# Initial Study of Autonomous Shipping in Indonesia

Author: Hafida Fahmiasari

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## Introduction of the Study
## This study extends the autonomous shipping understanding in Indonesia

- The study aims **to complete the international consultant understanding of MASS adoption in Indonesia**
- Interviews and desk studies have been conducted with **various stakeholders** to understand different perspectives of maritime autonomous surface ship (MASS): regulator, port operator, business players, academics, associations
- **Four main questions** related to autonomous shipping are asked to guide the interviews and desk research

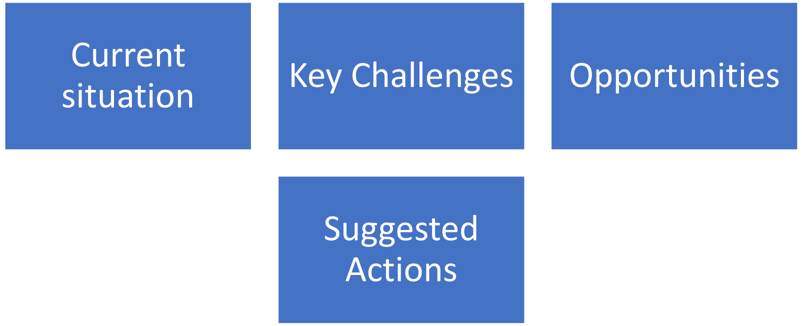


Figure 1: Main questions asked regarding the study

- Due to the very limited MASS concept adoption, we do not seek extensive lists of stakeholders

| Stakeholders | Sector | Method |
|---|---|---|
| **Ministry of Transport** | Regulation | Desk study, interview |
| **Samudera Indonesia Research Initiative, Pelindo** | Business Players | Desk study, interview |
| **Indonesia Transport Society, Indonesia Association of Seafarers** | Related Association | Desk study |
| **Institut Teknologi Sepuluh Nopember** | Academia | Desk study, interview |

Table 1: List of method and related stakeholders in this study

Current Situation in Indonesia

# Three aspects summarized the situation of MASS: regulation, infrastructure, and human resources. The regulation in Indonesia concerning MASS adoption is nonexistent.

**Regulation**

- The current regulator is the Ministry of Transport, especially **the Directorate General of Sea Transport** (DGST)
- Directorate General Land Transport (DGLT) is also in charge of this issue because the RoRo vessel (commonly used for ferry transport) is under DGLT.
- It regulates the different areas of transport and traffic, port, ship and sailor, navigation, and offshore safety
- Currently, **there are no laws, regulations, or guidelines mentioning the adoption of autonomous shipping** in the Indonesia context
- As the council member of IMO, Indonesia needs to keep up in introducing this issue in the country

