Improving safety of navigation and sustainability of shipping through innovative autonomous shipping technologies in Asia Pacific: Case Study of Thailand

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Current Maritime Transport Situation in Thailand

- Maritime transport accounts for more than 80 percent of all international transportation.
- Thailand has a coastline of 3,219 kilometers and divided into two parts: Thai gulf and Andaman coast.
- There are about 220 ports along coastline and categorized into 4 clusters:
  - (1) Inner Thai gulf covering Bangkok and the surrounding area incorporating key river ports such as Bangkok Port and other ports operated by private sectors along Chaopraya River, for example, Saha Thai Terminal, BMTP, and Bangkok Barge Terminals;
  - (2) Eastern Thai gulf embodying the Eastern region and is the heart of container and industrial deep seaport namely Laem Chabang Port, Maptaput Port, and Kerry Siam Seaport;
  - (3) Western Thai gulf combining parts of Lower Central region, Upper Southern region, and Lower Southern region which mostly focus on fishery and bulk cargoes. The main cargo ports in this region are Songkhla port and Prachub port;
  - (4) Andaman coast which mainly focus on passenger ferry, offshore supply, and short voyage connecting Thailand and neighboring countries. There are limited numbers of cargo ports in Andaman which mostly situated in Ranong, Trang, Phuket, and Krabi province.
Main Maritime and Water Transport Regulations

The main legislations concerning the maritime and waterborne transportation sector encompass:

- Navigation in Thai Waters Act
- Thai Vessels Act
- Mercantile Marine Promotion Act
- Carriage of Goods by Sea Act
- General Average in Maritime Adventure Act
- Preventing Ship Collision Act,
- Ship Mortgage and Maritime Lien Act
- Arrest of Ship Act
- Multimodal Transportation Act
- Port Authorities Act
- Immigration Act
- Customs Act.

Marine Department under the Ministry of Transport continues to be the sectoral regulator. It is in charge of law enforcement, navigation safety, ship registration and inspection, certifying ship’s equipment and facilities, maintenance of navigation channels, providing pilot services for seagoing vessels, port construction and extension, and minimizing environment impact caused by navigation and port activities. It is also responsible for the promotion and development of maritime transport and infrastructure development.
Gap Analysis of Autonomous Shipping in Thailand

**As is:** Used for Specific Purpose and only for Internal Usage of Company

- Used for Collecting Data of Water Quality and Depth
- Used for Farm Watering
- Collecting Water garbage and Trash

**To be:** To Carry Maritime Freight and Passenger

For discussion
Autonomous Vehicle in Thailand

- Most of efforts to invest and operate autonomous vehicle are initiated in the manufacturing and service industries, especially to be used in transporting raw material and parts within factories to minimize cost and errors in production process.
  - **At Level 0**: fully operated by human
  - **At Level 1**: Manned ships with automated processes and decision support. Some operations may be automated and at time be unsupervised but seafarers on board ready to take control.
  - **At Level 2**: remotely controlled ship with seafarers on board. Ship may be controlled and operated from another location.
  - **At Level 3**: Remotely controlled ship without seafarers on boards by communication technology (5G); No seafarers on board
  - **At level 4**: Full autonomous ship. Automated ships can make decision and determine actions by itself.
Current Situation of Autonomous Vehicle in Thailand

- On August 29, 2017, Thailand government approved three main mechanisms to build favorable ecosystem to propel the development of robot and automation system industry containing
  - (1) accelerating all manufacturing and service industries to enhance efficiency by utilizing robotic and automation system as well as to create local demand for robot and automation industry;
  - (2) promoting the production of system integrator (SI) to ensure the supply of SI will meet the demand;
  - (3) instituting the Center of Robotics Excellence (CORE) to provide technological and advisory support for the existing robot and automation system enterprises to advance their operations to other planned products such as elderly care robot, police robot, hospitality robot, autonomous vehicle, autonomous bus, robot taxi, autonomous ship, and autonomous aerospace.

To achieve the government objective to become a leader in ASEAN in developing and using robot and automation in 2026

1. Marketing Promotion Strategy: including (a) exempting income tax for any enterprise which change from current conventional system to automation system; (b) granting certain subsidies or special interest loan; (c) arranging business matching; and (d) supporting the enterprises to engage in relevant international trade exhibitions.

