

Proposal for Efficient Prevention of Bio-fouling and Preservation of Marine Environment

PERRIER KIM



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- Conclusion
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1

Background

Background

0. Relevant issue

DAELIM Marigold



DAELIM Marigold



New Zealand and Fiji turn away 'dirty' ship over barnacles - BBC News
BBC News - 2017. 3. 7.



Dirty Korean bulker allowed back into New Zealand
Splash 247 - 2017. 3. 29.



What next for dirty vessel DL Marigold?
Seatrade Maritime News - 2017. 3. 9.

Earlier this week, a Korean-owned bulk carrier **DL Marigold** made headlines after it was ordered to leave New Zealand waters because its hull ...

Dirty ship ordered to leave Tauranga
국제 - New Zealand Herald - 2017. 3. 6.

- A recent example of a ship not strictly observing the guideline
- The Korean ship (unclean hull) got refused to enter the port by New Zealand MPI **due to severe extent of Biofouling**

Hereby we need to reconsider :

Actual effectiveness of IMO Rules on Biofouling control

1. What is bio-fouling

Bio-fouling : The gradual accumulation of organisms such as algae, bacteria, barnacles, and protozoa on underwater equipment, pipes, and surfaces, corroding and impairing structures and systems

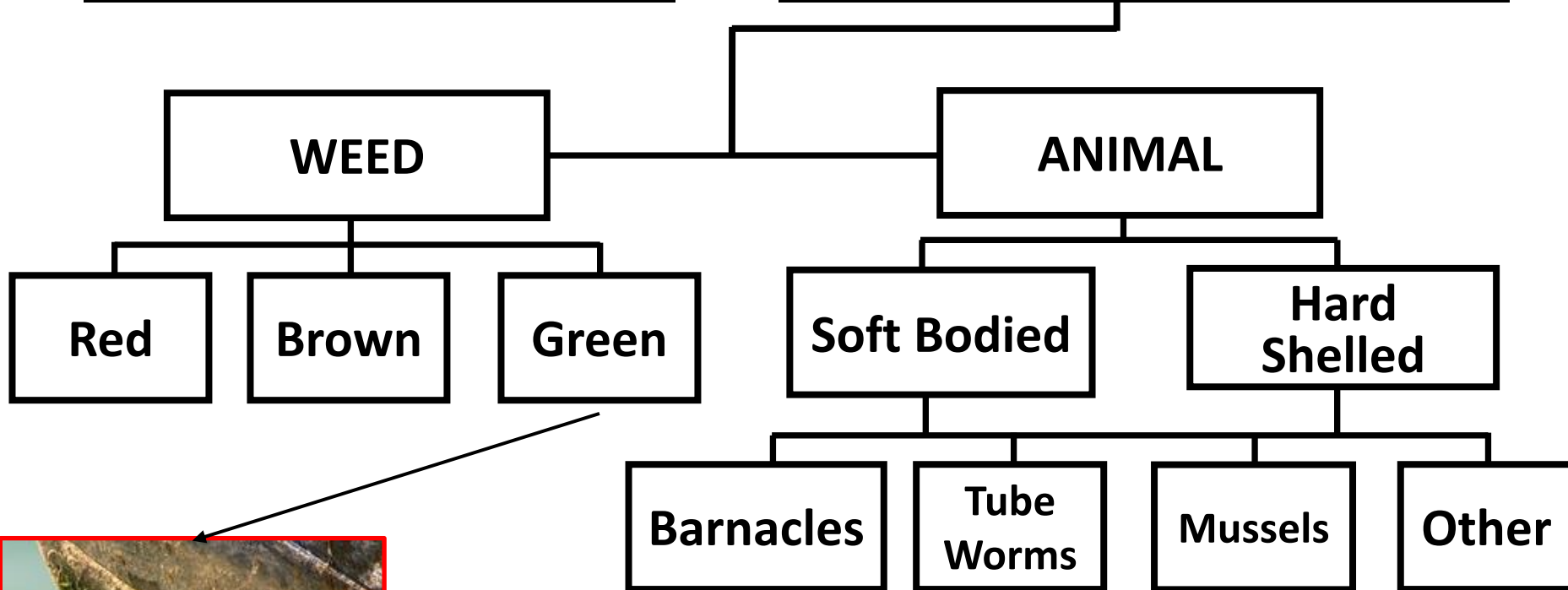


*Bio-fouling is continuing to increase
as the seaborne trade keeps going along high demand*

1. What is bio-fouling

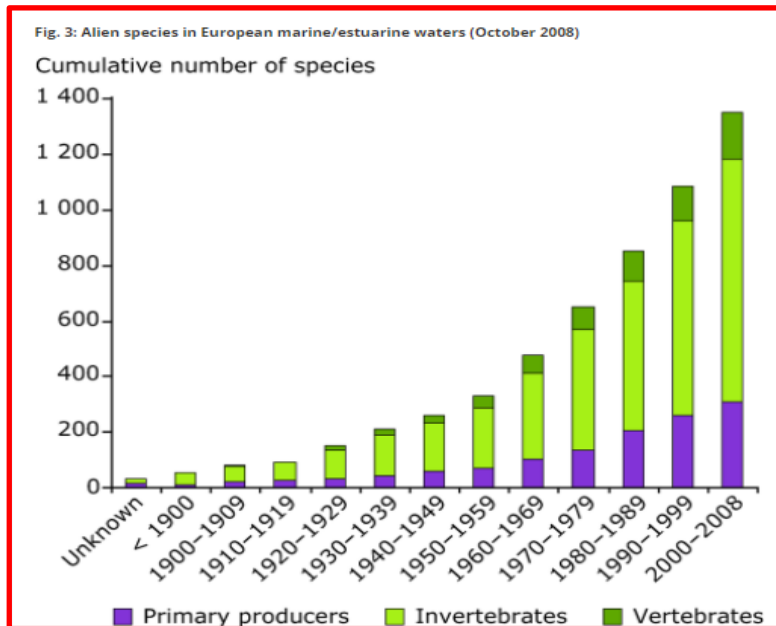
Micro-fouling = Slime

Macro-fouling = Weed + Animal



1. How does it impact ? – ① Primary problem

Disturbance on Marine Eco-system



- The introduction of invasive aquatic species to host environments **has been a major threat** to the conservation of biodiversity

