23rd Annual General Assembly

IAMU AGA23

Helsinki, Finland | 18-21st October 2023

The International Association of Maritime Universities (IAMU) Conference Book

IAMU International Association of Maritime Universities

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The International Association of
Maritime Universities (IAMU)

Conference Book

Helsinki, Finland 18-21st of October 2023

IAMU | AGA23

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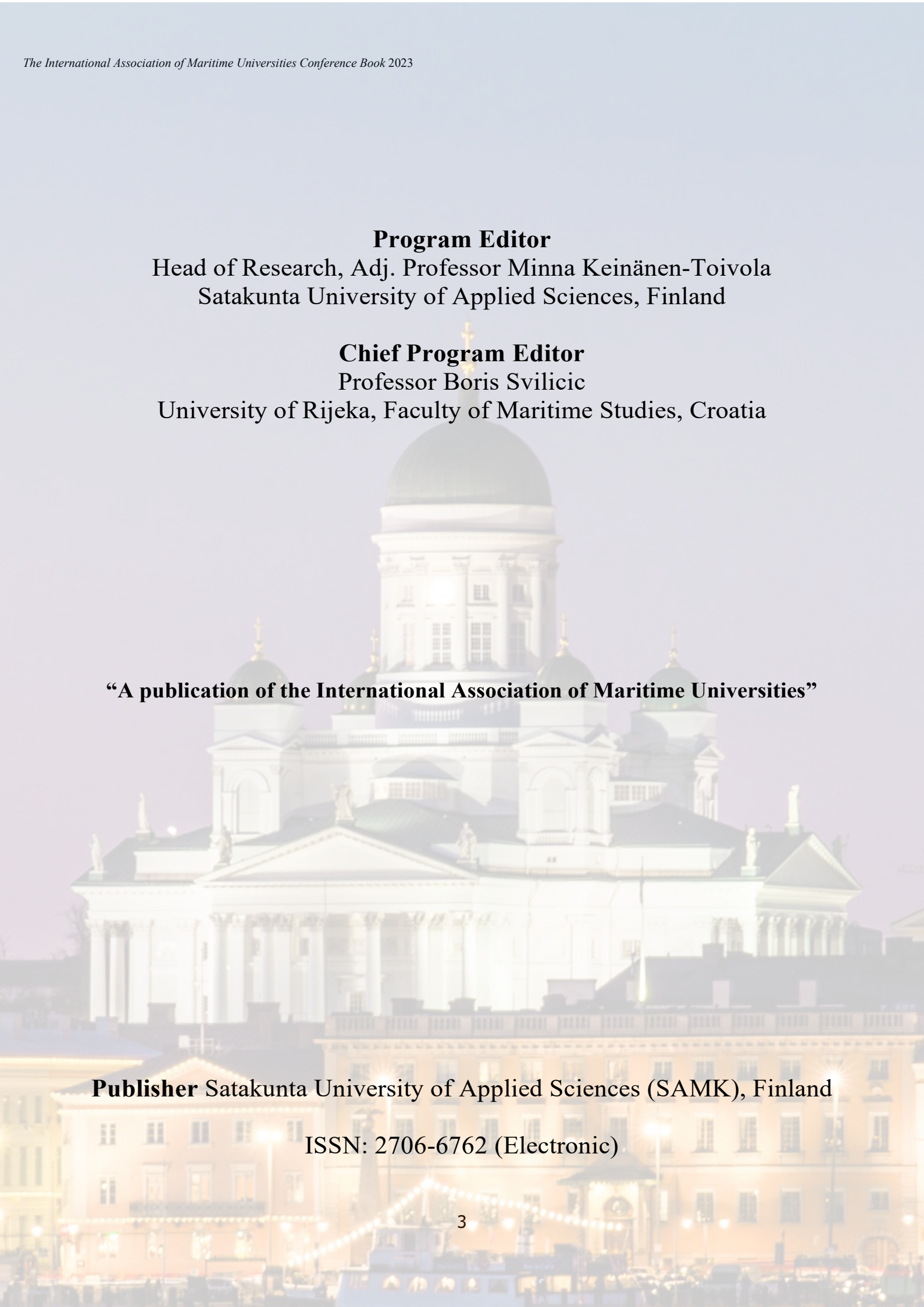

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Preface

Preface

The IAMU Conference (IAMUC) is the part of the 23rd Annual General Assembly (AGA 23) of the International Association of Maritime Universities (IAMU). The IAMUC offers its members the global platform to share their experience and to plan the development of maritime education and related research.

IAMUC 23 invites the international experts to disseminate their latest research results. As the hosting university, Satakunta University of Applied Sciences provides face-to-face in the Assembly activities. First time in IAMU Conference history, the Conference is organized on a ship between Helsinki, Finland and Stockholm, Sweden.

“Quality of the Education of Global Maritime Professionals” is the theme of the AGA 23 IAMUC.

The IAMUC program covers the whole range of maritime domain incorporating Environmental, Technology, Economic, Social and Policy sections. The Conference topics deal with Breakthrough Technologies for Seafaring and MET, Managing Maritime Safety and Security, Environmental Sustainability in Seafaring and Education of Global Maritime Professionals. During the conference, site visit to the ships deck and engine room are made.

IAMUC 23 participants are offered to take part in technical workshops and to discuss a wide range of scientific research with keynote and invited speakers.

“The International Association of Maritime Universities (IAMU) Conference Book” contains information concerning the organization and program of the IAMUC 2023 and the abstracts presented at the IAMUC in Helsinki, Finland on 19th and 20th of October 2023.

Submission of 99 high-level abstracts from 25 countries and 40 IAMU universities resulted in 26 oral and 24 poster presentations.

The oral presentations at the sessions are followed with the poster presentations held during coffee/tea breaks. First time, the posters are displayed electronically on screens.

We express our gratitude to the reviewers for their partnership with the authors and contribution in improvement of the quality of submitted papers.

We are very grateful to the International Program Committee, Session Chairs, IAMUC supporting team and SAMK Administrative assistants, who selflessly contributed to the success of the Conference. Also, we are thankful to all the authors who submitted the papers and shared their experience.

Last but not the least, we express our most heartfelt thanks to the IAMU Secretariat for the greatest support and inspiration at each stage of the IAMU AGA implementation.

We hope that experience, shared at IAMUC 23, will promote quality of global maritime professionals’ education and research.

Adjunct professor Minna Keinänen-Toivola

IAMUC 23 Program Editor

Professor Boris Svilicic

IAMUC Chief Program Editor

Theme

Quality of the Education of Global Maritime Professionals

- Breakthrough Technologies for Seafaring and MET
- Managing Maritime Safety and Security
- Environmental Sustainability in Seafaring
- Education of Global Maritime Professionals

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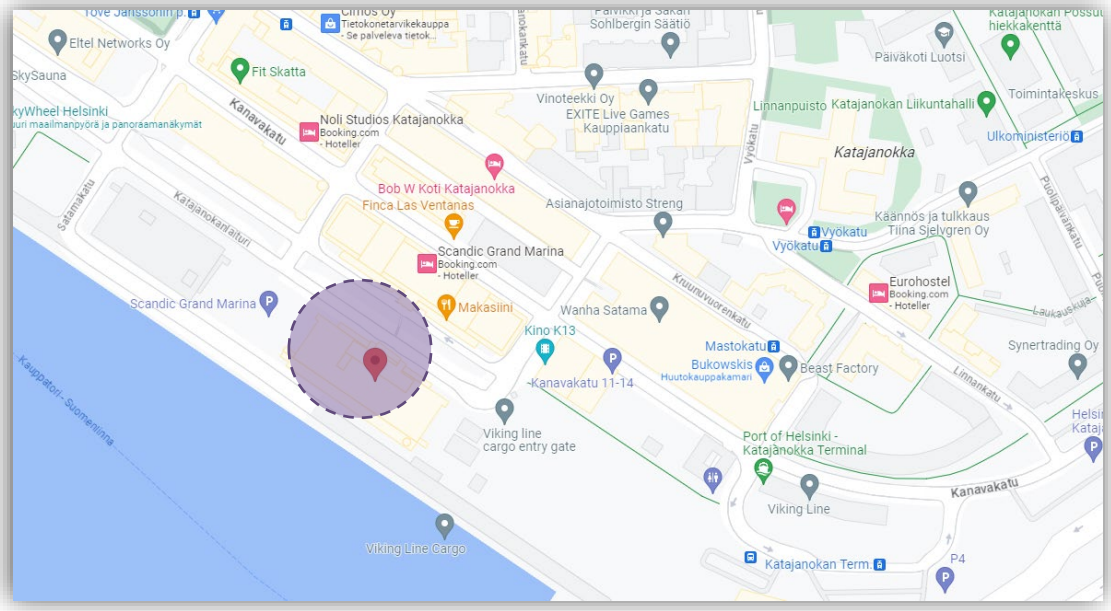
Venue

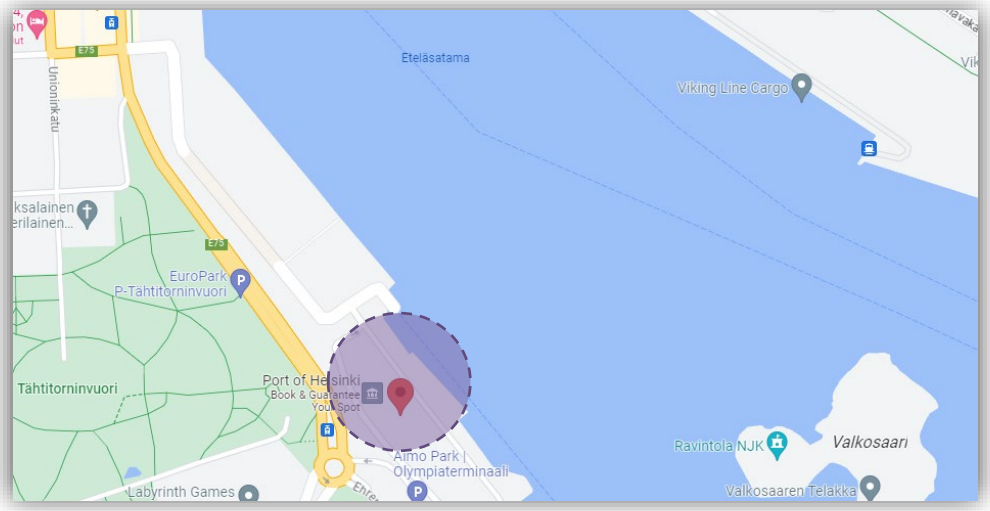
Helsinki – Scandic Grand Marina Congress Center

The opening of the 23rd IAMU Conference takes place at the Scandic Grand Marina Congress Center.

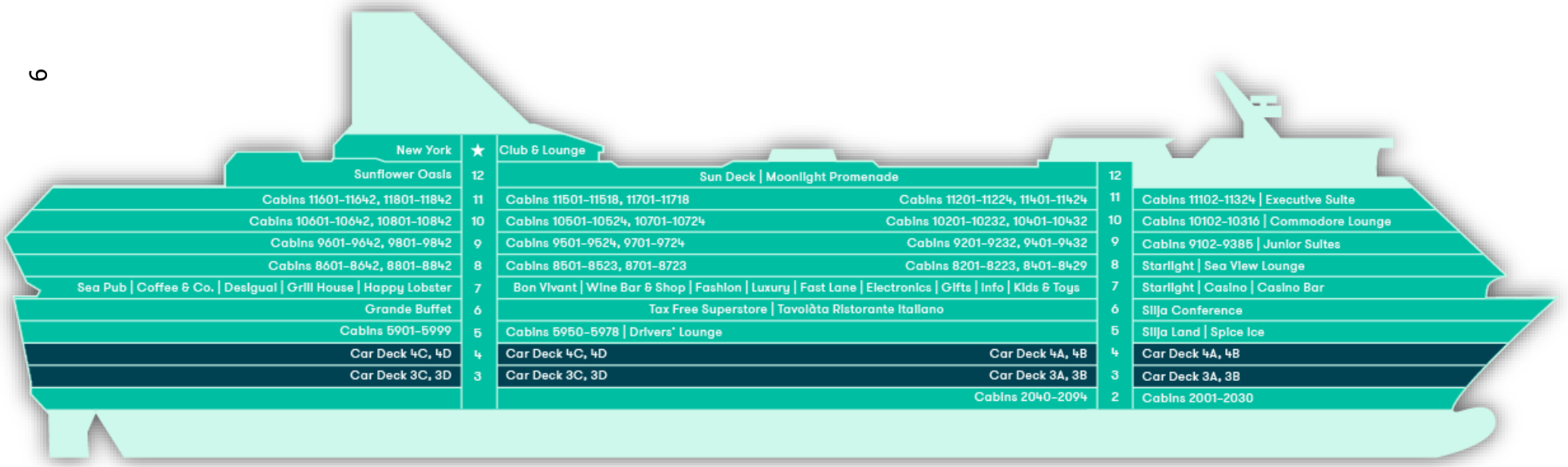
Katajanokanlaituri 6, 00160 Helsinki, Finland **Helsinki - Silja Boarding Terminal**