2. Grooming System Integration: the following actions are commenced to increase the supply of System Integration (SI) to accommodate growing investment in manufacturing robot and automation system by (a) temporarily removing import duties on materials and parts used in manufacturing robot and automation and (b) granting investment incentives by exempting income tax up to 8 years

3. Supply Generation: by (a) arranging education in colleges and non-degree training and development programs to increase human capital working in robot and automatic system industry at least 300 people per year; and (b) establishing Mutual Recognition Agreement (MRA) with other countries to enlarge market size for robot and autonomous products

4. Forming Center of Excellence: by institute Center of Robotics Excellence (CORE) to support the development of robot and autonomous technologies by strategically allying relevant technical institutes and universities to work together on selected tasks such as collaborating with business enterprise to develop industry prototype in priority sectors such as agricultural, industrial, healthcare, and logistics sector and developing laboratory test on safety and performance of products
Thai Government has established investment privileges of manufacturing all kinds of autonomous vehicle and equipment with engineering design including automation system integration and control system configuration, given that the autonomous vehicle must be fully automated and can perform at least 2 tasks at once continuously and collectively. The privileges include 8 year income tax exemption, import duty exemption, and non tax privileges.

All companies enjoying investment privileges are manufacturing automation equipment controlled by computerization used in limited space such as automated vending machine, automated electricity controllers, automated storage machine, automated guided vehicle (AGV), drone delivery, and factory robot. **The investment has not yet extend to autonomous shipping and other public transportation**

Other attempts are carried on by innovation funding agencies to do pilot projects in autonomous vessels used for collecting garbage, water quality and depth, and watering gardens and farms.
Main organization in Thailand driving the policy initiatives related to robot, autonomous vehicle, automation system industry is Ministry of Industry in cooperation with relevant agencies including:

- Office of Industry Economy
- Office of Industrial Standard,
- Department of Industrial Promotion
- National Science and Technology Development Agency,
- Board of Investment (BOI)
- Thai- German Institute,
- Electrical and Electronics Institute (EEI).

Limited connection of the working committee to Ministry of Transportation which may delay the progress made on inventing and commercializing autonomous vehicles used in transportation and shipping sector.
Autonomous Truck introduced by HPT in Laem Chabangkok Port

To reduce 11 percent in carbon emission per TEU by 2030 by adding more electrically operated autonomous trucks, remote control electric yard cranes, and switching to electronic gate pass since early of 2022.
Other attempts

- Used for Collecting Data of Water Quality and Depth
- Used for Farm Watering
- Collecting Water garbage and Trash
Current Situation of Autonomous Vehicle in Thailand

- Until now, the demand for autonomous shipping used for commercialization in Thailand is relatively limited which is opposite to the growing demand for environmental friendly and clean energy vessels as well as the growing application of internet and digital communication in maritime shipping and port business.

- Other challenging issues are
  - Existing regulations are not in line with technological advancements
  - In the Act of Navigation in Thai Water Territory, responsibility related to following issues must be undertaken by ship master:
    - ship collision and ship in distress,
    - notification of ship arrival and department,
    - enter of ship in restricted area and designated navigation route,
    - report of any accident or unpleasant evidence on ship,
    - report on cargo discharge and loading at port
    - Handling of dangerous / hazardous cargoes on board
    - Ship anchorage
    - Liability
    - trust of navigation safety when ship encountering complicated scenarios
  - Cybersecurity
  - Marine Pollution
  - Education and HR Training

For discussion
1. **Establishing Forum on Autonomous Vessel** to raise awareness and strategies to promote the progressive adoption of autonomous vessel in domestic and international water territory. Ministry of Industry should not miss Ministry of Transport.

2. **Opening Mindset**: The philosophy of launching autonomous vessel into commercial services to save cost and energy should predominantly focus on the safety management of operations, design, construction, and liability to stakeholders while relevant stakeholders should open their minds to accept new technological advancement.

3. **Innovating Education and HR Training**

4. **Experiment in closed system (Sandbox)** must be done to ensure the commercialization of autonomous vessels
   - Designating specific sandbox in closed system of water territory to do experiment in the context of domestic and international navigation.
   - Specification of the vessels should be accorded to international standard recognized by specialized UN bodies or global professional engineering societies.

5. **Modernizing Regulation**: government prepare to modernize or introduce regulations related of autonomous vessel design and construction, ship licensing, ship owner and ship controller licensing and qualification, safety management, safety assurance, cybersecurity, ship registration, and ship navigation in water territory, by basing on fact findings in sandbox experiment, if applicable.

6. **Establishing Technological platform** to monitoring and communicating with autonomous vessels and ship owners/controllers as well as mechanism of ship reporting in emergency or collision circumstances, ship arrival and departures from ports, and liability for ship owners/controllers to relevant stakeholders.