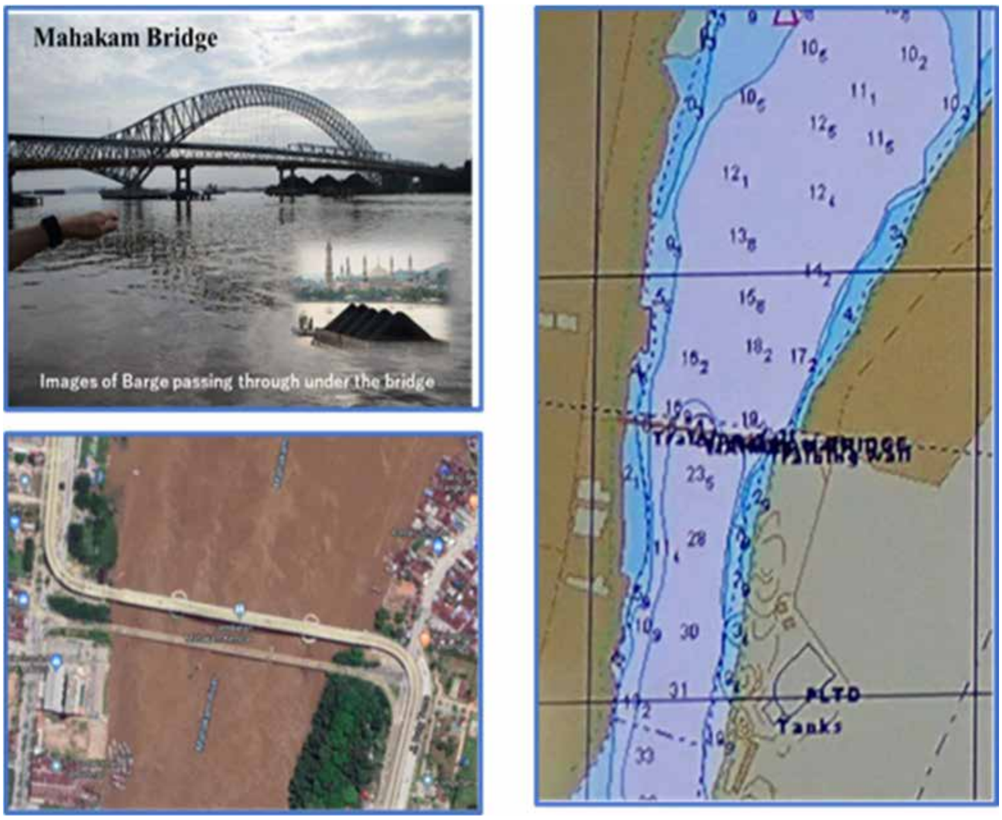


Figure 7.2.4 -6 : Mahakam River and Bridge

The Mahakam River, where vessels navigate, is divided into nine stream tributaries, and the distance from the estuary to the center of the port is about 50km. Although the VTS Samarinda has three sensor stations (Radar, AIS), the effective range covered by those sensors is not enough to obtain the movement of vessels throughout the navigable areas.

The layout of the sensor stations and the movement of vessels are shown in the Figure at the next page.

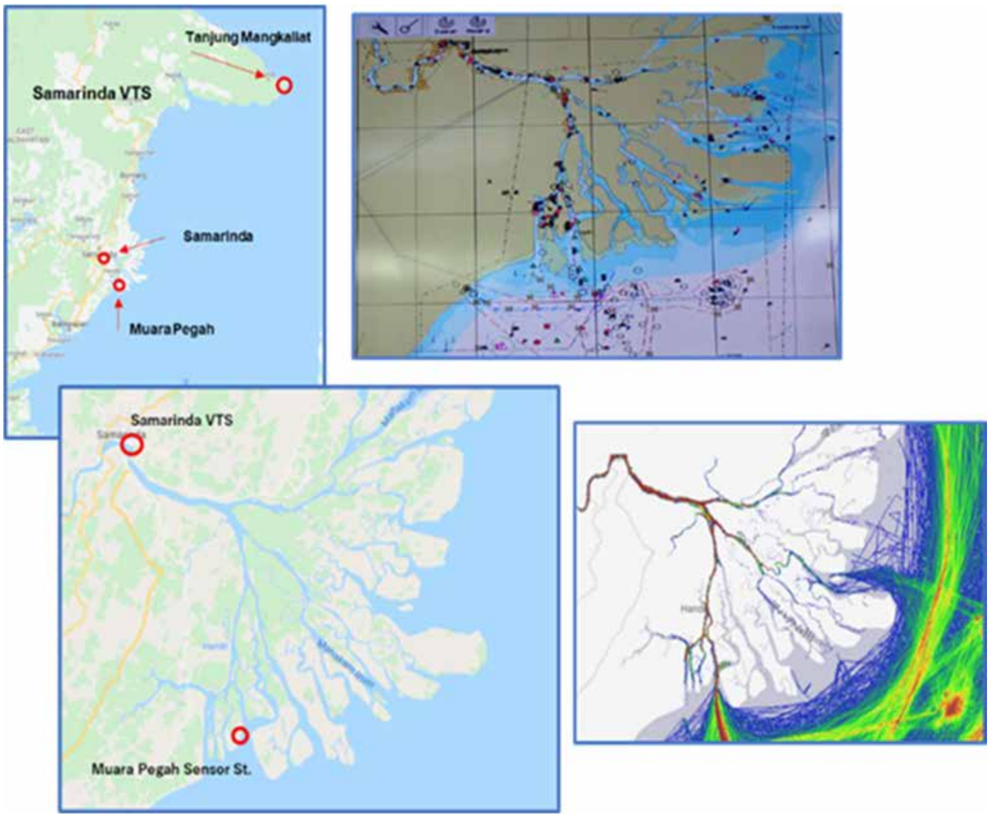


Figure 7.2.4 -7 : Location of AIS Station and Movement of Vessel

In the case of navigable waters in Samarinda, the river is winding and narrows for vessels to navigate, so that the CCTV may be more efficient than the radar to monitor the movement of vessels.

And, there are several tributaries leading to the port, and blind areas of AIS exist among them. It is recommended that an additional AIS stations are installed at the main tributary to obtain the movement information of vessels passing through there.

To ensure the safety navigation of vessels under strong currents and high tides, it is recommendable to establish the new information system with a current and tidal sensor.

The outline of establishment is as follows.

The implementation design of the expansion of AIS coverages and the new information system for vessels passing through under the bridge will be made at first.

The layout plan of new AIS sensor stations and signal station stations is shown in the Figure at the next page.

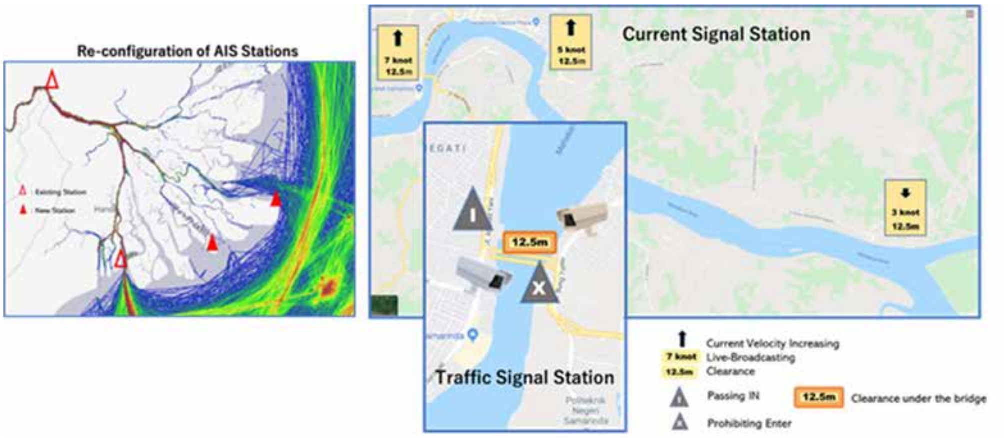


Figure 7.2.4 -8 : Layout of New AIS Station and Signal Station

a. An AIS station will be installed at the estuary of the main tributaries to expand the AIS coverage in order to finely monitor the movement of vessels going up the tributaries.

b. CCTVs are installed on both sides of the bridge to monitor traffic flow near the bridge.

c. Traffic lights (signals) are installed on both sides of the bridge girder to coordinate the encounters with vessels under the bridge.

d. A current signal station is set up at the bent of the river in order to provide information on the current velocity of the river and on the clearance under the bridge to vessels in real time.

e. The information board indicating the clearance under the bridge is also installed on both sides of the bridge.

The schematic diagram of the system is shown in the Figure below.

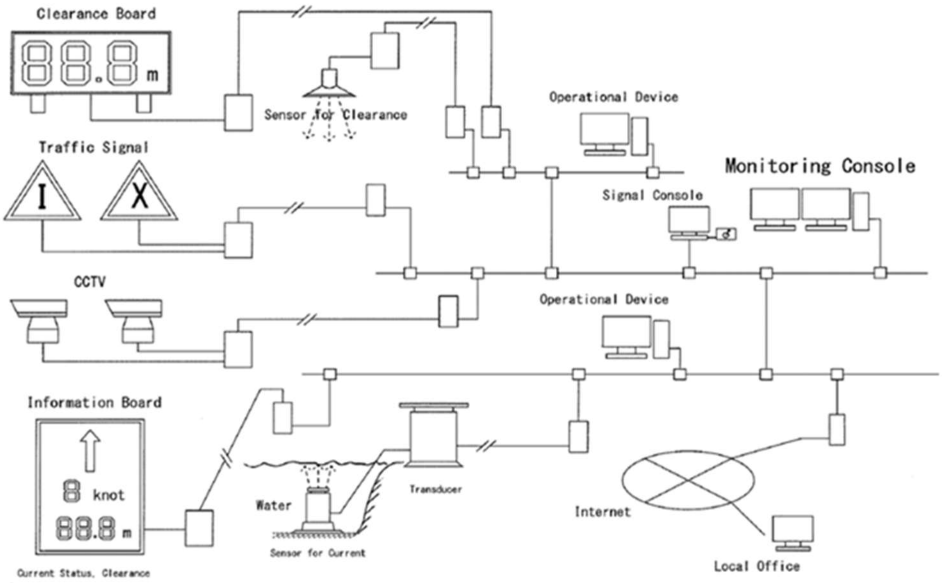


Figure 7.2.4 -9 : System Configuration of New Information System

The following effects can be expected by establishing the New Signal Information System.

a. The vessels will not meet head on under the bridge by placing a traffic signal in front of the bridge.

b. The display of a current velocity and a clearance distance makes it easier for vessels to determine whether a vessel can pass through under the bridge.

c. The information can be contributed to many stakeholders and provide resources for further safety measures.

7.2.5 Vessel for Aids to Navigation

A vessel should be safety first, and she should be replaced with new one from the oldest one that exceed the generally-known useful life of the vessel (an older vessel : 20 years) and from the one with the lower technical conditions (TC).

But, a new vessel should be designed after the specifications required are decided that is compared with the former amount of work days and of work content, rather than scrap-and-build everything.

A general process to determine the specification of a buoy tender is shown in the Figure 7.2.5 -2.

The required type and number of vessels will be fixed from operating days, maintenance days at the buoy base (including the holidays of crew) and the inspection days at a dockyard (Operating days reflect the reduction in the number of refueling work days for lighthouses and of replacing work days for buoys' storage batteries, and the increase in the number of inspection days due to the increase of aids to navigation).

Following missions are imposed on vessels for aids to navigation.

a. Installation and replacement of floating buoys

b. Regular inspection for the equipment of visual aids to navigation

c. Maintenance of lighting apparatus at the site of floating buoys, visual beacons, lighthouses

d. Supply of battery, parts of equipment, and goods for maintenance to the site

e. Transportation of lighthouse keepers to the site

f. Search and rescue (SAR) operation

Next, according to this confirmation of the work-amount for vessels, the detailed conditions of the old vessels will be investigated, and the order of scrapped vessels and of alternative vessels will be decided. In this process, the inspection and confirmation is indispensable by shipbuilding experts, and in some cases the docking of a vessel will be needed.

The vessels over 40 years old which go out into the ocean should be scrapped and built as soon as possible for the safety and efficiency of navigation. From this point of view only, the scrap and build schedule will be considered with reference to the vessel's age and the technical conditions.

The schedule of Scrap and Build for large sized vessels such as a buoy tender and for small sized vessels such as an inspection boar is shown in the Figure 7.2.5 -3 and the Figure 7.2.5 -4. And, the cost is estimated from a unit price per ton for shipbuilding which is just a reference for budget. As a matter of course, the detail construction cost will be calculated after the new type of a vessel and her equipment is decided.

The proposed concepts for designing the new vessels are shown below.

a. Single screw
b. Single rudder
c. Diesel engine driven
d. All-welded steel
e. Forecastle and poop (Buoy Tender)
f. Raked stem
g. Transom stern
h. Continuous upper deck

The baseline design of a typical buoy tender with the crane, and with the derrick is shown in the Figure below.

