ENTERING AUTONOMOUS SHIPPING ERA

challenges and opportunities

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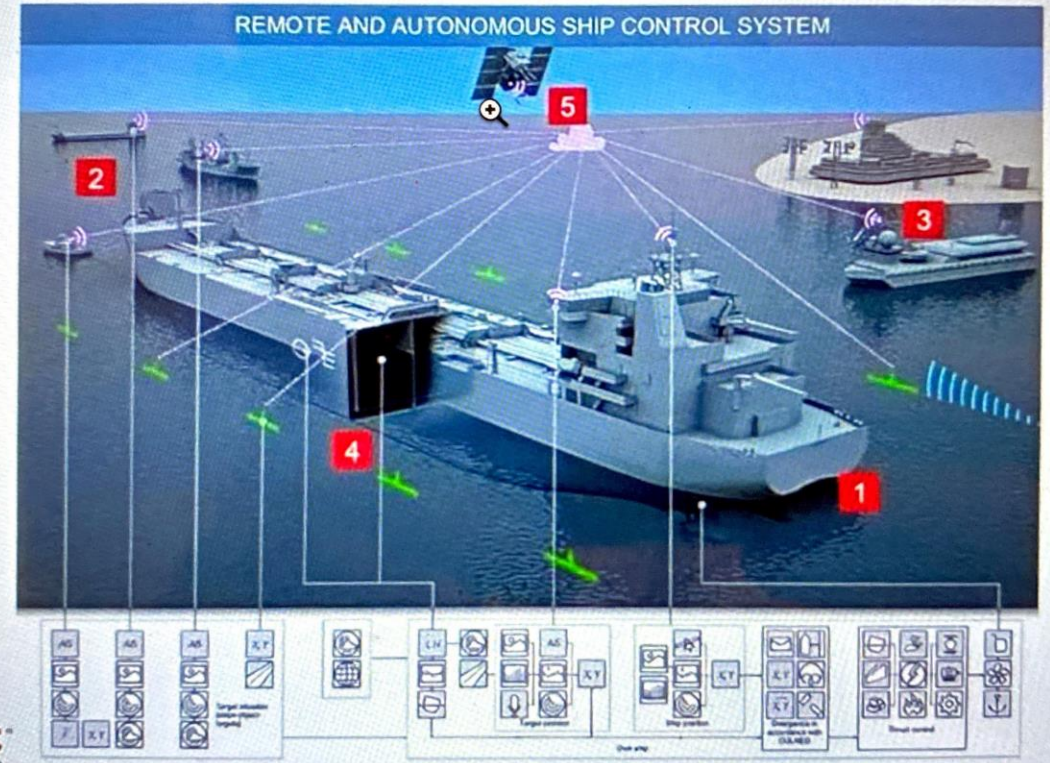
OUTLINE

- Introduction of MASS
- IMO Regulatory framework
- Challenges in the future

INTRODUCTION

Autonomous ship is there!
Research and trials were conducted around the world

Concept of MASS and ROC Operations



1 **Own ship**: Situational awareness system shall receive and process the information on the environmental conditions and MASS condition for making decisions on the ship and ship systems

2 **Target ships** have to be equipped with units and systems, which consolidate all available sources of information located on board the ship and in the ROC

3 **Remote Operations Centers (ROC)** with shore based cyber security systems

4 Navigation movement **delimiting marking** creates by navigational equipment "virtual" and "synthetic" limitation for fairway, mooring place for MASS

5 **Radio communication** and data exchange including cyber security systems support.

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Sources : multiple online publication

Autonomous Ships in trials

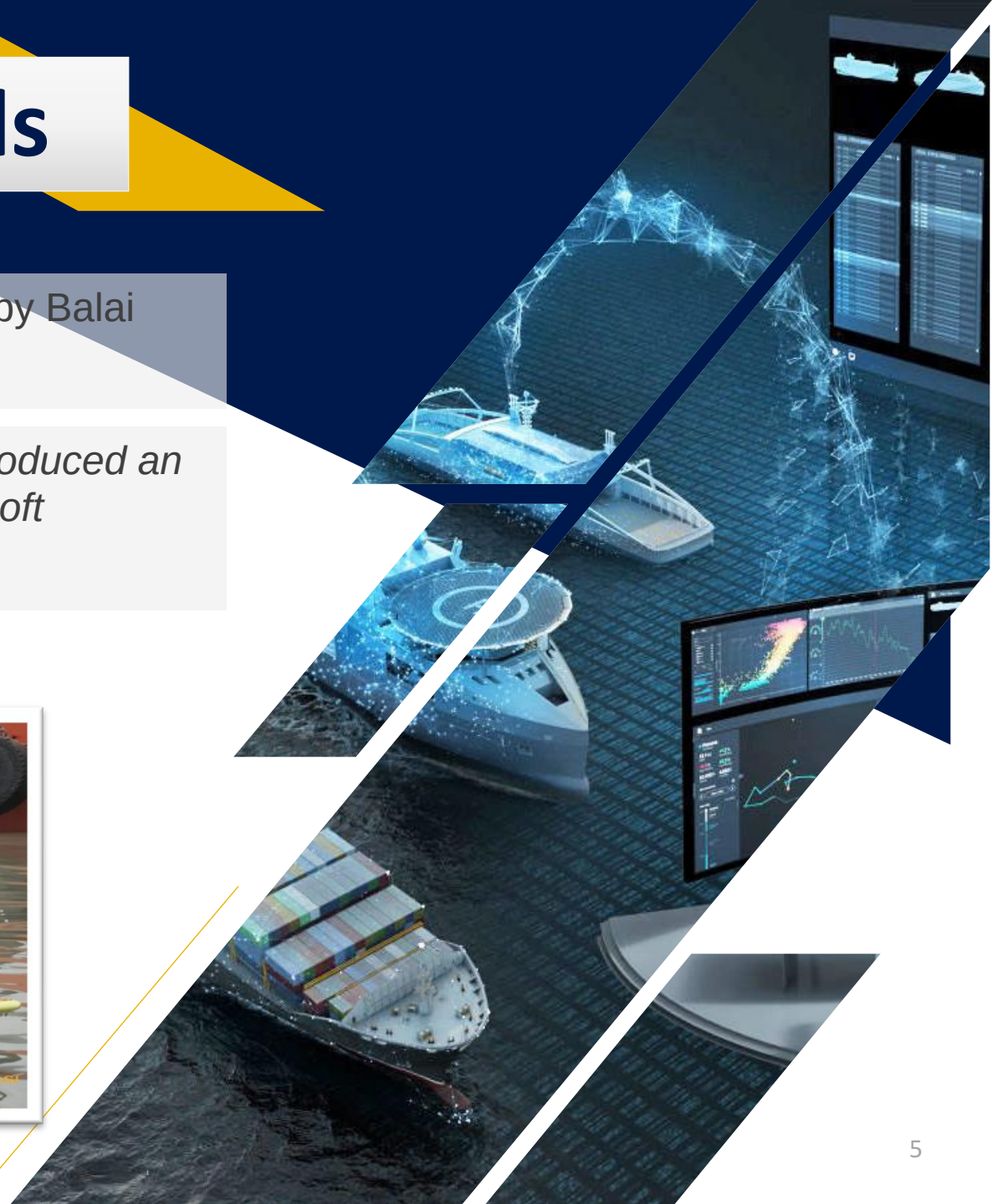
Autonomous Hydrographic Survey Boat (AHSB) develop by Balai Teksurla BPPT, 2018-2019, for hydrography survey