- Since the volumes of seaborne trade continue to increase, the problem even may **not yet have reached its peak**

Rate of Alien species in European marine/estuarine waters

Such ecological damage is often irreversible

1. How does it impact ? – ②Secondary Problem

Increased Frictional Resistance

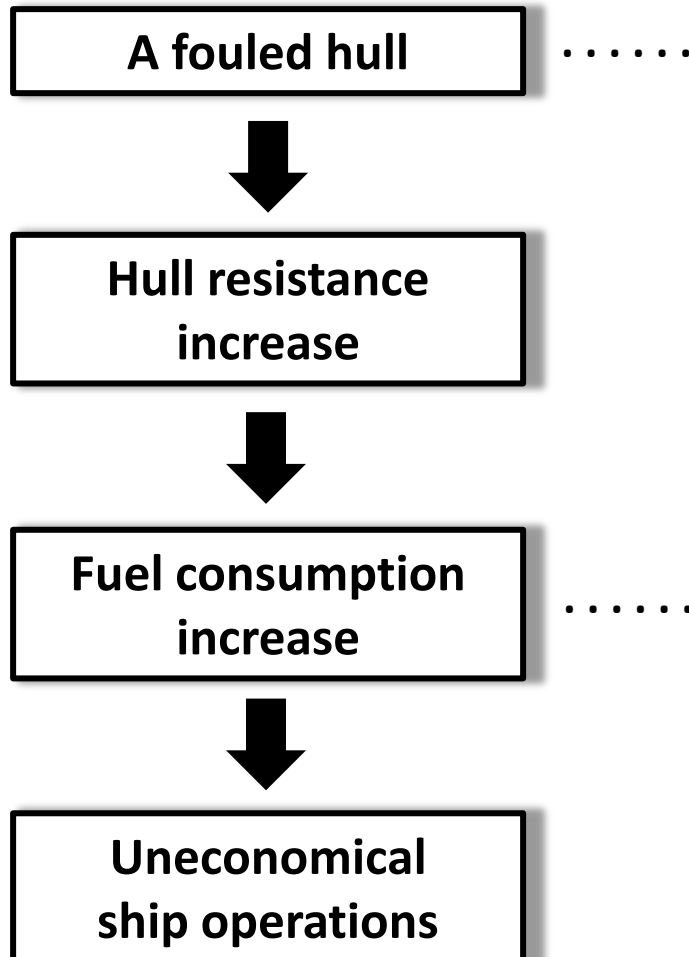


TABLE 1. Effect of Fouling after Six Months out of Dock in Temperate Waters

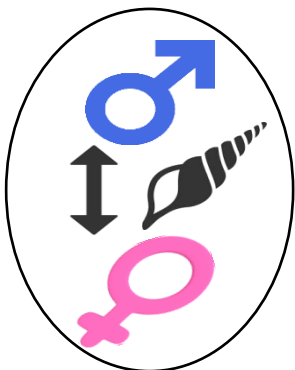
(Frictional resistance assumed to increase $\frac{1}{4}$ percent per day)

Type of Ship	Standard Displacement Tons	Loss of Maximum Speed Knots	Percentage Increase in Fuel Consumption* to Maintain a Speed of	
			10 Knots	20 Knots
Battleship	35,000	1½	45	40
Aircraft carrier	23,000	1¼	45	40
Cruiser	10,000	1¼	50	45
Destroyer	1,850	2	50	35

* These figures are based on the fuel consumptions for propulsion only, i.e. auxiliaries are not included.

1. How does it impact ? – ③Secondary Problem

Marine Pollution Caused by Usage of Anti-fouling Paint



Gender
Change



Deformed
Oyster Shell



Although at present copper antifouling paints present the BPEO available to the marine industry, there are a number of potential environmental impacts that may occur from using copper antifouling paints. Copper present in the water and sediments can be accumulated by benthic animals causing, for example, reduced respiration rates and impaired growth in mussels, clams and other shellfish (Sobral & Widdows 1997). The toxicity and accumulation of copper varies greatly depending on concentration levels, exposure, temperature and salinity, the presence of other metals and the type, size and age of the marine organism. It is therefore difficult to generalise about the toxicity of copper to marine organisms, there is evidence that certain species of fish are sensitive to quite low levels of copper even though other species are tolerant of much higher levels. Benthic marine organisms are thought to be slightly more sensitive to copper than fish, although some species demonstrate a capacity to adapt to elevated levels.

http://www.ukmarinesac.org.uk/activities/ports/ph4_3_1.htm

“There are a number of potential environmental impacts that may occur from using copper antifouling paints.”

1. The solutions for each problems

Summary of the Solutions and the Problems

- Ineffective Biofouling control under IMO Rules
- Marine pollution caused by usage of anti-fouling paint