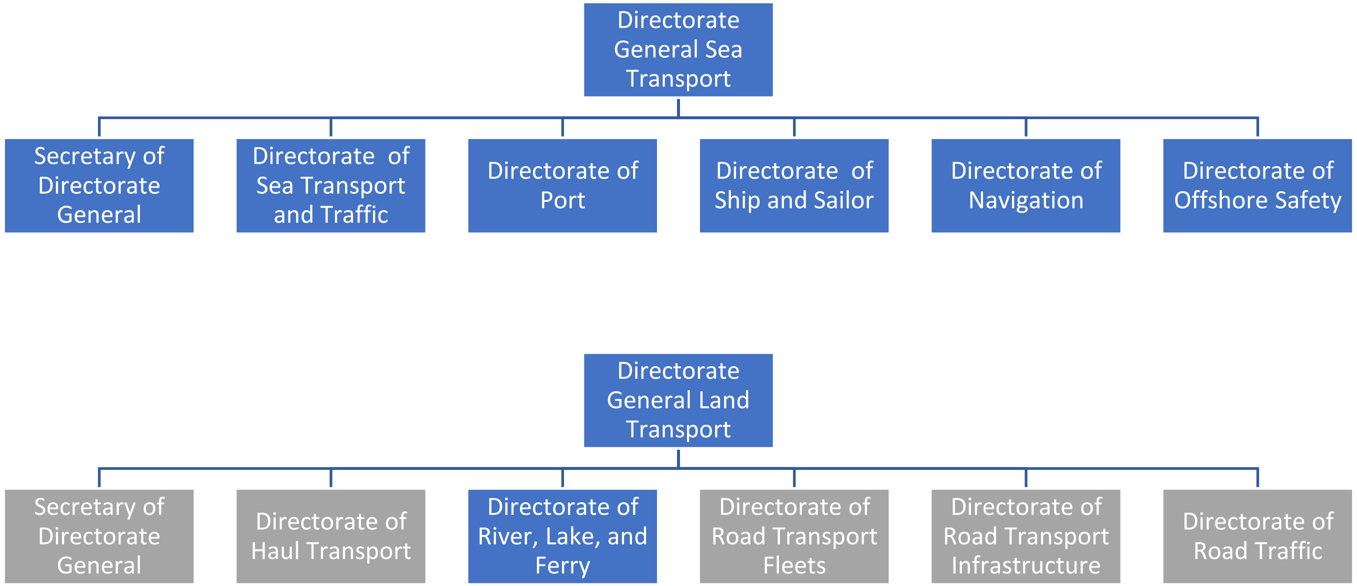


Figure 2: List of related regulators in Indonesia

# Current Situation in Indonesia
# Current seafarers' academics have no advanced curriculum concerning the MASS adoption other than understanding the data