Referensi, https://repository.its.ac.id/92536/1/Buku_3Dekade_KRBarunaJayaBPPT.pdf

Institut Teknologi Sepuluh Nopember (ITS) Surabaya, introduced an autopilot smart ship named intelligent Boat (i-BOAT) in a soft launching at Bangkalan, September 2020

Referensi, https://www.its.ac.id/news/en/2020/09/30/its-launches-i-boat-an-advanced-autopilot-boat/

Sources : multiple online publication



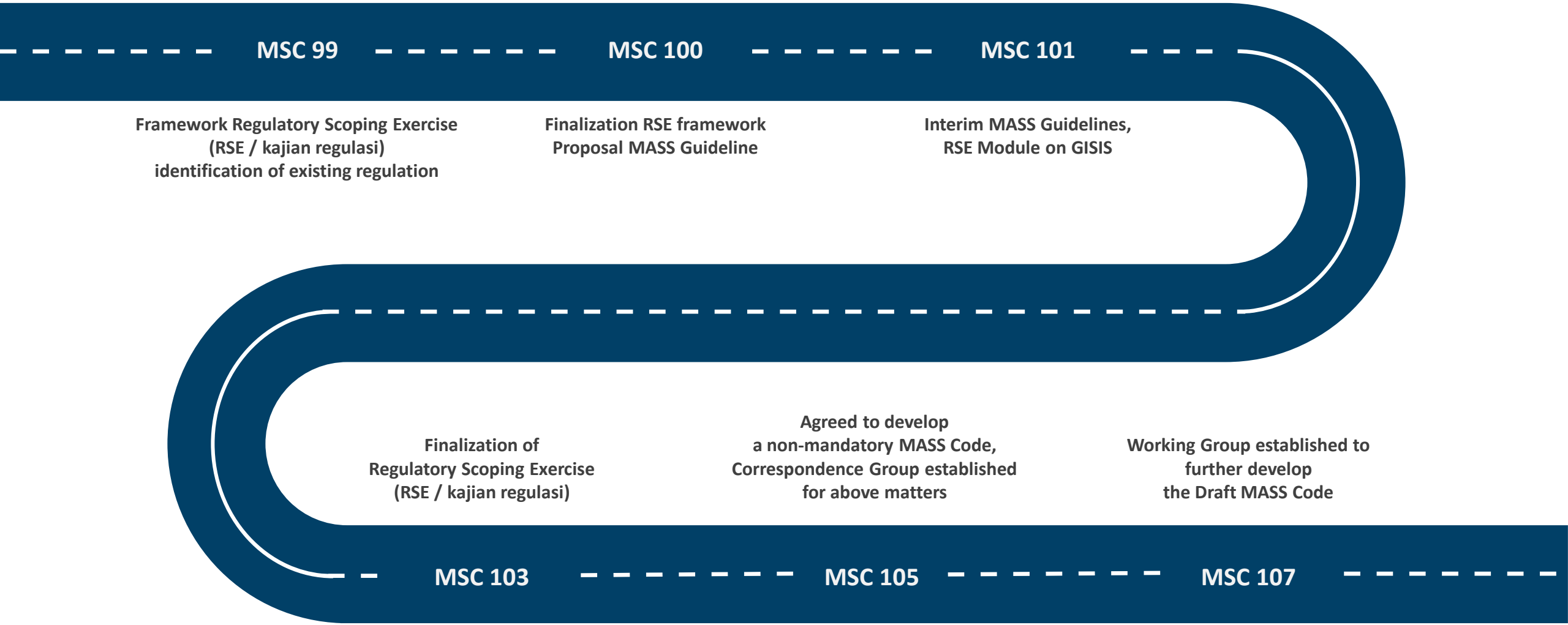
What standards to be followed?

