UN ESCAP PROJECT
“Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region”

AUTONOMOUS SHIPPING TECHNOLOGIES
VIETNAM STUDY

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
Methodology:
1. Review and study of literatures and articles on the public domains (websites, portals, fan page...)
2. Meeting and Interviews with stakeholders
3. Information and data/materials request via unofficial/official channels

Thanks to Stakeholders:
1. Vietnam Maritime Administration (Vinamarine)
2. Vietnam Register (VR)
3. Vietnam Maritime University (VIMARU) and Ship Science and Technology Institute (SSTI)
4. Vietnam Shipowner Association (VSA)
5. Ho Chi Minh City University of Transport (UT-HCMC)
6. Shipbuilding Industry Corporation (SBIC)
7. Vietnam Maritime Corporation (VIMC)
Report structure

1. General
2. Autonomous Shipping Technologies in the context of Vietnam
   2.1 Current Shipping Industry and Technology overview
       Sea going fleet
       Inland water transport fleet
       Seaport system
       Ship building and repairing industry
       Human resource in shipping
       The role of women
   2.2 National Legal Framework
   2.3 Status of autonomous technology R&D
       Autonomous technology R&D in different transport sectors
       Research of autonomous technologies in shipping
   2.4 Opportunities and challenges for autonomous shipping technologies
       Opportunities
       Challenges
3. Recommendations

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
General

Autonomous Shipping - one of the modern concepts support the goals of safe, secure and green shipping

- **Safety:**
  - Less Crew means less Human Errors, less risk of hazardous works
  - More advanced technologies mean more precise and safer navigation as better in recognizing and predicting hazardous situations

- **Operational Effectiveness and Operativity:** possibility for 24/7 operation, increased capacity for cargo, improved cargo handling, better route planning, reduced cost of accommodation construction and maintenance....

- **Security:** Less or no crew means less or no hostages and ransom. High-tech is a threat to piracy, arm robbery, highjack in South East Asia waters

- **Environment Protection:** More efficient fuel consumption, less garbage and emissions, green and renewable energy

- **Gender Equality:** Enhanced role of women and more job opportunities

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
General

IMO takes a proactive and leading role in supporting and encouraging autonomous technological developments

- IMO's Strategic Plan (2018-2023) to consider balancing the benefits of advanced technologies against safety, security, environment impact, trade facilitation and potential costs concerns
- The MSC 101st session in June 2019 approved Interim guidelines for Maritime Autonomous Surface Ships (MASS) trials (MSC.1-Circ.1604)
- The MSC 103rd session in May 2021, has completed the regulatory scoping exercise (RSE) on MASS
- The MSC 106th session in November 2022 decided on the development of goal-based MASS Code (non-mandatory in 2025, mandatory from 2028)
- The Joint MSC/LEG/FAL Working Group has been established to address common issues identified by the RSE with half yearly meetings.

4 degrees of autonomy of MASS by IMO:

- Degree one: Ship with automated processes and decision support
- Degree two: Remotely controlled ship with seafarers on board
- Degree three: Remotely controlled ship without seafarers on board
- Degree four: Fully autonomous ship
General

**Maritime nations and Autonomous Shipping**

Leading governments such as EU, UK, Russian, US, Republic Korean, Japan, China etc.:

- express great concerns and actively support IMO and progressing several MASS research projects

- trialling and putting in commerce a number of the autonomous ships, i.e: Rail/vehicle carriers Marshal Rokossovsky and General Chernyakhovsky (Russian Federation), ferry Soleil [Nippon Foundation – Japan], LNG carrier Prism Courage (Korean), the Mayflower Autonomous Ship (US), Maju 510 tug (Singapore) etc...

**UN ESCAP**

- Promoting cooperation, technical assistance and capacity-building in pursuit of solutions to sustainable development of Asia-Pacific region

- Implementing project “Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region” for beneficiary countries in Asia and the Pacific, including Vietnam
General

How about Vietnam?