1

Marine-eco
Disturbance

2

Resistance
Increase

3

Pollution
By antifouling

Solution



Monitoring
Control



Supportive Rules

Solution



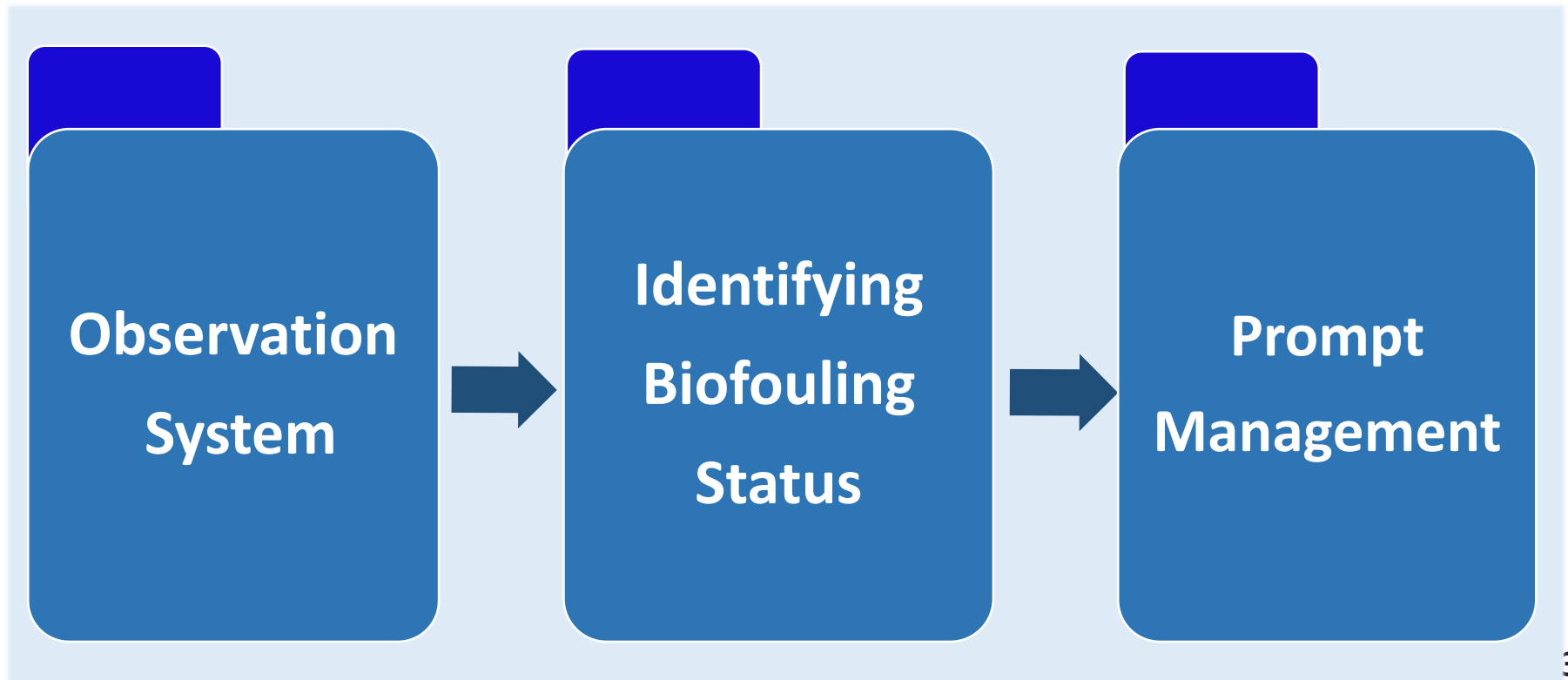
New Paint

2

Proposals

Proposal 1

- ① **Primary Problem - Disturbance on Marine eco-system**
- ② **Secondary Problem 1 - Increased frictional resistance**



Guideline Analysis - 1

MEPC 62/24/Add.1
Annex 26, page 6

Biofouling Management Plan

5.2 It is recommended that every ship should have a biofouling management plan. The intent of the plan should be to provide effective procedures for biofouling management. An example of a Biofouling Management Plan is outlined in appendix 1 of these Guidelines. The Biofouling Management Plan may be a stand-alone document, or integrated in part or fully, into the existing ships' operational and procedural manuals and/or planned maintenance system.

5.3 The biofouling management plan should be specific to each ship and included in the ship's operational documentation. Such a plan should address, among other things, the following:

- .1 relevant parts of these Guidelines;
- .2 details of the anti-fouling systems and operational practices or treatments used, including those for niche areas;
- 1** .3 hull locations susceptible to biofouling, schedule of planned inspections, repairs, maintenance and renewal of anti-fouling systems;
- .4 details of the recommended operating conditions suitable for the chosen anti-fouling systems and operational practices;
- .5 details relevant for the safety of the crew, including details on the anti-fouling system(s) used; and
- .6 details of the documentation required to verify any treatments recorded in the Biofouling Record Book as outlined in appendix 2.

5.4 The biofouling management plan should be updated as necessary.

“Management plan - Advised to address hull locations susceptible to biofouling”

12 FUTURE WORK

Research needs

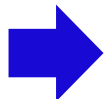
12.1 States and other interested parties should encourage and support research into, and development of technologies for:

- .1 minimizing and/or managing both macrofouling and microfouling particularly in niche areas (e.g., new or different anti-fouling systems and different designs for niche areas to minimize biofouling);
- .2 in-water cleaning that ensures effective management of the anti-fouling system, biofouling and other contaminants, including effective capture of biological material;
- .3 comprehensive methods for assessing the risks associated with in-water cleaning;
- 2** .4 shipboard monitoring and detection of biofouling;
- .5 reducing the macrofouling risk posed by the dry-docking support strips, (e.g., alternative keel block designs that leave less uncoated hull area);
- .6 the geographic distribution of biofouling invasive aquatic species; and
- .7 the rapid response to invasive aquatic species incursions, including diagnostic tools and eradication methods.

12.2 Potential operational benefits of such technologies should also be highlighted and relevant information provided to the Organization.