International Regulatory Framework

IMO need to incorporate emerging technology into its regulation

MASS REGULATION DEVELOPMENT

Internatinal maritime regulatory framework



MASS Terminology

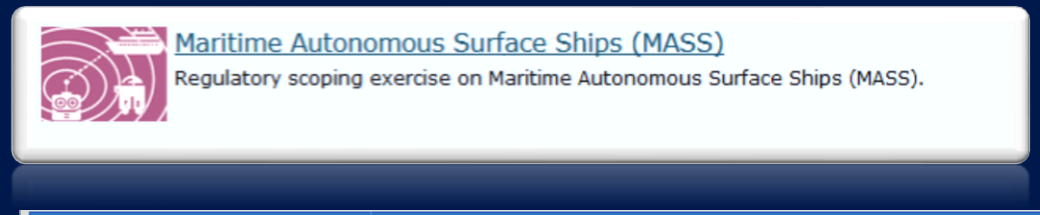
Maritime Autonomous Surfaces Ships (MASS) is defined as a ship which, to a varying degree , can operate independent of human interaction *(IMO terminology)*

Four degree of automation, **MSC 100**

- **Degree one**: **Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.**
- **Degree two**: **Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.**
- **Degree three**: **Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.**
- **Degree four**: **Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself.**

Sources : MSC 100/5/1

IMO Module GISIS on MASS



IMO INTERNATIONAL MARITIME ORGANIZATION

GISIS: Regulatory scoping exercise on Maritime Autonomous Surface Ships (MASS)

Members Area > Maritime Autonomous Surface Ships (MASS) > Instruments

Instruments

Committee	Committee status	Instrument	Degree of autonomy
Maritime Safety Committee	First step: Revision stage	Bulk carrier bulkhead and double bottom strength standards	All
Maritime Safety Committee	First step: Revision stage	Code for Recognized Organizations (RO Code)	All
Maritime Safety Committee	First step: Revision stage	Code of Safe Practice for Cargo Stowage and Securing (CSS Code)	All
Maritime Safety Committee	First step: Revision stage	Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code)	All
Maritime Safety Committee	First step: Revision stage	Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREG 1972)	All
Maritime Safety Committee	First step: Revision stage	IMO Instruments Implementation Code (III Code)	All
Maritime Safety Committee	First step: Revision stage	International Code for Application of Fire Test Procedures, 2010 (2010 FTP Code)	All
Maritime Safety Committee	First step: Revision stage	International Code for Fire Safety Systems (FSS Code)	All
Maritime Safety Committee	First step: Revision stage	International Code for Ships Operating in Polar Waters (Polar Code)	All
Maritime Safety Committee	First step: Revision stage	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)	All
Maritime Safety Committee	First step: Revision stage	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)	All

INTERNATIONAL MEETINGS

- May 2018, International Workshop on Maritime Autonomous Surface Ships and IMO regulations
- July 2019, Informal Workshop on the future of Shipping MASS held by INDONESIA
- June 2021, Regulatory Scoping Exercise (RSE) finalized at IMO MSC 103, as basis for development on new regulation
- October 2021, at IMO MSC 104, agreed to start develop a “goal-based” regulation of MASS Code
- June 2023, at IMO MSC 107, the draft MASS Code is being discussed and developed in MASS Working Group

Discussion at MSC 107

- Some of the **Functional Requirements related to human presence on board**, such as fire safety, and LSA, are considered irrelevant, especially for degree four (fully autonomous).
- **Communication/Connectivity**. MASS is required to have two-way communication, both MASS or vessels and with ports. Therefore, at least operator is still needed for such two-way communication, especially with ports in the case of international voyages.
- The discussion also involves the connection to STCW, whether **MASS Operators** in Remote Operations Centers (ROCs) **are considered seafarers**. If so, it should be regulated by STCW; otherwise, the training, certification, and competency requirements should be regulated by the MASS Code.