The objective of the Study with regards to autonomous shipping

- Brief overview of the country maritime industry
- Identifying opportunities and challenges
- Generating recommendation for future consideration

Primary and preparatory Report in supporting UN ESCAP project

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
Shipping Context of Vietnam

Sea going Fleet

- Vietnam seaport cargo throughput grows rapidly (approximately 3-4%) each recent years: 692 million tons in 2020, 706 million tons in 2021 (source: Vinamarine)
- important link in the logistics service chain of the economy, has taken over almost 100% of the domestic freight by sea
- 1,502 ships in operation, total 7,145 million GT and 11.7 million tons Deadweight as of December 2021 (source: Vietnam Register) - at the 3rd rank in the ASEAN region (after Singapore, Indonesia) and at the 22nd in the world (UNCTAD)
- mainly of small size (from 5,000 GT or less) and medium (from over 5,000 GT to 10,000 GT)
- average age is 16.5, that is 5 years younger than the world's average ship age 21.9 (according to UNCTAD)
Shipping Context of Vietnam

Sea going Fleet
- tending to restructure, reducing number of small, increasing the number of large vessels: decreased by over 200 but total increased by over 6% in 2016 – 2020 (source: Vietnam Register)

Table 1: Sea going cargo ship fleet of Vietnam (31/12/2021)

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity</th>
<th>Increasing/reducing in quantity (%)</th>
<th>Deadweight (DWT)</th>
<th>Increasing/reducing in deadweight (%)</th>
<th>Gross Tonnage (GT)</th>
<th>Increasing/reducing in GT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1.267</td>
<td></td>
<td>7.588.447</td>
<td></td>
<td>4.602.861</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>1.194</td>
<td>-5,8</td>
<td>6.933.450</td>
<td>-8,6</td>
<td>4.213.173</td>
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<td>2018</td>
<td>1.147</td>
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<td>7.101.152</td>
<td>2,4</td>
<td>4.150.596</td>
<td>-1,5</td>
</tr>
<tr>
<td>2019</td>
<td>1.047</td>
<td>-8,7</td>
<td>7.192.694</td>
<td>1,3</td>
<td>4.300.013</td>
<td>3,6</td>
</tr>
<tr>
<td>2020</td>
<td>1.049</td>
<td>0,2</td>
<td>8.045.815</td>
<td>11,9</td>
<td>4.787.224</td>
<td>11,3</td>
</tr>
<tr>
<td>2021</td>
<td>1.032</td>
<td>-1,6</td>
<td>10.610.730</td>
<td>31,9</td>
<td>6.310.352</td>
<td>31,8</td>
</tr>
</tbody>
</table>
Shipping Context of Vietnam

Sea going Fleet

- 600 ship owners, 33 ship owners operate the fleet of over 10,000 DWT (4 state owned groups such as Vietnam National Shipping Lines Corporation (VIMC), Vietnam Oil and Gas Group (Petrovietnam or PVN), Vietnam National Petroleum Group (Petrolimex) and Shipbuilding Industry Corporation (SBIC)). Many operate only 1 ship
- More investing in foreign-flagged ships with large tonnage; shifting from state ownership to private
- Import and export goods transportation market dominated by major shipping lines such as MSC, Maersk, CMA - CGM, Hapag - Lloyd, O.N.E, OOCL, Evergreen, COSCO, HMM and Yang Ming
- The level of automation in fleet is still very limited. Automated and remote-control technologies applied on board are just for specific function such as the autopilot system, the liquid cargo control system, the anchor monitoring system, the dynamic positioning system, etc. No integrated autonomous technology

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
Shipping Context of Vietnam

**Sea going Fleet**

The Government encourages and prioritizes advanced and innovative shipping technologies:
- To address the growing demand of domestic cargo transportation by sea
- To compete and gradually replace the foreign shipping line domination in the import/export market
- To create an more competitive, efficient, green fleet as part of circular economy and net-Zero emission

(Master Plan on Development of Vietnam's shipping fleet approved by the Ministry of Transport under Decision No. 1254/QD-BGTVT dated September 28, 2022)
Shipping Context of Vietnam

Inland water transport fleet

• Vietnam has 2,360 rivers and canals with a total length of about 42,000 km and with 9 major river systems flowing into the sea through 120 estuaries. The total length of the country's waterways is more than 17,000 km; inland water transport takes over for about 19% of the total transported volume of domestic goods (Source: Vietnam Inland Waterway Administration – VIWA)
• 34 waterway transport routes from the shore to the islands short-distance coastal passenger cruise ships for sea tourism destinations such as Ha Long Bay, Nha Trang, Phan Thiet, Phu Quoc …)
• about 237,000 inland water vessels nationwide, with a total deadweight of more than 22.2 million tons, by September 2022 goods (Source: VIWA)
• inland water vessels are of small size, operated on short routes, with low efficiency, no automatic technologies.
• waterway transport enterprises are mostly private, spontaneous developed, fragmented, with low financial capacity and old equipment
• A lot of rooms, opportunities for innovative technology application. All welcome by the government
Shipping Context of Vietnam