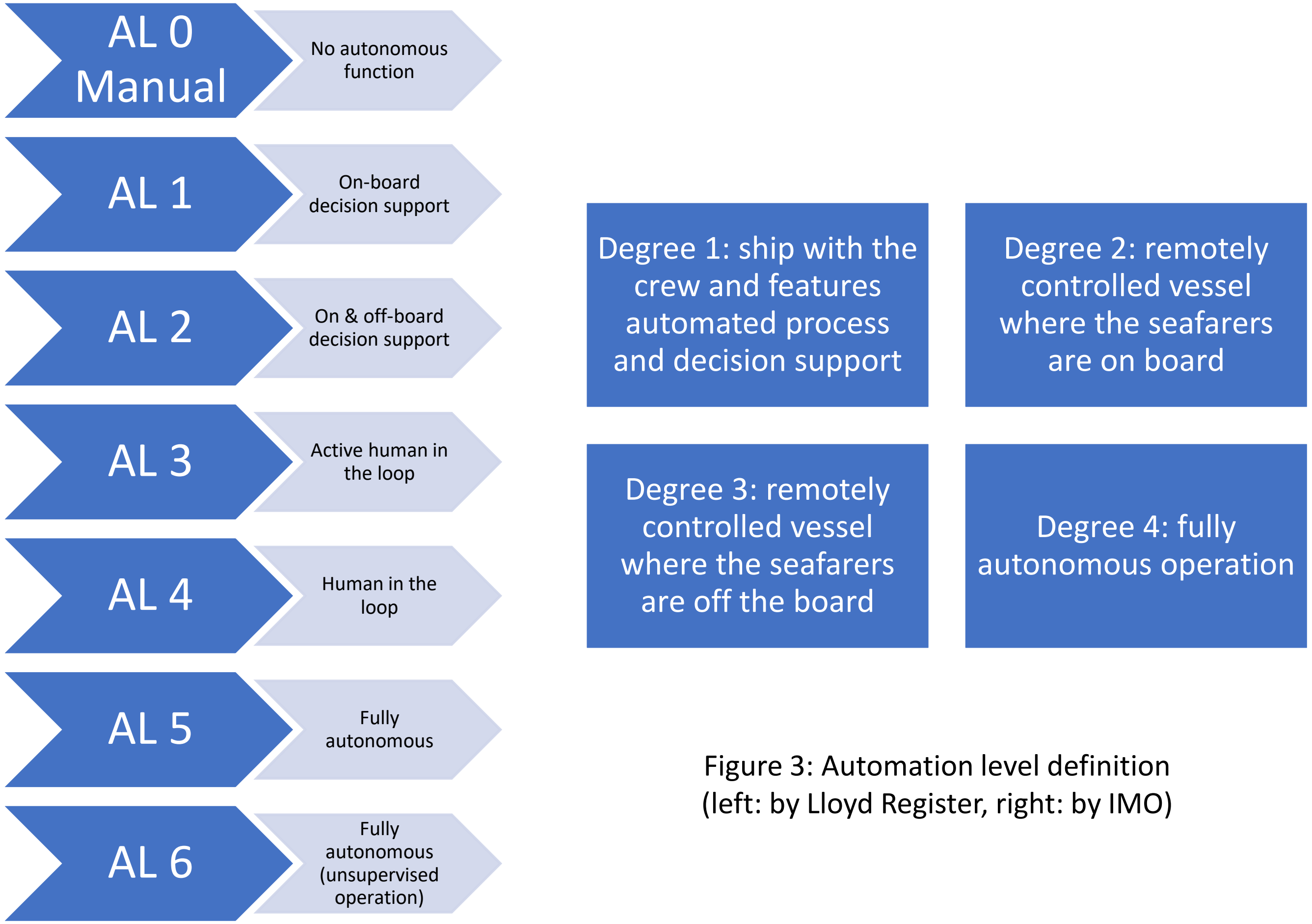


Figure 3: Automation level definition
(left: by Lloyd Register, right: by IMO)

**Human Resources**

- The automation level that has been defined varies from Lloyd Register and IMO's.
- It needs **the role of seafarers to control the operation** depends on the automation level.
- There are +80 seafarer academics throughout the nations. The major range:
  - Navigation
  - Engineering
  - Port and Ship Management
- **The current curriculum has no advanced subjects to adopt the MASS concept** other than understanding the data, such as AIS
- Adoption of MASS in the future **requires very specific IT courses** to produce more tech-savvy seafarers

# Current Situation in Indonesia
## Institut Teknologi Sepuluh Nopember (ITS) in Surabaya is a pioneer in MASS research in Indonesia

2020: I-Boat
identify potential dangers and prevent collisions with objects at sea

2022: ROV W-101
streamline the process of monitoring underwater cables and pipelines and conducting marine exploration in Indonesia

2023: Aksanawa
an autonomous surface ship, to do Search and Rescue (SAR)

Current: collaborating with MoT to research on ship size vessel for outer island logistics

# Current Situation in Indonesia

## To uphold its infrastructure and technology in MASS, Indonesia is still far from the current global shipyard competition

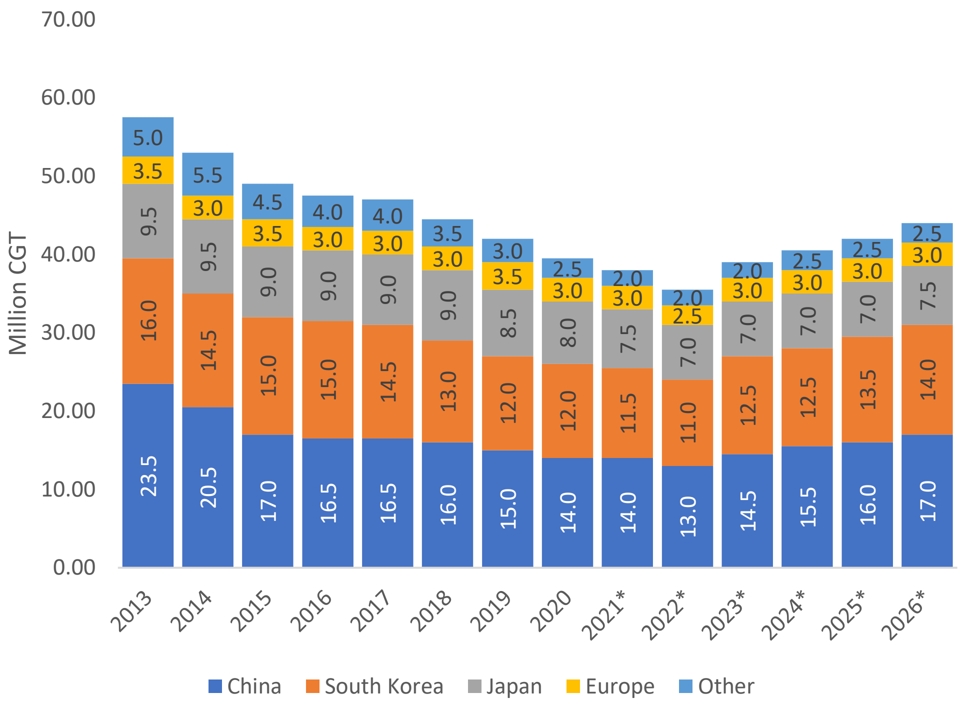


Figure 4: Global shipbuilding capacity and the forecasted figure
Source: Clarkson and Cargotech (2020)