CHALLENGES

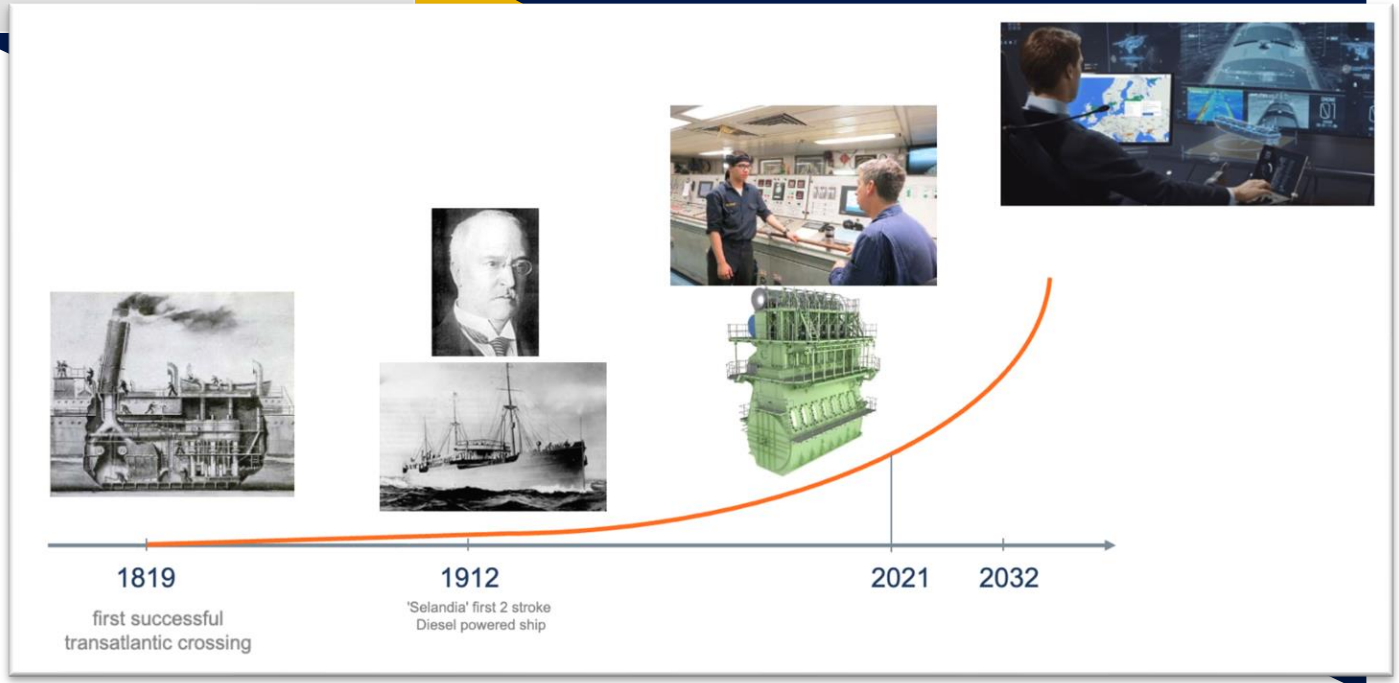
IMPACT ON HUMAN ELEMENT

Impact on Human Element

Reduction of person involved in marine operation

Where are we now?

- **Moving control from Ship to Shore**



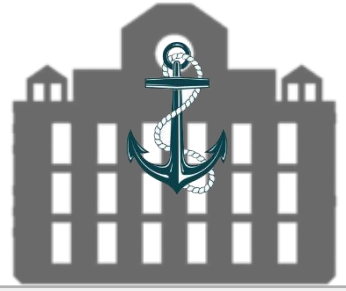
- Average of number crew onboard around 20 person, are they gone?
- It depends on industry, how fast shipping company will utilize autonomous ship
- it depends on the market, how profitable is the usage of autonomous ship
- But the future will come anyway, **<u>better prepare for new training and competency</u>**

NUMBER OF MARINE TRAINING INSTITUTION

UNIVERSITAS / SEKOLAH TINGGI / POLITEKNIK / AKADEMI
33 INSTITUTION

SEKOLAH MENENGAH KEJURUAN (SMK)