The boarding terminal for the Ship “Silja Serenade” is located on the opposite side of thehabour bay, to Scandic Marina Congress Center. **Olympiaranta 3, 00140 Helsinki**



Silja Serenade Deck Map



Program Overview

Tuesday 17.10.2023	
FI Time	**Activity & Location**
16:00 - 19:00	**Registration** Hotel Scandic Grand Marina
19:00 - 22:00	**WelcomeDinner** Restaurant Marine, Grand Marina Congress Center

Wednesday 18.10.23		
FI Time	**Activity & Location**	
08:30 - 13:00	**Registration** Grand Marina Congress Center 2nd floor	
09:00 - 10:00	**Opening Ceremony** Fennia II, Grand Marina Congress Center	
10:00 - 10:15	**Coffee Break** Grand Marina Congress Center	
10:15 - 12:00	**Presidents Forum** (Presidents/official proxies only)	Grand Marina Congress Center Room #Baltica
10:15 - 12:00	**Icebreaker visit** (max 20 pers. Per group)	Icebreaker Fleet 15 min walk
12:00 - 13:00	**Lunch** Resteurant Marine, Grand Marina Congress Center	
13:00 - 14:30	**Plenary Session** (IAMU members only)	Grand Marina Congress Center Room #Fennia II
14:00 - 15:00	**Coffee Break** Grand Marina Congress Center	
15:00 - 16:30	**Boarding Ship** (Shuttle bus between Hotel Scandic Grand Marina - Olympiaterminaali)	
On board Silja Serenade		
FI Time	**Activity & Location**	
16:30 - 18:00	**Project Presentations** Starlight	
18:00	**Welcome on board** Starlight	
20:30	**Gala Dinner** Seaport	

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FI Time	**Activity & Location**	
08:00 - 9:30	**Breakfast** Grande Buffet	
	IAMU Conference, Technical Sessions Conference Department	
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10:00 - 10:20	Opening Session	
10:20 - 10:40	**Esma Uflaz, Hadi Fadil Bantan, Hollie Black, Ozcan Arslan, Emre Akyuz and Osman Turan:** Concepts and Applications of Eye Tracking Technology in Maritime Shipboard Operation with Pilot Case Study	**Scott MacKinnon, Reto Weber, Monica Lundh, Fredrik Olindersson, Johan Magnusson and Mats Gruvefeldt:** Assessing the Challenges to the International Convention of Standards of Training, Certification and Watchkeeping in the Era of Digitalization and Automation
10:40 - 11:00	**Ender Asyali, Steve Tarrant, Adam Slazas, Steve Cole:** A Comparative Analysis of Workload for Navigation Tasks Performed onboard and at Simulated Remote Control Centers for MASS Using NASA-TLX	**Hoang Nguyen Vuong:** Enhancing e-learning in Maritime Education and Training: Action research in Vietnam context
11:00 - 11:20	**Qi Chen, Amanda Pang and Daniel Pang:** Navigating the Future: Integrating AI into Maritime Education	**Theodore Marr, Jennifer Smith, and Elizabeth Sanli:** A Delphi Study to Formalize Domain Knowledge on Maritime Collision Avoidance and Inform Training
11:20 - 12:00	**Coffee Break / Poster Presentations**	
11:00	**Ship Arrival to Stockholm, Sweden** Värta Terminal	
	Session 1 continuation	**Session 2 continuation**
12:00 - 12:20	**Gholam Reza Emad, Mehrangiz Shahbakhsh, Koivisto Heikki, Stephen Hurd and Janne Lahtinen:** Simulator as a Critical Training Tool for Autonomous Ship Operators	**Meric Karahalil, Margareta Lützhöft and Joel Scanlan:** Factors Impacting Curricula in Maritime Simulator-based Education

12:20 - 12:40	**Goran Vizentin, Darko Glujić, Goran Vukelić, Dean Bernečić and Dario Ogrizović:** Coupling CFD and VR for Advanced Fire Training in Ship Engine Room	**Jens Brauchli Jensen:** Exploring possible content and structure of a quality maritime master program in Denmark
12:40 – 13:00	**Srđan Vujičić, Damir Zec, Martina Hrnić, Nermin Hasanspahić and George Gabedava:** The factors affecting cruise ships' evacuation efficiency	**Mao Tze M. Bayotas:** BoK- STCW-TRB Triumvirate Course Mapping for Learning Outcome Matrix of BS Marine Engineering Program
13:00 - 13:30	Session 1 Discussion	Session 2 Discussion
13:00 - 14:00	**Deck visits** (Command bridge & Engine room)	
13:30 - 14:30	**Lunch** Grande Buffet	
	IAMU Conference, Technical Sessions Conference Department	
	Session 3: Environmental Aspects Chair: Prof. Minna Keinänen-Toivola	**Session 4: Social Aspects Chair: Capt. Heikki Koivisto**
14:30 - 14:50	**Malini Shankar, Sheeja Janardhanan, Pavan Kumar, Ramakrishna Patnaik, Vanshika Khandelwal and Bhadra Vazhappully:** A study of the effect of shipping polution in the port and territorial waters of Visakhapatham	**Momoko Kitada, Alina Balasanyan, Inga Bartusevičienė, Mary Chakvetadze, Besik Chkhikvadze, George Gabedava, Rima Mickienė, Iryna Savelieva, Alessandro Schönborn, and Koskina Yuliia:** People-Centered Clean Energy Transition: The Role of Maritime Education and Training
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	Session 3 continuation & Economical Aspects	Session 4 continuation
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16:40 – 17:10	**Peggy Shu-ling Chen, Hongjun Fan, Hossein Enshaei, Wei Zhang, Wenming Shi, Nagi Abdussamie, Takashi Miwa, Zhuohua Qu and Zaili Yang:** Hydrogen Shipping Cost Evaluation for Potential Corridors	
17:15 - 18:00	Session 3 Discussion Summary of day 1	Session 4 Discussion Summary of day 1
16:45	**Ship departs Stockholm, Sweden** Värta Terminal	
20:30	**Buffet Dinner** Grande Buffet	

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FI Time	**Activity & Location**
07:30	**Breakfast** Grande Buffet
	IAMU Conference, Technical Sessions Conference Department
	Session 5 Technological Aspects **Chair: Capt. Heikki Koivisto**
09:00 - 09:20	**Mesut Can Köseoğlu and H. Funda Yercan:** Conceptual Modelling of the Use of Artificial Intelligence in Maritime Education and Training: An Exploratory Approach
09:20 - 09:40	**Heikki Koivisto, Lesya Demydenko, German de Melo, Taner Albayrak, Gintvilė Šimkonienė and Artem Ivanov:** On-line ERS
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	Session 5 Continuation

10:30 - 10:50	**Gholam Reza Emad, Aditi Kataria and Gamini Lokuketagoda:** Developments in Engine Room Simulator Training Technology for Future Ships: Facilitating Training in Context
10:50 - 11:10	**Anna Mujal-Colilles and Jordi Fonollosa:** Data acquisition differences between two AIS receiving antennas
11:10 - 11:30	Session Discussion 5
11:30 - 12:00	**Closing Ceremony**
12:00 - 13:00	**Lunch** Grande Buffet
13:00	**Leave ship** Oplympiaterminal
13:30 - 14:30	Helsinki Tour by bus
14:30	**Bus departure Helsinki - Rauma**
18:30	**Bus arrival in Rauma**

	Saturday 21.10.23
FI Time	**Rauma, Finland**
08:30 - 09:00	**Pick-Up from hotel by bus**
09:00 - 10:30	Old Rauma Tour on foot
10:30 - 12:00	Campus Tour
12:00 - 13:00	**Lunch**
13:30	**Bus departure Rauma - Helsinki**
17:00	**Bus arrival Helsinki - Vantaa airport/Helsinki City**

Poster presentations

Authors	Title
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Dr T Sasilatha, J. Padmapriya, Dr D Lakshmi and Col. Dr. G. Thiruvasagam	Green Energy towards autonomous Shipping: Climate crisis perspectives for zero carbon emission, usage of renewable energy resources in marine propulsion for sustainable seafaring
Chuanyong Yang Yuan Gu , Sifan Zhen and George Gabedava	Research on Seafarers' Depression, Anxiety, Safe Working Factors and Anamnesis
Brindusa Cristina CHIOTOROIU	Visual observations of floating marine litter. Students' contribution
Riina Otsason, Ulla Tapaninen	Energy Consumption and GHG Emission Comparison Analysis
Randi Lynn Martins	Bridging the gap of maritime education and maritime sustainability: an introduction to USA case
Angelica Baylon*, and Cristina Dragomir	Sustainable Development Perspectives of Asia Pacific Maritime Institutions: Implications to Quality Education Towards Global Maritime Professionals
Christiana Atanasova	Need to implement an automatic reporting system related to the supply and dispensing of pharmaceuticals onboard ships
Serap Goksu	Determination of Failure Modes for Safe Ship Operations Under Dynamic Risk Conditions
Gizem Kayisoglu, Pelin Bolat and Emre Duzenli	Analysis of Cyber Attacks related to Remote Code Execution for shipboard Radar by using Bayesian Networks
Jimmy Ehnberg, Stefan Lundberg, Johan Eliasson and Sami Syrjänen	Electric Power Engineering for the Next Generation of Marine Engineers
Manel Grifoll	SIMROUTE: a Weather Routing Software for academic purposes
Stoyanov Valeri	Impact of the strictness of the order in the Naval Academy on the building of resilience in the trainees
Marieta Stefanova	The Impact of Master's Programs in Logistics on Career Development and Professional Outcomes
Christiana Atanasova, Marina Yordanova	Benefits of information technology in the field of primary health care of crew members onboard ships
Dimitar Dimitrakiev, Ivan Conev	Use of modern technologies in maritime safety training at Nikola Vaptsarov Naval Academy
Christiana Atanasova	Challenges to the professional training of cruise industry employees in Bulgaria
Galina Velikova	Techniques of Shortening in Maritime English
Goran Vukelić	Introducing Maritime Educational Standard for Mitigation of Infectious Diseases Spread on Large Passenger Ships
Chia-Hsun Chang, Robyn Pyne and Christos Kontovas	Evaluating skill requirements for maritime autonomous surface ships: a literature review
Yuli Chen, Jinbiao Chen, Yang Sun, Han Jiang, Naiyuan Lou	Enforcement Effectiveness of International Maritime Instruments based on PSC Inspection
Damir Zec and Jana Kegalj	Semantic Clustering for Maritime Knowledge Representation
Angelica Baylon, and Eduardo Ma R Santos	MAAP Students SDiMET Practices Towards Quality Education of Global Maritime Professionals

IAMUC 2023 Instructions

For any further help regarding guidance, please contact iamuc23@samk.fi.

Oral Presentation Guidelines

- Oral presentation slots have 20 minutes (15 min presentation, 5 min questions).
- Session Chairs will strictly demand time to allow members of the audience to switch sessions between presentations.
- All session rooms are equipped with LED Screens, a computer (MS Windows, MS PowerPoint, and Adobe Acrobat), microphone, remote control, and laser pointer. To avoid software compatibility problems, please embed all fonts in your PPTX file and bring a backup PDF file of your presentation.
- Preferable: send final presentation in PPTX or PDF format to iamuc23@samk.fi by Friday 13th of October.
- Another option, bring your presentation on a USB storage device and report to the Session Chair indicated in IAMUC Program 15 minutes before the start of the Session.
- Online presentation is not possible, neither a recorded presentation
- Each session has Session Discussion, all presenters have to participate also this part of the program as they have to be ready to answer questions.

Poster Presentation Guidelines

- Posters will be presented during the Poster Sessions indicated in the IAMUC Program. Presenters should be standing next to the poster during the Poster Sessions to answer any question.
- Poster should be made in size A0 (height 841 mm x length 1189 mm). Please use large fonts (24 or above), avoid using dense text, tell the story in graphics, diagrams, and pictures as much as possible. Poster main ideas should be spelled out in the introduction and conclusions sections. The main point of the work should be crystal clear from spending only a few moments reading these sections.
- Posters will be electronical, to be presented in LED screen. **Posters have to be sent either as PPTX or PDF format to iamuc23@samk.fi by Friday 13th of October**.
- For any help regarding this matter please contact iamuc23@samk.fi.

Name Badge

All attendees must wear the name badge at all times to gain admission to IAMUC.

Mobile Phone

As a courtesy to our presenters and other attendees, please turn off your mobile phones during the sessions.

Quick Index

Content

Session

Environmental Aspects

Visual observations of floating marine litter. Students' contribution

Brindusa Cristina Chiotoroiu*

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Keywords: floating marine litter, world ocean, ship-based observations, students' skills

Micro-plastic debris is widely distributed in different regions and has emerged as a major ocean pollutant. The low degradation rates and continuous release from different sources resulted in a considerable increase in total plastic waste in oceans presenting a considerable threat to global and regional ecosystems but causing also direct or indirect damage to human activities and properties such as fishing and aquaculture, shipping and tourism and recreational activities.