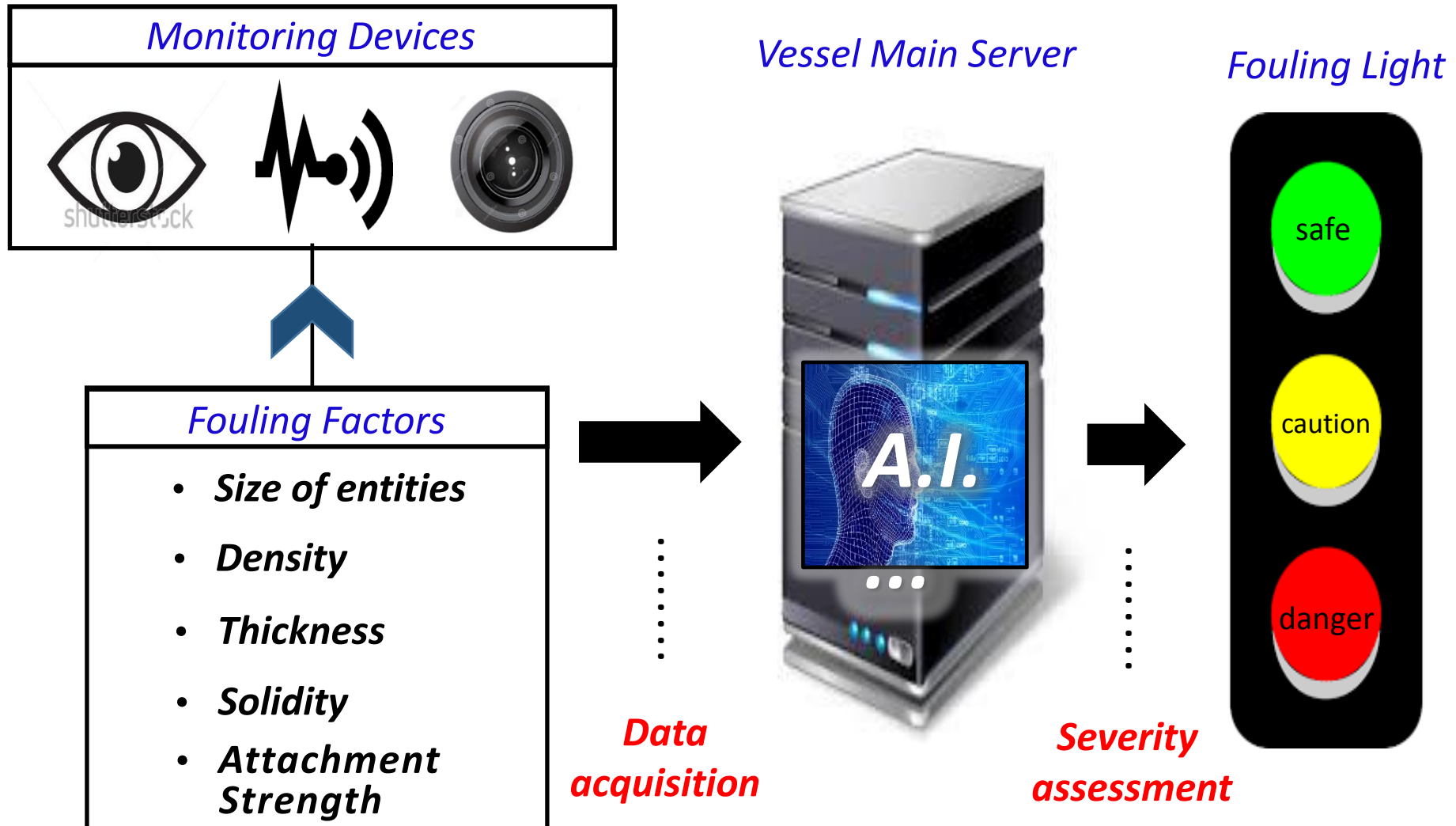
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“Future work – Advised to encourage and Support research of shipboard monitoring and detection of biofouling”



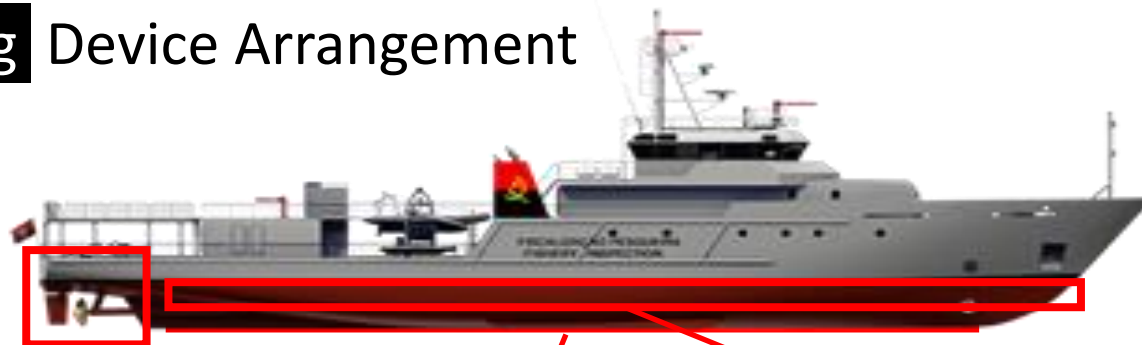
Need of Monitoring System

Introduction of Monitoring System



2. Proposal 1

Monitoring Device Arrangement



Propulsion Section

Bottom Section

Alongside wetted surface



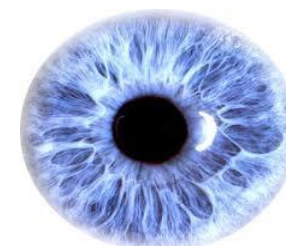
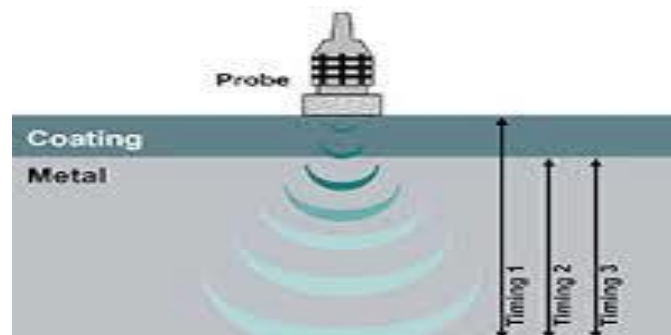
Infrared camera