33 INSTITUTION

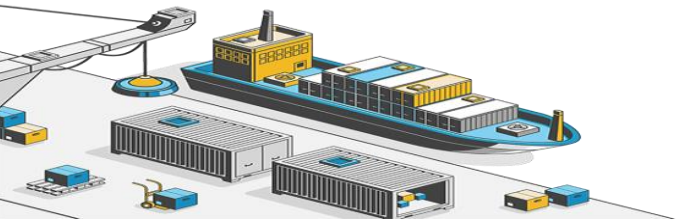


TRAINING CENTRE

33 INSTITUTION

TOTAL

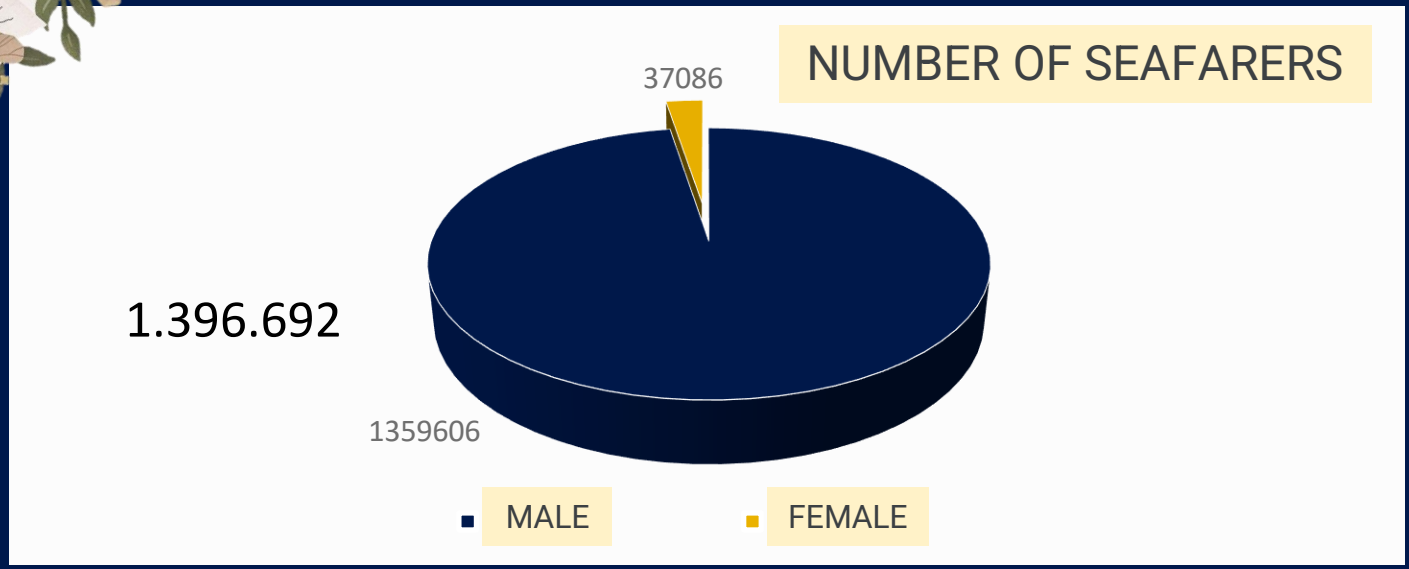
99 INSTITUTION



DATA OF MARINE TRAINING INSTITUTIONS

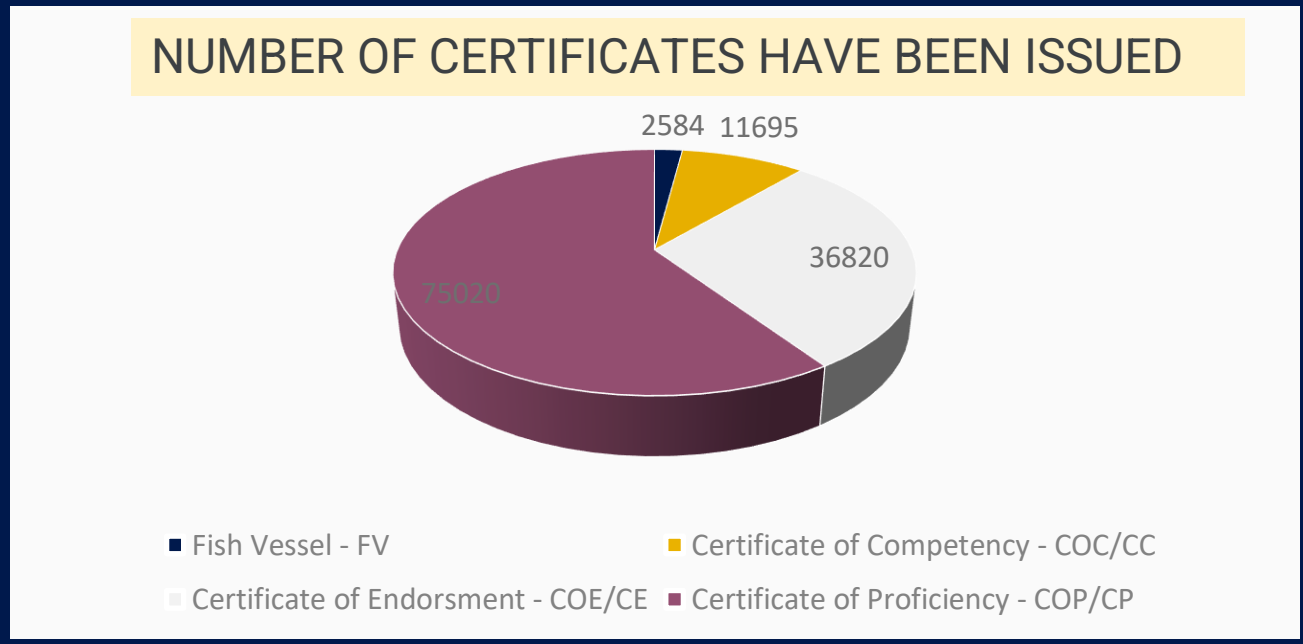
NUMBER OF SEAFARERS

KEMENTERIAN PERHUBUNGAN
DIREKTORAT JENDERAL
PERHUBUNGAN LAUT



TABEL DATA PELAUT PER 12 JULI 2023

Sumber : pelaut.dephub.go.id



DATA OF COMPANY (SIUPPAK) AND HOSPITAL

- The Seafarers who are placed by sea transportation companies and most are placed by crew agency companies (SIUPPAK)
- The number of Crew Recruitment and Placement Companies as of July 2023 totaled 264 Companies
- Crew Recruitment and Placement Company cooperates with Marine Education and Training Institutions in recruiting and placing crew

COMPANY SIUPPAK	HOSPITAL/ MAIN CLINIC	UPT PENERBITAN SID
264 COMPANY	84 RS/KU	3 LOCATION

How about existing Ships?

- Set of equipment and decision support system is available for installation in conventional vessel, to be more autonomous
- Aim of technology is to be more efficient. Efficiency in industry, means more profit.
- Profitability will depend on the cost (investment, maintenance cost, operational) compared to income.
- Supply vs Demand.
  Demand for shipping versus price of autonomous technology.

HiNAS
Navigation

+

Interface with
Autopilot

Interface with
BMS
*Bridge Maneuvering System

SVM

HiNAS SVM (Surround-View Monitoring) shows a 360-degree top-view AR image converted from input images recorded by multiple fish-eye cameras installed around the ship.

32-channel LiDAR

Safety & Security during Navigation

Current development of MASS Code is using a **"goal-based" approach**, no more prescriptive formula.

MASS have to meet all Functional Requirements in the Draft Code, and this still being discussed in several Correspondence Group and Working Group at IMO.

MSC 107/WP.9
Annex 1, page 11

PART 3 GOALS, FUNCTIONAL REQUIREMENTS AND PROVISIONS

N.B All sections will be further developed in the Correspondence group by volunteering Member States and/or international organizations

1 NAVIGATION

1.1 Goal

The goal of this section is to provide for safe [and secure] navigation of MASS for any mission phase [including collision avoidance in each environment condition], taking into account the mode of operation of the ship [and the number of persons on board].

5.5 Functional requirements

In order to achieve the goal, set out in paragraph 1.1 above, the following functional requirements are embodied in the provisions of this chapter.

FR1.1 General

A MASS should achieve the following functional requirements for navigation in general.

FR1.1.1: A MASS should comply with all relevant SOLAS Navigation Requirements [and MARPOL Requirements except where modified by the second Tier Functional Requirements below].

FR1.1.2: [A MASS should have the capability to meet all relevant STCW and COLREG requirements]/[A MASS should meet all relevant STCW and COLREG requirements by the collaboration with seafarer, remote operator, and/or Autonomous Navigation System(ANS)].]

FR1.1.3: The use of Autonomous Navigation Systems (ANS) should not endanger the safety of persons onboard, the vessel or [the traffic environment including] other vessels.]