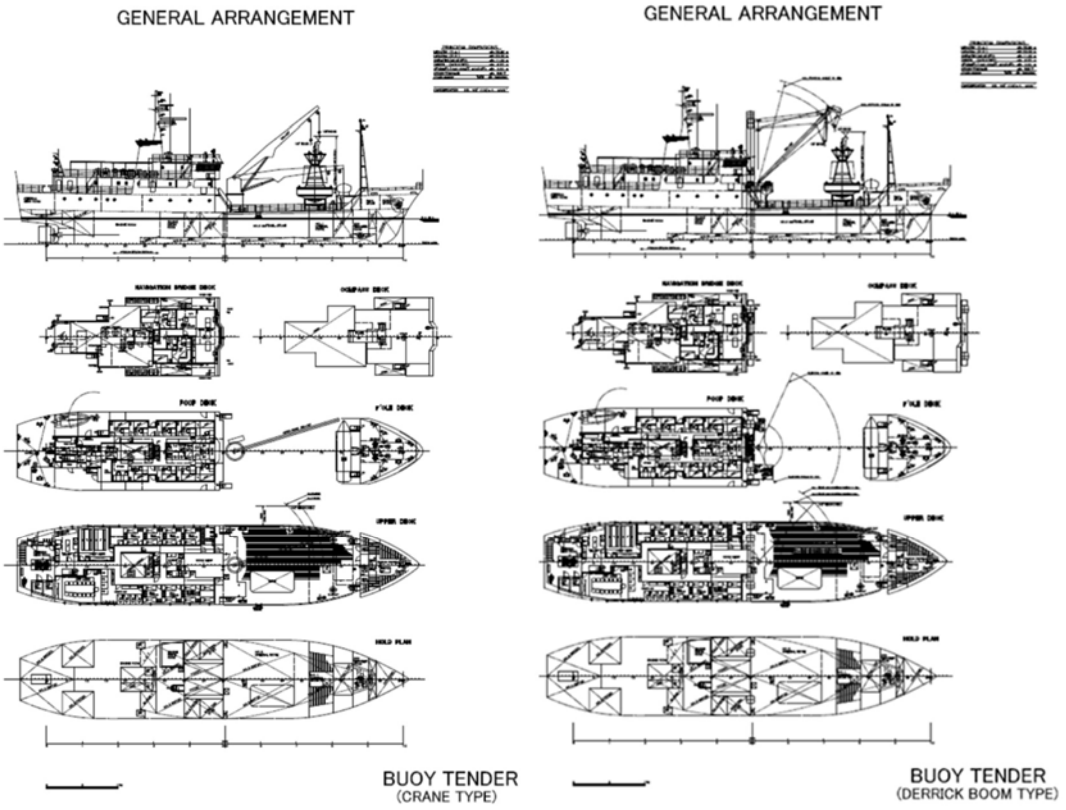


Figure 7.2.5 -1 : Design Drawing of Hull Line

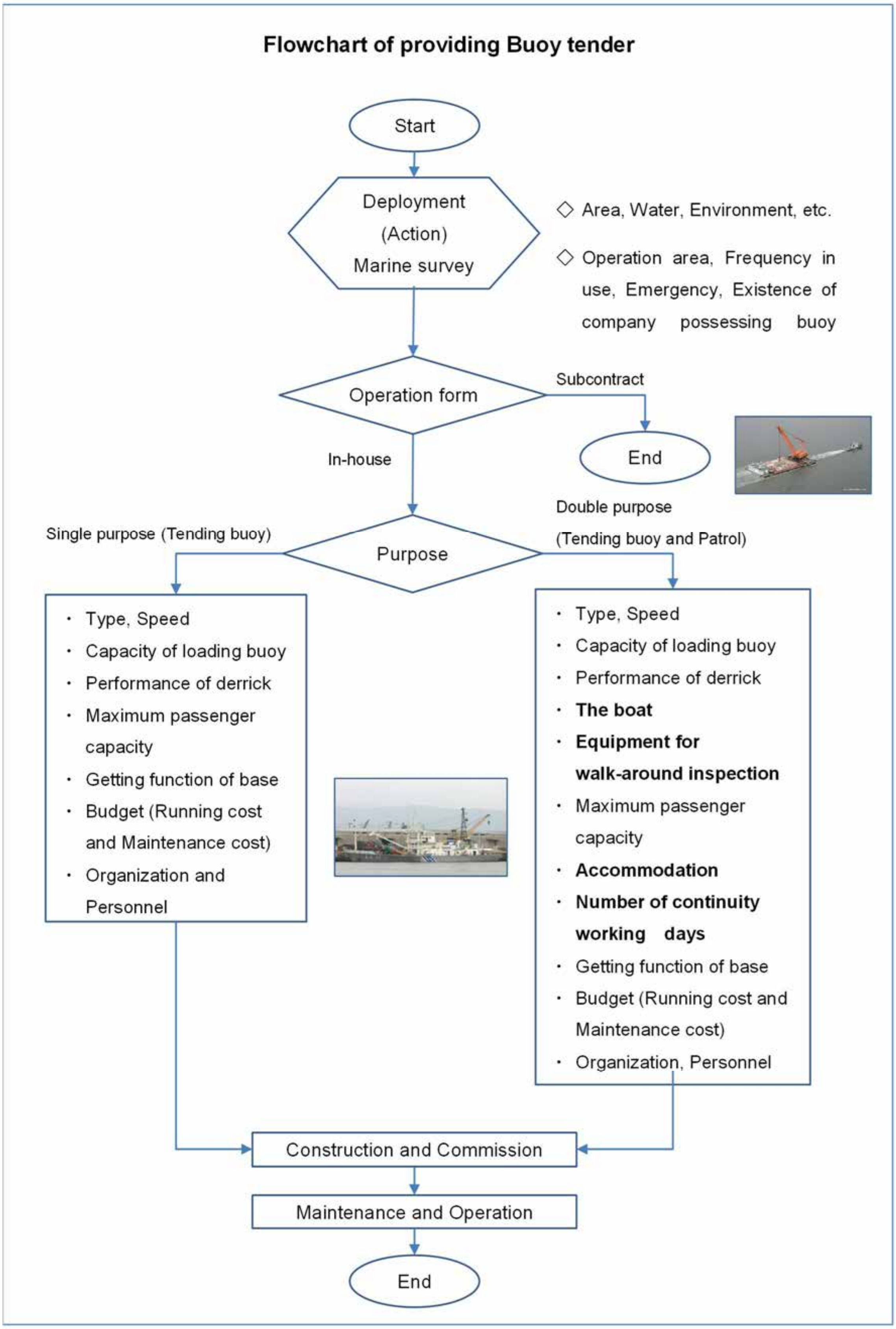


Figure 7.2.5 -2 : General Process

Reference

◎ Specification of Buoy tender ”HOKUTO”

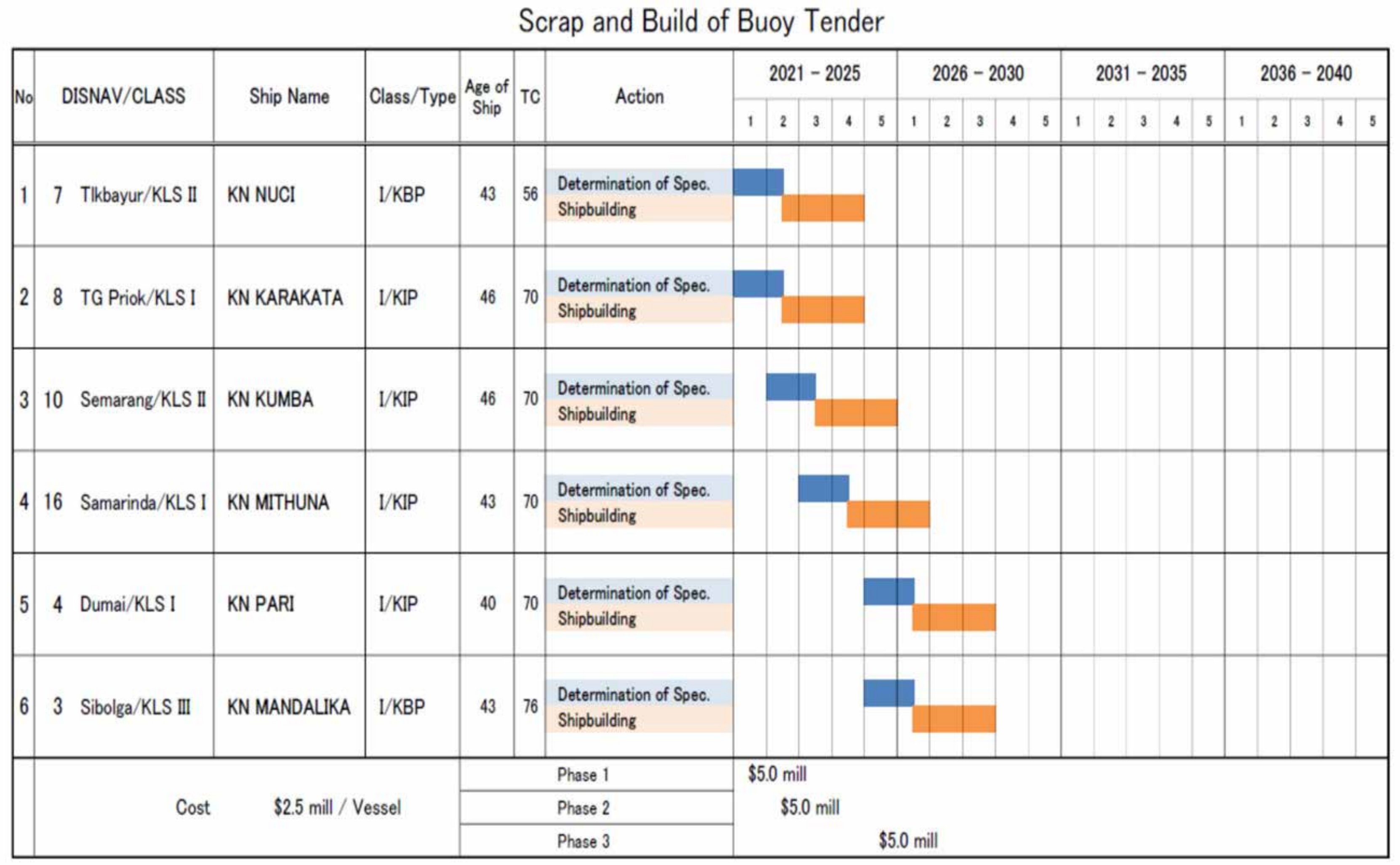
Length	55.0 m
Width	10.6 m
Depth	4.8 m
Gross ton	619 GT
Speed	14.1 Kt
Type	Flush decker

◎ Characteristics

- The derrick of Beret Thomson system with lifting capacity of 15 tons is equipped for lifting and recovery. 2 or 3 light buoys (L-2 type), 2 light buoys (L-3 type) and 4 sinkers with weight of 4 tons can be loaded in front deck. Fender is equipped on the broadside deck.
- The body of ship is painted gray color due to get dirty easily.
- Installation work of light buoy is done while checking and adjusting ship position by the position measurement device, variable pitch propeller and bow thruster.
- Bridge has 3 layers. Top shelf is pilothouse. Middle layer is cockpit of crane.

◎ Picture

Buoy tender HOKUTO

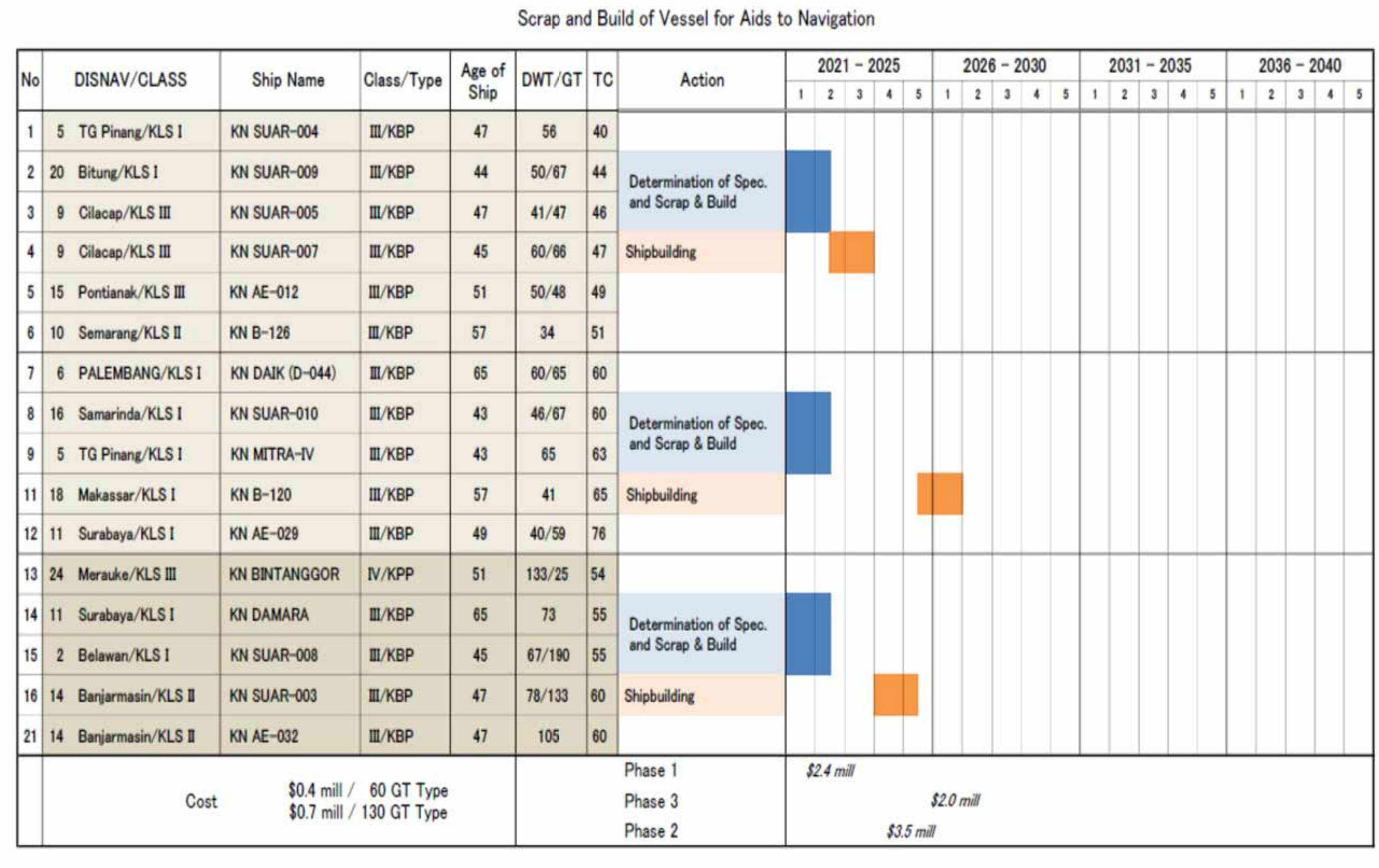


Scrap and Build of Buoy Tender

No	DISNAV/CLASS	Ship Name	Class/Type	Age of Ship	TC	Action
1	7 Tlkbayur/KLS II	KN NUCI	I/KBP	43	56	Determination of Spec. Shipbuilding
2	8 TG Priok/KLS I	KN KARAKATA	I/KIP	46	70	Determination of Spec. Shipbuilding
3	10 Semarang/KLS II	KN KUMBA	I/KIP	46	70	Determination of Spec. Shipbuilding
4	16 Samarinda/KLS I	KN MITHUNA	I/KIP	43	70	Determination of Spec. Shipbuilding
5	4 Dumai/KLS I	KN PARI	I/KIP	40	70	Determination of Spec. Shipbuilding
6	3 Sibolga/KLS III	KN MANDALIKA	I/KBP	43	76	Determination of Spec. Shipbuilding

Cost $2.5 mill / Vessel	Phase 1	$5.0 mill
	Phase 2	$5.0 mill
	Phase 3	$5.0 mill

Figure 7.2.5 -3 : Schedule of Scrap and Build for Buoy Tender



Scrap and Build of Vessel for Aids to Navigation

No	DISNAV/CLASS	Ship Name	Class/Type	Age of Ship	DWT/GT	TC	Action
1	5 TG Pinang/KLS I	KN SUAR-004	III/KBP	47	56	40	
2	20 Bitung/KLS I	KN SUAR-009	III/KBP	44	50/67	44	Determination of Spec. and Scrap & Build
3	9 Cilacap/KLS III	KN SUAR-005	III/KBP	47	41/47	46	
4	9 Cilacap/KLS III	KN SUAR-007	III/KBP	45	60/66	47	Shipbuilding
5	15 Pontianak/KLS III	KN AE-012	III/KBP	51	50/48	49	
6	10 Semarang/KLS II	KN B-126	III/KBP	57	34	51	
7	6 PALEMBANG/KLS I	KN DAIK (D-044)	III/KBP	65	60/65	60	
8	16 Samarinda/KLS I	KN SUAR-010	III/KBP	43	46/67	60	Determination of Spec. and Scrap & Build
9	5 TG Pinang/KLS I	KN MITRA-IV	III/KBP	43	65	63	
11	18 Makassar/KLS I	KN B-120	III/KBP	57	41	65	Shipbuilding
12	11 Surabaya/KLS I	KN AE-029	III/KBP	49	40/59	76	
13	24 Merauke/KLS III	KN BINTANGGOR	IV/KPP	51	133/25	54	
14	11 Surabaya/KLS I	KN DAMARA	III/KBP	65	73	55	Determination of Spec. and Scrap & Build
15	2 Belawan/KLS I	KN SUAR-008	III/KBP	45	67/190	55	
16	14 Banjarmasin/KLS II	KN SUAR-003	III/KBP	47	78/133	60	Shipbuilding
21	14 Banjarmasin/KLS II	KN AE-032	III/KBP	47	105	60	

Cost $0.4 mill / 60 GT Type
$0.7 mill / 130 GT Type

Phase 1 $2.4 mill
Phase 3 $2.0 mill
Phase 2 $3.5 mill

Figure 7.2.5 -4 : Schedule of Scrap and Build for Inspection Boat

7.2.6 Capacity Building

The specialists who have not only general maritime knowledge but also who are familiar with each field of aids to navigation are required in planning maritime traffic safety measures and promoting the operations of the task, and the staff involved in the operation of these fields must also have the minimum maritime knowledge.