The need to improve the education of nautical students, related to marine environment protection, through which they would become aware, among other things, of the importance of achieving the main objective of the IMO strategy adopted in 2021, namely "zero plastic waste discharges to sea from ships by 2025" is presented in this paper.

One step was to involve nautical students in activities through which they learn and contribute to identify the sources of floating marine litter, to evaluate the behavior and factors affecting the transport and distribution. The students carried out ship-based observations of floating debris in 2021 and 2022 in different ports and on different shipping routes, following NOAA recommendations and EU methodology for monitoring of marine litter.

Another step was the collection of water samples from the points (transects) along which they made the observations, in order to detect and quantify the microplastic concentrations.

The findings highlight the importance of students' knowledge and skills when faced with numerous variables in the observation conditions.

Implementations to decrease noxious emissions and develop environmental sustainability in seafaring

Mamdouh Elmallah [1], Mohamed Shouman [2]

[1] *Arab academy for science, technology, and maritime transport, Egypt*
Mamdouhelmallah@aast.edu; Tel.: 00201101196097

Keywords: Greenhouse Gases (GHG); Nitrogen Oxides (NOx); Tier III

Many researchers have confirmed that gasoline is taken into consideration as the primary component that causes climate change and other environmental problems. A large chunk of the greenhouse gases (GHG) that blanket the Earth and trap the sun's heat are generated through energy production by burning fossil fuels.

A significant portion of the world's energy consumption, which rises annually, is caused by the transportation industry, especially the shipping industry.

This study highlights the IMO regulations and the technological methods to develop environmental sustainability in seafaring.

Nitrogen oxide (NOx) is one of the major components of shipping exhaust emissions. To adapt to expanding natural requests and environmental issues, the International Maritime Organization (IMO) applied restrictions to limit NOx emissions. Annex VI, NOx control requirements, apply to marine diesel engines with output power greater than 130 kW. According to IMO levels (Tiers), the Tier III controls apply only to the specified ships while operating in Emission Control Areas (ECAs) established to limit NOx emissions; outside such areas, the Tier II controls apply. The IMO's first limitation was named Tier I and was introduced in the year 2000. More recently, the stricter Tier III emission limitations have been introduced and constitute an essential step towards environmentally friendly maritime transportation. Tier III has strengthened the emissions standards, requiring NOx emissions in NOx ECAs to be less than 3.4 g/(kWh). New emission reduction technologies have to be developed to fulfil the Tier III limits.

There are several promising technologies to achieve the required NOx reductions. This study focuses on the NOx formation and the technological methods to decrease the NOx emissions to achieve the standards of the IMO regulations.

Table 1 Summary of Emission Mitigation Options for Ships (Han, 2010).

Measure Types	**Measure**	**Description**	**Examples**
Technological strategies	Lower sulfur fuel	- Marine residual or bunker with sulfur content at 1.5%, or below (44% Sox reduction, 18% PM reduction) - Marine distillate and gas oil with sulfur content at 0.1% or below (> 90% Sox, > 80% PM reduction)	- EU (and IMO) Sulfur Emission Control Area: Baltic Sea (2006), English Channel, and North Sea (2007) - San Pedro Harbor Maersk voluntary agreement (0.2% sulfur fuel, 2006)-California auxiliary engine rule (2007)
	Selective catalytic reduction (SCR)	- exhaust after-treatment technology providing over 90% reduction in NOx, PM, CO, and HC reduction can	- Units in service starting in early 1990s in applications ranging from ferry, cruise ship, to roll-on roll-off

		be obtained when SCR is combined with a PM filter and oxidation catalyst	vessels
Operational strategies	Vessel speed reduction	- speed within harbors is reduced to reduce engine load and NOx production (4%-8% reduction)	Voluntary program in the Los Angeles/Long Beach harbor since 2001
	Shore-side power	- Land based power for docked ships (100% reduction in at-port emission)	- Facilities operating in the Baltic and North Seas, Juneau (Alaska), and Port of Los Angeles
Market-based strategies	Environmentally differentiated fee	- Fee reductions based on vessel environmental performance - Emissions benefits depend on level of participation and implemented technologies	- Voluntary Environmentally Differentiated Fairway Dues Program in Sweden since 1998
	Cap and trade system	- A government or regulatory body first sets a limit or (cap) on the amount of environmental degradation or pollution permitted in a given area and then allows firms or individual to trade permits or credits in order to meet the cap	

References

Han, C. H. (2010, June). Strategies to Reduce Air Pollution in Shipping Industry. The Asian Journal of Shipping and Logistics, 26(1), 7–29. https://doi.org/10.1016/s2092-5212(10)80009-4

Life Cycle Assessment to Determine the Relevance of Including Absorption Cooling Plants in the Curriculum for Marine Engineers

Johannes Kolind[1*] and Mads Klit Rønn[1]

[1] *Svendborg International Maritime Academy (SIMAC), Denmark*

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Keywords: LCA; absorption cooling; intended learning outcomes

The overall content of the Danish Bachelor's Degree Program in Technology Management and Marine Engineering is defined in the pertinent law act and the STCW convention. While STCW lists specific requirements for a number of subjects, the law act offers high level requirements and intended learning outcomes in a number of technical and management fields. The professional colleges offering the program are thus allowed some flexibility in determining the taught subjects. Given the technological advancements seen in recent years and the ever increasing focus on the importance of sustainable trade and development, we see that continuous effort is required to determine the most relevant technologies to be included in the educational program.

A frequently utilized data source to determine updates to the curriculum is dialogue with shipping companies and maritime authorities. In this study we propose a supplementary methodology, in which suggestions for changes to the curriculum may be qualified via their change to the potential environmental impact for a given use case or service. The methodology proposed is Life Cycle Assessment (Bjørn et al., 2018), a tool used for comparative assessment of different technologies. Life cycle stages of the compared systems are illustrated in Figure 1.

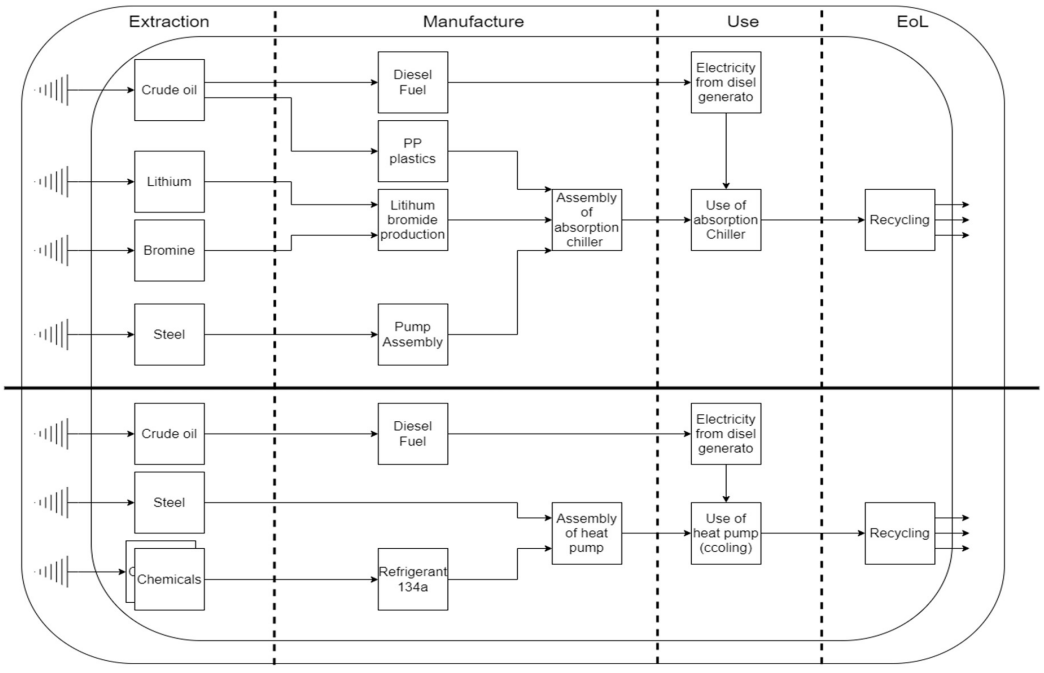

Figure 1 - Process Flow Diagram (PFD) illustrating the compared systems

Living quarters onboard ocean-going vessels are often equipped with air-conditioning (AC), usually via conventional AC-units with compressors and synthetic refrigerants. An alternative solution could be the use ofan absorption heat pump, utilizing waste heat from main and auxiliary engines to produce cooling. Few such plants presently exists onboard ships due to various technical matters (Hafner et al., 2019), however, recent innovations (APS, 2016) are likely to increase the applicability in the coming years. From an environmental and sustainability viewpoint, absorption heat pumps offer lower electricity consumption and do not contain ozone depleting refrigerants with high global warming potential.

The present study serves two purposes; 1) assessing the potential environmental impact of the compared technological solutions; 2) presenting a novel approach to qualifying subject matter included in an educationalprogram. As such, the LCA carried out in this study serves as a pilot study to illustrate the validity and relevanceof the methodology while offering concrete decision support to determine the best environmentally performingcooling solution in a concrete use case.

References

APS, C. S. (2016). *ABSORPTION REFRIGERATION AND AIR CONDITIONING DEVICES.* https://worldwide.espacenet.com/patent/search/family/057984884/publication/WO2017129464A2?q=pn%3DWO2017129464A2

Bjørn, A., Owsianiak, M., Molin, C., & Hauschild, M. Z. (2018). LCA History. In M. Z. Hauschild, R. K. Rosenbaum, & S. I. Olsen (Eds.), *Life Cycle Assessment: Theory and Practice* (pp. 17-30). Springer International Publishing. https://doi.org/10.1007/978-3-319-56475-3_3

Hafner, I., Gabrielii, C., & Norne Widell, K. (2019). *Refrigeration units in marine vessels*. https://doi.org/10.6027/TN2019-527

Bridging the gap of maritime education and maritime sustainability: an introduction to USA case

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Keywords: maritime education; sustainability; curriculum innovation; content analysis; maritime academies

Abstract: As the invisible backbone of international trade, the maritime industry is currently responsible for 3% of global carbon dioxide (CO_2) emissions which the International Maritime Organization (IMO) intends to further reduce by 70% by 2050. To reach this goal, the gap in research must be addressed at the collegiate level. By including education on Liquefied Natural Gas (LNG), cadets gain exposure to an alternative, sustainable marine fuel. The expansion of the LNG industry can play a key role in lowering global greenhouse gas emissions by reducing emitted soot, dust, or fumes and allowing ships to meet new regulations. LNG generates 30% less carbon dioxide than fuel oil, with a twofold reduction in nitrogen oxide emissions and almost no environmentally-damaging sulfur dioxide emissions. Taking the perspective of maritime education, there is still a large gap in research regarding the education of sustainability at the university level in regard to the use of LNG as a marine fuel. The seven academies' course catalogs were investigated employing content analysis techniques. A pilot survey was also distributed to the students of one of the academies to add evidence of how LNG topics were introduced and discussed in these specialized higher education institutions. In addition, taking a marketing perspective, the social media accounts of these academies were also analyzed to verify additional insights on how LNG is disseminated by higher education institutions to society at large (not just the students). The preliminary results show a significant gap, indicating that the curriculum is lacking LNG as a dedicated topic of study in the required and elective courses. Our conclusions indicate that this represented a limitation of LNG knowledge dissemination and application in merchant's vessels. Further research is necessary to better understand curriculum dynamics and possible changes to include LNG and other maritime sustainability courses.

Acknowledgements

This research was conducted with the support of funding provided by Aggies Commit to Excellence Scholar (ACES) Program funding undergraduate research projects at Texas A&M University at Galveston.

Energy Consumption and GHG Emission Comparison Analysis

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Keywords: carbon neutrality, GHG emission reduction, full electrical ferry, diesel ferry

The EU's Fit for 55 package is targeting carbon neutrality in shipping by 2050. Several countries are already taking actions to lower GHG emissions of their fleets. One of the measures to achieve the targets is using alternative fuels and renewable energy sources. In this study we focus on vessels under 5000 GT that have received less attention in academic literature.

The use and applications of alternative fuels in shipping are rising in the newbuilt market. Nevertheless, there is no fit-for-all solution for minimizing GHG emissions due to operational envelopes, weather conditions, routes and port infrastructure. This study focuses on comparing energy consumptions and GHG emissions on a fully electrical and diesel fueled catamaran ferries. The vessels are almost identical and they operate on the same line.

The assessment of energy consumption and GHG emissions is carried out according to the requirements of EVS-EN 16258:2012 using WTW method. It must be emphasized that with WTW method emission factors in EU member countries vary due to different WTW energy factors of electricity suppliers. Due to that countries with higher amounts of renewable energy sources and lower energy consumption factors have lower GHG emissions.