Seaport system

• seaport system has developed synchronously to welcome the world's largest seagoing ships (over 200,000 DWT). Seaports in Hai Phong, Ho Chi Minh City, Ho Chi Minh City, Ba Ria - Vung Tau have entered the list of 50 seaports with the largest cargo throughput in the world in 2022

• 34 seaports with a total 299 port facilities, with about 94,486 km of total wharf length, and with a total capacity of over 700 million tons/year (Source: Vinamarine)

• in the trend of modernization and increasingly applying automation and digitization technologies: electronic seaport applications (E-ports), smart seaports (Smart Port, Port 4.0) technology, port operating and planning software system (TOPX), container data management software (TOPO), Electric E-RTG cranes with automatic load control (ALC and smart control cabin with DGPS system, modern port management software CATOS;...

• increasingly modernized seaport and shore base system support modernized shipping
Shipping Context of Vietnam

Ship building and repairing industry

• a system of 82 large and small shipyards throughout the country, capable of building cargo ships of 53,000 DWT, car carriers with capacity of 4900 cars, container ships; 21 facilities for building, converting, and repairing ships for ships of 10,000 DWT or more, such as 8 shipyards belonging to SBIC; Hyundai-Vietnam Shipbuilding Co. Ltd., Dung Quat Shipbuilding Industry Co., Ltd.; NOSCO Shipyard Joint Stock Company…

• Currently 66 new ships under construction; 17 new ship designs have been reviewed and approved in 2022

• Challenges: shipyards are not properly invested and limited in building modern ships; insufficient supporting industries (meeting just about 10-15%); financial difficulties and barriers due to large investment debts at banks from crisis in 2008-2010 period
Shipping Context of Vietnam

**Human resource and role of women**

- Vietnam has 7 education and training institutions for maritime field: Vietnam Maritime University, University of Transport of Ho Chi Minh City, Maritime College No.I, and Maritime College No.II, Hai Phong Polytechnic College, College of Waterway Transport No.II, Duyen Hai College.

- Currently more than 54,000 seafarers available; in 2022 the number of graduated officers and engineers at operational level is 1,503 people and at management level is 702 people (Source: Vinamarine as of October, 2022)

- Since 2013 there are 30 female students have been trained and graduated nationwide in the major of ship navigation; the first female seafarer awarded the Deck Officer Certificates of Competency (CoC) to work onboard ocean-going ship in 2022 and the first female engineer officer CoC was awarded recently in 2023.

- Challenges: insufficient number of seafarers; sea going jobs become less attractive; hard works for women (autonomous navigation could be a solution)
National Legal Framework

Innovative technologies R&D and Application Policies

Key element and propulsion for sustainable development of the economy and social progress, supported by many policies and strategies

- Resolution No. 29-NQ/TW, adopted November 17, 2022 addressing ongoing acceleration of the country's industrialization and modernization until 2030, with a vision to 2045
- Resolution No. 36-NQ/TW adopted October 22nd, 2018 by the Central Committee of the Communist Party of Vietnam on the Strategy for sustainable development of Vietnam's marine economy to 2030, with a vision to 2045
- The Law on High Technology 2008, the Law on Science and Technology 2013, Decree No. 08/2014/ND-CP, Decree 13/2019/ND-CP stipulate incentive policies for Science and Technology Enterprises
- The Vietnam Maritime Code 2015, (as amended and supplemented in 2018; Directive No. 37/CT-TTg of the Prime Minister dated September 29, 2020 on promoting the development of inland waterway transport and coastal transport

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National Legal Framework

Innovative technologies R&D and Application Policies

Resolution No. 29-NQ/TW and Resolution No. 36-NQ/TW

• Direction: industrialization and modernization of the country will be based mainly on the development of science-technology, innovation, and harmonization between economic development and environmental protection, taking digital transformation