In order to develop such human resources, it is ideal for related staff to study at a permanent educational institution, acquire the qualification necessary for work, and start working, but it takes time to set up this kind of educational system and framework. It is urgently proposed to form a special management group and deal with the issues which were identified in Chapter 6.

In addition, a large number of the operator of VTS and Coastal Radio Station, who are requested a qualification, is required for daily operation, and it is also an urgent task to arrange a system in which as many people as can take training.

Therefore, the special management group will be had be in charge of this mission, and the Setting up the Management Group and the training of the VTS operators should be considered as a priority project.

In order to maintain the sustainable operation of the maritime safety system over the long term, securing human resources is inevitable. One of the means for a stable supply of human resources is to build an institutional education system according to needs. As mentioned in Section 6.9, although various training courses have been prepared, the establishment of a new basic maritime knowledge course will be proposed that will be the prerequisite for attending training courses. It is expected to improve the effectiveness of the existing courses.

In the long term, it is desirable to establish a system in which all personnel engaged in maritime affairs can acquire maritime basic knowledge. There is something like a training school where all newly hired employees acquire basic knowledge for a certain period of time and take courses in each specialized field after attending the basic course.

The outline of this proposal is described briefly below.

◆Establishment of Basic Maritime Knowledge Course

This course is open to anyone who wants to take various existing training courses in the future, and is especially aimed at staff that has no experience or knowledge of maritime affairs. It may be positioned as pre-education of the existing "Basic Level Technical Training of Aids to Navigation" course.

The following outline is proposed.

a. This course is established at BPPTL.

b. Participants are those who belong to NAVIGASI, and who will be engaged in the work related to maritime affaires for the first time, and who will be engaged in aids to navigation services in the future.

c. Lesson hour will be 200/30 days, following other courses.

d. The curriculum is a concise summary of the minimum knowledge of "Maritime Affairs" that everyone involved in the sea (The detailed program shall be made by the group described in Section 7.1).

The curriculum content is based on a further breakdown of the existing basic level training of aids to navigation course, and is selected from those that can be understood from ordinary life.

The curriculum items that are expected are shown in the Table below.

Table 7.2.6 -1 : Curriculum Subjects for Basic Maritime Knowledge Course

	Subject		
	Item	Basic Level	General Knowledge
1	Ocean	What is the sea?	
		Size	
		Depth	
		Territorial waters	Baseline, UNCLOS, Right of Passage, The Open Sea, EEZ
		Straight	Waterway, Traffic routes, Chanals
2	Ship	Types	Merchant, Work, Fishing, Special and Naval vessels
		Size	Tonnage, LOA,
		Speed	Nautical miles, Knot
		Shipbuilding	Body, Painting, Ship-power, Fuel, Electricity, Dirinking water
		Maneuvering	Steering wheel, Ladder, Side-thrusters, Mooring, Ballast
		Cargo	Loading, Unloading, Quantity and Weight of the cargo
		Ship marks	Ship's name, Nationality-Port, Load Water Line, Deck Line, Pushlines, Funnel marks
		Inspection	Global standards, Insurance, P&I Insurance
3	Navigation	Fixing position	Celestial navigation, Radio navigation,
		Nautical charts	Marks, ECDIS
		Course	Gyrocompass
		Aids to Navigation	Visual aids, Radio aids, Buoyage
		Navigation roules	Act on Preventing Collision at Sea, Maritime Traffic Law, Lights
		Marine accident	Stranding, Collision, Distress signals, Search and Rescue
		Sailor	Captain, Engineer, Navigator, Deck crew, Watchstander
		Radio Communication	Morse code, Flag signals,Hand signals, Radio
		Other	UTC, Anchor, Pilot, Pirate, Call sign
4	Marine Transportation	Trade	Import and Export, Number and nationality of ships, Flag of convenience
		Port	Passenger terminal, Cargo terminal, Cointainer Terminal, Fishing port

The Management Group will thoroughly consider participation requirements, curriculum items, and the career path after training for getting approval from relevant departments. Text books will be developed here too.

The implementing of this plan is expected to bring about the following spreading effect.

a. There are no more vague approaches to work

b. It is expected that the acquisition of maritime knowledge not only increases the level of understanding of the work, but also positively works on the job.

c. It is possible to make good judgment on the job related to maritime affairs.

d. It opens the way to the specialized maritime fields of interest.

e. Self-confidence will be gained and activeness is shown on the job.

◆ Establishment of an educational institution for Aids to Navigation

The permanent training course is to be established for all fresh graduates in all aspects of education and training for aids to navigation services including VTS operation.

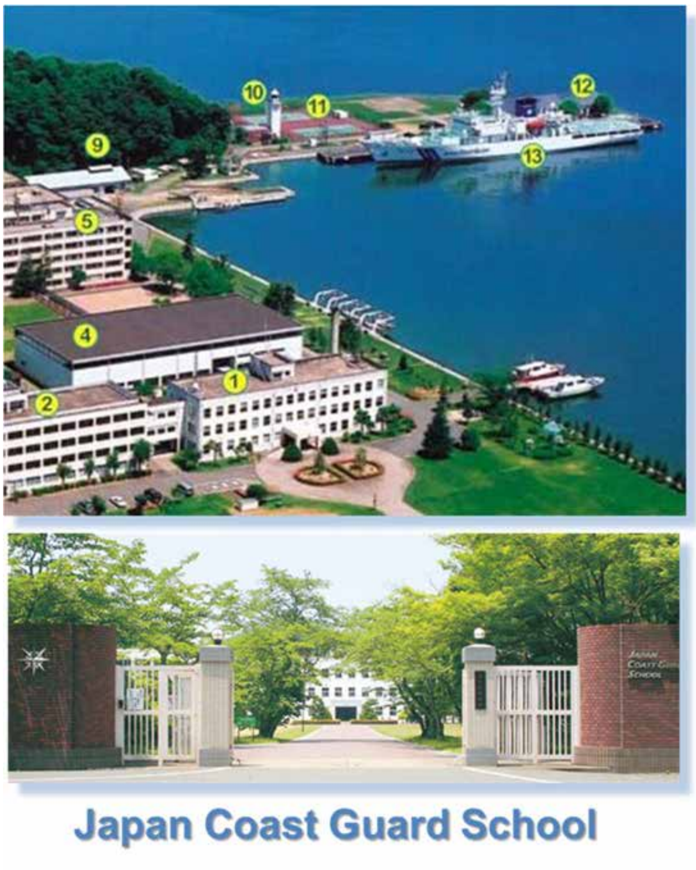
The course is year-round and all new hires must attend the course from the beginning of the new school year.

The period of completion of the course is one year (or two years). During this time, the necessary knowledge and skills will be acquired as NAVIGASI staff.

If it is possible in terms of facilities and systems, all trainees stay in a dormitory and have a meal together, which will be able to achieve the training outcome efficiently and to lead to their sense of solidarity.

The explanation is given below by taking the training system for the staffs that are engaging in aids to navigation services in Japan as an example.

All staffs involved in aids to navigation in Japan are the maritime safety officers of Japan Coast Guard and they must enter the Coast Guard School established by the Ministry of Land, Infrastructure and Transport and graduate from there.



Picture 7.2.6 -1 : Maritime Training School

a. Requirement of admission

- * Examinees are 18 – 30 years old and graduate from high school
- * Applicants are recruited from all over the country and on gender equality.

b. Status of students

- * Examinees passed the exam are temporarily employed as the government employee for a certain period of time.
- * They have the status of a "Student" and receive their salary while training at the school.

c. Location and facilities

- * A site is adequately wide and easy accessible place to enable a comprehensive education and training.
- * The following facilities are prepared.

  Class rooms, Training rooms, Equipment storages, Ground, Gymnasium, Swimming pool, Instructor's room, ICT (Information and Communication Technology) training room, Administration building, Dormitory, Canteen, Hall, School bus.

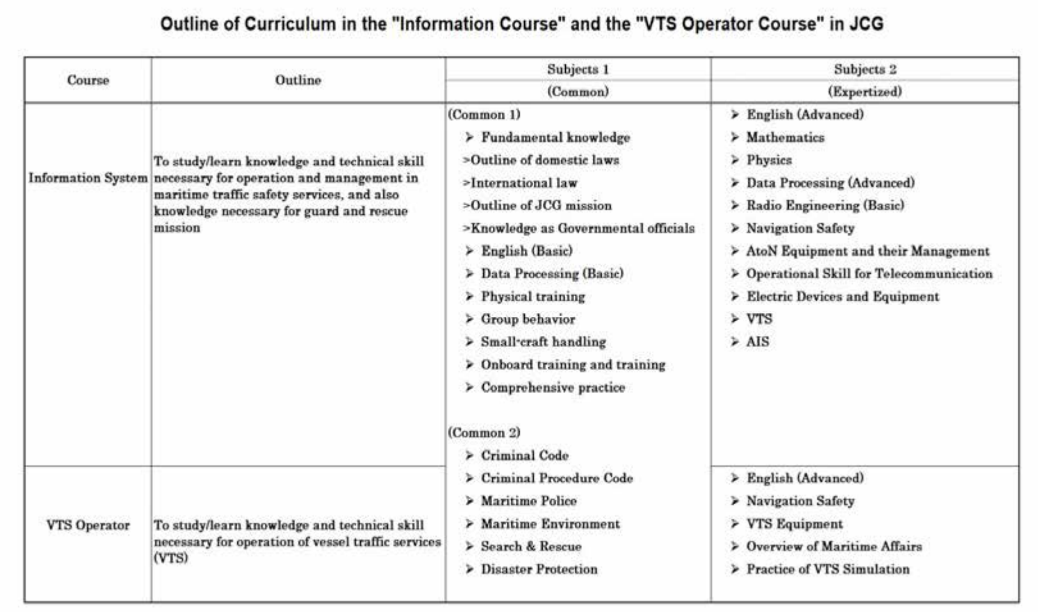
d. Training period

- * The completion period is 2 years to acquire the relevant knowledge and skills as well as a national qualification required for the job.

e. Major subjects

- * There are two courses, the "Information Course" and the "VTS Operator Course", which are outlined in the Table below.

Table 7.2.6 -2 : Outline of Curriculum

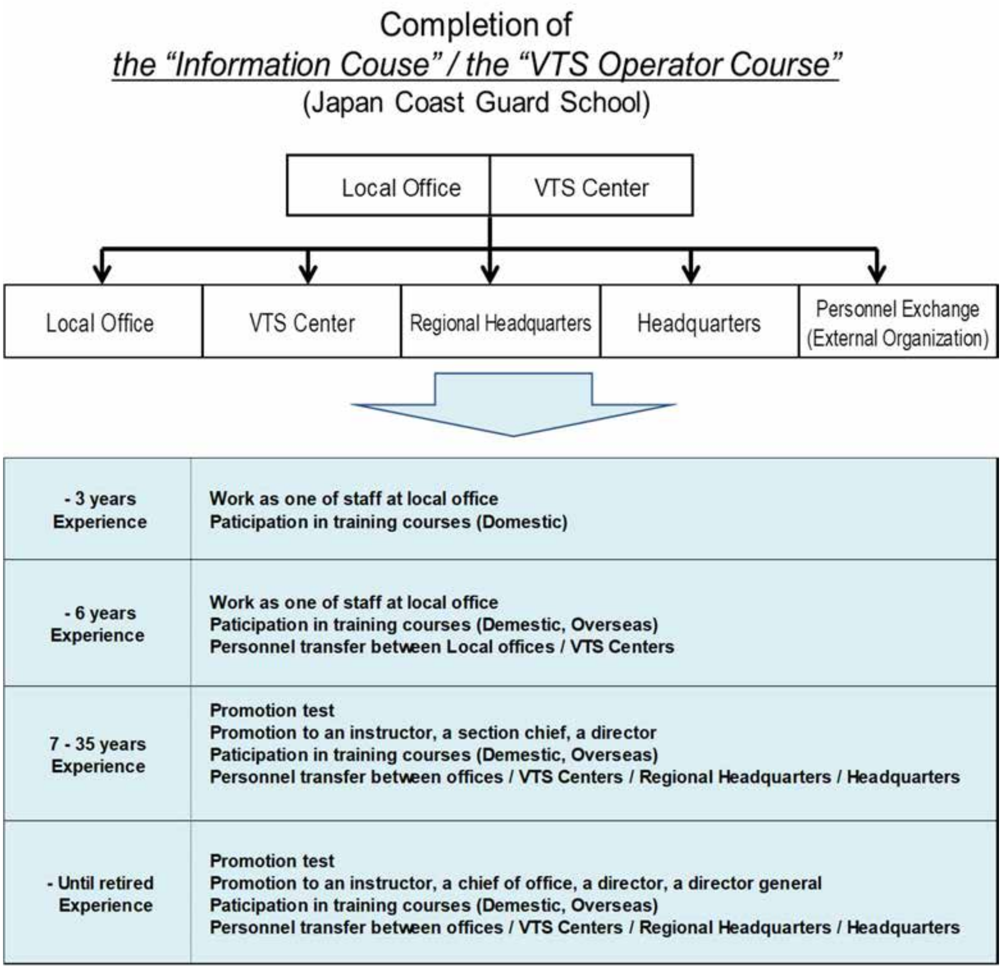


Outline of Curriculum in the "Information Course" and the "VTS Operator Course" in JCG

Course	Outline	Subjects 1	Subjects 2
		(Common)	(Expertized)
Information System	To study/learn knowledge and technical skill necessary for operation and management in maritime traffic safety services, and also knowledge necessary for guard and rescue mission	(Common 1) ➢ Fundamental knowledge >Outline of domestic laws >International law >Outline of JCG mission >Knowledge as Governmental officials ➢ English (Basic) ➢ Data Processing (Basic) ➢ Physical training ➢ Group behavior ➢ Small-craft handling ➢ Onboard training and training ➢ Comprehensive practice (Common 2) ➢ Criminal Code ➢ Criminal Procedure Code ➢ Maritime Police ➢ Maritime Environment ➢ Search & Rescue ➢ Disaster Protection	➢ English (Advanced) ➢ Mathematics ➢ Physics ➢ Data Processing (Advanced) ➢ Radio Engineering (Basic) ➢ Navigation Safety ➢ AtoN Equipment and their Management ➢ Operational Skill for Telecommunication ➢ Electric Devices and Equipment ➢ VTS ➢ AIS
VTS Operator	To study/learn knowledge and technical skill necessary for operation of vessel traffic services (VTS)		➢ English (Advanced) ➢ Navigation Safety ➢ VTS Equipment ➢ Overview of Maritime Affairs ➢ Practice of VTS Simulation

The main point of the establishment of an educational institution for Aids to Navigation is that who intend to engage in maritime safety services have to take the permanent training or participate in the minimum training courses. In addition, the purpose of participation for trainees will be clarified by showing the career path after graduation or promotional treatment after taking the course.