Geographical Condition

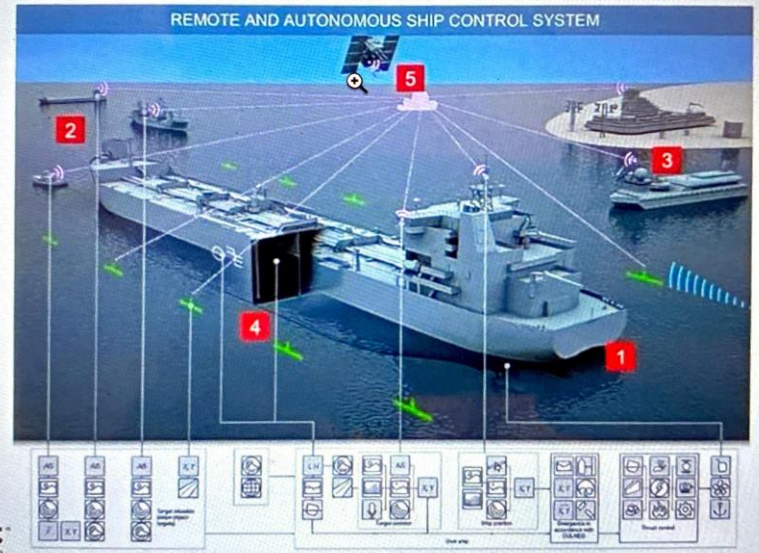
Small fishing boats and traditional vessels are rarely equipped with proper and adequate communicational and navigational equipment.

They may not be aware of their surroundings and can be undetected by sensors of MASS.

- As an archipelagic nation, Indonesia consists of many islands, big and small, with so many shallow waters between these islands.
- Indonesia is also located on the equator, resulted in warm waters with lots of fish.
- Consequently, Indonesian waters, including those on the International sea-lanes mainly filled with small fishing boats and traditional vessels.
- These small fishing boats and traditional vessels are rarely equipped with proper and adequate communicational and navigational equipment.

the future will come anyway,
better prepare for new training and competency

Concept of MASS and ROC Operations



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Training of MASS and ROC Officers

In April 2023 the first group of Captains of the Remote Operations Center (ROC) and the crews of two ferries «**Marshal Rokossovsky**» and «**General Chernyakhovsky**» completed the following training programs using the simulator at the Russian University of Transport:

- Captain of the autonomous ships in Remote Operations Center;
- Advanced training of Captain on operation of semi-autonomous ships (MCDS, RCMC) and RC ships;
- Advanced training of Chief Mate on operation of semi-autonomous ships (MCDS, RCMC) and RC ships;
- Advanced training of Watch officer on operation of semi-autonomous ships (MCDS, RCMC) and RC ships.

During the simulation-based training, the trainees practiced:

- Manual control (MC);
- Manual control with decision support system (MCDS);
- Remote control with manual control override capability (RCMC)
- Remote control (RC)

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COLREG-72 Collision Avoidance System for MASS and ROC Officers Training

COLREG-72 collision avoidance system is operator's decision support system, which is intended for enhancing the operator's awareness of situation in the responsibility area, minimizing the number of false alerts and human factor effect during the decision making in a pre-alarm situation:

- Forecast of ship tracks based on information on traffic and ships maneuvering models.
- Calculation around each ship safety domains.
- Alarms on ship's collision, grounding and approach to a safe zone generated on the basis of estimated ship tracks, data from charts and other sources of information.
- Calculation of Collision Avoidance Maneuver planning based on COLREG-72, good seamanship practice and ship's track forecast calculations.
- Calculation of "last moment maneuver".

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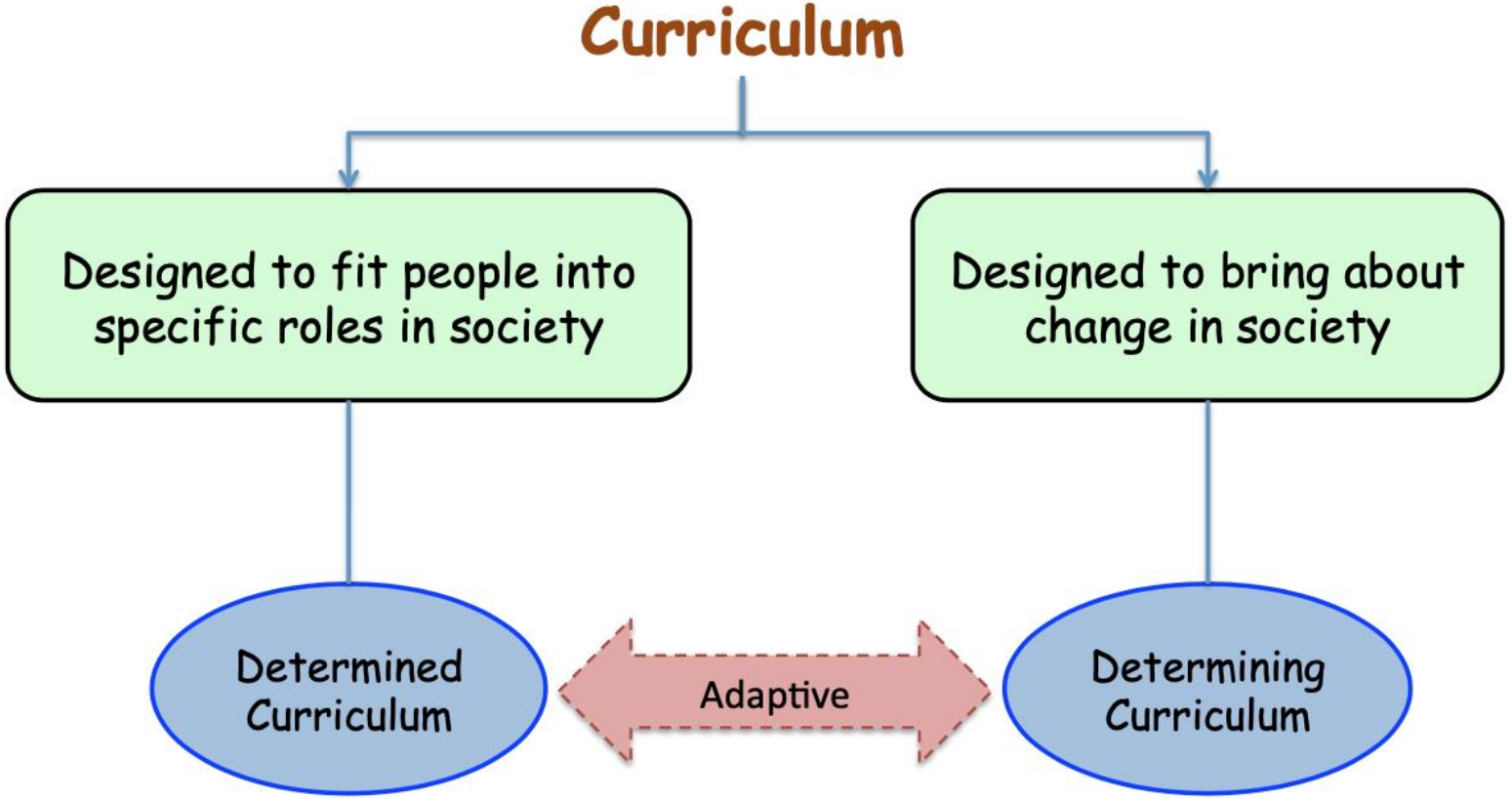
Additional/hidden, **Curricullum needed!**