• Target: by 2030 being in the group of 3 leading ASEAN countries in terms of the value of high-tech industrial products of over 45% of GDP; to become an advanced and sustainable leading country in ASEAN based on breakthrough factors of advanced marine science and modern technology development and high-quality human resources
National Legal Framework

Innovative technologies R&D and Application Policies

Resolution No. 29-NQ/TW and Resolution No. 36-NQ/TW

• Plan: in the 2021-2030 period is to promote strong application of science-technology and innovation, especially achievements of the industrial revolution 4.0

• Solutions: prioritizing the legal framework for the development of smart manufacturing, science-technology development; encouraging enterprises to invest in R&D activities, investment funds for science, technology and innovation; adopting incentive tax policies; development of the digital economy, and mechanism for testing and applying digital technology-based products, service solutions, and business models on digital platform; attracting investment in hi-tech projects and technology transfer.
Autonomous shipping technologies R&D and Application Policies
Resolution No. 29-NQ/TW and Resolution No. 36-NQ/TW

Scope:

- shipbuilding and digital technology sectors, manufacturing robots, automatic operation equipment, remote control, intelligent electronic and automation equipment;
- developing a modern high quality and safer shipping fleet in line with minimizing environmental pollution and energy saving, developing high-quality marine human resources, promoting innovation and creativity, taking advantage of scientific achievements, new and advanced technology;
- attracting experts, and leading scientists;
- improving the legal instruments on the sea towards sustainable development and ensuring feasibility, synchronous and conformity with international maritime treaties;
- promoting the cooperation and support of international and regional
National Legal Framework

Innovative technologies R&D and Application Policies

The Law on High Technology 2008, the Law on Science and Technology 2013, Decree No. 08/2014/ND-CP, Decree 13/2019/ND-CP - incentive policies:

- incomes from products based on scientific and technological R&D results are entitled to 04-year corporate tax exemption and 50% reduction of payable tax for the further next 9 years;

- the raw materials, supplies and components are exempted from import tax for a period of 5 years;

- the scientific and technological services serving and providing technical support for innovation R&D activities, technology transfer are entitled to the incentive of 5% Value Added Tax reduction

- exemption or reduction of land rent and water surface rent rate, and exemption of registration fee for land using or house ownership rights

- National Fund for Technology Innovation provide credit incentives including grants and loans with preferential interest rates up to 50% of the same rates at commercial banks
National Legal Framework

Innovative technologies R&D and Application Policies

• Vietnam Maritime Code 2015, (as amended and supplemented in 2018): encourages research and transfer of advanced and modern technologies in the maritime domain, including in developing fleets of seagoing ships, seaports, shipbuilding industry through the preferential and incentive policies on taxes and loan interest rates

• Directive No. 37/CT-TTg of the Prime Minister dated September 29, 2020 on promoting the development of inland waterway transport and coastal transport sets out specific tasks to develop a fleet of inland waterway transport vessels with high quality, efficiency in term of operation, environmental protection and energy saving, promote the application of advanced science and technology, the digital platform
National Legal Framework

Innovative technologies R&D and Application Policies

National technical regulations on ships:

• QCVN 21: 2015/BGTVT National Technical Regulation on the Classification and Construction of Sea-going Steel Ships;
• QCVN 60: 2019/BGTVT National Technical Regulation on Automatic and Remote Control Systems;
• QCVN 62: 2013/BGTVT National Technical Regulation on Navigation Bridge Systems;
• QCVN72:2013/BGTVT National Technical Regulation on Rule of Inland – Waterway Ships Classification and Construction

These Regulations impose the inspection, classification of ships and technical systems on board.

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
National Legal Framework

Innovative technologies R&D and Application Policies

National technical regulations on ships:

Levels of automation of ship’s machinery systems with notations MC, M0, M0.A, M0.B, M0.C, M0.D

Requirements regarding automation systems: the remotely controlled system for fuel oil, the remotely controlled mooring system, the autopilot (steering) system, remote controlled liquid cargo transfer pump system, remote controlled ballast water system, motorized opening and closing system, frozen container monitoring system, emergency towing, cargo hose handling equipment, automatic devices for recording main engine parameters, centralized monitoring and control systems for machineries, mechanical pilot hoister, fixed deck washing system and control devices on either side of the bridge etc.
National Legal Framework

Summary

General policies to support R&D, high-tech application, and automation are relatively comprehensive

Lack of specific regulations for R&D and application of innovative autonomous navigation technologies:

- Vietnam Maritime Code 2015, and the Inland Waterway Traffic Law 2019, currently do not contain provisions specifying the development and application of autonomous navigation and remotely controlled ships. Therefore, the sub-law guiding documents (decrees, circulars...) do not stipulate the same.