**Infrastructure and Technology**

- **Globally, the shipbuilding capacity has reduced** from 57.7 million CGT in 2013 to 39.5 CGT.
- The capacity has reduced greatly caused of the financial crisis of 2008 and the weakening of vessel prices. Indonesia has significant gap to catch up in the shipyard industry compared to other maritime giants (China, South Korea, and Japan).
- In Indonesia, the **shipbuilding industry has experienced hard time** due to the lack of spare part and capacity causing the lack of appetite of ship orders from other and inside the country
- Indonesia has 250 shipyard companies. The **production capacity is 1 million DWT annually for new ship construction and 12 million DWT for ship maintenance and reparation**
- The shipyard industry constructs passenger ships, cargo ships, and special needs vessels. The largest capacity of the graving dock in the country is 150,000 DWT.
- PT PAL in Surabaya is the largest shipyard in the country. Most of the products are tanker vessels with sizes of 30,000 DWT and 17,500 DWT.

# Turning Challenges into Opportunity
## Three main challenges of MASS in Indonesia: one of the largest global seafarer community, high capital of autonomous ship, and question of economies of scale

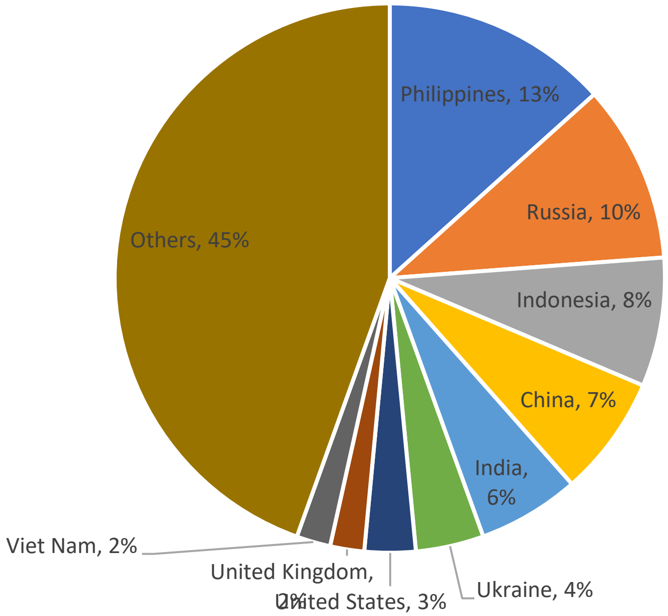


Figure 5: Share of seafarer number in the world
Source: UNCTAD, 2021

**Challenge #1: The third largest seafarer producer globally**

- Indonesia is the **world's third-largest country of seafarers**
- **The agenda of MASS still needs to be prioritized within the ministry**
- Adopting autonomous shipping would significantly impact countries that heavily rely on the maritime industry and have a large population of seafarers.
- The maritime industry contributed 11% of Indonesia’s GDP.

**Opportunity**

- **Train the seafarers** in adopting MASS technology by adding specific courses to adopt the MASS concept: Autonomous system, data analytics and AI, cybersecurity, human-AI interaction, and regulatory and legal frameworks
- Elevate and expand the quality to be **seafarer supply** for the country who has a crisis in seafarer numbers, such as Greece, Italy, Netherlands, and Japan

# Turning Challenges into Opportunity
## The high capital expenditure depends on the level of automation

| Component | Type | Automation Level |
|---|---|---|
| **Shore control center for remotely controlled vessels** | System | AL – 2, 3, 4, 5, 6 |
| **Data integration to support Vessel Traffic services** | System | AL – 2, 3, 4, 5, 6 |
| **Auto-mooring facilities for complete unmanned sailing to the terminals** | Infrastructure | AL 5, 6 |
| **Training for new process in automation** | Human resource related | AL – 2, 3, 4,5, 6 |
| **Adjustment of berthing infrastructure for small ports** | Infrastructure | AL 5, 6 |