The evaluation in this study is based on actual measured data of two passenger catamaran ferries that navigate in the exact same weather conditions during 1 month. The measurements were carried out in winter period and therefore the solar energy impact is considered minor. The significant factor of the study is that both of these ferries have the same main dimensions and they operate daily alternately the same route.

As a result of the study, we will show difference in GHG emissions of two identical small ferries- one diesel one electric, in similar circumstances This study brings more insight to academic literature on decreasing maritime CO_2 emissions. As managerial implications, it can be used when shipping companies evaluate options to reduce their emission.

Green Energy towards autonomous Shipping: Climate crisis perspectives for zero carbon emission, usage of renewable energy resources in marine propulsion for sustainable seafaring

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Keywords: Marine propulsion system, Renewable Energy Resources, Green Shipping, Zero Carbon Emission, Sustainable Development Goals.

Sub Theme: Environmental Sustainability in Seafaring

Abstract: The Sustainable Development Goals (SDGs) constitute a holistic approach that has been universally adopted to promote economic, environmental, and social sustainability. Sustainable seafaring is a comprehensive development to the responsible use and management of marine resources and vessels. Its goal is to balance long-term social and economic benefits with minimal environmental impact. Sustainable Seafaring practices comprises of optimizing fuel efficiency, reducing carbon emissions, implementing responsible fishing practices, managing marine resources, preventing pollution, and protecting marine ecosystems and biodiversity.

Effective utilization of abundant renewable resources in the Maritime sector which cannot be depleted and could be able to supply continuous source of clean energy would be a promising solution for oceanic sustainability since the Carbon di-oxide emissions are 3% annually and the marine pollutions are hazardous to the ocean. The industry is highly dynamic and the significant demand for tank containers has underscored the urgency to implement measures aimed at reducing carbon footprint. In order to reduce its potential impact on the environment, the shipping industry recognizes the alternative solution for the burning of fossil fuels as renewable energy resources such as solar, wind, tidal, etc., The green ship technology with the renewable resources aims to reduce emissions, lower energy consumption, prevention of marine pollution, and increase efficiency by adopting environmentally friendly procedures.

The availability and forecasting of renewable energy resources have become increasingly significant for utilities and grid balancing as the deployment of wind and solar power capacity grows. Accurate prediction and estimation of variables such as wind speed, solar irradiance, and the resulting power output are required for various time horizons, ranging from a few minutes to an hour for grid stabilization and resource scheduling for the next day, to several days ahead for unit optimization. To achieve accurate forecasts across such a wide range of time horizons, it is essential to combine multiple methodologies, each with its unique capabilities, into a single forecasting system. Marine solar power has limitations when used as the sole power source for large ships due to the unpredictable nature of weather conditions at sea. Additionally, using renewable energy sources like wind turbines and solar panels can pose challenges in controlling and managing electrical generation. The article proposes the 11-level modular multi-level inverter to achieve high-quality waveform, lower switch stress due to reduced frequency, better electromagnetic interference, and reduced Total Harmonic Distortion (THD) of output voltage and currents. Finally,

an effective Maximum Peak Power tracking approach will be applied to the propulsion systems and other relevant components to enhance efficiency.

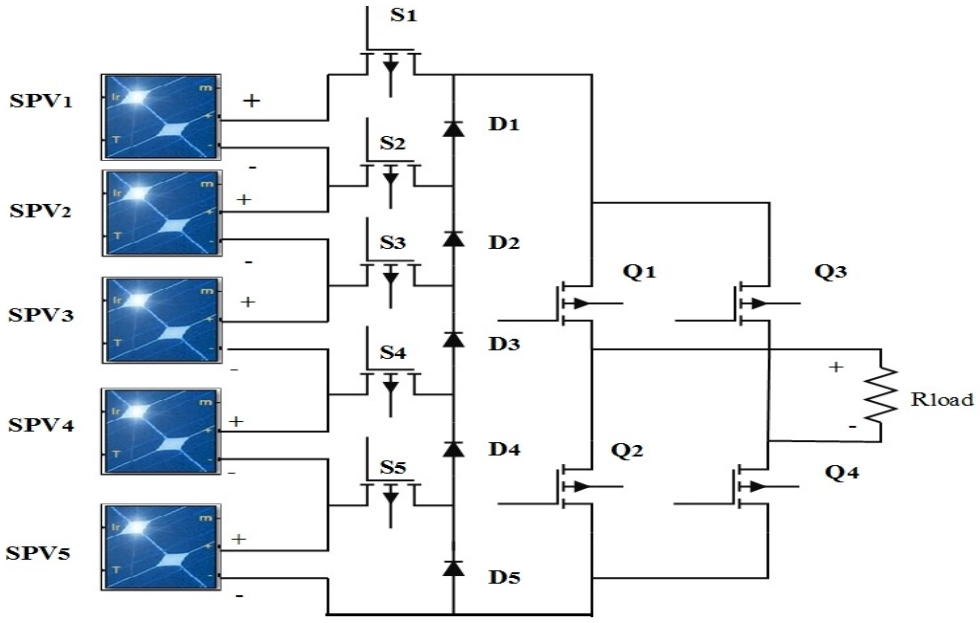

Figure 1 Proposed 11-level Modular Multi-level Inverter

Table 2 Modulation Techniques Comparison

Waveforms	**Multiple carrier with sinusoidal reference**	**Multiple carrier of variable frequency**	**Multiple carrier of variable amplitude**	**Multiple carrier with trapezoidal amalgamated reference**	**Multiple carrier with sinusoidal and trapezoidal amalgamated reference**
APOD (Alternate phase disposition)	10.4	9.4	8.6	8.3	8.3
POD (Phase opposition disposition)	8.4	7.14	8.9	8.9	9.8
PD (Phase disposition)	10.21	8.2	9.6	8.6	10.1

This study evaluates the appropriate technologies and challenges associated with implementing Maritime Industry 4.0. It provides recommendations for upgrading the maritime industry towards Green Shipping while incorporating renewable energy utilization. The study concludes with potential approaches for maintaining and modifying the industry to facilitate the transition towards Industry 4.0.

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A Study on the Effect of Shipping Pollution in the Port and Territorial WaterS of Visakhapatnam

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Keywords: shipping pollution; emission; Air Quality Index; Water Quality Index; noise levels; green ports

Shipping contributes to air, water, and soil pollution in coastal and port communities. The shipping industry relies on materials such as heavy fuel oil, which releases large amounts of pollutants such as carbon dioxide (CO_2), sulfur oxide (SO_X), nitrogen oxides (NO_X), and particulate matter (PM) into the air. Additionally, they release oils, chemicals, and other hazardous substances into the ocean in the event of spills or leaks, causing harm to marine life and ecosystems.

Pollution caused by the vessels in mid-ocean and the ports differs both in terms of causes and their effects and adversities. Port facilities can contribute significantly to air, water, and soil pollution due to the presence of numerous ships, cargo, fuel, chemicals, and waste associated with port operations. Some prevalent sources of pollution at ports include emissions, container leaks, spills, waste from ships, and port construction and maintenance activities. In addition, chemicals such as Tributyltin (TBT) present in anti-fouling paints used to prevent the biofouling on ship hulls are also hazardous to the marine environment.

Discrepancies in the environment due to the vessels in ports will pertain only to the region of the ports, unlike the effects of shipping pollution in mid ocean. To mitigate the impact of port pollution many ports have implemented environmental management systems, reduced emissions from ships and cargo handling equipment, and improved waste management practices. The MARPOL convention in its latest 2020 amendment, has proposed new regulations to reduce greenhouse gases by at least 40% by 2030 and 70% by 2050, compared to 2008 levels along with the introduction of new discharge requirements for scrubber systems, to prevent the discharge of harmful substances into the oceans. Studies and surveys on air, water quality, and underwater noise measurements at the Indian ports are scanty. Such studies have become imperative to maritime universities for easy dissemination of information, knowledge and awareness among the youth and commoners.

Quality of air has become a substantial part of the discussions regarding pollution, especially in port cities and coastal areas due to the presence of plentiful emitting sources. Despite conducting numerous studies on road traffic-related air pollution in the past, only little is known about the magnitude and effects of air pollution due to marine vessel emissions. COP 26 addresses the need for documentation of shipping emissions. Visakhapatnam Port, the second largest port by volume of cargo handled in India, has seen substantial growth in cargo throughput over the past decade, increasing from 44.34 million tonnes in 2000-01 to 67.42 million tonnes in 2011-12. As per the reports of May 2022, the port has handled 9.7% of the total cargo handled in India. Such bustling ports are also responsible for high levels of air emissions, especially NOx, SOx, CO_2, and particulate matter (PM).

The marine biodiversity and biological productivity of coastal and marine ecosystems also depend on the quality of coastal waters. Therefore, monitoring water quality in ports and coastal

regions is essential for protecting human health, maintaining healthy ecosystems, and supporting economic activity while ensuring compliance with regulations and standards.

Alongside air and water quality depreciation, anthropogenic noise can interfere with and mask out the sounds that marine species rely on for communication, mating, finding food, and navigating their environment. Evaluation of underwater vibration generated in port areas will provide a tool to help monitor the amount of anthropogenic noise generated by maritime traffic while also assessing the radius of propagation of these vibrations into territorial waters.

Air Quality Index (AQI) is calculated using data collected from the quantity of NO_2, SO_2, CO_2 and PM present in ship emissions using a Flue Gas Analyser and a filter-based monitoring for PM2.5 and 10. The governing factors of water quality for instance, salinity, temperature, turbidity, pH, dissolved oxygen (DO), nutrients, faecal coliforms, and oil traces, are determined for determining the Water Quality Index (WQI). A hydrophone is used to detect and test the frequency of noises due to ship and port operations. On the whole, this paper investigates the above-mentioned parameters to calculate the AQI, WQI, and the noise levels to compare and contrast the environment of the territorial waters and that of the port.

Through the thorough analysis of the data collected from the Visakhapatnam Port and territorial waters of Visakhapatnam, a proposal suggesting schemes, ideas, and technological solutions for the enhancement of air and water quality as also the underwater noise-levels in and around the coast of Vishakhapatnam will be presented. This study aims to generate a more reliable source of data about water quality, air quality, and underwater vibrations in ports, providing a better understanding of shipping pollution, and creating a vision towards adopting green initiatives at Visakhapatnam port. Greener ports will ensure the reduction of greenhouse gases emissions, marine pollution, waste, and will maintain the natural habitat and ecological balance around the port. Addressing shipping pollution can help one preserve the health of the oceans and the species that depend on them while ensuring a sustainable future for coastal communities while still promoting shipping as a means of global transport.

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Environmental impact assessment study for modernization of existing facilities and addition of new facilities entailing capacity at Visakhapatnam port.

Breakthought simulator technologies of seafaringfor research, education, and training

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Keywords: navigation simulator, maritime training, maritime know-how

In today's maritime world, ship owners and stakeholders have new requirements. Modern ship technology is getting more complicated and demanding. Training onboard is very expensive if it affects the ships operations. Simulator testing can respond to these in a flexible and cost-effective way. The wider use of maritime simulators will become more important in the future as increasingly automated shipping enters the maritime transport market. The consideration of different contingencies and the comprehensive modelling of ship operations by combining the capabilities of navigation and engineering simulators will provide the opportunity for more extensive testing of different scenarios in an environment more alike the ship environment. Communication between the engine control room and the bridge management must be undisturbed in all situations. In a modern simulator environment this can be tested and practiced in a safe way.

In SAMK we have state-of-the-art navigation, engine room, as well as hydrostatistics and stability simulators which can be combined to one training entity. In SAMK Maritime Training Centre is the only 360-degree bridge simulator in Finland. With the present software it is possible to simulate all sea fairways in Finland and in addition it is possible to model any fairway in the world.

In our simulator we can perform port maneuvers, fairway steering practising, operating of different types and sizes of vessels, familiarization, line pilot examinations (half of the fairway navigation practicing can be done on a simulator). In Finland we are highly skilled in ice navigation, and with SAMK simulator it is possible to arrange audited ice navigation courses: Polar Code/Azipod and DP (meets audited IMO DP3 requirements).

In addition to above, verification and testing of the motions of different vessel types under different and extreme conditions, it is also possible to learn squat and bank effects as well as ROT variations of the ship's turning radius with optimal steering angle, *e.g.* in narrow passages. Simulator also enables the testing and planning of various fuel-efficient routes and effect of wind, current, ice and various other sea conditions affecting the vessel. When analyzing conditions affecting chosen route is possible to optimize the passage andthereby cut the ships fuel consumption and thus reduce the CO_2 emissions.

In SAMK we have also training for management in case of accidents, OSC role: setting up a command centre on the bridge, practising rescue patterns, going over the safety of new fairways (impact of weather conditions on vessel types, *e.g.* in case of accidents, and pre-testing of safety limits for demanding transport and preparation of rescue plans). An important part of safety training are joint exercises with authorities and companies in maritime industry.

The simulator is used in various research projects for development of technology and skills or seafarers. The paper will present the practical usage of simulator technologies in many research projects as well as maritime education and training at SAMK. The projects and their results to be presented are ERDF MeriLoki, ERDF MariLab and Interreg Central Baltic Sustainable Flow projects.