An example of the current state of Japan regarding the career path after completing the course is shown in the Figure below.



- 3 years Experience	Work as one of staff at local office Paticipation in training courses (Domestic)
- 6 years Experience	Work as one of staff at local office Paticipation in training courses (Demestic, Overseas) Personnel transfer between Local offices / VTS Centers
7 - 35 years Experience	Promotion test Promotion to an instructor, a section chief, a director Paticipation in training courses (Demestic, Overseas) Personnel transfer between offices / VTS Centers / Regional Headquarters / Headquarters
- Until retired Experience	Promotion test Promotion to an instructor, a chief of office, a director, a director general Paticipation in training courses (Demestic, Overseas) Personnel transfer between offices / VTS Centers / Regional Headquarters / Headquarters

Figure 7.2.6 -1 : General Career Path after the Graduation

(Expected Outcome)

a. By adopting a training school system, it is possible to stably recruit and assign staffs, and also unify existing training courses.

b. Make it easy to gain the qualifications and certifications required for work.

c. The ability of all staff can be equalized.

d. Personnel exchanges are also possible, which leads to activation of the office.

e. Instructors can be brought up by an internal organization.

f. Human resource development can be systematically planned.

(Reference)

The cover copy of the recruitment brochure for VTS Operator in Japan, and the training system and the model of the career path for VTS operators who belong to the Maritime and Port Authority of Singapore are shown below.

Video is available on the Web.

Emblem showing the qualified VTS Operator

Enrollment (Recruitment) of VTS Operator

Source : HP of Japan Coast Guard School

Picture 7.2.6 -2 : Poster of Recruitment for VTS Operator

Functional Training Plan

New Staff

IALA V-103/1 VTS Operator Training
- 8 week training conducted by Singapore Maritime Academy

Awarded:
- IALA V103/1 Certificate

IALA V-103/3 VTS Operator OJT
- 6 week training conducted by MPA

Awarded:
- IALA V103/3 Certificate
- VTIS Operator Logbook

Certified VTS Operator

MPA-VTS Training
- 3 week training per workstation conducted by MPA

Awarded:
- VTM Competency Certificate

Year 0.0 Commencement IALA Training
Year 0.5 Completion of IALA Training & Commencement of Service
Year 2.0 Onwards Embark on Career Development Training

Career Development Path - with new job designations

Entry Level	Basic Level	Intermediate Level	Advance Level	Watch Sup Level	Snr Watch Sup Level	Watch Mgr Level	Snr Watch Mgr Level
Trainee	Assistant Vessel Traffic Officer	Vessel Traffic Officer	Senior Vessel Traffic Officer	Watch Supervisor	Senior Watch Supervisor	Watch Manager	Senior Watch Manager
Undergo IALA V-103/1 Training	Data Entry	VTIS East	VTIS Central	Sembawang Control MTC	Sensitive Vessel	Watch Manager (Vista or Changi)	Overall IC for entire Watch
Undergo IALA V-103/3 Training	Cruise Bay	VTIS West	Pasir Panjang Control	Pasir Panjang Control MTC		Bridging Course (for non-mariners)	
	East Control	Jurong Control	Keppel Control	VTIS MTC			
	West Control	Sembawang Control	Undergo IALA V-103/2	Undergo IALA V-103/4			
	Sinki Control		GMDSS (By Selection)				

Year 0.0 Commencement of Service
Year 2-4 Advancement to Intermediate Level
Year 3-6 Advancement to Advance Level
Year 5-8 Advancement to Watch Supervisor Level
Year 6-10 Advancement to Watch Snr Supervisor Level
Year =>12.0 Advancement to Watch Manager Level
Year =>16.0 Advancement to Snr Watch Manager Level

Figure 7.2.6 -2 : Training and Career Path of VTS Operator in Singapore

7.2.7 Other Topics

Nowadays, the system that works on computer technology including IT (Information Technology) has become commonplace and efficient and rational systems are required. Those must be conforming to a high quality age. In other words, it is the introduction of new technology and the creation of an integrated system that takes advantage of the social infrastructure.

Regarding the introduction of new technologies in the maritime sector, it is important to build a system that can respond to any time while watching trends in E-Navigation.

In the future, the use of communication infrastructures and the introduction of new technologies using IT will be essential for the construction of a wide-area maritime safety information system.

◆Development of Integrated Information System

The information on the movement of vessels, which is derived from the radar system, the AIS system and the coastal radio stations operated by DGST, is essential to formulate a safety counterplan of maritime traffic, and it is processed statistically and used for analysis for future forecasts.

On the other hand, these pieces of information are useful to maritime organizations, and they contain a lot of valuable intelligence contents for other government agencies.

Since the information communication network has been improved rapidly, it became easier to share such information via the network, and the establishment of an integrated information system with the network is beneficial for all agencies. Consolidating a lot of information saves waste of collecting information individually and may result in more valuable information.

In the world of maritime traffic, a lot of research and study on systems incorporating IT has been done, and E-Navigation is one of them, which is a system related to support for maritime navigation. In the configuration of E-Navigation, the functions of VTS and AIS are highly related as land-based facilities. It will be difficult for VTS and AIS to join the group of E-Navigation system, unless they are well integrated by the time the E-Navigation is formed.

Since it takes time and budget to make preparations and design for establishing an integrated information system instantaneously, it is more reasonable to start with the development of Database for AIS, the innovation of VTS Operation and the consolidation of Coastal Radio Station and the development of human resource should not be forgotten.

The conceptual diagram of the integrated information system is shown in the Figure at the next page.

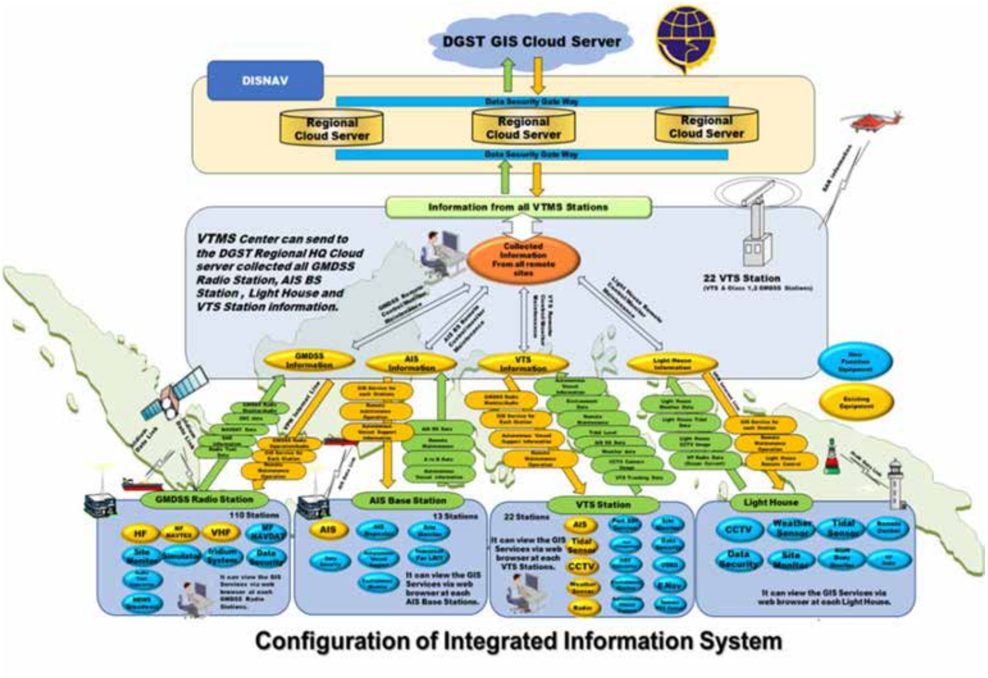


Figure 7.2.7 -1 : Conceptual Diagram of System

The image of the integrated information hierarchy and the display is shown in the Figure below.

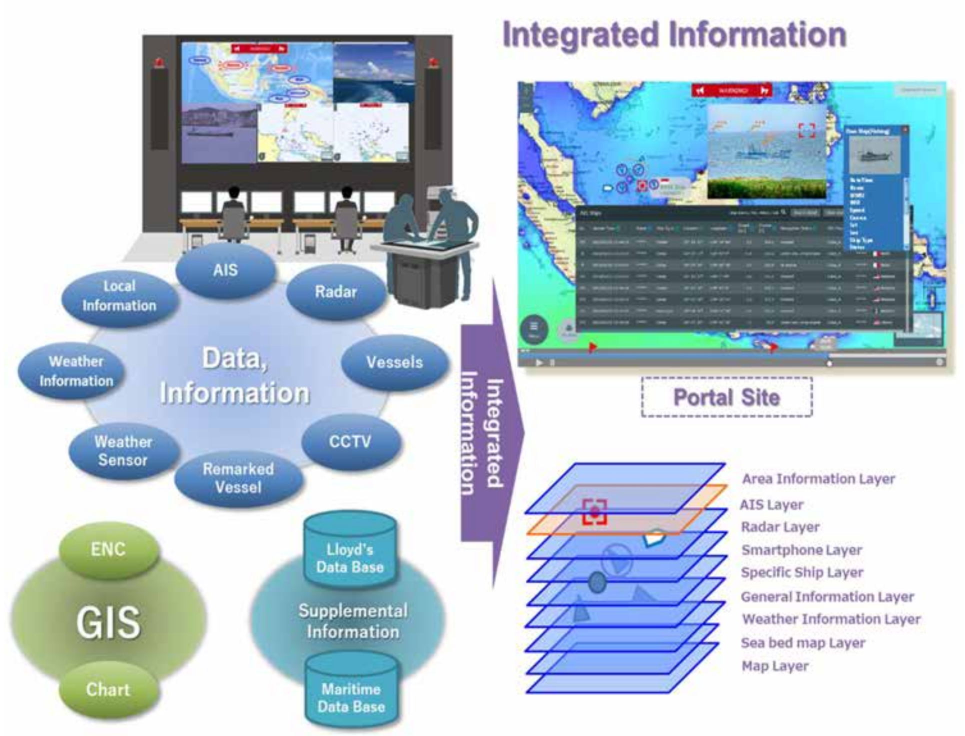
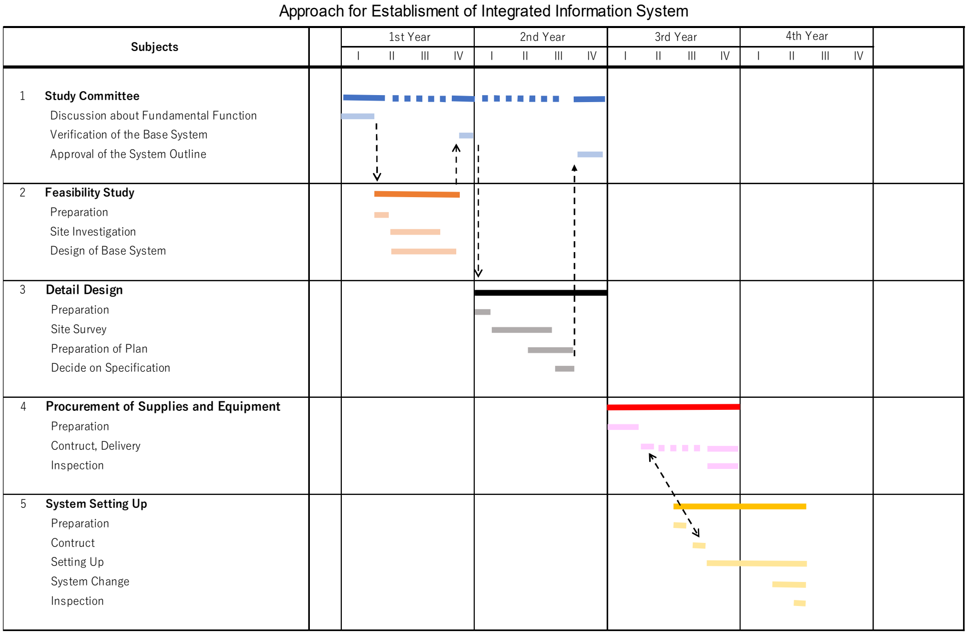


Figure 7.2.7 -2 : Display Image of Integrated Information

The establishment process for introducing an integrated information system is shown in the Figure below.

Table 7.2.7 -1 : Establishment Schedule of Integrated Information System



The correlation with the administrative organizations and maritime parties is shown in the Figure below.

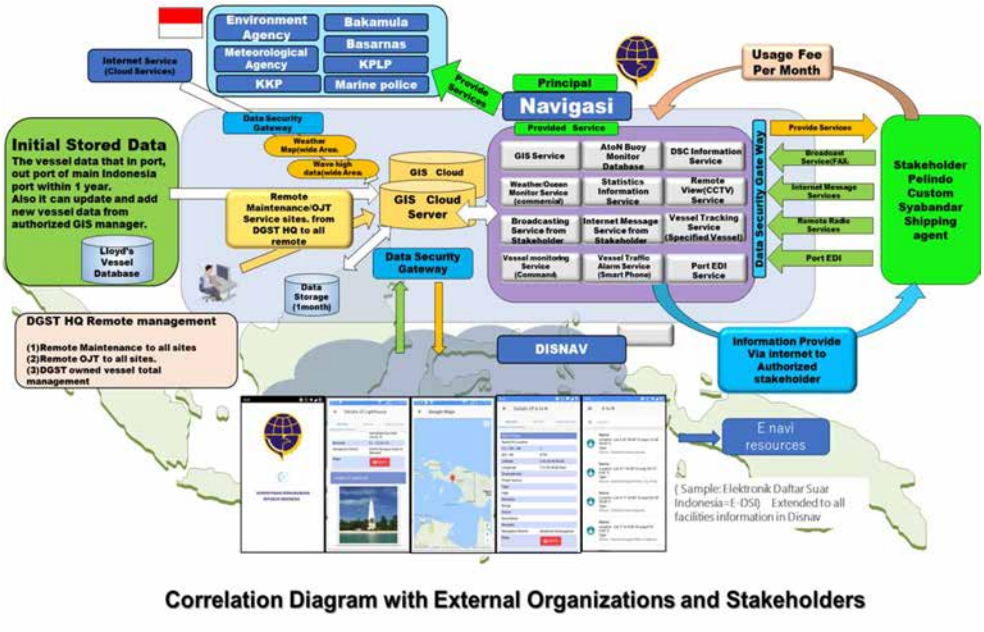


Figure 7.2.7 -3 : Correlation Diagram with Related Organization

7.3 Priority Project

The issues that have emerged in each sector related to aids to navigation is that the task is not being carried out enough as one expected. The background is clearly the lack of human resources and the absence of the specialists. The development of human resource is a top priority subject that should be addressed immediately without hesitation.

Regarding VTS which is established at 23 locations nationwide, it is advisable to immediately consider the daily operation performed by VTS operators and the training for them, before any problems related operation occur.

The next one is that AIS has been operated independently by each station and has not been the system which can be used for analysis of maritime traffic to take further safety measures. There is an urgent need to build a system that can integrate the data collected by individual AIS stations into a database and analyze them.

Furthermore, the project of tourism promotion is being performed as one of the national strategic policy, and tourists to enjoy marine leisure are being attracted. In places visited by many of these people, it is necessary to take urgent maritime safety measures, especially against small crafts and pleasure boats, to prevent marine accidents.