Ultrasonic sensitive sensor

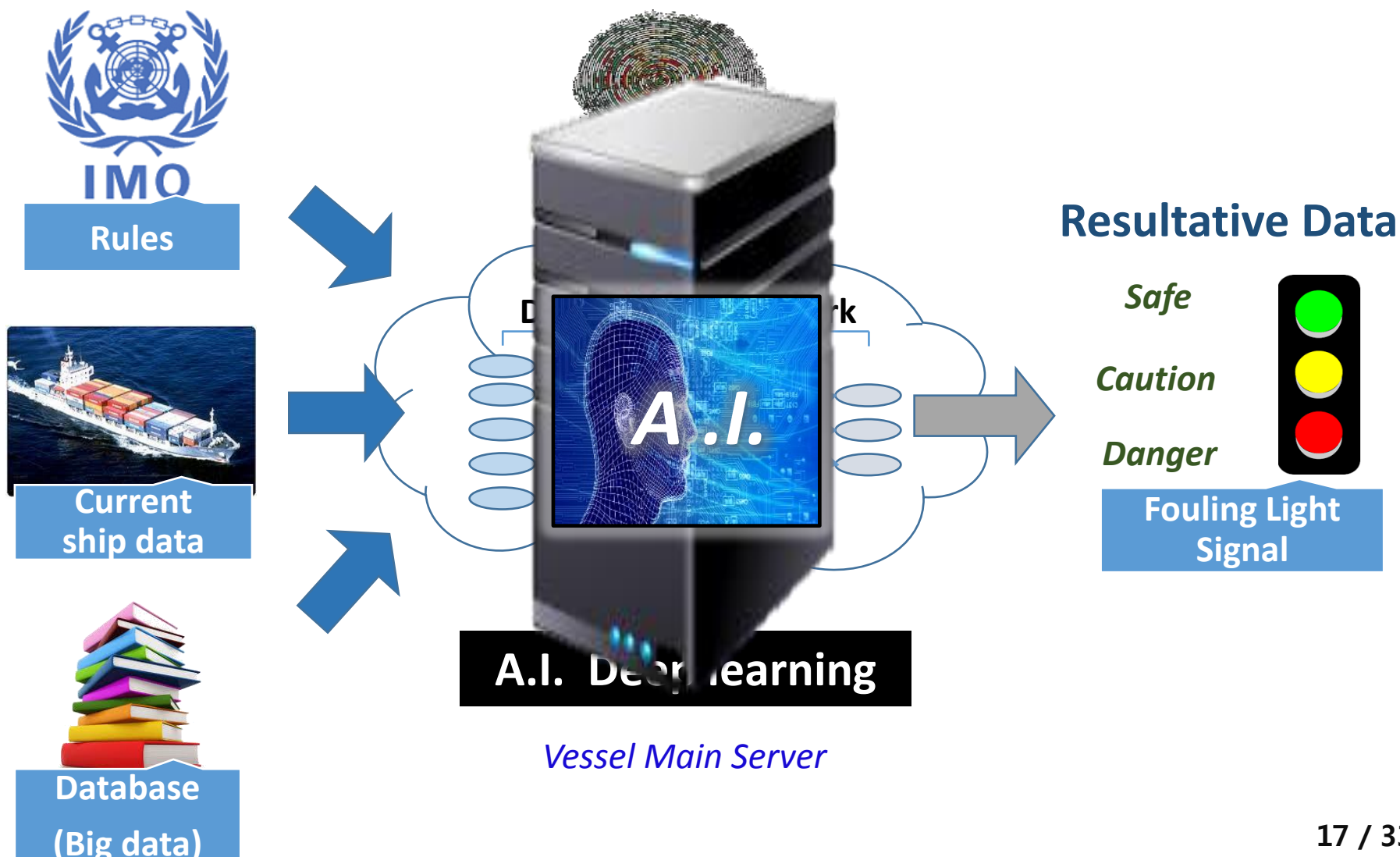


Visual Observation



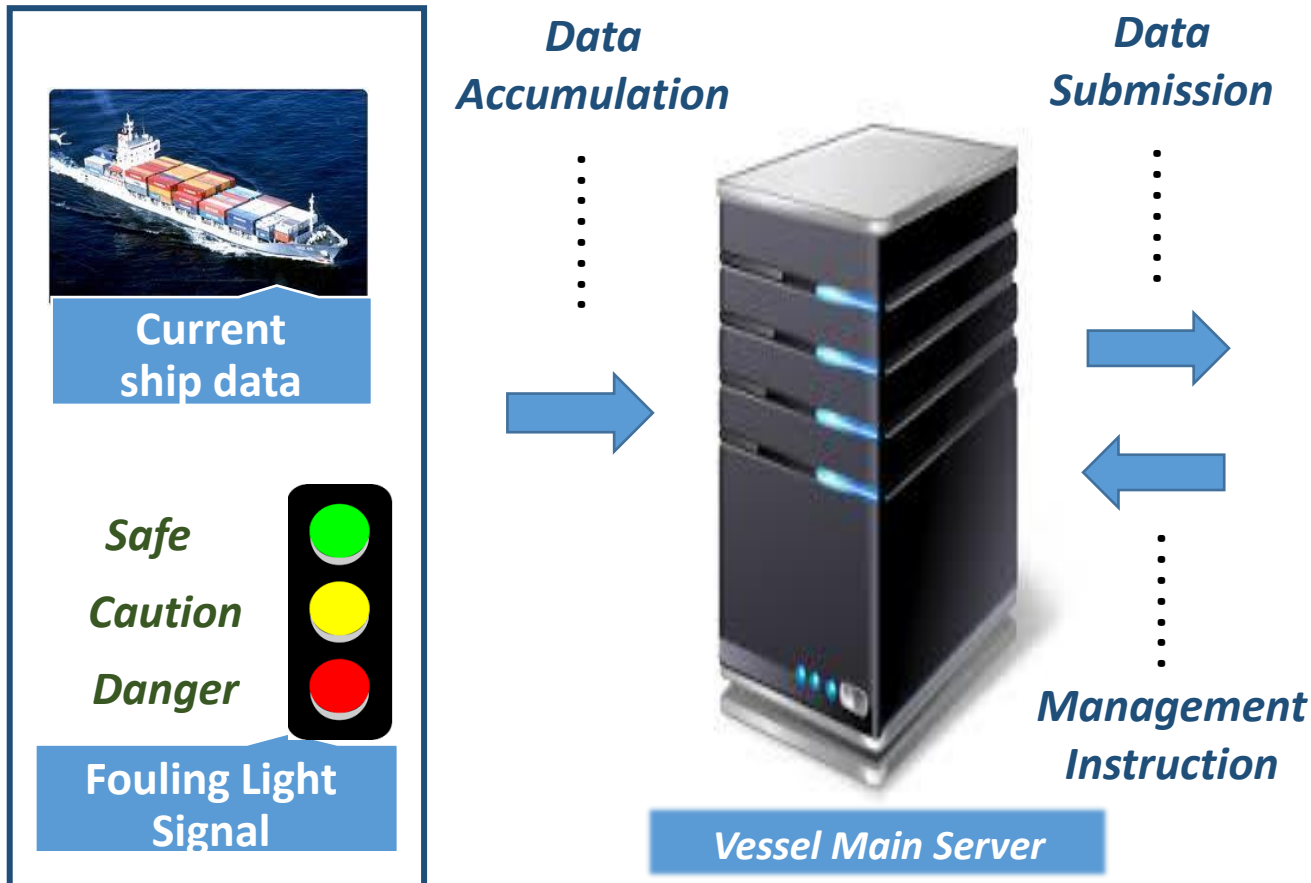
2. Proposal 1

Severity Assessment Process



2. Proposal 1

How to Share the Resultative Data ?