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Session
Technological Aspects

A Comparative Analysis of Workload for Navigation Tasks Performed onboard and at Simulated Remote Control Centers for MASS Using NASA-TLX

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Keywords: Workload, Remote Control Center, MASS, NASA-TLX

The Maritime industry is on the verge of dramatic technological change as the maritime world transitions to industry 4.0 and the development of Maritime Autonomous Surface Ships (MASS). MASS are defined as ships which, to a varying degree, can operate independently of human interaction (IMO 2021). The development of MASS will impact how the maritime workforce is trained and how it operates.

Maritime education and training (MET) institutions are one of the most important stakeholders in the maritime transportation system. MET institutions must prepare, equip, and support students to successfully adopt the technology required to operate and manage MASS in the coming, highly competitive and changing workplace. Remote control centers for Maritime Autonomous Surface Ships will be the main work environment during the MASS era. More human-factor studies should be performed related to Remote Control Stations on topics including workload, stress, and fatigue. Many potential human factors, technical, and regulatory challenges have already been analyzed by many researchers including information overload, boredom, mishaps during changeovers and handoffs, lack of feel of the vessel, constant reorientation to new tasks, delays in control and monitoring, and the need for human understanding in local knowledge and object differentiation (Wahlström et al. 2015); state of operator situational awareness (Porathe et al. 2014; Man et al. 2015; Mackinnon et al. 2015); uncertainty related to all, both the human-machine and human-human interactions which will affect operations (Kari and Steinert 2021); operator's stress in different levels of workload (Kari et al. 2019); ship-sense and harmony (Man et al. 2014); design criteria for the Human-Machine Interface (HMI); safe and secure transfer of very large data quantities (Porathe 2014); Operational, Regulatory, and Quality Challenges (Komianos 2018); cybers risks (Andersen 2018); and autonomous system design to meet the STCW requirements (Dittmann et al. 2021).

In this study, a comparative analysis is performed between real world navigation task workload and the simulated remote control center navigation workload. NASA-TLX (NASA Task Load Index) was used to measure the task load of navigators while underway compared to a similar simulated voyage. NASA-TLX is one of the widely used, subjective mental workload measurement tools. It uses six factors: namely the mental demand, physical demand, temporal demand, performance, effort, and frustration levels (Hart and Staveland 1988). NASA-TLX has been used in many work domains including operator control rooms to measure workload and is the most cited survey-based workload measure (Sugarindra et al. 2017; Grier 2015).

Real world navigation tasks were performed by cadets aboard the *T/S State of Maine* during the summer term cruises of 2019 and 2022. The same cadets then participated in similar navigations tasks performed on a full mission bridge simulator and also in a simulated remote control center (RCC) in which where similar routes, environmental conditions, and traffic patterns were reproduced. TLX scores of participants were then compared between the real world and the

simulator. Findings support the out-of-the-loop performance problem which is a major potential consequence of automation (Endsley and Kiris 1995). This study opens the discussion about improving the organization, lay out and procedures at MASS remote control centers and also developing training requirements of RCC operators.

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Need to implement an automatic reporting system related to the supply and dispensing of pharmaceuticals onboard ships

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Keywords: digitization, mobile health, ship medicine chest, maritime pharmacy management

Background

In recent years, with the advent of digitalization, many spheres have changed their way of working, and it has been felt most strongly in healthcare and pharmacy. It has sparked a new wave of innovation and a significantly accelerated pace of digitization in this sector. This transformation requires a new, more dynamic, and flexible system. Depending on the situation, sometimes this means improving processes, for example, through automation.

The role of pharmacies during the pandemic has expanded significantly. They now include additional services such as contact for health information, training, patient monitoring, supply of consumables, vaccinations, etc.

Objective

The present paper discusses the role of pharmacy digitization processes on board ships. The goal thus set is achievable by performing the following tasks:

(1) presentation of methods for providing medical information on board; and

(2) presentation of an idea for different perspectives of digital technologies development, particularly in the field of pharmacy informatics.

Digitization of the information regarding the necessary stocks of medicines in the ship's pharmacy

The main problems with using previous practices, namely paper reporting, create several issues. Examples are the lack of up-to-date information on the suitability of all products, the impossibility of determining the exact quantities of all medications (given their number), and the lack of documentation on which crew member has been given a drug and the reasons for it.

Healthcare professionals, locally and globally, strive to develop and facilitate procedures related to medical information processing and digitization of collected data. In 2014, the International Maritime Medical Association (IMMA) launched a free app for iOS and Android that lists all the medical and health-related items needed on board ships.

Development of digital technologies in the field of pharmacy informatics

The biggest problem with online resources is diversity and lack of credibility. However, the data must be verified and secure when it comes to medical information. In shipping, the methods of obtaining information about medical products and drugs by unqualified non-medical persons are precisely from these sources. The Internet and the various mobile applications created are becoming the leading resource for dealing with a crisis peak situation, intending to make a life-saving decision.

Preparing Maritime Cadets for Applying Artificial Intelligence to Route Optimization in Shipping Industry

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Keywords: artificial intelligence; route optimization; maritime education and training

Route optimization in maritime transportation has always been a key challenge for the shipping industry. In recent years, technological advancements, particularly, artificial intelligence (AI), have made it possible to optimize routes to ensure rent efficiency and cost-effectiveness for the shipping companies. AI algorithms have been applied extensively in route optimization, using methods such as: analyzing historical data on shipping routes; weather patterns and sea currents to make predictions about future conditions; applying real-time information on weather, shipping traffic, port availability to plan the most cost-effective routes; and automatically adjusting ships' course to reduce risks of accidents. As route optimization is dependent on a multitude of factors, including fluctuating weather and sea conditions, and real-time data on fuel prices and consumption rates, it requires a high level of expertise and education to effectively apply advanced algorithms and data analysis to achieve optimization objectives with validated accuracy.

As a result, it has become increasingly crucial for maritime universities to enhance AI education and trainings so that cadets may obtain the proficient knowledge and specialized skills to navigate through a new era of AI-powered technology. Maritime institutions are well equipped to produce an exceptionally capable and sustainable workforce to meet the specialized demands of maritime shipping. In-house AI expertise gives rise to a wealth of opportunities for the maritime industry to develop novel AI algorithms designed to optimize shipping patterns, routes, and cargo based on real-time market and weather data. Optimization of resources is key in this increasingly competitive global market, and maritime universities are uniquely poised to fulfill the exponentially growing need to educate maritime cadets on modern methods of applied data science, machine learning, and Artificial Intelligence.

In this paper, we focus on how new technological breakthroughs, particularly AI-powered machine learning algorithms, will ensure route optimization with consideration to profit-efficiency and cost-effectiveness in maritime transportation. We also examine the important role maritime institutions play in educating qualified graduates, as well as possible shifts from traditional maritime education to more technology and AI-orientated frameworks. Using perspectives and survey results collected from administration, faculty, students, and infrastructures, we identify issues and potential obstacles that preclude widespread adaptation of AI. Proposed solutions, which include introducing new courses in data analytics, algorithm design, and the use of AI-powered simulation software, are a vital first step for the maritime industry to join the AI technology main stage.

This research intends to provide a comprehensive understanding of how modern technological breakthroughs, exemplified by AI-powered algorithms, have the potential to create significant industry-wide improvements in regards to shipping efficiency, costs reduction, and safety enhancements. As the maritime industry continues to evolve and adapt to new challenges, it is essential that maritime institutions enhance education and training of cadets so that the future

maritime workforce is equipped with the necessary skills, expertise, and prerequisite knowledge to rise to the challenges posed by a new horizon of AI-powered technology.

Electric Power Engineering for the Next Generation of Marine Engineers

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Keywords: Continuous assessment, Electric circuits, Electric drives, Learning outcomes

To combat the climate challenge, all sectors of the society must contribute. The IMO goal of a 50 % CO_2e reduction 2050, compared to 2008, is part of the solution (IMO, 2021). However, this will require a technology shift in the sector. Worldwide, but specifically in the Nordic countries, the number of electrified ferries is rapidly increasing (Tarkowski, 2021) and at least a container ship has been deployed (Yara, 2023). A major challenge in the electrification of shipping is the size, weight, and cost of batteries, but the development is promising (Kersey et al., 2022). The authors claim the economical range of battery-operated ships are about to double within the decade, which could lead to a 40 % reduction in CO_2e emissions. If environmental costs are included, the range could increase four to eight times within the same time span, dependent on this size of the ship. However, it should be remembered that there are so much more to electric shipping than just electric propulsion (Wärtsilä, 2022), such as different types of hybrids and onshore connections. The future onshore connections will also be used for charging which mean higher power, higher voltage, and more automated systems

Marine engineering (Marine Engineering Officer class V) is a four-year education program including B.Sc. and one-year internship and workshop courses. The program focus on mechanical and electrical engineering and cover Standards of Training Certification and Watchkeeping (STCW), especially in electrical engineering and logical control courses. The engineers are thereby well-prepared for a career both onboard as well as onshore. The internship is a substantial part of the program, both for personal development and to be able to apply for an unlimited license as engineer onboard merchant navy vessels. Since the academic year 2016/2017, high voltage engineering is included and that gives the marine engineers a possibility to apply for Electro Technical Officers license after fulfilled onboard time, according to the regulation from Swedish Transport Agency.

Due to recent development in the sector, the competence for onboard as well as onshore has increased when it comes to electric power engineering and high voltage. This together with the interest to 1) allow the students to study with students from other programs 2) allow the engineers to continue, not being a dead end, in the academic system but also 3) raise the status and ranking of the education, the learning outcomes of the marine engineer education in electric power engineering at Chalmers University of Technology were developed beyond the STCW.

The aim of the development work is to prepare the students for their professional career and to increase the knowledge on electric power engineering to be better prepared for (the upcoming) electrification in the marine sector and the aim of this contribution is to present what was done and reflect upon the outcome.

For the academic year 2017/2018, the learning outcomes of two courses of 7,5 ECTS Electrical systems (SSY) and Electrical system advanced (LNB) were revised to be more homogeneous with the academic system at Chalmers and to clarify the content of high voltage engineering. More focus was put on general knowledge on how to solve problems and modelling of electric component and system. Rules thumbs were removed, to be replaced by more theoretical based on methods that

require more work but has no limitations, like the complex method for alternating current calculations. The understanding of modelling was developed to make it easier for the student in the future to understand now concepts. Issues with the passing rate were anticipated so continuous assessments were introduced. The assessment of both courses was split into three parts each and special assessments for the more practical and high voltage engineering parts were used. As can be seen in Figure 1, the overall impression grade of the courses made a dip for the first years but has steady but slowly climbed back. The passing rate, see Figure 2, has a slower recovery, but it is noticeable at least for LNB. The passing rate could also be affected by the decrease in competition for admission to the program. Last five years all qualified applicants got accepted into the program which has led to an increase dropout rate of the program.

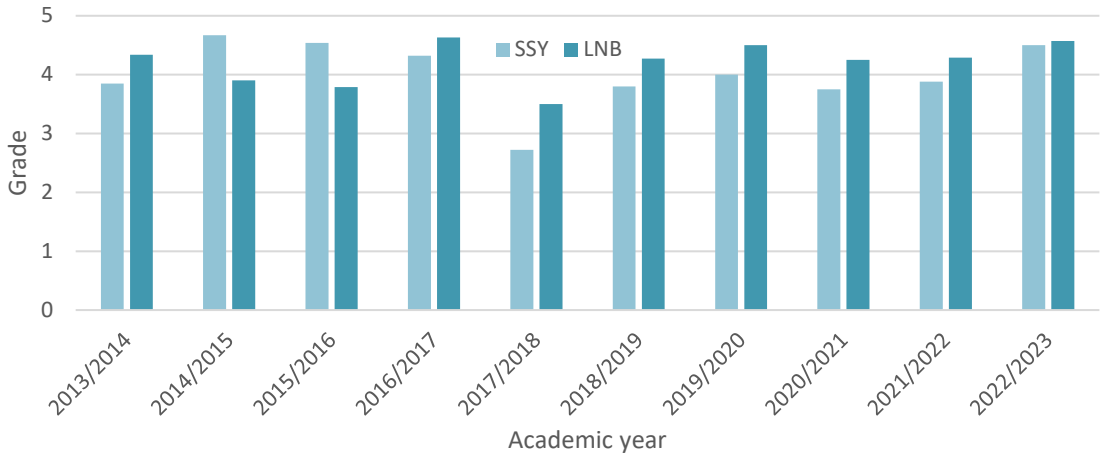

Figure 1. Overall impression grade (1-5) of the courses where 5 is the highest.