7.3.1 Development of Capacity Building

1) Setting up the Management Group

Presently, trainees are simply sent to BPPTL which is the specialized agency for training, and the selection of trainees, training outcomes, and subsequent training plans are not centralized within the DGST. From these points, there are some aspects where sufficient results have not been obtained.

The first step to be taken is the effective implementation and verification of the existing training courses, and the establishment of a group within the DGST to comprehensively manage and plan these courses. Concurrently, the staff engaged in this group will become full-time instructor.

(Action)

One person is selected from each department of the DGST to form a group, which has a mission to formulate training plans, to review curriculum / text and to verify training results. The group will be set up under the guidance of an outside expert or an experience for the time being at first.

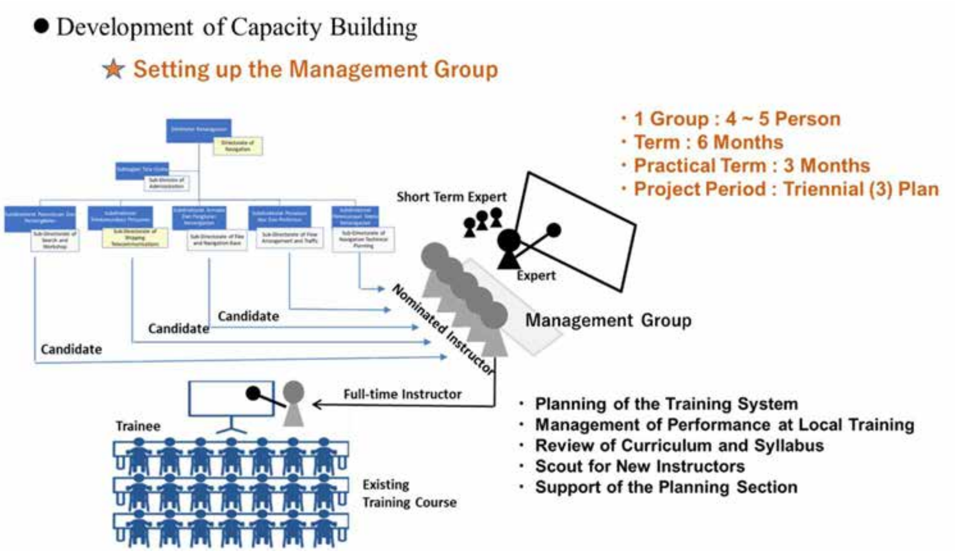
These staff members can devote themselves to becoming their full-time instructors.

(Roadmap to Implementation)

After inviting an outside expert and selecting group members, those selected will be trained for one year to become an instructor and a manager under the program prepared by the expert.

This program will be continued for 3 years. Each year, about 4 persons will be trained and a total about 12 instructors will be brought up in 3 years.

The following figure is a conceptional drawing, and the roadmap and the budget list are shown on the next page.



- Development of Capacity Building

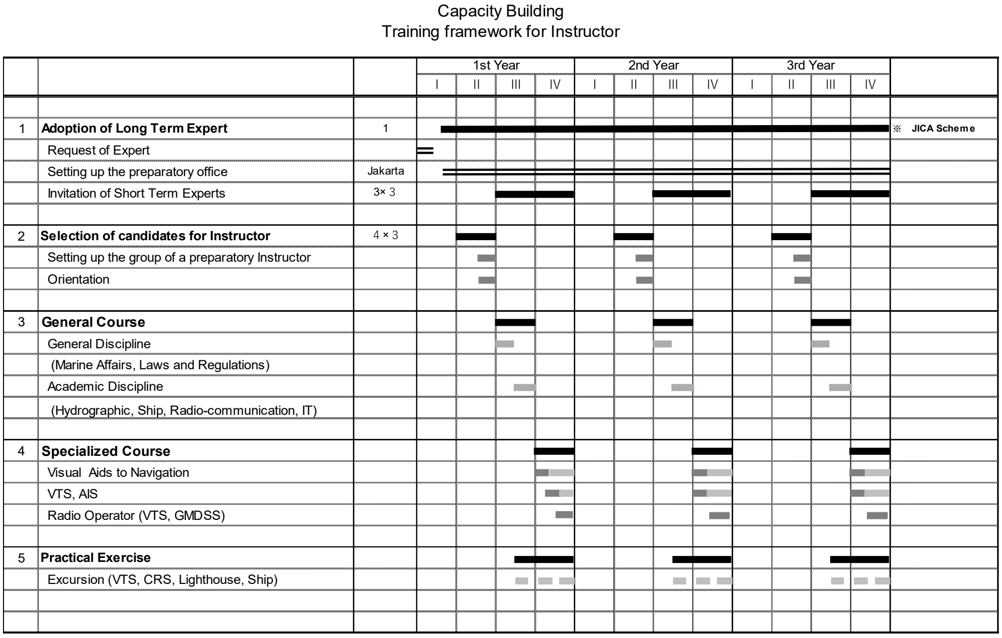
★ Setting up the Management Group

- 1 Group : 4 ~ 5 Person
- Term : 6 Months
- Practical Term : 3 Months
- Project Period : Triennial (3) Plan

- Planning of the Training System
- Management of Performance at Local Training
- Review of Curriculum and Syllabus
- Scout for New Instructors
- Support of the Planning Section

Figure 7.3.1 1) -1 : Image of Training

Table 7.3.1 1) -1 : Training Course for Instructor



Capacity Building
Training framework for Instructor

			1st Year				2nd Year				3rd Year				
			I	II	III	IV	I	II	III	IV	I	II	III	IV	
1	**Adoption of Long Term Expert**	1	■	■	■	■	■	■	■	■	■	■	■	■	※ JICA Scheme
	Request of Expert		═												
	Setting up the preparatory office	Jakarta	═	═	═	═	═	═	═	═	═	═	═	═	
	Invitation of Short Term Experts	3× 3			■	■			■	■			■	■	
2	**Selection of candidates for Instructor**	4 × 3		■				■				■			
	Setting up the group of a preparatory Instructor			▨				▨				▨			
	Orientation			▨				▨				▨			
3	**General Course**				■				■				■		
	General Discipline				▨				▨				▨		
	(Marine Affairs, Laws and Regulations)														
	Academic Discipline				▨				▨				▨		
	(Hydrographic, Ship, Radio-communication, IT)														
4	**Specialized Course**					■				■				■	
	Visual Aids to Navigation					▨				▨				▨	
	VTS, AIS					▨				▨				▨	
	Radio Operator (VTS, GMDSS)					▨				▨				▨	
5	**Practical Exercise**				■	■			■	■			■	■	
	Excursion (VTS, CRS, Lighthouse, Ship)				▨	▨			▨	▨			▨	▨	

(Budget)

Budget						
	Item	Spec.	Quan.	Price ($)	Total ($)	Remarks
1	Equipment	PC, Book	1	18,500	18,500	
2	Expenses (Expert)*	Training Course for Instructor	3	6,800	20,400	1 x 3 years
3	Expenses (Short-term Expert)*	〃	3	18,525	55,575	2 x 3 months x 3 years
	* Excluding the expensies for labor costs of Expert and Short-term experts					
				Total	94,475	

(Expected Outcome)

The implementing of this plan is expected to bring about the next spreading effect.

a. Dispatch of full-time instructors to training courses conducted at BPPTL

b. Planning of the training system

c. Management of the actual conditions for training at all DISNAVs

d. Review of curriculum and syllabus

e. Scout for new instructors

f. Support of the planning section

The Roadmap and the Budget Table is attached as an Appendix 7.3.1 1) -1 and an Appendix 7.3.1 1) -2.

2) For the VTS Operator

At present, there are three VTS training courses (the basic, the operator and the instructor, and two others for OJT) being conducted at BPPTL. Besides these, neighboring countries have the training courses such as Malaysia in the ASEAN frame work or Singapore, and there is an opportunity to participate in these courses.

By the way, there are 23 VTS stations in operation now, and the total number of VTS operators is hundreds. It would take years for everyone to attend this kind of training courses without the disruption of their work.

Recently, an e-learning system has been enriched with replete learning software along with the spread of Internet, and is being adopted for learning and training in remote areas. This system enables local people such as VTS operators to receive training at their own site.

By putting in place a system consisting of one terminal in each station and the server at a management site, each VTS personnel can participate in the training at their own station. (If the above-mentioned Management Group supervises and operates the system, a synergistic effect will be created and more sustainable operation will be possible.)

(Action)

The implementation design for the system including the contents of each subject for VTS operation will be made. Then, the communication infrastructure will be prepared and related necessary equipment will be procured.

After these preparations are made, the system will be set up and exercises will be done.

The schematic diagram of the system is shown in the Figure below.

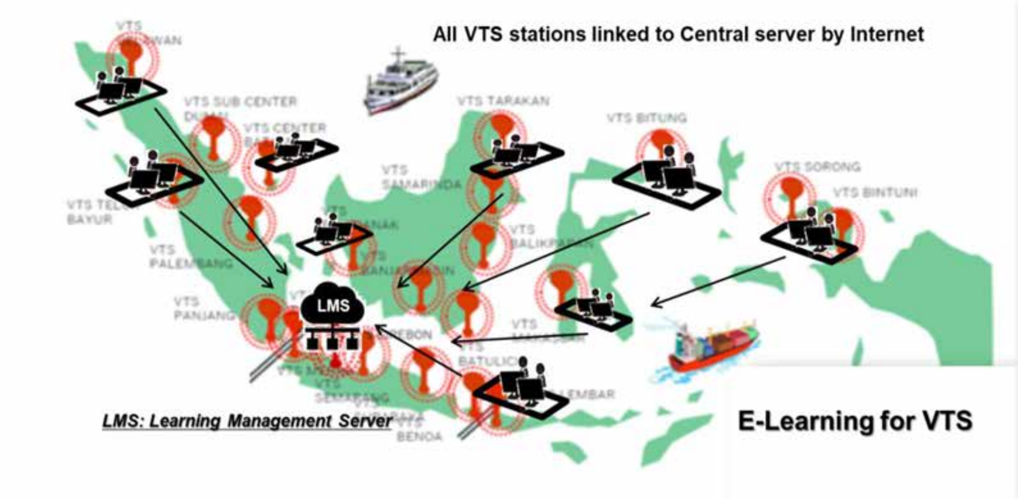


Figure 7.3.1 2) -1 : E-Learning System for VTS Operator

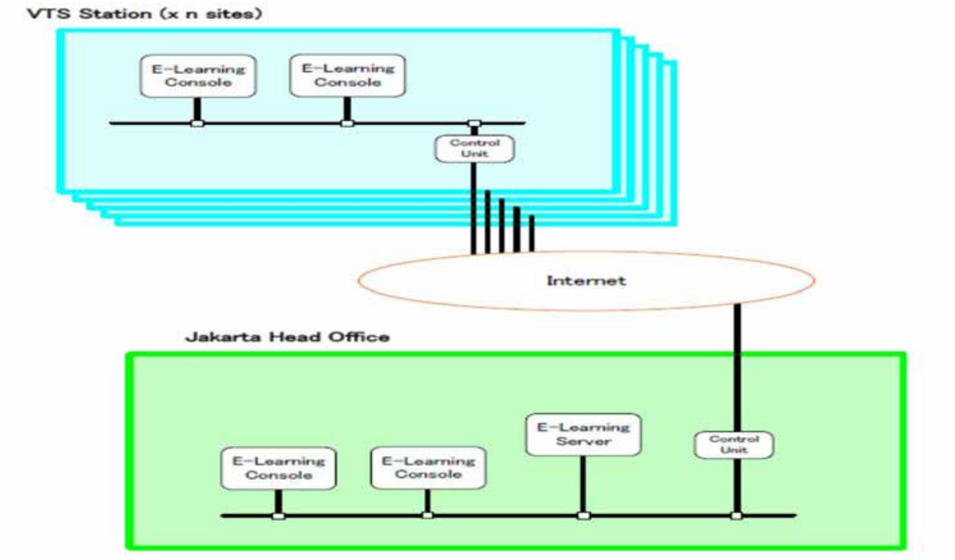


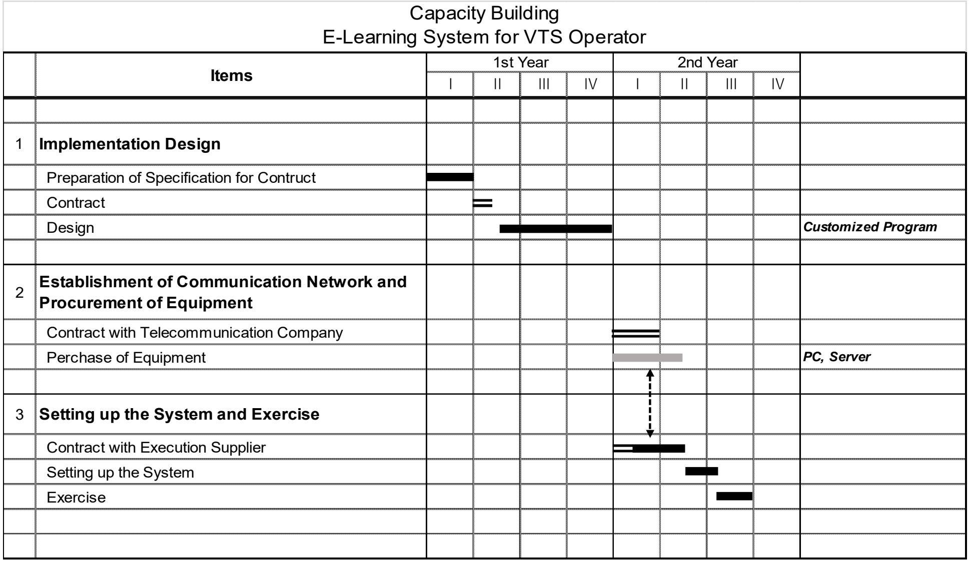
Figure 7.3.1 2) -2 : System Configuration of E-Learning System

(Equipment List)

Equipment List				
	Item	Site	Quan.	Remarks
1	E-Learning Console	VTS Station	2	Lap top PC
	Control Unit	〃	1	Hub, Router
2	E=Lerning Server	Management Office	1	Software
	E-Learning Console	〃	2	Desk top PC
	Control Unit	〃	1	Hub, Router

(Roadmap)

Table 7.3.1 2) -1 : Establishment of E-Learning System



Capacity Building
E-Learning System for VTS Operator

	Items	1st Year				2nd Year				
		I	II	III	IV	I	II	III	IV	
1	**Implementation Design**									
	Preparation of Specification for Contruct	▬								
	Contract		=							
	Design		▬	▬	▬					***Customized Program***
2	**Establishment of Communication Network and Procurement of Equipment**									
	Contract with Telecommunication Company					=				
	Perchase of Equipment					▬	▬			***PC, Server***
3	**Setting up the System and Exercise**									
	Contract with Execution Supplier					▬	▬			
	Setting up the System						▬	▬		
	Exercise							▬		

*Roadmap is attached as an Appendix 7.3.1 2) -1.

(Budget)

Approximate cost for 23 VTS stations

Implementation Design :	US $	24,000.-	
Purchase of Equipment :	US $	519,000.-	(Including Setting up)

*Breakdown of the cost is attached as an Appendix 7.3.1 2) -2.