***Data Accumulation and Submission
to the Institutions / Bridge consoles***



Port authority



Ship classification



Ship bridge console

Amendments to MEPC 207(62)

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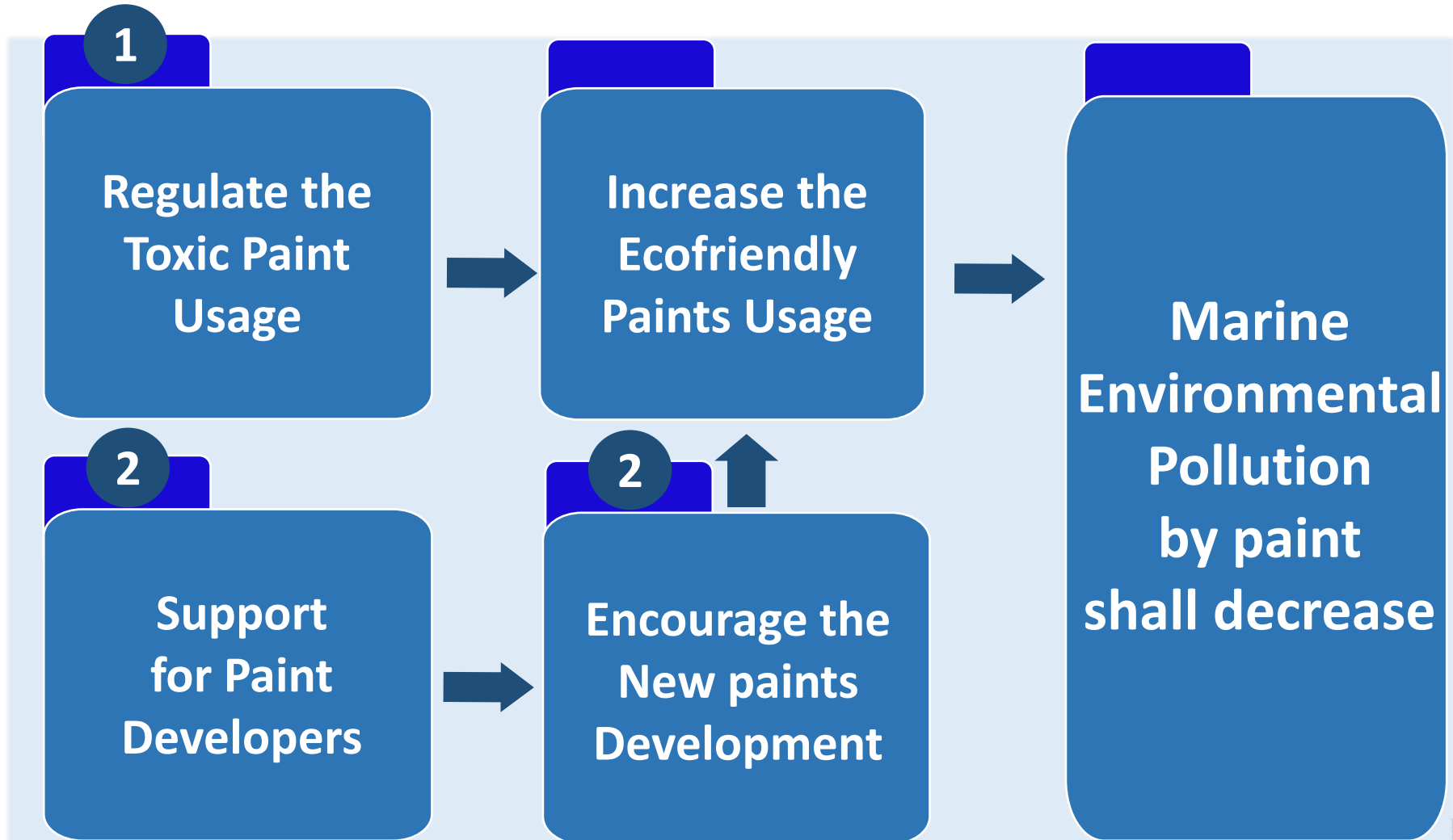
Complementary Proposal

5.9 Every ships is obligated to be equipped with a monitoring system within the deadlines set depending on types and purposes of operations.

- .1 if an existing vessel of at least 20,000 DWT but less than 40,000DWT, not later than June 1, 2020, If more than 40,000DWT, not later than January 1, 2020, be equipped with monitoring system.**
- .2 if a vessel anchored or not operating for more than 3 months in a year, or on purpose of intercontinental trade, not later than January 1, 2020, be equipped with monitoring system.**
- .3 if a vessel that was warned by the government authority or IMO in recent 1 year for its severe fouling extent, not later than January 1, 2020, be equipped with monitoring system.**

Proposal 2

③ Marine Pollution caused by usage of Anti-fouling paints



Guideline Analysis 2

6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

6.1 Anti-fouling systems and operational practices are the primary means of biofouling prevention and control for existing ships' submerged surfaces, including the hull and niche areas. An anti-fouling system can be a coating system applied to exposed surfaces, biofouling resistant materials used for piping and other unpainted components, marine growth prevention systems (MGPSs) for sea chests and internal seawater cooling systems, or other innovative measures to control biofouling.

6.2 The anti-fouling system used should comply with the AFS Convention, where necessary.

Choosing the anti-fouling system

6.3 Different anti-fouling systems are designed for different ship operating profiles so it is essential that ship operators, designers and builders obtain appropriate technical advice to ensure an appropriate system is applied or installed. If an appropriate anti-fouling system is not applied, biofouling accumulation increases.