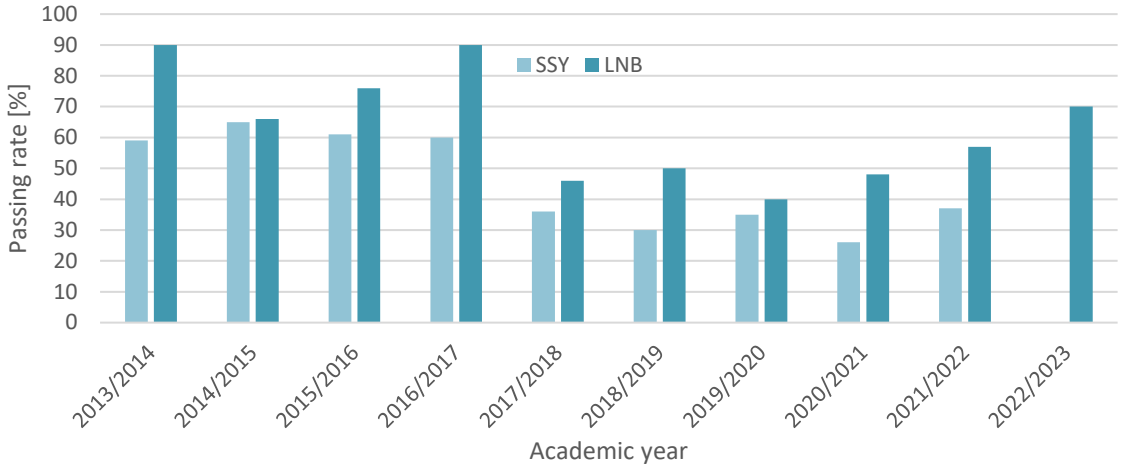

Figure 2. Passing rate for both the courses. For the course SSY is the assessment for 2022/2023 not finalized

An early, and common, comments from students were that electricity is tricky and they will not need it because many of today's chief engineers says that they do not need it. However, with time and a lot of discussions regarding the difference between their and the current chiefs future, the students have accepted the need and have started gaining interest in the subject which made the implementation successful but there are drawbacks too.

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How Advancement of Simulation Technology Can Replace Onboard Training for Future Ship: Case of Engine room Simulator

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Keywords: Maritime education and training; Marine engine room simulator; Future ships; MASS; Digitaltwin

The Global Maritime Professional (GMP) (IAMU 2019) will benefit from immersive high fidelity engineroom simulator training technologies that support quasi-context training and enable the trainee to vicariously experience the workplace in the virtual world (Baldauf *et al.* 2016). A major development in this direction is the walk-through marine engine room simulator (see figures 1 and 2) that affords access to the different spaces, systems, and equipment of the ship's engine room and permits trainees to undertake realistic actions and see consequences in real time (Lokuketagoda *et al.* 2017). Due to diverse factors, including the efficacy of technological advancements in simulator training technology, there is an increasing demand from some administrations to consider simulator training in lieu of sea time in maritime training requirements for certification and this is irrevocable (Nautilus-International 2020). Work on identifying sea time equivalence has been/is being undertaken in several countries whereby the required sea service time can be reduced by up to thirty days in certain niche maritime sectors such as dynamic positioning vessels in offshore operations (Sea- Maritime 2022; STC 2023). This reduction in sea time is extremely attractive for the maritime industry, however, it raises questions regarding the efficacy of the training. In the recent past, the proposal of simulator training in lieu of sea service was largely motivated due to the lack of training berths available on-board ships. Currently, the developments in simulator training technology make it a powerful pedagogical tool that can facilitate enriching context-near training. The substitution of simulator training for sea service for engineers will eventually become the norm and the natural choice, mainly due to the circumstances warranted by the future technology such as the 'digital twin' in future ship operation.

This paper presents the developments in engine room simulator training technology and argues that the immersive training experience afforded by this novel technology facilitates quasi-context training in the case ofmodern and future ships.

With respect to modern and future ship operations, the International Maritime Organization (IMO) has delineated 4 degrees of Maritime Autonomous Surface Ships (MASS) underpinned by technological advancements in operations, control, and the presence/absence of humans onboard (IMO 2021). Modern shipsof today are in stage 1 of MASS with some automated processes and decision support systems (DSS) onboard where seafarers can take control when required. Stage 2 of MASS is imminent and denotes a vessel that is remotely controlled, but with seafarers present onboard to take control if required. Stages 3 and 4 of MASS donot have seafarers onboard. While the ship is remotely controlled and operated in stage 3, stage 4 is characterisedby a fully autonomous ship capable of independent decision making and action. Advancements in simulator training technology can be mapped to the training requirements of the different stages of MASS ships. The

walk-through marine engine room simulator is suitable for all stages of MASS ships (Lokuketagoda *et al.* 2018)– A limited number of stage 1 MASS ships have unmanned engine rooms and the simulator presents the opportunity to familiarise the engine room crew with the space, equipment, and training requirements. Additionally, the principle of this simulator to vicariously experience the engine room and take remote action is suitable for stages 2, 3, and 4 of MASS operations.

Three current and complementary trends in the maritime industry will inform and shape the technology intensive training environment of future shipping operations. Trend 1 is the increasing adoption of technology onboard ships that has led to increased digitalisation and automation onboard that will culminate in autonomous ships of the future (Narayanan & Emad 2020; Emad, Narayanan & Kataria 2022); Trend 2 is the increasing uptake of technology in MET such as continually advancing simulator training technology (Emad & Kataria 2022); Trend 3 is the blurring of the physical and the virtual workspace in MASS stages 3 and 4 wherein human operators will not be present onboard and the workplace itself will be digital in nature– training utilising the digital twin of a vessel appears to be a logical pedagogical development in the MET continuum (Kataria & Emad 2022).

On the job workplace training has been considered the gold standard of training (Billett 2020). This paper argues that simulator technology developments in MET such as the walk-through marine engineering simulator bring the trainee as close to the context of work as possible. Furthermore, technological advancements such as the digital twin when incorporated into training would enable the trainee to train in the (digital) workplace itself, thereby bringing the context back into training and positively impacting its efficacy.

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Simulator as a Critical Training Tool for Autonomous Ship Operators

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Keywords: Autonomous Ship; Industry 4.0; Seafarers; Simulator; Training; MASS

Industry 4.0 is revolutionizing all industries across the world. As the backbone of the world economy, the shipping industry is not exempted from this revolution and transforming under the new framework. This framework will affect all aspects of shipping through Industry 4.0 drivers. The drivers utilize advanced technologies such as Internet of Things (IoT), Additive Manufacturing (AM), Artificial Intelligence (AI), and more importantly Virtualization including digital twin and simulation. Indeed, the implementation of technologies have enhanced but increased the level of complexity of the workplaces on ships. These technologies have paved the way for all aspects of the industry toward unmanned and autonomous shipping. International Maritime Organization (IMO) proposed four degrees of operation to map to progression from traditional to autonomous shipping with increasing level of human machine interaction over time. In this classification, as the ships progress to degree two and three seafarers/operators require to be trained for the skills and competencies that enable them to work with the advanced systems and intelligent machines. Training the novel skills need progressive training system that utilizes the advanced technologies for training future seafarers. Currently, the most advanced training tool is simulator. From its inception simulators always had a fundamental role in training systems. Although has its roots in Industry 3.0 it matures to virtualization as one of the main industry 4.0 technologies. The aviation and aerospace industries are successful examples of utilizing simulators for training operators of remotely controlled and autonomous systems. The new generation of training simulators employ technologies such as augmented reality and virtual reality (AR/VR) to provide immersive experience and better human-machine interaction.

At the same time, simulation as part of Industry 4.0 virtualization technologies is revolutionizing the workplaces across maritime industries including shipping, ports, and shipbuilding. It will also be utilized as an effective tool for regulatory bodies and classification societies when the maritime industry fully embraced the autonomy. Virtualization employ AR/VR, CPS, cloud computing, and IoT, to construct digital twins for seamless human-machine interaction. The digital twin is a virtual model of a physical system. It is a simulation system with the variable input from a physical entity such as a ship or part of a system for example the ship's engine. The future simulators and digital twins will be used by seafarers to operate the ship and perform different tasks such as navigation and maintenance. Whilst the digital twin being the future workplace of the ship operators, it will provide an unparallel opportunity for the training providers to replicate the digital twin of the actual ship for the benefit of training seafarers of the future. Indeed, access of future trainee seafarers/operators to these technologies in the training environment assist emerging Operator 4.0 the intelligent operator interacting and collaborating with smart machines.

Although the degree 4 autonomy and digital twin is the future of the industry however, its realization for the oceangoing shipping is predicated to be decades away. Currently, the shipping industry is experiencing a transition from degree 1 to 2 with the degree 3 in horizon. At stage 2 and 3 the ship operators will handle the ships through a Shore Control Center (SCC). A SCC is a control center/room where SCC operator remotely monitor and control one or more MASS ships and intervene in the operation of the ship if necessary. SCCs will become the center of the future shipping industry. With the advancement of technology and its deployment during the course of time the SCC environment will become more dynamic and realistic. Even for the degree2 of MASS where there are seafarers are still onboard, the SCC's role as a backup control in the case of emergency and other dangerous or critical circumstances would be immense.

The progress of SCC design, equipment, and functions depend on the Degree of MASS and the level of automation of the ship. Thus the utilization of Industry 4.0 technologies will define the operator's role and level of human-machine interaction as gradually workplace transfer from onboard ship to the SCC. In the transition period from traditional shipping to autonomous shipping the human operators will need to gradually mature its competencies for interaction with the advanced technologies. Therefore, the maritime education system needs new and non-traditional programs and facilities to make the operators ready for future shipping operation. Here the simulators can play an essential role during the transition phase. As digitalization and implementation of Industry 4.0 technologies progress onboard ships the same would be applied in simulator facilities. By incorporating virtualization and technologies such Augmented Reality (AR) and Virtual Reality (VR) along with deployment of Artificial Intelligence (AI), and Machine Learning (ML) future smart simulators the maritime training institutions would be able to replicate authentically the actual onboard ship environment at shore. In this regards SCC simulators will be the realistic, dynamic, and advanced replication of the SCC that is the central part of the future ship operations.

As MASS matures and more and more digitalization and automation embrace the maritime industry the human presence onboard ship will decrease, and seafarers' role shifts to human operators in SCC. This provides the opportunity for maritime training institutions to use technology-based training models for training remote ship operations. Virtualization as one of the advanced technologies of the Industry 4.0 in the form of simulators can play a centric training facet and make a bridge between on-board training into SCC training. Moreover, the simulator can be utilized as a main tool not only for instructing but also for assessing the competency of seafarers/operators for remotely controlling ships from SCC. This allows transferring major part of onboard training to simulation-based training.

Currently, the maritime universities across the world are facing a major challenge in responding to maritime industries needs of providing them with the quality seafarers who are not only be competent to work onboard ships of today but be prepared to operate the ships which need to be remotely controlled. To fill this gap the authors designed a qualitative research project tilted "Simulation Training Program for the Future Autonomous Ship Operators". This project is funded for the 2022-2023 period by the Nippon Foundation through IAMU Organisational Development Project scheme. The project investigates and test the application of MASS simulation technology for training future seafarers.

The research utilized the Intelligent Shipping Technology Test Laboratory (ISTLAB) in SAMK university, Finland's SCC simulator to replicate the degree two of autonomous ship operation from a SCC. The ISTLAB simulator provides a unique testing and research platform that enabled the research team to test and analyze different scenarios and map out the required skills and competency of future seafarers/operators for autonomous ships' operation. Moreover, the result of these scenarios will assist to assess how the maturity level of technologies helps to progressively shift onboard training to simulator training as the onboard workplace shift from onboard ship to SCC. This paper illustrates the results of research on simulation training program for the future autonomous ship operator's and to inform maritime stakeholders to be aware of the prominent role of advanced simulators in the current and future training of seafarers. This paper highlights the

critical role of advanced simulators in training the next generation of seafarers/operators known as Operator 4.0 and strongly recommends the gradual shift from onboard training to simulator training.

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Analysis of Cyber Attacks related to Remote Code Execution for shipboard Radar by using Bayesian Networks

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Keywords: maritime cyber security; radar cyber risk; remote code execution; maritime cyber-attacks; bayesian network

Radio Detection and Ranging (RADAR) equipment is an important cyber space onboard ships as an electronic system that can detect surrounding objects, indicate positions of them, and allow tracking targets by using radio waves (Longo et al., 2022). RADAR system includes information and operational technologies (OT) such as SCADA systems, LAN networks, Ethernet and TCP/IP protocols (Wee, 2017). While these technological and communicational frameworks procure effective contributions for safety of navigation, they also embody various cyber vulnerabilities due to their unique design functions. Various cyber-attacks such as man in the middle attacks, DoS attacks, malware injection, jamming attacks, arbitrary code injection, or remote code injection are possible for RADAR due to the cyber vulnerabilities of it (Leite Junior et al., 2021; Yang et al., 2018; Svilicic et al., 2020). All these cyber-attacks against RADAR onboard ships can cause navigational accidents, critical economic costs, environmental pollution, and loss of human life. In this study, the possibility of remote code execution on the shipboard RADAR is aimed to analyze by using Bayesian Network to achieve effective identification of RADAR cyber risk factors for remote code execution and explore the mechanism of interaction between risk factors and their importance. In case of remote code execution, attacker scans the RADAR processor unit across local area network (LAN) seeking known vulnerabilities that may support a successful attack. Once a targeted vulnerability is identified, attacker performs the exploit to gain access. When the attacker is in, attacker executes remote malicious code on the RADAR processor unit software across local area network (LAN) in order to exfiltrate data, perform detail surveillance, and disrupt service (Xiao, 2022). A Bayesian network is a probabilistic graph model that represents a set of variables and their conditional dependencies via a directed acyclic graph (DAG) (Ches and Pollino, 2012). Bayesian networks are an ideal and relatively new technique for taking an event occurring and estimating the probability that any of several known possible causes is the contributing factor. This research offers a new perspective on the identification of cyber risk factors and complex interaction mechanisms, which are of great importance for RADAR cyber risk pre-control management.