Having more competencies is better for employment, better chance to work abroad, and more value added to the seafarer

Read more,
Learn more,
Practice more,
Earn more!

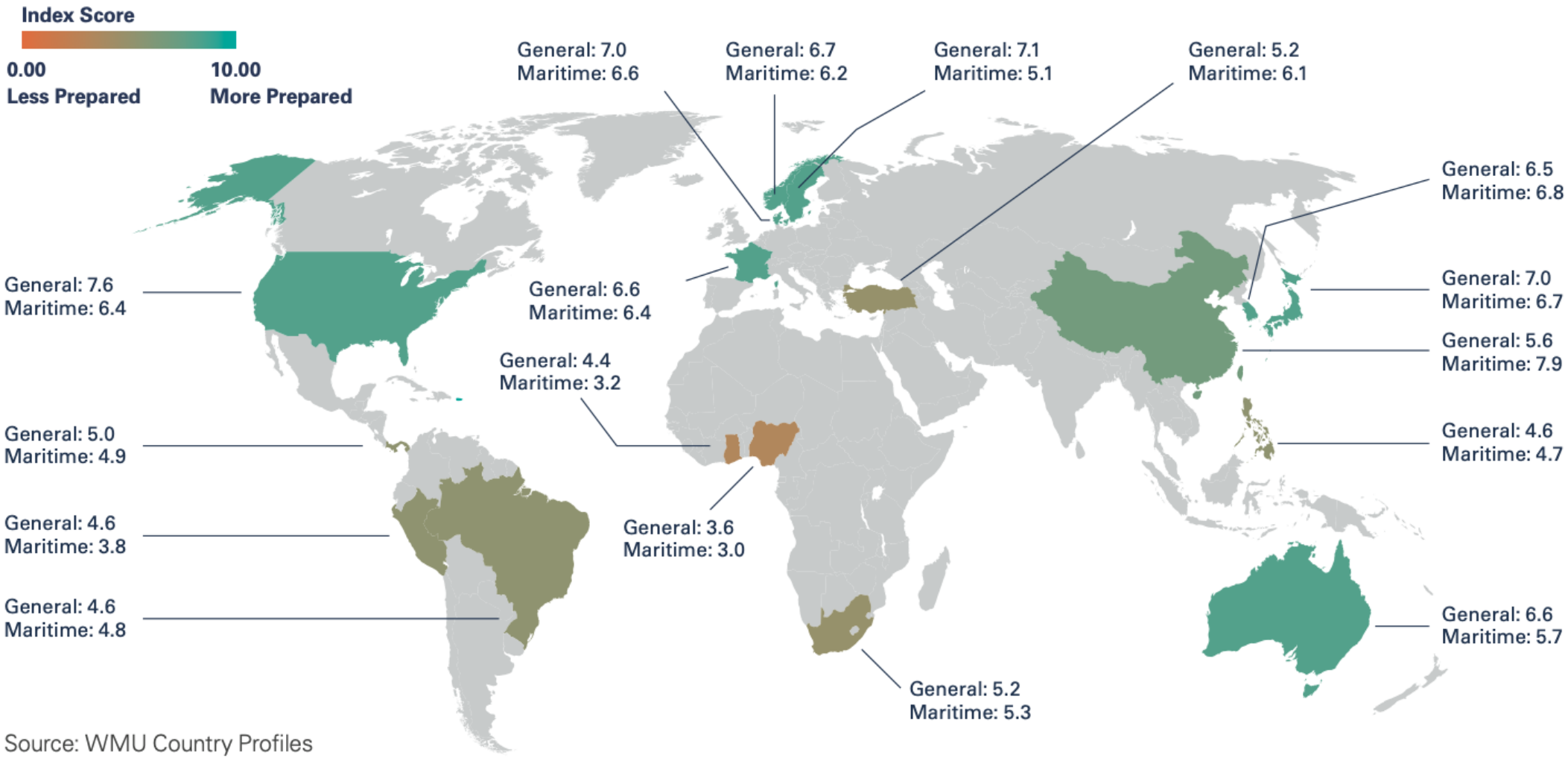


Source: Dr. Michael Ekow Manuel, WMU, 2016

Are we ready?