(Expected Effects)

The following effects can be expected.

a) More staff can participate in the training.

b) Anytime and Anywhere (No travel)

c) Trainees can exchange information and ideas among their colleagues, and learn together.

d) Acquisition of participation requirements for IALA V-103 Training

e) System expansion for other services, such as web-meeting, sharing statistical data

7.3.2 Development of Data-base for AIS

The AIS is an important device in the VTS system to detect the movement of vessels and is indispensable for VTS operation.

The AIS base-stations managed by NAVIGASI are established at the VTS stations and the coastal radio stations, and there are 62 stations in all (Additionally, there are several other AIS stations operated by KPLP (Indonesian Sea and Coast Guard).

The received AIS information is displayed on the monitor in the VTS station and is mainly used for monitoring and confirming the location of a vessel that makes a position report.

The monitoring equipment in use now is different at each station on a manufacturer and the general functions have only been provided. There is no specific functionality required for individual VTS stations to operate.

There are functions to display static information (Name, Type, etc.), dynamic information (Course, Speed, etc.), and the extension vector of course and speed, and the tracking course of an AIS vessel, but these are the minimum functions required for the operation. There are no functions for data-search and data-editing functions to analyze the traffic flow and statistical processing.

AIS data is useful not only for monitoring work, but also for statistical work by accumulating data and can be very valuable for planning navigational safety measures. These data become more valuable by centralizing and constructing database rather than being processed by an individual VTS station alone.

In addition, by collecting the data at the center, the movement of vessels in the entire Indonesian waters will be displayed on a single screen. This will make it easier to understand the overall situation in the event of a marine accident, and this system is extremely useful for quickly giving instructions in rescue operation at the center (Headquarters).

(Action)

The implementation design for the development of AIS Data Base system will be made, including the confirmation of the communication network between an AIS base-station and the center (Headquarters), of the situation of the equipment installed now, and of the out-put signal format of those equipment, and then the communication network equipment including a server and an operational console is procured.

After these preparations are made, the system will be set up.

The schematic diagram of the system is shown in the Figure at the next page.

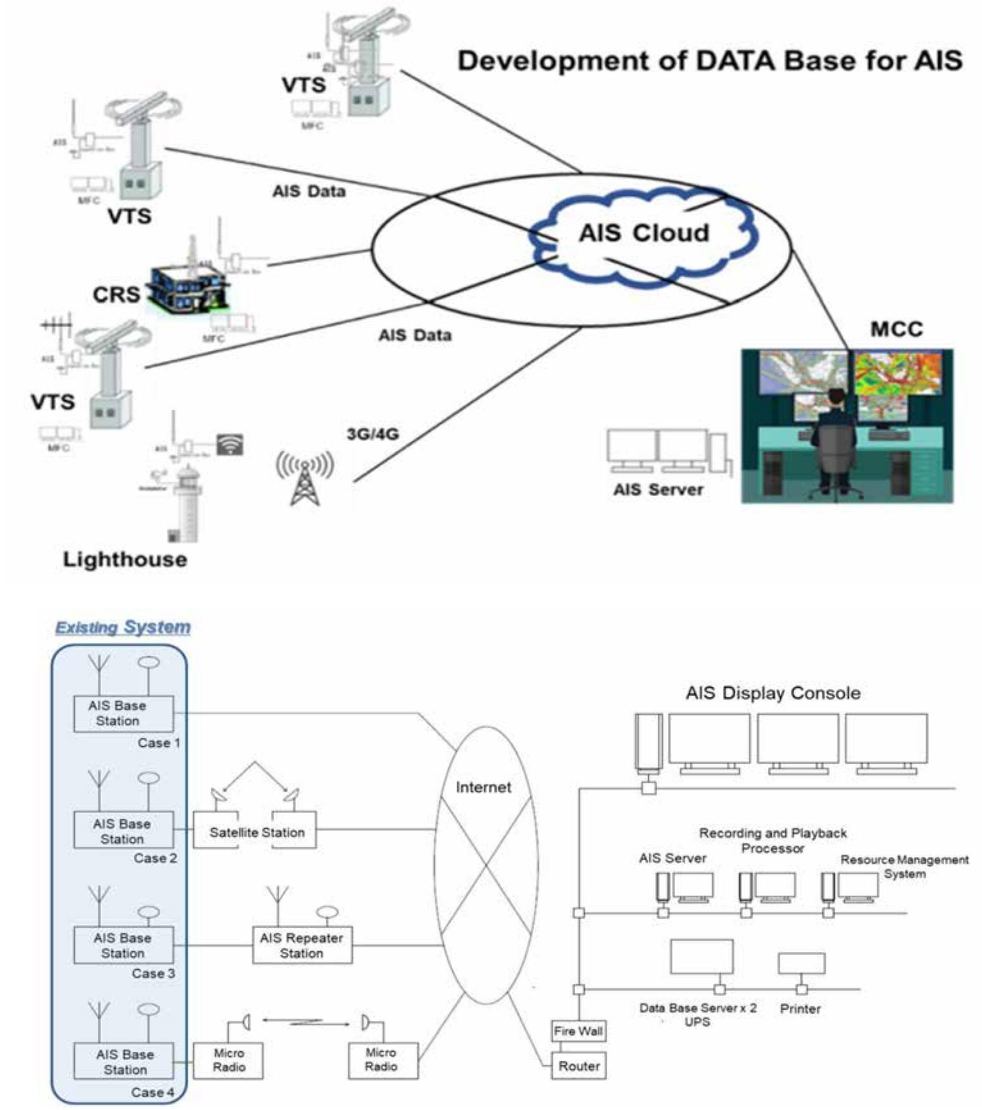


Figure 7.3.2 -1 : System Configuration of Data Base for AIS

(Equipment List)

Equipment List (AIS Data Base)				
	Item	Site	Quan.	Remarks
	Operation Console	Multi Function Console	3	MCC
	Network Terminal	Hub, Router, Firewall	1	〃
	Integrated AIS Data Base Server	AIS, RP Processor, Resorce System	1	〃
	System Software		1	〃
	IP Converter	Serial - LAN	1	AIS Base Station
	Network Terminal	Switching Hub, Router	1	〃
	Firewall		1	〃
	※Possible devices are listed.			

(Roadmap)

Table 7.3.2 -1 : Establishment of Data Base for AIS

Establishment of AIS Data Base

	Items	1st Year				2nd Year				
		I	II	III	IV	I	II	III	IV	
1	**Implementation Design**									
	Preparation of Specification for Contruct	▬								
	Contract		═							
	Design		▬	▬	▬					***62 staions***
2	**Establishment of Communication Network and Procurement of Equipment**									
	Contract with Telecommunication Company					═				
	Perchase of Equipment					▬				***Server, Operatinal Console, Network Equipment***
3	**Setting up the System and Exercise**									
	Contract with Execution Supplier					═▬				
	Setting up the System						▬			
	Guidance						▬			***Training (IWRAP)***

*Roadmap is attached as an Appendix 7.3.2 -1.

(Budget)

Implementation Design	US $	75,000.-
Purchase of Equipment	US $	2,365,000.- (MCC + 62 AIS sites)
System Construction Costs	US $	122,000.-

*Breakdown of the cost is attached as an Appendix 7.3.2 -2.

(Expected Effects)

The movements of vessels navigating the Indonesian waters can be monitored in real time and in an integrated way by collecting data from AIS stations distributed throughout Indonesia and by building a database. And, by statistically processing the accumulated data, it is possible to see into the current traffic flow and the change in a traffic situation, and to prospect a next policy. An AIS data serves as a fundamental data for formulating safety measures and economic policies, and will be essential for the analysis of economic growth.

The following items can be known by centrally managing the monitoring data and analyzing the accumulated data.

a) Monitoring, Searching, Tracking of a Specified Vessel

b) Maritime Traffic Flow

c) Vessel Traffic Situation for Each Sea-area (Size, Type, Congestion, Transit Time/Zone)

d) Predicted Navigation for a Specified Vessel (Route, Time)

e) Navigation History of a Specified Vessel

f) Various Statistical Information (Shipping tonnage, Ship's nationality, etc.)

h) Risk Management (Collision, Grounding)

The effective utilization of AIS data is regarded as one of the very important information sources in the agencies that operate vessels, conduct quarantine, make a search and rescue, and maintain the security. This system can share information with these other agencies, and the agency that manages the information could be a key agency.

7.3.3 Innovation of VTS Operation

The mission of VTS operation is to support the safe and efficient navigation for vessels by providing information. The content of information provided and the vessels to which the information is provided will depend on the environment and circumstances of the port in which the VTS is located.

The VTS installed in a port or a harbor is responsible for performing the port radio-communication, the management of port entry/exit, the designation of anchorage, the safety management in a port, etc.

The VTS installed at the location where the traffic rout is managed under its jurisdiction is responsible for receiving position reports, managing transit vessels, providing navigational information service including weather information, etc.

The VTS operator displays the prescribed monitoring and supporting area on the operation console, and watches the movement of vessels entering and leaving a port or a traffic route. The vessel which makes a position report is confirmed on the display.

In order to carry out these tasks smoothly, there must be an operational console that can display the sea area and the information suitable for this mission. The display devices installed at the existing VTS stations mainly indicates the vessel positions obtained from radar and AIS, and the functions of these devices differ from manufacturer to manufacturer, which does not always satisfy the operational needs.

The operational needs are specified in the SOP (Standard Operational Procedure) which is made by each VTS station. The SOP describes the jurisdiction area, the provision of information, the radio communication procedures and the on-duty procedures in detail.

However, there is no detailed description such as the "*Operating*" procedure (the procedure manual/the process document) for monitoring the images on a display and for making radio communication to provide practical messages for a vessel, which are necessary for VTS operators on watch, in order to avoid the discrepancy of individual style or ability on the specifically actual operation. These kinds of operating procedures are the role model for the VTS operators on duty to perform the operation actually, and the operators increase their skill through OJT while always assuming actual vessel's movements.

VTS innovation requires the provision of specific operational needs and equipment to handle them.

1) Development of Customized Operation Console

The operational console of a VTS station must be customizable to meet the station's operational needs. The console has the functions for superimposing radar and AIS data on a display, drawing monitoring areas and characters, counting the number of vessels in a specific area, searching a specific vessel and data, compiling and accumulating ship's data, displaying weather information and maritime warning, etc.

(Action)

The implementation design for the development of a customized operation console will be made at each VTS station, including the confirmation of an interface and an out-put signal format for equipment installed now, and then an operational console is procured.

In addition, a detailed operation manual based on the operational needs will be formulated, and this will be reflected on the console.

After these preparations are made, the system will be set up and the OJT will be conducted with this console.

The schematic diagram of the configuration is shown in the Figure below.

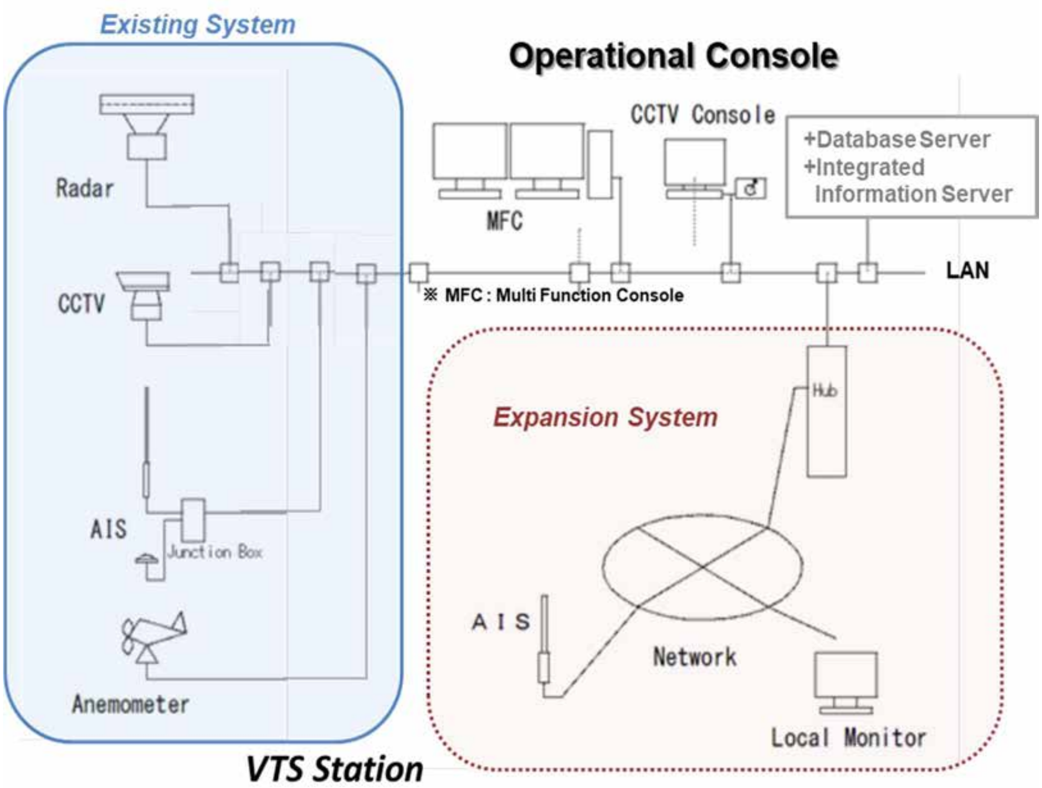


Figure 7.3.3 -1 : Configuration of Equipment for VTS Station

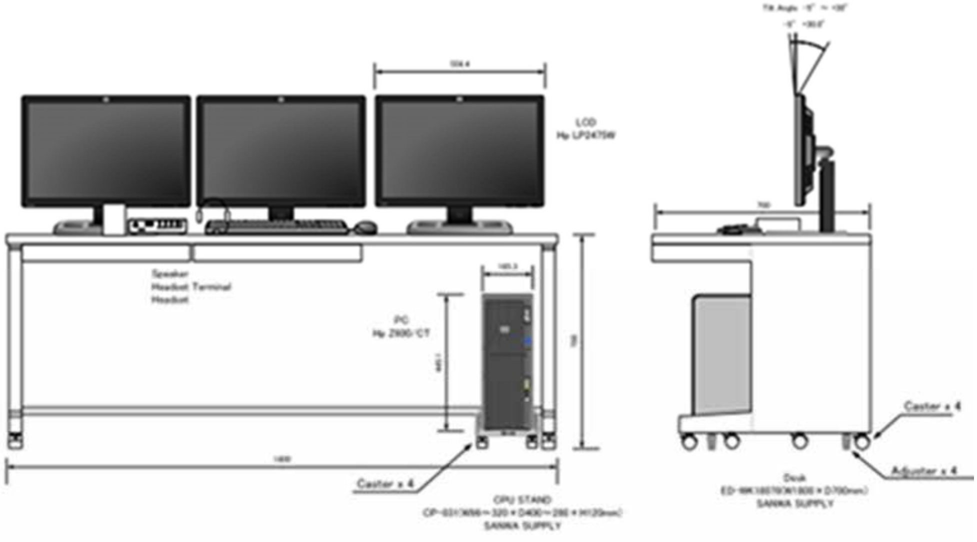
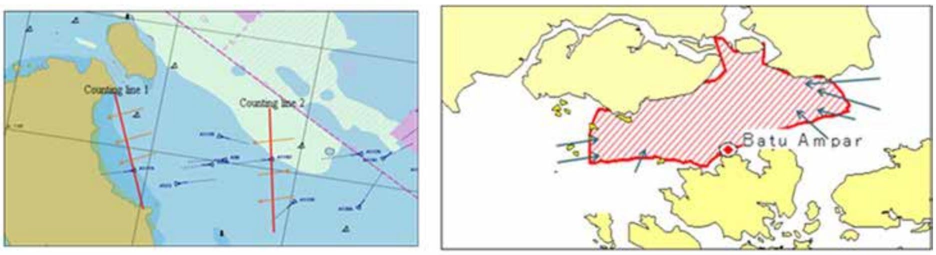


Figure 7.3.3 -2 : Operational Console

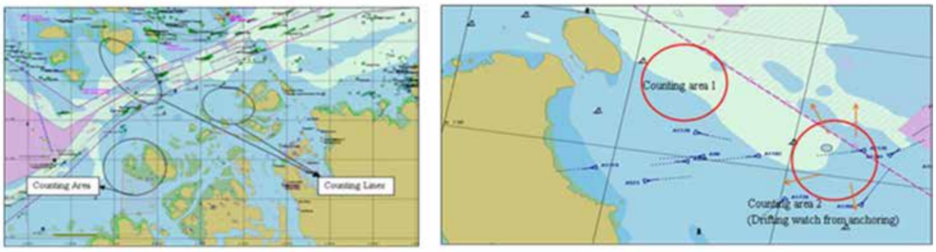
In reviewing the current SOP and formulating the "Operating" procedure (the procedure manual/the process document) for monitoring the images on a display and for making radio communication, etc., a workshop will be held with all VTS operators to share their awareness of the situation surrounding their own VTS and the operating procedure will be created through the training. After that, OJT is carried out based on the new procedure.