Table 2: Investment in the MASS concept and its related automation level.
Source: Fiedler, Bosse, Gehlken, Brümmerstedt, & Burmeister (2019)

**Challenge #2: High capital expenditure**

- High capital costs in **upfront investment** to develop, integrate, and deploy autonomous technologies:
  - Retrofitting existing vessels or constructing new autonomous vessels
  - Advanced systems, sensors,
  - Communication infrastructure
- **The higher the automation level, the higher the capital cost required**

**Opportunity**

- **Technology Localization**: Indonesia can explore opportunities to localize the production and integration of autonomous systems and components
- **Public-Private Partnerships:** Collaboration between the government, private sector, and research institutions can lead to public-private partnerships focused on financing, research, and deploying MASS technologies
- **Leveraging Existing Infrastructure**: Indonesia can capitalize on its existing maritime infrastructure and capabilities to facilitate the adoption of MASS

# Turning Challenges into Opportunity
# The economy of scale of MASS is still in question

| Parameter | | Ship size | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Capacity (TEU) | | 1,000 | 1,350 | 2,000 | 2,550 | 3,500 |
| Conventional ship | Fuel usage (ton/hr) | 0.61 | 0.69 | 0.75 | 0.80 | 0.85 |
| | Weekly time charter cost (kUSD) | 53 | 54 | 56 | 58 | 64 |
| Autonomous ship | Fuel usage (ton/hr) | 0.55 | 0.62 | 0.68 | 0.72 | 0.77 |
| | Weekly time charter cost (kUSD) | 32.5 | 33.5 | 35.6 | 37.7 | 44.0 |

Table 2: Different potential reduction of long-term cost operation in MASS
Source: Akbar, et.al., 2020

**Challenges and Opportunity**

- The high capital of MASS adoption creates **a question on the economies of scale** of this operation.
- Some notable research shows the potential for cost savings in the long term of MASS operation.
  - Akbar, et.al., 2020
    - Reduced fuel consumption by 9.75%
    - Reduced crewing costs --> reduced weekly charter cost by 36%,
    - Reduced construction cost by removing the deckhouse, by 5-10%
  - Nguyen, Ruzaeva, Góez, & Guajardo, 2022
    - Optimize routes, improve fuel efficiency, and enhance overall operational efficiency → reduction of 7% of operating cost
- **Different ship size has a different percentage of reduced cost**

# Turning Challenges into Opportunity
# Other than decrease, there is also increase of cost in some components

| Component | Sub-components | Autonomous container ship | Autonomous bulk carrier |
|---|---|---|---|
| **Voyage costs** | Bunker fuel | The fuel consumption is reduced by 13-15%[a] | the fuel consumption is reduced by 6-15%[a] |
| | Port charges | Boarding crew cost is not estimated | Boarding crew cost +20% |
| **Operating costs** | Crew wages | -30 – 35% due to removal of crew cost; cost of shore control center +250k USD | -945,000 USD cost of wages; additional cost of shore control center +149k USD |
| | Stores | Removal of stores concerning crew is not estimated | -67k USD |
| | Maintenance and Repairs | Maintenance of autonomous systems carried in ports - the scale of increase unknown | Maintenance of autonomous systems carried in ports: -135k USD |

*a = autonomous, c = conventional

| Component | Sub-components | Autonomous container ship | Autonomous bulk carrier |
|---|---|---|---|
| **Capital Cost** | Purchase cost | Additional cost of redundancies, removed deckhouse, and hotel system – not estimated | Additional cost of redundancies (+10%), removed deckhouse (+5%), and hotel system (1-10%) |

Table 3: Increase and Decrease Cost during the Ship Operation
Source: Ziajka-Poznanska & Montewka, 2021

- The cost decrease in fuel consumption, crew cost, removal of stores, maintenance, and repairs
- The cost increase in boarding crew costs, procurement of shore control center, redundancy in capital costs, removal of deckhouse
- The economy of scale in MASS operations is **contingent on various factors**, including the scale of operations, the nature of the shipping routes, the cargo volume, and the regulatory framework in place