Theme Category

The theme category in which the abstract can be take place is Managing Maritime Safety and Security, if it is also deemed as appropriate by the editors.

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On-lining ERS

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Keywords: ERS, online, guidebook

The European Education and Culture Executive Agency, EACEA, opened an additional call for proposals as part of the measures supporting recovery from the coronavirus crisis. The funding in the additional call was granted to Erasmus+ KA2 strategic partnerships. The application period was very short, only two months but the MERSol consortium was established by Satakunta University of Applied Sciences (SAMK), Finland due to good partners from previous projects, some even +20 years co-operation. SAMK called experienced simulator manufacturer Image Soft Ltd. as well from Finland to bring the engine room simulation model in this project as two years project time (1.6.2021 – 31.5.2023) would be too short if engine room simulator model has to be developed from the scratch. Slovenian IT-specialist company Spinaker Ltd. was invited to bring online solution expertise. SAMK invited maritime training partners from Spain, Universitat Politecnica de Catalunya (Nautical Studies of Barcelona) Lithuania, Lietuvos aukstoji jureivystes mokykla (Lithuanian Maritime Academy, Klaipeda), Turkey, T. C. Piri Reis Universitesi (Maritime University of Piri Reis, Istanbul) and Ukraine (Kherson State Maritime Academy, Kherson) to join the MERSol Consortium.

Products were developed nearly according to the project plan. Russian invasion to Ukraine in February 2022 shocked all partners and made Ukrainian partner work nearly impossible but brave Ukrainians did they part of research without full time electricity and internet. Eight study and assessment modules were developed by maritime engineer partners. Moodle platform was chosen as the online platform for these modules. Respected Finnish simulator manufacturer Image Soft Ltd. developed earlier a standalone engine room simulator model of M/S MIRABILIS, research vessel built and delivered to Namibian Ministry of Fisheries and Marine Resources on the year 2012 from Rauma shipyard. This ERS version was modified to work online and SAMK server was chosen to be used as the simulator home base were other partners connected. This paper will present all abovementioned research which is gathered together as the last product, guidebook to the related industry introducing difficulties met and problems solved.

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The European Education and Culture Executive Agency, EACEA, opening an additional call for proposals as part of the measures supporting recovery from the coronavirus crisis.

Data acquisition differences between two AIS receivingantennas

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Keywords: Automatic Identification System, Vessel Tracking Systems, Geo-spatial data

The use of Automatic Identification Systems (AIS) data has recently spread throughout scientific community working on Blue Economy topics such as collision avoidance, tracking fishing activity or maritime related emissions, (James et al., 2018; Mujal-Colilles et al., 2022; Silveira et al., 2013). Although it was originally designed to improve marine safety and it is only internationally mandatory on merchant fleet larger than 300GT, the use of it in other fleets such as recreational vessels and fishing fleet has increased significantly due to the simplicity and usefulness of the system. At the same time, the detailed information yielded by AIS systems makes it an interesting source of data for researchers.

AIS preprocessed data can be acquired through several private providers with significant economic cost, increasing with the spatial and temporal range. However, at the same time, it is very straightforward to have your own do-it-yourself antenna, recording maritime traffic within a mean range of 30 nm and a maximum range of 120-150 nm depending on the weather conditions.

The Barcelona School of Nautical Studies has hosted an AIS antenna for the last 10 years (AIS1). After an update on the recording system, data is hourly stored since September 2019 and is decodified using an open source code (pyAIS.py) and preprocessed following the standards described in (ITU-R, 2014). An acquisition of a new antenna in 2021(AIS2) located in an apparent better position both in plane and vertically, see Figure 1, was originally thought as a renewal of the old antenna. However, previous to the final removal, a comparison study is being carried out in order to see if both antennas are complementary.

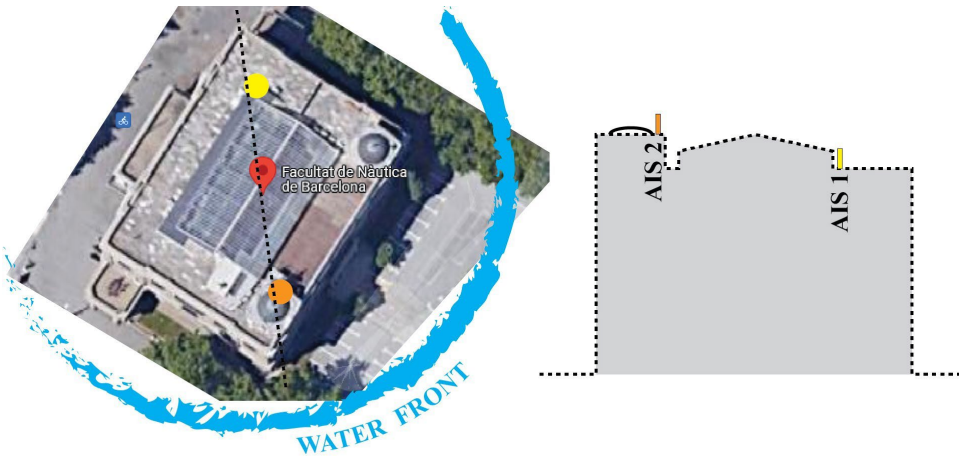

Figure 1. Location of the new and old antenna in plane view (left) and in vertical view (right)

In this abstract we will present the differences found in both antennas and the relation between the differences and the meteorological variables. Figure 2 shows the 1-day recorded data (21-June, UTC +1) fromboth antennas once the messages have been pre-processed. Subtle differences can be observed in this figure, such as missing data on from the newer antenna. More detailed analysis will be carried out to explain the differences encountered and presented in the full-length paper, including range of the antenna, resolution, correlation with weather conditions, among others.

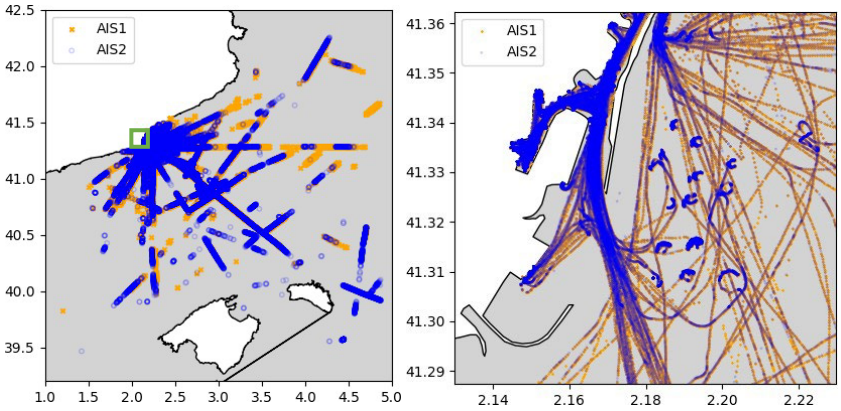

Figure 2. Geo-positional AIS received messages in June 1st, 2021. AIS1: old antenna, AIS2: new antenna. Left: all data received; right: zoom in the green square in left figure

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Concepts and Applications of Eye Tracking Technology in Maritime Shipboard Operation with Pilot Case Study

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Keywords: Human factor, eye tracker, eye movement, human behaviour

Although modern ships are well-equipped with cutting-edge technologies, human factors still play a significant role in accidents (Fan et al., 2020). Fatigue, poor communication, improper maintenance, inadequate training, incorrect situation assessment, mental workload, a lack of situational awareness, and stress contributed to most incidents (Vinagre-Ríos and Iglesias-Baniela, 2013; Chauvin et al., 2013; Psarros, 2015). In order to explore the risk analysis of human factors in maritime accidents, it is crucial to analyse and measure the variables that are hard to measure in accident reports, i.e., mental workload and situational awareness.

Eye-tracking technology has been extensively utilised in numerous fields for various purposes. In general, eye tracking technologies provide the means to gather in real time a variety of eye movements that represent different human cognitive, emotional, and physiological states, which may be used to get a deeper understanding of the human brain in various scenarios. Eye tracking technology, one of the objective measurements, is a relatively new approach in the maritime sector.

This study provided a significant opportunity to advance the understanding of eye-tracking applications in maritime with a pilot experiment in a bridge simulator. The pilot study's findings and review of concepts and application of the eye tracker contribute to further developing and exploring eye movement analyses as an objective indicator in maritime operations.

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Coupling CFD and VR for Advanced Fire Training in Ship Engine Room

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Keywords: marine fire training; CFD fire modeling; VR engine room

Fire hazards on marine structures and vessels are of great importance and affect significantly structural design, engineering decision making and training procedures. An on-board fire is extremely dynamic and case dependent phenomenon. Therefore, experimental real fire hazard training is not an option for obvious safety reasons. The emergence of new technologies, such as virtual reality (VR) offer a valid alternative for training in dangerous situations (Ting et al. 2018; Lovreglio et al. 2021). Fire and smoke exhibit fluid like behavior so computational fluid dynamics (CFD) modelling approach is necessary to ensure the realism of fire models (Solmaz and Van Gerven 2022) in VR.

A CFD and VR integration methodology for development of improved fire hazard marine training, comprising of ship engine room vector and bitmap model generation, CFD fire behavior analysis, results validation and CFD/VR integration, is presented here. SMARTFIRE, an advanced CFD software package, is used to calculate fire parameters, analyze its development and spreading. Heat and smoke progression in a ship engine room environment are subsequently visualized in a VR system based on Unreal Engine.

The analysis parameters considered are time-dependent temperature and smoke density at various point throughout the entire engine room volume. The evaluation of the simulation results comprises of visual analysis of the fire behavior using a software generated video animation executed by competent analysts. The evaluated model is then transferred to the VR environment by linking the fire visualization parameters (graphics fire representation) to the CFD analysis data (temperature and smoke density data). In the first phase of the research the CFD-VR integration is done on case to case scenario basis, using the CFD time dependent results. The ultimate goal is to produce an interactive dynamical VR simulator environment in which fire extinguishing actions will produce real-time changes in the model itself with the intention to provide safe experience gain for crew members and firefighters.

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The factors affecting cruise ships evacuation efficiency

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Theme category:

- *Managing Maritime Safety and Security*

Keywords: cruise ship, evacuation, factors affecting evacuation process

In the maritime industry, the full evacuation of cruise ships is considered one of the most dangerous tasks. The evacuation's effectiveness may be described as a function of the crew's readiness at a given time because it changes during the 24-hour periods, but it also depends on the ship's activity at the time (sailing, berthing/unberthing, manoeuvring, etc.). The evacuation's effectiveness may also be understood as the time required to rescue all persons on board. In both cases, the critical factor is the crew's ability to perform as a team under exceptional circumstances. The crew's ability to perform effectively is demonstrated in timely decision-making and proper execution of the required actions. The SOLAS Convention and IMO Resolution MSC/Circ. 1533 specifies the maximum allowable duration of the evacuation to be achieved by evacuation drills.

The main objective of the research presented here was to identify the current state of affairs on large passenger ships (knowledge and procedural gaps) and the key factors that may jeopardize evacuation effectiveness. It mostly focuses on crew readiness as the most critical factor. The research activities lasted from September 2020 through September 2021 and involved questionnaires and interviews of 81 seafarers from 24 cruise companies.

The paper to be presented demonstrates the research methodology, assumed and actual restrictions, and findings. Finally, the paper also indicates the main conclusions and recommendations, particularly those that may be included in the international regulatory framework.

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Conceptual Modelling of the Use of Artificial Intelligence Platforms in Maritime Education and Training: An Exploratory Approach

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Keywords: artificial intelligence, maritime education and training, e-learning.

The maritime industry has been experiencing a digital revolution with recent concepts, such as industry 4.0, blockchain, smart contracts and autonomous ships. The high pace of digitalization is expected to continue with enabling new generation artificial intelligence (AI) utilization, which also calls for improved and increased adoption of automation. There is no doubt that the impact of AI on maritime transportation in the future will be substantial. Therefore, it is equally important to have deck and engine officers having the technological thinking and savoir-faire in the merchant fleet. In this study, an exploratory approach has been taken for evaluating the implementation of artificial intelligence as a tool in maritime education and training (MET) through the conceptualization of the use of AI in MET, while researching the benefits, challenges and limitations of the involvement of such technology into conventional ways of education with qualitative data analysis.