Examples of the display function are shown in the Figure below.



Measuring line to count the number of vessels crossing over the line

Counting the number of vessels entering the monitoring area

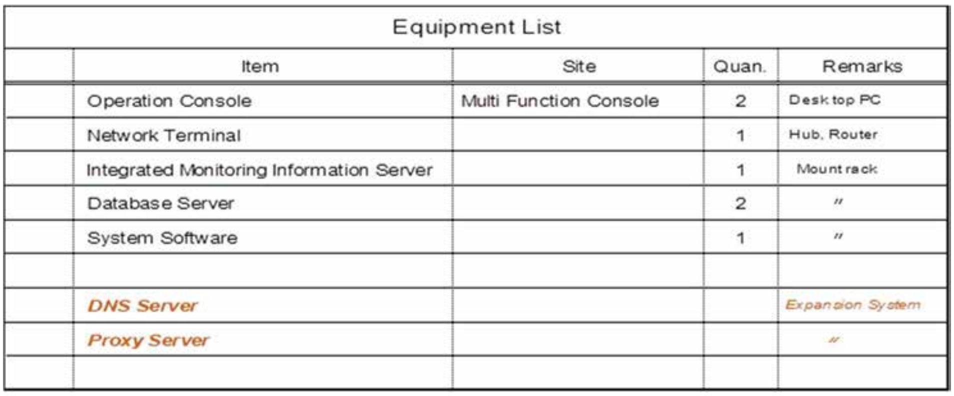


Counting line and area for congestion situation

Monitoring area for anchoring with automatic alarm system

Figure 7.3.3. -3 : Image of Display

(Equipment List)

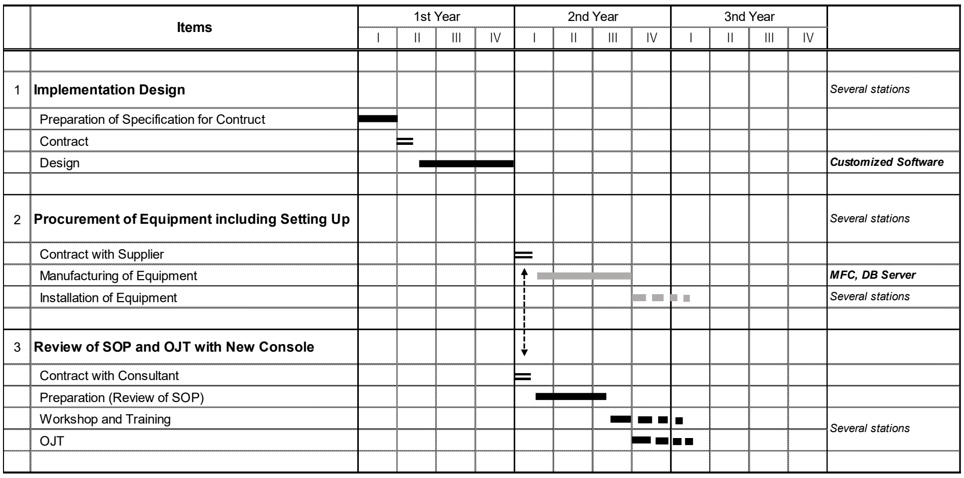


Equipment List				
	Item	Site	Quan.	Remarks
	Operation Console	Multi Function Console	2	Desk top PC
	Network Terminal		1	Hub, Router
	Integrated Monitoring Information Server		1	Mount rack
	Database Server		2	〃
	System Software		1	〃
	DNS Server			*Expansion System*
	Proxy Server			〃

(Roadmap)

Table 7.3.3 -1 : Innovation of VTS Operation

Development of Customized Operation Console and OJT



	Items	1st Year				2nd Year				3nd Year				
		I	II	III	IV	I	II	III	IV	I	II	III	IV	
1	**Implementation Design**													*Several stations*
	Preparation of Specification for Contruct	■												
	Contract		■											
	Design		■	■	■									***Customized Software***
2	**Procurement of Equipment including Setting Up**													*Several stations*
	Contract with Supplier					■								
	Manufacturing of Equipment					■	■	■						***MFC, DB Server***
	Installation of Equipment								■	■				*Several stations*
3	**Review of SOP and OJT with New Console**													
	Contract with Consultant					■								
	Preparation (Review of SOP)					■	■	■						
	Workshop and Training							■	■	■				*Several stations*
	OJT								■	■				

*Roadmap is attached as an Appendix 7.3.3 -1.

(Budget)

Approximate cost for one (1) VTS station

Implementation Design :	US $	44,300.-
Purchase of Equipment :	US $	269,000.-
System Construction Costs :	US $	89,500.-

*Breakdown of the cost is attached as an Appendix 7.3.3 -2.

(Expected Effects)

The introduction of an operation console corresponding to individual tasks can clarify what VTS operators should do. And it can unify the method of monitoring vessels and of the information provision.

Statistical processing for knowing the operational results is recorded and it leads to improvement of the operation.

The operation procedure is enacted depending on the situations of a traffic flow and volume, and the operation console must be able to manually be configured for operational modification.

It can be expected that the duties of a VTS operator become active and the full of operation will contribute to the safe and efficient navigation of vessels.

2) Implementation of OJT

Training to fully utilize the functions of the customized operation console and to provide precise and pertinent information is important for supporting safe and efficient navigation of vessels.

The timing of providing information will also be learned from OJT.

The following is the example for OJT implementation.

Guidance for the Practical Operation of VTS

* Basic Knowledge for VTS Operator
  1) System composition
  2) Equipment configuration
  3) Display target's symbol
  4) Operational items
  5) Radio communication

* Content of Exercise
  1) Basic key operation for operation console
  2) Basic key operation for VHF communication
  3) Individual operation (In accordance with the Operation Manual)
    a. Routine Communication for Port Control
    b. Provision of Maritime Information
    c. Inquiry
    d. State of Emergency
  4) Editing and Filing

* Procedure for Exercise
  1) Classroom Practice
    a. General knowledge for VTS
    b. Standard Marine Communication by VHF Radio
  2) Operation Console Training
    a. Operational procedure
    b. Group exercise for radio communication

3) Simulation Exercise
    a. Key operation
    b. VHF Radio operation
    c. Console operation
4) OJT (under the guidance of Instructor)
5) Review

(Action)

The reintroduction VTS training and OJT will be included in contracts for the purchase of the operation console.

(Roadmap)

The schedule is shown in the Table 7.3.3 -1 : Innovation of VTS Operation (Development of Customized Operation Console and OJT).

7.3.4 Development of Maritime Safety Measures for Tourism

The Indonesian Government is promoting the marine tourism in its policy as a maritime nation. Labuan Bajo is one of the candidate sites, and there are many good diving spots nearby and Komodo Island, inhabited by dragons, has been crowded with tourists in recent years.

There are many small islands off the coast of Labuan Bajo that serve tourist hubs, and many small boats and crafts carrying tourists come and go.

Picture 7.3.4 -1: Many Small Vessels berthing off the Port

The number of small vessels cruising in the bay is expected to increase further as the number of tourists increases.

It is essential to correctly get the movement of these small vessels and to take the necessary maritime safety measures for them. The establishment of a system is required for providing mariners and people who engage in marine activities with information on maritime safety.

Most of the vessels navigating in these waters are small vessels, and the use of an AIS Class-B and a smart-phone which transmits position information is effective as well as a radar system for the grasp of small vessel’s movement and for the information service.

The marine office is equipped with an operational console including data processing devices, a data Server, a web Server for managing AIS and smartphone information and for disseminating information.

The sensor stations equipped with AIS, radar and meteorological observation devices are established at appropriate locations in the bay.

(Action)

The implementation design of the maritime safety system for small vessels will be made, including the survey of radio propagation for radar, AIS and smartphone.

Because the Labuan Bajo Bay is dotted with many small islands, and AIS signals from vessels sailing offshore are affected by these islands and radio disturbance often occurs.

Therefore, AIS base stations and radar stations should be installed on islands in the bay to minimize signal dead zones.

After these preparations are made, procurement of equipment necessary for the system configuration and the construction work of related facilities will be done.

The schematic diagram and the Configuration of the system are shown in the Figure below.

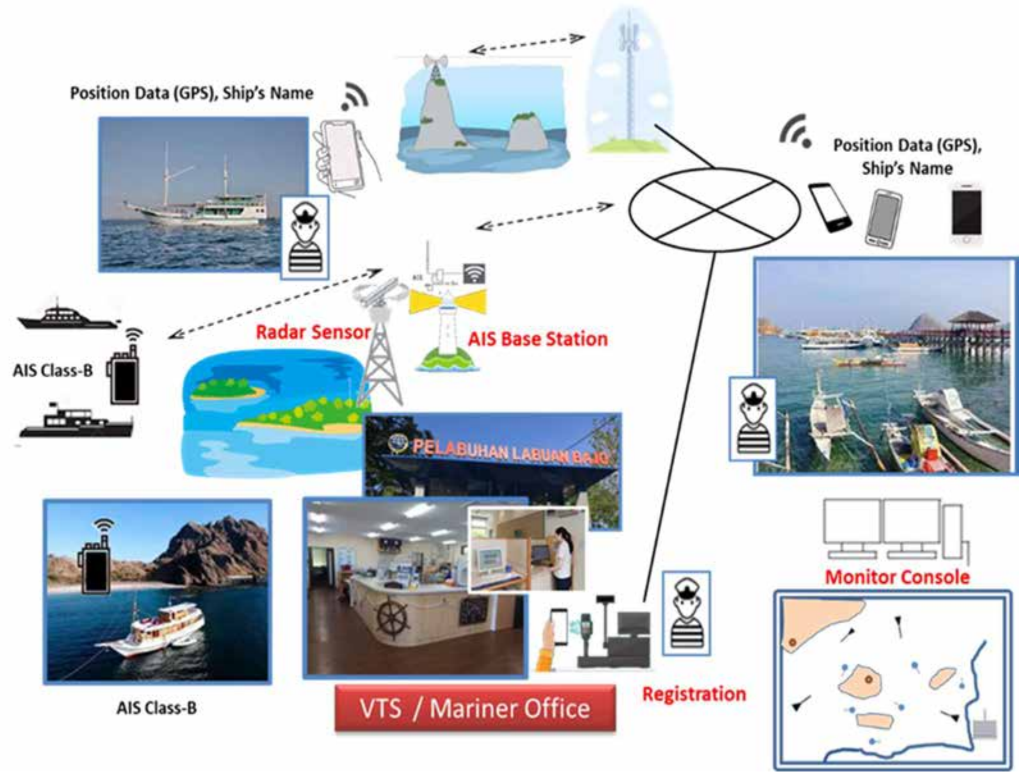


Figure 7.3.4 -1 : Marine Safety System for Small Craft

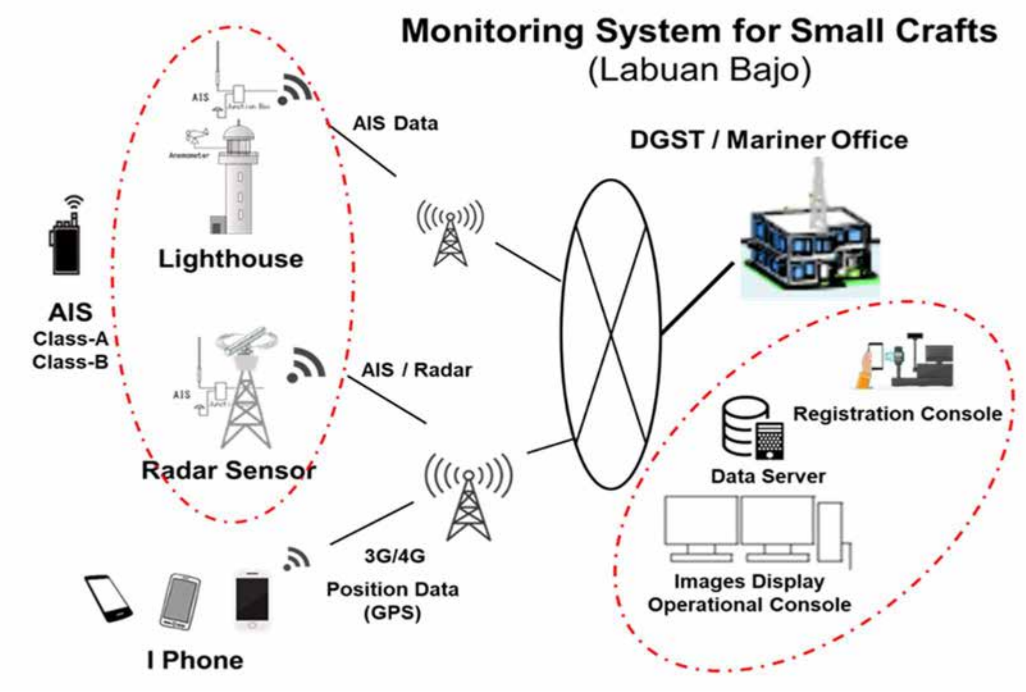


Figure 7.3.4 -2 : System Configuration

This time, a detailed survey could not be done on-site, but when considering the layout of radar stations and AIS base stations on paper, the following placement may be shown as one of the proposals.