6.4 Some factors to consider when choosing an anti-fouling system include the following:

- .1 planned periods between dry-docking – including any mandatory requirements for ships survey;
- .2 ship speed – different anti-fouling systems are designed to optimize anti-fouling performance for specific ship speeds;
- .3 operating profile – patterns of use, trade routes and activity levels, including periods of inactivity, influence the rate of biofouling accumulation;
- .4 ship type and construction; and
- .5 any legal requirements for the sale and use of the anti-fouling systems.

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MEPC.207(62)

Ch 6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

6.2-6.5

Choosing the anti-fouling system

6.6-6.8

Installing, re-installing, or repairing the anti-fouling system

6.9

Procedures for ship maintenance and recycling facilities

*There is no provision for **regulating usage of the toxic paints***

Suggestion for Rule Amendment

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Annex 26, page 10

6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

Procedures for ship maintenance and recycling facilities

Complementary Proposal

6.10 As the humanity is in the communal obligation of preserving the marine environment, there shall be a regulation for each nations on the usage of the toxic paints.

- .1 The governments should regularly dispatch inspectors to the vessels.**
- .2 A vessel that exceeds the limitation of toxic paint usage allowance shall pay the penalty according to the regulation set by IMO.**

Problems of Current Tin-free Anti-fouling Paints

- Functional & Economical but **Non – Ecofriendly**

➡ Ex 1) Copper base Self Polishing Copolymer Type

Acute toxicity indicates that substances such as **Cu paints have a similar or rather stronger toxic effect than TBT**, a very potent toxic substance to aquatic organisms. So California's Department of Pesticide Regulation has proposed a new regulation requiring all new copper-based antifouling paint and coating products to submit the estimated Mean Copper Release Rate of the product when registering.

2017-06-15 21:08

- Ecofriendly & Functional but **Non - Economical**

➡ Ex 2) Silicon base Foul Release Type

Silicon base Foul Release Type Anti-fouling paints do not contain biocide – there is no environmental problems, but **the painting processes and post-painting managements are very difficult also, it is prone to biofouling and expensive**. So it is burdensome for shipowners to adopt.

2017-06-14 14:25

The Current Difficulties in the Development Procedures

Antifouling paints typically require five to eight years of development and testing to reach the market, including the time to get a new biocide registered with the EPA. This is a long and expensive process. Similarly, it may take a company that manufactures biocides as much as \$5 million in testing before it can provide it to the paint companies.

2017-06-15 19:09

➡ **Even a development of new AF paint takes much expense and time**

- It is **too burdening to develop** a new eco-friendly AF paint
- Ship-owners are **reluctant to use** an eco-friendly AF paint
- **An easy way to approach the development** is needed for researchers

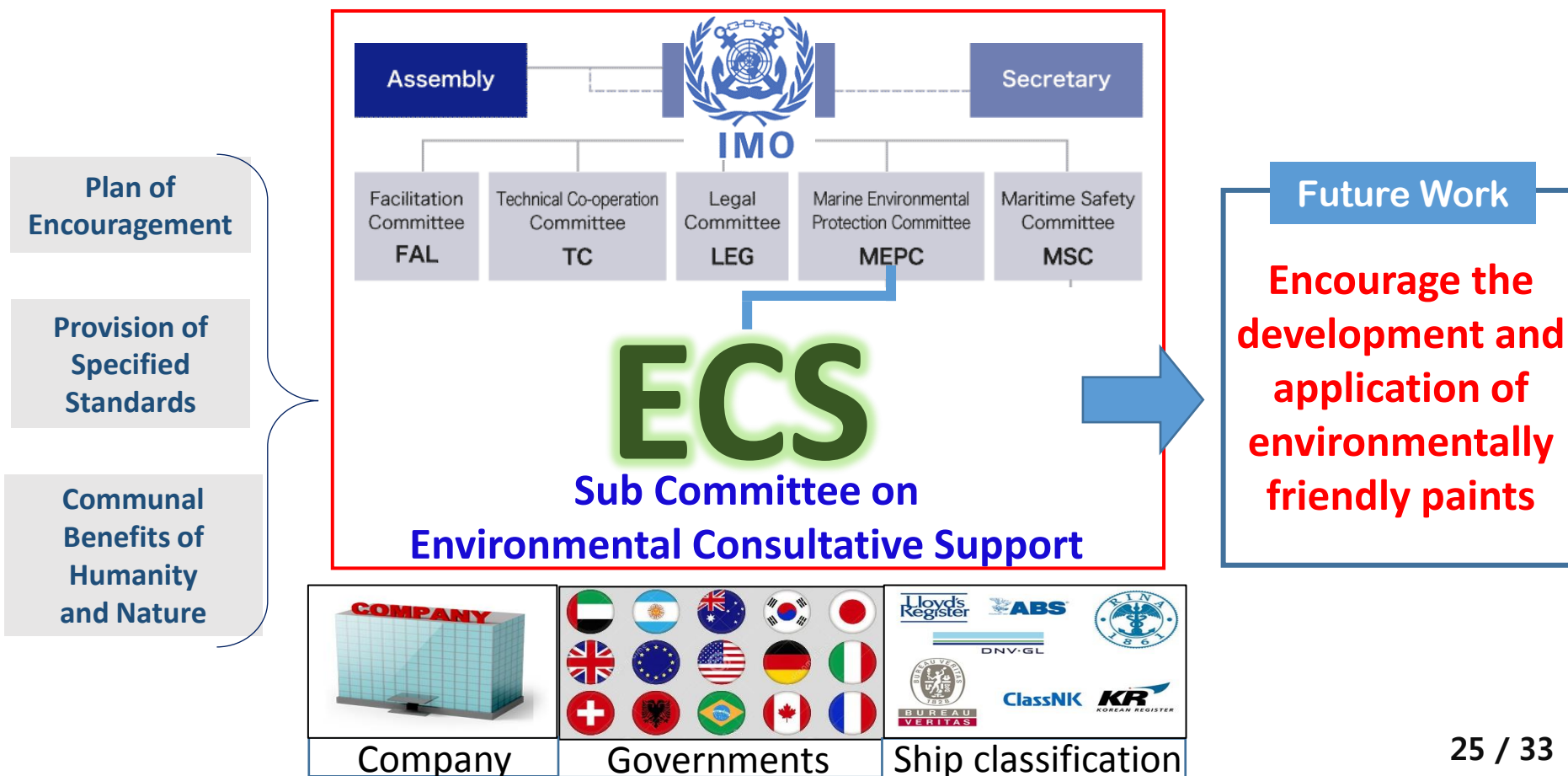
*Therefore it is required for IMO
to take supportive actions to encourage developers*

2. Proposal 2-2

IDEA for the developments of new paint

How to give supports to developers ?