- The current national technical regulations do not have detailed requirement on autonomous and remotely controlled ship, except for requirement regarding local automatic and remote control systems on board (engine, control, cargo handling...) with the relatively low level of automation
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

- Autonomous technology has developed rapidly and widely applied in many economic sectors, including transport.
- Automotive industry: self-driving car, eco-friendly with automation and advanced connectivity features, based on smart technology platforms such as artificial intelligence, big data, cloud effect...
- Unmanned aerial vehicles (UAV)
- Automated systems for waterborne vehicles
- Various leading domestic institutions involved: FPT Group, Hanoi University of Science and Technology, Phenikaa University and VinAI Research Institute (Vin Group)...

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region.
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

VinFast

• series of self-driving smart cars VF e34, VF31, VF32, VF33 possessing face recognition, multi-language virtual assistant and especially artificial intelligence (AI) technology, multi-point collision warning and mitigation, high-precision object recognition technologies based on low-profile hardware (MagNet), multi-camera and multi-object motion tracking (DyGLIP), monitoring and recognizing driver status, or panoramic view of the vehicle's environment (SVM). Series VF e35 and VF e36 integrated with automatic driving assistance system (ADAS) introduced in 2022 at the North America and Europe markets

• self-driving system complies with automation level 2+ and level 3 (vehicle with conditional self-driving capability) of the Society of Automotive Engineers (SAE) six-level automation scale

• meet the safety standards by NHTSA (US Highways Traffic Safety Administration) and EURO NCAP (European Vehicle Safety Performance Assessment Program)
Overview of autonomous technology R&D in Vietnam

**Autonomous technology R&D in different transport sectors**

**Phenikaa X**

- the self-driving car model, 2020, is currently operated within the campus of Phenikaa University, and is designed mainly to operate in resorts or golf course.
- equipped with many advanced features such as automatic lane change, pedestrian and road sign recognition, traffic motion of surrounding objects analysis, using artificial intelligence technology and most advanced technologies in the world such as 2D/3D maps, Lidar sensors, SLAM, machine learning, deep learning...
- is announced to meet level 4 based on the 6-level scale of SAE.
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

FPT Group

• launched first self-driving car in 2017 at Ho Chi Minh City Hi-Tech Park

• two different car models tested: a small electric self-driving car that runs in golf courses and urban areas and a self-driving version for normal cars after converting the features of a commercial existing vehicle

• the self-driving car is possessing many advanced smart technologies and can be booked remotely through a smartphone application developed by FPT Software

• FPT's self-driving cars have reached level 3 by the Society of Automotive Engineers (SAE)
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

Unmanned aerial vehicles (UAV)

Institute of Science and Cartography:

- UAV for cartography under the project "Researching and manufacturing a swarm UAV system" and building a flight control software to take pictures, implement automated LiDAR ((Light Detection And Ranging) scanning work, and to maximize the ability to collect geospatial data automatically in real time
- has been tested for LiDAR scanning flights using UAVs to create topographic maps in Ha Tinh and Quang Binh provinces with 4 UAVs flying at altitude 20km over an area of 4,000 ha consumed 5 hours of flight time

VietSolutions 2020:

- the drone project "Than Nong" (Demeter VS 20) applied for agricultural application purposes such as spraying pesticides, spreading fertilizers or sowing seeds....
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

Unmanned aerial vehicles (UAV)

MiSmart:
- the drone project Drone MiSmart Demeter VS30C Using automatic technology e combined with AI and operating on a big data platform

Realtime Robotics Inc VN:
- the Multi Purpose Hera drone project for domestic and export use: fire forest monitoring, high voltage grid checking...
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

Water born vehicle

National Economics University and Hanoi University of Technology:

- model of unmanned vessel with three main functions of depth measurement, water sampling and garbage collection in rivers and lakes, tested in 2022
- two-hull form model made of composite, weighs 8 kg, has dimensions of 1.15 x 0.7 x 0.5 m, equipped with a camera, three sensors to detect obstacles around, GPS and wifi communication module to connect to the control computer with application
- the modes include to navigate automatically in a straight line or by zig zac, capable for total operating time about 3 hours within the range 1 km and can measure a maximum depth of 50 m, with an error of 20 cm
Overview of autonomous technology R&D in Vietnam

**Autonomous technology R&D in different transport sectors**

**Water born vehicle**

The Ho Chi Minh City University of Technology:

- a number of topics such as design of a dynamic positioning for unmanned surface vehicles (USV) using GPS/INS (VIAM-NAVI-M)

- Model VIAM-USV1000 uses Lithium battery and can move to the waypoints designated by the operator and be remotely monitored on the computer.

- The USV with the size of 1.2 meters x 0.8 meters, weighs 70kg, can develop a speed up to 4 knots and operated continuously for 5 hours, capable to perform automatic monitoring at river areas, transmitting the collected data for processing and displaying on website in the real time mode

- applicable in the field of environmental research and monitoring, transporting small diving equipment, water patrolling, rescue and security activities
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

Water borne vehicle

The Ho Chi Minh City University of Technology:

- Remotely operated vehicle (ROV) model VIAM-ROV500 and model VIAM-ROV900 with sizes of 0.9 meters x 0.4 meters x 0.4 meters, weight 70kg, depth of movement 100 meters under surface, speed range from 0 to 2 knots, designed for demining, security patrol, rescue, oil and gas exploration, underwater archeology, shipwreck searching.

- An autonomous underwater vehicle (AUV) with the sizes of 2 meters (length), 0.25 meters (diameter), weight 80kg, depth of movement 100 meters under surface, moving speed 5 knots, designed for surveying geological surfaces, gathering information on mineral deposits, clearing mines, and other military purposes.
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in different transport sectors

Water born vehicle

The Vietnam Institute of Geodesy and Cartography:

- USV to conduct surveillance of the seabed and collect the natural resource and environmental data, completed in June 2020
- constructed of composite plastic and equipped with data recording software, online camera, GPS, antenna and an echo sounding device, load capacity of 60kg and is fitted with two batteries for continuous operation from 8-10 hours
- applicable for measuring data in water depth from 1 to 1,000 meters and automatically send data back via radio signals and GPRS waves
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in shipping

Overview:

- autonomous technology in shipping is more challenged than in other sectors: big vessel, complicated systems, harsh environment
- for many reasons, the R&D projects are still limited in number and small in scale
- most are at the research stage and have not been applied in practice
- Some examples below
Overview of autonomous technology R&D in Vietnam

**Autonomous technology R&D in shipping**

**Vietnam Maritime University (VIMARU):**

Project Code DT194025 “Research, Design, Production of Autopilot System applying Adaptive Control Methods”, approved by Ministry of Transport in 2019:

- The ship's autopilot system with adaptive algorithm used in the controller for cargo ships with a DWT of 22,000 or less, based on the digital steering system technology, in which the controller is programmed and installed in the CPU including the PLC device and computer, linked with HMI display, peripheral elements and alarm panel.

- Applied optimal algorithm makes the control system using Kalman observer unit better adapt to the change of objects and environmental disturbances and achieve the energy optimization of the rudder, hence improving the quality of ship navigation control, optimizing energy use compared to other systems using the current classic PID algorithm.
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in shipping

Vietnam Maritime University (VIMARU):

Project code AT22303 “Research, design and manufacture of smart traffic control system for ships on the basis of application of artificial intelligence in processing big data from RADAR/AIS to enhance maritime safety” approved by Ministry of Transport in 2022:

- The smart traffic control system for ships with application of artificial intelligence in processing big data from the ship's RADAR/AIS devices in real time to bring forecasting, early warning of risk of collisions and support making optimal decisions for crew members in changing direction, speed of ship or both to avoid the situation

- The system was built and tested to fully meet the technical standards: the parameters CPamin and TCPAmin are in accordance with COLREG 72, high accuracy and reliability with learning error up to 0.05%, number of learning samples is over 4000, and processing latency 900ms. The system have been independently verified by Center for Standards - Measurement – Quality No. 1 (QUATEST 1) and the Department of Naval Engineering
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in shipping