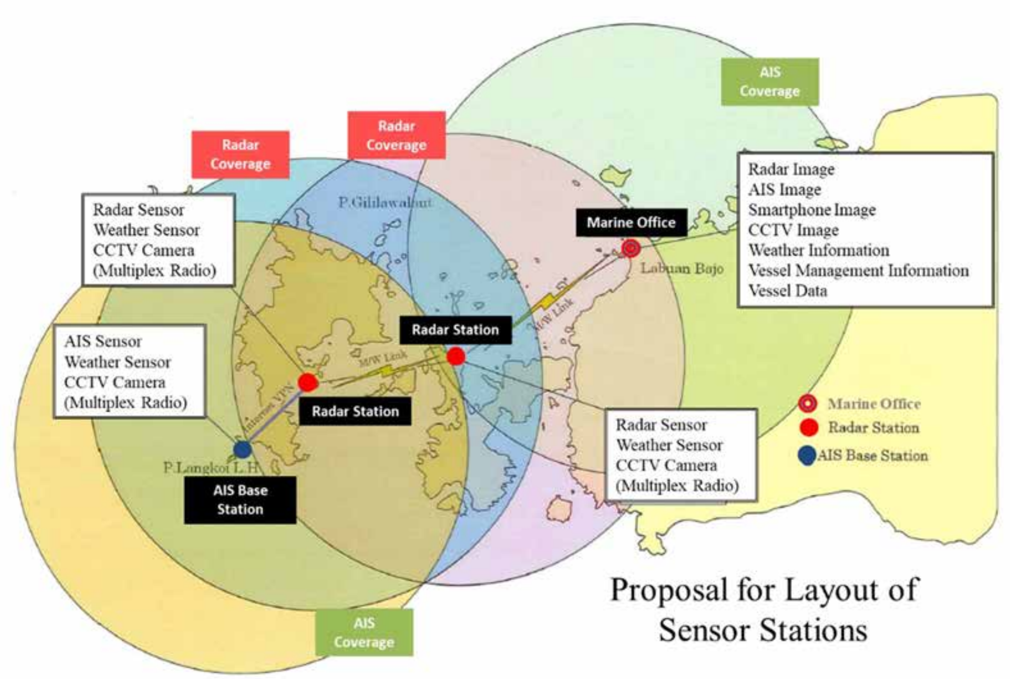


Figure 7.3.4 -3 : Coverage of Radar, AIS

(Equipment List)

Since the site conditions of communication lines at the radar and AIS stations are not known, the lines for digital data communication between the stations have been undecided. The line is selected from any one of an existing fixed telephone line, a microwave radio line, an internet line, or a satellite line.

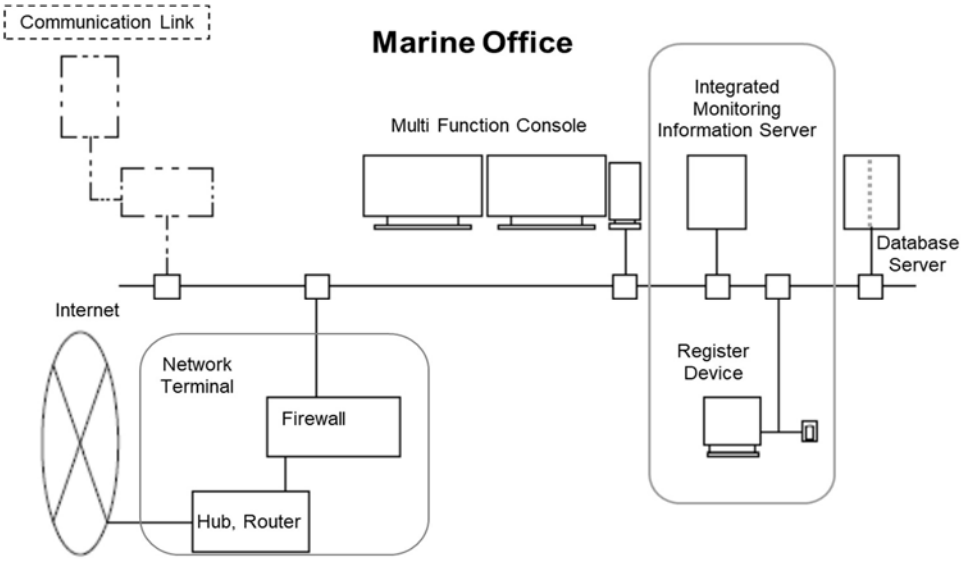


Figure 7.3.4 -4 : Configuration of Equipment for Main Office

Equipment List (Marine Office)				
	Item	Spec.	Quan.	Remarks
1	Multi Function Console		2	
2	Network Terminal		1	Hub, Router
3	Integrated Monitoring Information Server		1	Mount rack
4	Database Server		2	〃
5	System Software		1	

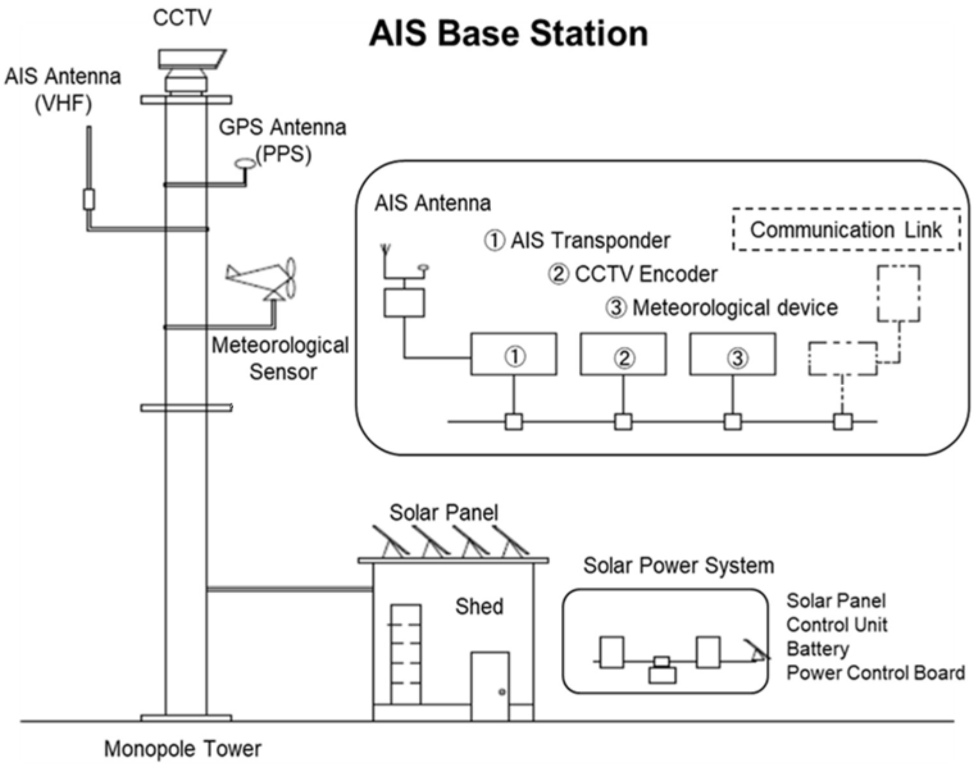


Figure 7.3.4 -5 : Configuration of Equipment for AIS Base Station

Equipment List (AIS Base Station)				
	Item	Spec.	Quan.	Remarks
1	AIS Transponder	Dual Type	1	
2	CCTV Camera		1	
3	Meteorological Sensor		1	
4	Shed		1	
5	Solar Power System		1	
6	Monopole Tower		1	

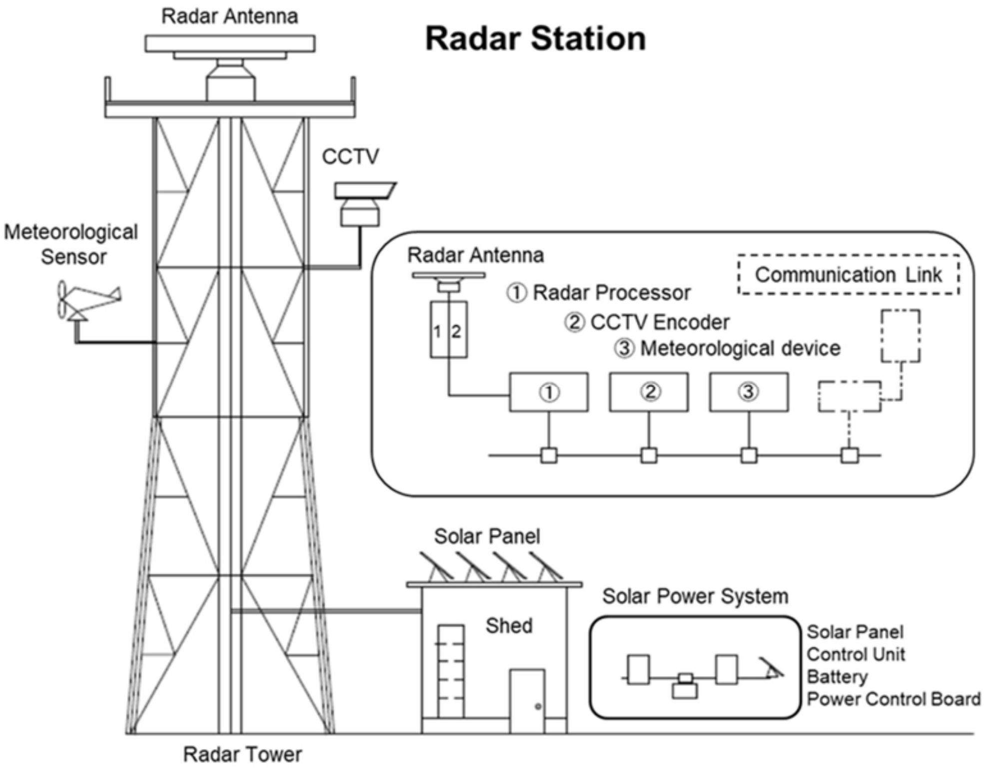


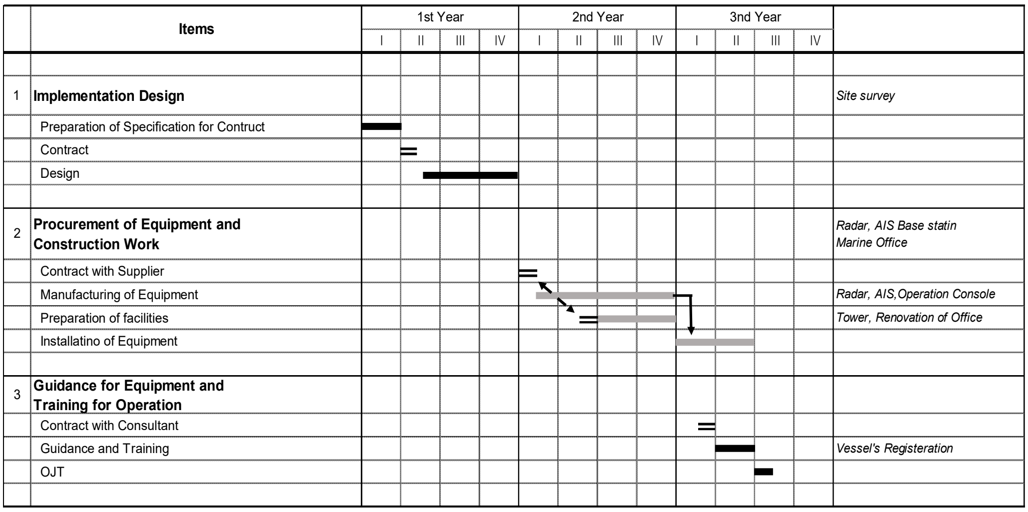
Figure 7.3.4 -6 : Configuration of Equipment for Radar Station

Equipment List (Radar Station)				
	Item	Spec.	Quan.	Remarks
1	Radar Antenna	18 Feet	1	
2	Radar TRX		1	
3	Radar Images Processor		1	
4	CCTV Camera		1	
5	Meteorological Sensor		1	
6	Shed		1	
7	Solar Power System		1	
8	Radar Tower		1	

(Roadmap)

Table 7.3.4 -1 : Development of Maritime Safety System

Development of Maritime Safety System for Small Craft



	Items	1st Year				2nd Year				3rd Year				
		I	II	III	IV	I	II	III	IV	I	II	III	IV	
1	**Implementation Design**													*Site survey*
	Preparation of Specification for Contruct	▬												
	Contract		=											
	Design		▬	▬	▬									
2	**Procurement of Equipment and Construction Work**													*Radar, AIS Base statin* *Marine Office*
	Contract with Supplier					=								
	Manufacturing of Equipment					▬	▬	▬						*Radar, AIS,Operation Console*
	Preparation of facilities						=	▬						*Tower, Renovation of Office*
	Installatino of Equipment									▬	▬			
3	**Guidance for Equipment and Training for Operation**													
	Contract with Consultant									=				
	Guidance and Training										▬			*Vessel's Registeration*
	OJT											▬		

*Roadmap is attached as an Appendix 7.3.4 -1.

(Budget)

Approximate cost for Marine Office, one AIS Base Station and two Radar Stations

Implementation Design : US $ 57,800.-

Purchase of Equipment : US $ 6,139,000.-

(Marine Office, one AIS Station, Two Radar Stations)

System Construction Costs : US $ 1,841,000.-

*Do not include the cost for Communication Line

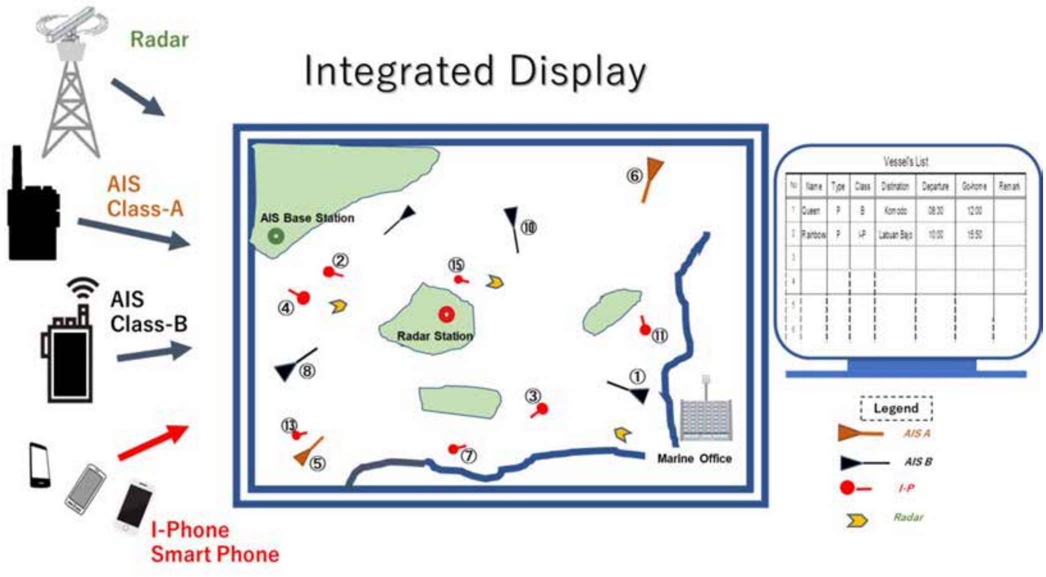
*Breakdown of the cost is attached as an Appendix 7.3.4 -2.

(Expected Effects)

By monitoring vessels, quick response can be taken to unexpected accidents of small crafts such as engine trouble, running out of fuel, grounding, etc. In addition, the information on sudden weather changes and navigation restrictions can be issued promptly and appropriately, which contributes to safe and efficient navigation.

The data accumulated in relation to the movement of vessels can be used for statistics of the number of people visiting the islands and for management of registration ships, which will be valuable data for future administrative policy planning.

Figure 7.3.4 –7 : Image of Marine Office



No	Name	Type	Class	Distination	Departure	Go-home	Remark
1	Queen	P	B	Komodo	08:30	12:00	
2	Rainbow	P	I-P	Labuan Bajo	10:00	15:50	
3							
4							
5							
6							

Figure 7.3.4 -8 : Image of Operation Console