# Suggested Road Map for National Authority
## The road map is divided into short, mid, and long terms

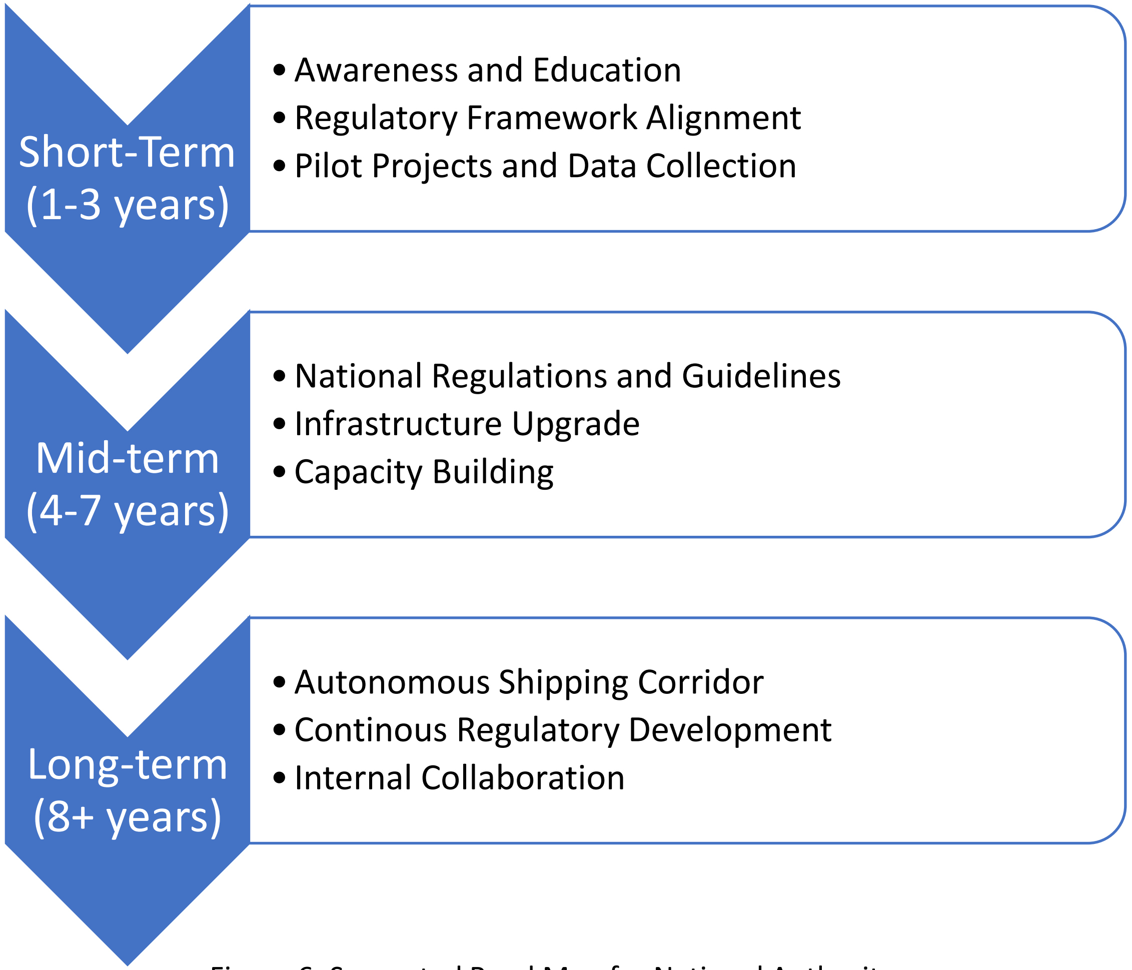


Figure 6: Suggested Road Map for National Authority

- **Short-term (1-3 years)**
  - introduce the concept aligning with IMO's progress on setting guidelines
  - initiating pilot projects to test autonomous vessels' performance, safety, and efficiency in Indonesian maritime conditions. The test will provide data on navigational challenges, vessel interactions, and environmental impact to inform the development of national guidelines and regulations
- **Mid-term (4-7 years)**
  - It concern the operation of autonomous vessels in Indonesia, considering the IMO's Interim Guidelines on Maritime Autonomous Surface Ships.
  - Focusing on what upgrade should country hard and soft infrastructure has
- **Long-term (8+ years)**
  - Specify shipping corridor and continue to develop the suitable regulation