Some country were ready, some still need time

FIGURE 0.8 Readiness level for the introduction of emerging and new technologies



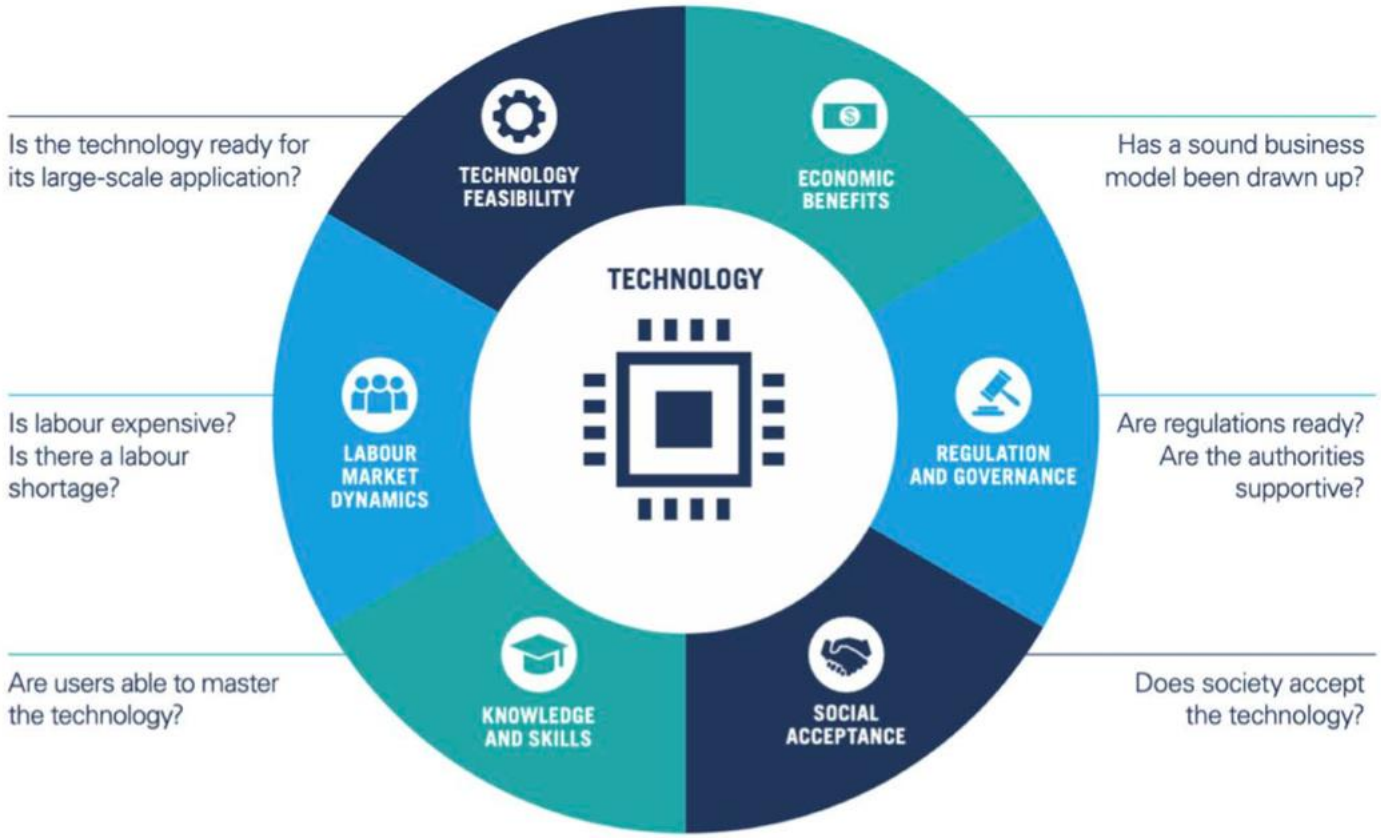
Source: WMU Country Profiles

[4] 17 countries are: Australia, Brazil, China, Denmark, France, Ghana, Japan, Nigeria, Norway, Panama, Peru, Philippines, Republic of Korea, South Africa, Sweden, U.S. and Turkey.

Don’t worry!

Introduction of MASS is evolutionary rather than evolutionary

- **WMU RESEARCH HAS IDENTIFIED SIX MAIN FACTORS THAT CAN ACCELERATE OR DELAY THE ADOPTION OF TECHNOLOGY**



Source: WMU/ITF: Transport 2040: the future of work

Next question …

- Shall we be ready to enter autonomous shipping era?
- What are new training and competency needed?

- The capability to operate unmanned is a particularly attractive option for vessels involved in operations that are dangerous or tedious, such as oil spill response vessels, fire boats, and rescue boats
- elimination or reduction of crew provides attractive cost savings, vessel owners indicate that there is also value in reduction of risk
- operate with cleaner power systems, such as batteries or diesel electric.
- improve security and vessel traffic monitoring on port.

opportunities

"I believe that the 4.0 Industrial Revolution will create far more new jobs than the number of jobs lost"
Presiden Jokowi, 2018

https://www.kominfo.go.id/content/detail/12847/presiden-jadikan-making-indonesia-40-sebagai-agenda-nasional/0/berita

THE FUTURE IS NEAR MASS IS UNAVOIDABLE

THANK YOU!

Dr. Hartanto

Director of Marine Safety and Seafarers