- ➔ Proposal of **establishing a new public utilities agency** to encourage Developments and applications of the environmentally friendly paints



Agenda Submission

INTERNATIONAL MARITIME ORGANIZATION



Agenda Details

X.XX As the humanity is in the communal obligation of preserving the marine environment, Paint companies, Ship owners, Ship companies, Shipyards, Port states, Classifications and IMO should consider this guidance document.

- .1 The members of the committee are to be designated from each institution (Paint companies, Ship owners, Ship companies, Shipyards, Port states, Classifications and IMO), and the regular conference shall be held every 6 months on the agendas from the respective institutions.**
- .2 Any Party of ECS should provide specified environmental standards, the maintenance and application plan and the expected price and confirm possibilities thereof until the next conference.**
- .3 Any Party of ECS may propose an encouraging development plan of new eco-friendly paint to ECS.**

Conclusion & Prospective

Problems

There is a rule to manage the foul, but the effect is insignificant.

The environmentally friendly paints that can reduce marine pollution are not well developed.



Proposals

The installation of a monitoring system combined with artificial intelligence technology.

The establishment of ECS that can activate eco-friendly paints development.

3. Conclusion

1

Phasing in Monitoring system and Forming up DB to facilitate bio-fouling observation

**expectancy
1**

1

Less burden on Developing procedure will activate developments of superb ecofriendly antifouling paints

2

There no longer will be any passing ship that does not comply with the regulations

**expectancy
2**

2

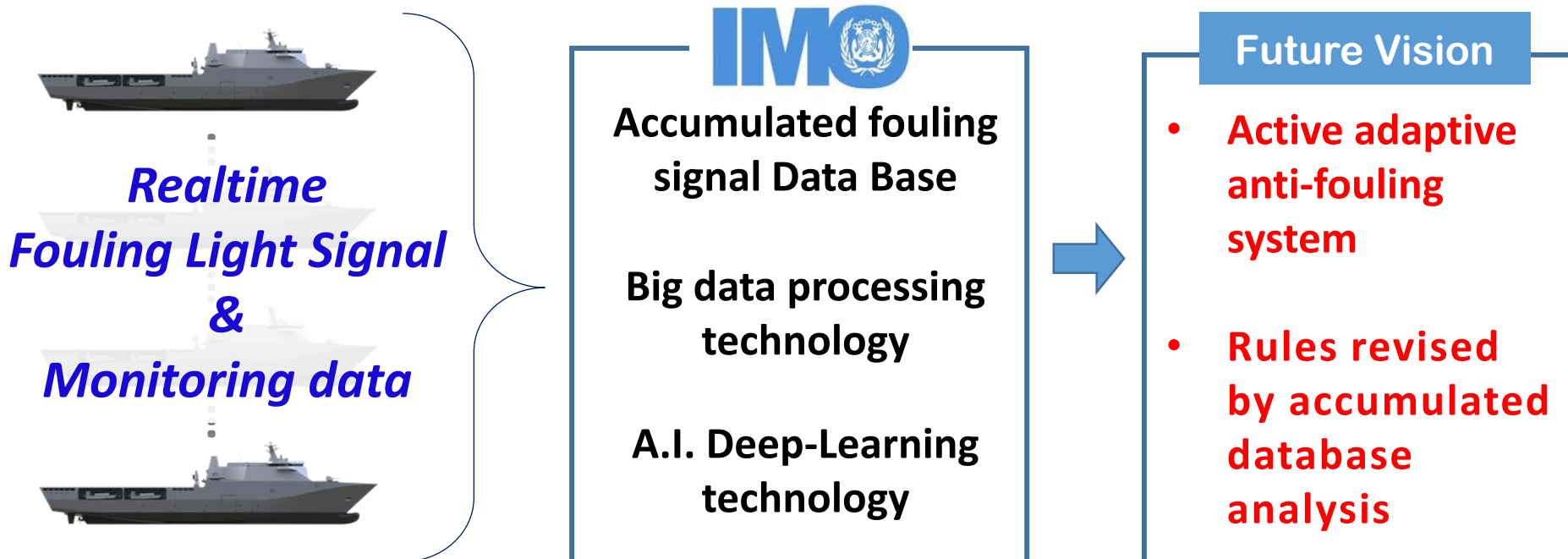
Environmental pollution of marine eco-system by paint can decrease



As a result of reduced fouling of the ship, disturbance of the marine ecosystem, Increase of ship resistance, environmental pollution caused by antifouling paints will reduce consequently

Future vision of Monitoring system

- **Active adaptive Anti-fouling management system** considering ship type, age and navigation area using Big data Processing Technology and Deep-Learning Technology
- **IMO shall revise the rules** properly following the circumstances by analysis with accumulated database



- [1] Konstantinou, Ioannis (Feb 22, 2006), Antifouling Paint Biocides. Springer, p. 1.
- [2] MAF Technical Paper, 2012, Scenarios of Vessel Biofouling Risk and their Management, P18
- [3] Woods Hole Oceanographic Institution, 1952, Marine fouling and its prevention, P3
- [4] MEPC.207(62), 2011, 2011 GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BIOFOULING TO MINIMIZE THE TRANSFER OF INVASIVE AQUATIC SPECIES
- [5] IMO, Biofouling, Retrieved from <http://www.imo.org/en/OurWork/Environment/Biofouling/Pages/default.aspx>
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- [9] SailMagazine, 2017, Regulations and Technology Change Antifouling Paints, Retrieved from <http://www.sailmagazine.com/diy/materials/regulations-technology-change-antifouling-paints/>
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- [11] Chemicalwatch, 2017, California proposes restriction on copper antifouling paint Retrieved from <https://chemicalwatch.com/51158/California-proposes-restriction-on-copper-antifouling-paint>

Ocean & Human

***“If you want to go fast, go alone,
if you want to go far, go together.”***





Thank you