University of Transport of Ho Chi Minh City:
Project “Ship Autopilot System Design and Testing on Santana Ship Model Based on Neural-Fuzzy Method”:

- Design of Ship autopilot system based on the output feedback neural-fuzzy (ANFIS) controller in 3-axis coordinate system which controls a heading of the ship under the effect of the waves, wind and water currents
- The inputs of system include the feedback heading of the ship, angle of the waves, wind and water currents, and then the outputs area rudder angle and the heading. In order to increase the adaptability of the system under the effect of the environment, ANFIS controller is designed using of neural-fuzzy with the Takagi–Sugeno method that approximate the input signals and linearized the output signal. The simulation results via Matlab software and the experimental results on Santana ship model showed the effectiveness and advantages
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in shipping

Summary:

• Automation technology is highly interested and prioritized for development in Vietnam, as widely applied in different fields of economy
• R&D projects are still relatively limited in the transport sector, especially in maritime field
• There are some R&D projects on automation of ship control systems, but these studies are also focusing on specific ship component systems onboard such as auto pilot system
• **There is no overall integrated research and development project on autonomous shipping technologies in the proper meaning**
Overview of autonomous technology R&D in Vietnam

Autonomous technology R&D in shipping

Summary:

Some reasons:

• shipping technology is a new field of research with very limited partners, high risks - especially the risk of pioneering research with long-term investment and difficulty in accessing financial and public resources

• the enterprises and institutes have focused on the recovery and development of businesses after the pandemic time, so new technology investment may be in wait list

• the access to information and awareness about the benefits, current development status and future trend, the opportunities for cooperation in autonomous shipping technologies is still limited
Overview of autonomous technology R&D in Vietnam

Opportunities and challenges for autonomous shipping technologies

Opportunities:

Great advantages and potential to develop a fleet of ships with green, modern and sustainable technology:

• geographical position of the country with a long coastline and is close to important international shipping routes

• stable political environment, strong economic grow rate in recent years and in the coming time, more important roles in global supply chain, highly integrated with the global economy, by participating in many bilateral and free trade agreements: CPTPP, EVFTA, the Regional Comprehensive Economic Partnership (RCEP), including 28 bilateral maritime agreements; active member of many international organizations: IMO, ILO, WTO, ASEAN

• government priority to advanced and digital technologies in all sectors, including shipping through series of positive changes in simplification of administrative procedures, electronic customs, tax procedures, incentive policies

Improving the safety of navigation and the sustainability of shipping through the introduction of innovative autonomous shipping technologies in the Asia-Pacific region
Overview of autonomous technology R&D in Vietnam

Opportunities and challenges for autonomous shipping technologies

Opportunities:

• continuous growing demand for good transportation by sea, as forecasted total volume of about 906.8 million tons by 2030

• maritime and technological education system capable of providing sufficient skilled human resources for the shipping industry, including R&D of maritime innovative autonomous navigation technology; pool of engineers experts in digital technology and artificial intelligence working for Google, Facebook, Microsoft, Amazon....

• trend of more concerns and application of information technology, software, data science achievement by shipowners

• many pioneering IT enterprises, which are currently investing in R&D projects in automation, robotics, smart transport and production

• traffic conditions and transport culture in Vietnam are very diverse and complicated, which can be an ideal environment for developing and testing control algorithms for better lability and wider applicability
Overview of autonomous technology R&D in Vietnam

Opportunities and challenges for autonomous shipping technologies

Challenges:

- The fleet: small vessels with not-good-enough technical condition, non-state-of-the-art equipment
- The Investors: The role and scale of state-owned shipping companies have all been narrowed down; many shipping companies are private with limited size and financial potential
- Business culture: Investment-as-movement, short-term thinking and seasonality versus advanced technologies, with high risk, high capital and long term investment
- Financial resources: 2008-2010 crisis greatly affected the investment capital for shipbuilding and modernization of the fleet; limited access the bank credit with higher interest rates; the post pandemic burden
Overview of autonomous technology R&D in Vietnam

Opportunities and challenges for autonomous shipping technologies

Challenges:

• Legal framework: the gaps between new technology development and the regulatory become barriers; no specific regulation for autonomous shipping, including technical regulations for research, testing, manufacturing, construction and operation, safety, liability in the event of an accident

• Investment risk: R&D in autonomous shipping technologies can be expensive and risky – needs insurance and supports

• Technical standards and compatibility: lack of technical rules or standards for autonomous ship, system and equipment thereof for harmonization and collaboration in R&D

• Public awareness and perception: Awareness of autonomous navigation technologies and their benefits are still very limited
Overview of autonomous technology R&D in Vietnam

Opportunities and challenges for autonomous shipping technologies

Challenges:

• Hardware manufacturing capability limitation: limited capability in manufacturing computer system and sensors with high accuracy and speed in processing large amounts of data for autonomous shipping technologies (must be imported)

• Operation conditions and environment: unfavorable operation environment at sea and bad weather; the traffic conditions, the culture of waterway transport and traffic rule compliance in Vietnam

• Risk consideration regarding safety, security, cyber-attacks: Hardware faults, software faults, machine learning data...together with security and Cyber security issues

• Training and cooperation: higher operational skill requirements; lack of expert in new field and cooperation; software and data engineers are not trained in marine technology and vice versa
Recommendations

For Vietnam

• A road map to be created with Vietnam Maritime Administration (Vinamarine) as a focal coordinating point
• Communication and public perception engagement: communication and awareness campaign on autonomous shipping technologies (via public media topics, forums, exhibitions, workshops, press releases…) to draw the attention of all stakeholders, public resources and consensus perception
• Policy and regulatory frameworks: regulations need to be revised in more specific way regarding autonomous navigation technologies including revision of the Vietnam Maritime Code 2015 in 2025-2026 and related under law guiding regulations such as decrees, circulars, national technical rules, based on R&D updates
• Research and development: prioritized program with appropriate funding sources (governmental, public, private or internationally supporting budgets) for specific research and development projects relating to autonomous shipping technologies with partnerships between maritime industry and economy (such as VIMC, SBIC, Thaco Group, Vin Group…), academia (Vietnam Maritime University, University Transport of HCMC, University of Science and Technology…) and the domestic entities with potential experience and knowledge in the fields of automation, digital technology, such as Viettel, Phenikaa, VNPT, FPT, MiSmart, Realtime Robotics Inc VN….
Recommendations

For Vietnam

• Infrastructure: Plans and resources allocation should be considered for investment in infrastructure needed to support: construction and maintenance base for autonomous ship and equipment, shore based control center, autonomous ports and routes with supporting safety of navigation facilities, emergency response and rescue, high-speed communication networks, data centers etc.

• Human resource preparation and capacity building: Current training programs in the maritime institutions and colleges need to be updated accordingly with formal training on autonomous navigation technologies; IT and data engineers should be included.

• Collaboration and knowledge-sharing: The Government, MoT and Vinamarine should organize a floor for connecting and experience and knowledge sharing between the stakeholders on the topic of autonomous navigation to facilitate the collaboration (forum, fan page, portal and any other appropriate form and moderated by Vinamarine); allocating and connecting the international supports and cooperations in R&D, funding, co-funding, training, experience sharing, technology transfer based on the win-win principle, benefit harmonizing, risk sharing should be prioritized.
Recommendations

For Vietnam

• Timeline:
  • Phase 1 from 2024 to 2026 for carrying out the necessary preparation steps such as developing plans, objectives, projects, awareness and communication, preparing the temporary legal framework, finding resources, connecting partners, setting up environment and infrastructure etc. for autonomous shipping technologies R&D
  • Phase 2 from 2026 to 2030 for implementing research and development projects on autonomous shipping technologies, collaboration, technology transferring, revising legal and technical regulations based on research results, planning and infrastructure investment for appropriate levels automation selected, including the preparation of port areas and routes for future operation of autonomous ships
  • Phase 3 after 2030 onward for putting into commercial operation any pilot autonomous navigation project at different levels of automation and thereby to adjust, plan and prepare for the replication of this technology in the country maritime sector
Recommendations

For UN ESCAP and the international partners, doners, stakeholders, leading countries

• proposal for collaboration in specific pilot project of autonomous shipping technologies with the participation of Vietnamese stakeholders via focal point Vinamarine

• enhancement of collaboration in communication and awareness training, capacity building, experience sharing, research and development activities, technology and equipment transferring-supplying, allocation and/or provision of funding resources
Questions?

THANK YOU