To establish a framework on AI utilization in MET, a set of questions on AI application in simulator training, theoretical classes as well as mandatory safety of life at sea and ship security training (survival at sea, firefighting, first aid, security training etc.) were asked to experts and decision makers in the MET comprise of ship captains and academics. Furthermore, the same set of questions were asked to recently popularized chatbot of the AI company OpenAI's ChatGPT to make a comparison of the answers. Acquired answers from both parties have been analyzed with respect to the maritime education and training literature to set up a framework regarding the utilization of AI in MET. For the analysis process within the methodology, keywords and phrases matching with each other received from the human experts and AI were listed as well as different opinions of both parties. These linguistic answers were analyzed to compare the reliability and possibility of the current MET literature being embedded into the framework for the AI utilization in MET.

Concludingly, the benefits, challenges and limitations of using AI in MET were analyzed and examined by using data received from human experts and ChatGPT through an exploratory approach. The results indicate that in the current conjuncture of MET, AI may provide benefits and support to a certain extend on providing perspective to students in the form of research, basic knowledge, project development and career pathing. On the contrary, stemming from easiness to access knowledge without questioning surely will decrease the level of decision-making skills, in addition to having the challenges of constantly utilizing such technologies as the main tool for learning may affect students' personal developments as the future deck officers and marine engineers. For MET lecturers, AI tools enable to develop multiple scenarios for simulator training, analyze big data packs and ensure interactive class environments and the tools can also be used as a personal teaching assistant. One of the major current challenges for the lecturers is considered that the information acquired from the AI tools may not be reliable and valid, hence it may cause a cumbersome workload for the lecturer to check the information received from the AI platform as

opposed to researching the information from the already acknowledged sources and academic material. Overall, although it is clear that there will be benefits of using artificial intelligence platforms in maritime education and training, as in many other fields, it still is considered to be a situation that requires improvement and progress.

Session
Economic Aspects

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Hydrogen Shipping Cost Evaluation for Potential Corridors

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Keywords: liquid hydrogen; ammonia; methanol; LOHC, shipping cost

The use of hydrogen (H2) is expected to be one of the critical deep decarbonisation options for the world. The predictions suggested that H2 could account for 10-18% of the global energy consumption mix by 2050 (Hydrogen Council, 2017; IRENA, 2022; WNA, 2021). As global demand for green H2 increases, it is important to consider the renewable energy resource (RER) endowments and H2 production costs of different countries and regions. For instance, the RERs in European and East Asian countries are insufficient and H2 production costs are relatively high in these countries, while Australia, the Middle East, North Africa, and South America are RER-rich and their H2 production costs relatively low (IRENA; Platts, 2023). This leads to the formation of international H2 supply chains between countries or regions.

Ports and shipping are essential in the international H2 supply chains. Some ports in such countries as Australia, Japan, South Korea, Singapore, and the Netherlands are preparing for the international H2 trade. Chen et al. (2023) identified twenty possible early H2 ports, including twelve exporting and eight importing ports. The H2 shipping corridors could appear between these ports. H2 shipping cost, being a costly part of the supply chains (Johnston, Ali Khan, Amal, Daiyan, & MacGill, 2022), will be a key factor in determining each corridor's competitiveness. The H2 shipping cost varies greatly depending on the H2 mediums used. Liquid hydrogen (LH2), ammonia, methanol, and liquid organic hydrogen carriers (LOHCs), including dibenzyl toluene (DBT) and methylcyclohexane (MCH), are considered suitable H2 international transportation mediums.

This paper aims to estimate the hydrogen shipping costs in different shipping corridors. An H2 shipping cost evaluation model was developed. The evaluation scope of the model covers H2 exporting ports' storage and loading costs and shipping costs between exporting ports and importing ports. The annual levelized H2 shipping cost can be evaluated using the developed model based on a project's capital expenditure (CAPEX) and operating expenditure (OPEX), as shown in Figure 1.

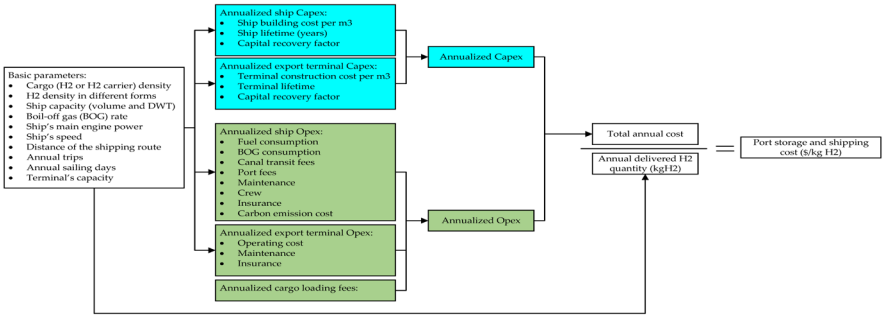

Figure 1. H2 shipping cost evaluation model.

A case study was conducted to demonstrate and validate the model. Five ships with the same capacity of 100,000 m^3 were considered to transport LH2, ammonia, methanol, LOHC(DBT), and LOHC(MCH) in bulk respectively in twelve H2 corridors, as shown in Figure 2.

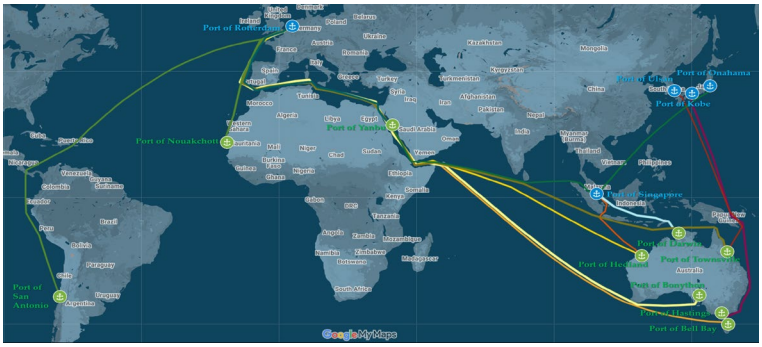

Figure 2. Twelve H2 corridors.

The results (Figure 3) shows that methanol, as an H2 medium, had the cheapest shipping cost in all corridors, followed by ammonia, LOHC(DBT), LOHC(MCH), and LH2. The H2 shipping costs (USD 0.3-1.4/kgH2) in the Australia-East/Southeast Asia, West Africa-Europe, and the Middle East-Europe corridors were more competitive than those (USD 1.2-3.3/kgH2) in the Australia-Europe and the Middle East-East Asia corridors. The developed model could be used for economic assessment of future H2 shipping routes.

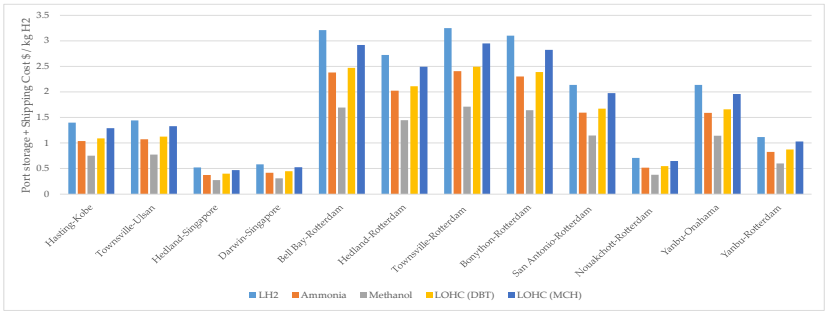

Figure 3. H2 shipping costs in twelve H2 corridors.

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Coopetitive game fundamentals and concept model representation for LNGtransportation industry

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Keywords: Coopetition, Game theory, LNG shipping

Forming strategic alliances, known as *coopetition game*, offers operational flexibility and collaborative relationships, where usually carriers cooperate to reduce operational costs and consequently to improve the environmental sustainability.

This paper presents a mathematical expression of the coopetition strategy in the LNG transportation segment. Furthermore, in this study, the coopetition game represents game-theoretic mathematical framework for LNG shipping structure in order to better understand motivations when forming an alliance; how do participating companies organize their business models, at which level do they cooperate and what is an incentive for competition, and finally to comprehend strategic decision-making processes when participating inan alliance.

The novelty of this paper is game theory usage in the LNG market industry for profit maximization and improving environmental protection. In order to set conceptual model, we define mixed-integer nonlinear problem with iterative heuristics approach. Also, the constraints related to LNG transportation industry for conceptual model framework of coopetition game are presented and elaborated.

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Session

Social Aspects

Challenges to the professional training of cruise industry employees in Bulgaria

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Keywords: cruise industry; professional training; tourism; employees; Bulgaria.

Today, the tourism sector is one of the industries that generate some of the highest levels of employment. The tourism industry as part of the whole concept of travel, tourism and entertainment also annually marks a remarkable growth in its development. The need for well-trained and promising personnel in the sector is becoming more and more tangible, given the desire of the business to recover quickly after the years of the pandemic. In order to meet the global demand, managers in the industry are joining their efforts in the direction of human resource development in order to optimize recruitment processes and study the possibilities of retaining well-trained specialists. The study of the relationship between the two economic activities, tourism and cruise industry, in terms of creation and development of prospective manpower, will highlight the range of the professional growth with high importance to the cruise business.

Professional training is a key element in the development of human resources in the cruise industry. The specificity of the working environment determines the requirement for available complex knowledge and skills of those employed in the sector. The psychological attitude of working away from home, communicating in a multicultural and multinational environment, skills to work under pressure and with insufficient time for rest and free time activities, are some of the challenges facing future employees. According to analysts, the problems of staff turnover in the industry are largely exacerbated, as practice shows a gap between efficient employment and labor payment.

On the other hand, this modern type of tourism offers a wide variety of work positions in different departments and an extremely wide range of ongoing trainings and professional development. But a need for improvement is observed to attract more motivated and skilled employees. Changes in working conditions, upgrading the social benefits package, preparing a development plan and goals, seeking constant feedback are just some of the measures that would rise the attractiveness of the profession.

Modern educational trainings for personnel in the cruise industry worldwide reveal new directions for improving knowledge and skills for teamwork, conflict resolving, multi-tasking, cross-department training, building sustainable educational habits. The level of staff training depends on a number of factors and conditions, and for the optimal result building effective communication between educational institutions and business is determinative.

In this regard, the present study aims to find out how well the personnel and students studying in Bulgaria are prepared to meet the above-mentioned work environment specifics related to the cruise industry and whether operational mechanisms and standards are available to give them the confidence and freedom to make an informed and aware choice of workplace.

Bulgaria is a maritime country in Northeastern Europe, bordering the Black Sea to the east. Historically, the direction of the country's development has been and still is extremely strongly determined by its geographical location. In the economic aspect, the construction of the infrastructure and superstructure of the ports support of the trade and supply activities growth. In order to provide a workforce in the maritime sector and to prepare qualified specialists for work in

national and international companies, maritime educational institutions have been established in the country. In parallel with this, the development of the tourism sector in Bulgaria contributes to the emergence of specialized educational structures engaged in the education andtraining of tourism personnel.

The object of the study is both employees in the industry and those who are in the process of training inthe following areas:

- Hotel and restaurant management
- Tourism and leisure management
- Tourism
- Management of cruise ships
- International tourism business
- Tour operator, agency and transport activity
- Food technologies in the culinary arts

Research methods include conducting in-depth interviews with HR and training managers from international cruise companies, as well as surveying cruise industry employees and Bulgarian trainees in someof the closely related to cruise industry service operational management issues.

Analysis of the research results and the subsequent findings and conclusion will be a good basis for future improvements and creating a successful pathway in the cruise business with priority to safety and well-being, working time and work-life balance.

Benefits of information technology in the field of primary health care of crew members onboard ships

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Keywords: digitization, big data, diagnosis, artificial intelligence, data processing

Automation and digitization are already changing the maritime industry. It is essential for the communication, storage, and exchange of data. The application of digital technologies is only a prerequisite for forming the frameworks for transformation. The hard part is integrating them. Digitization should be the tool, and digital transformation should be the way. The terms eHealth and telemedicine are closely related to this. In this regard, the article examines some of the various applications of digital technologies in healthcare, particularly in the primary healthcare of ship crew members.

Information technology undoubtedly leads to improved planning and automation of routine activities. And in the field of shipping, they will provide even an increased possibility of saving human life. Mobile applications increase the level of competence and provide qualitatively new opportunities to refresh the practical medical skills of seafarers.

An analysis of relevant literature regarding the need for the use of information technologies in modern shipping is provided. It can be concluded that modern mobile technology allows crew members to access information in real time and at any time.

However, digital transformation is not a destination, it is a journey. Keeping up with the latest digital trends is vital.

Incorporating the gender perspective in teaching: the case of Barcelona School of Nautical Studies

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Keywords: gender mainstreaming; Maritime Education and Training (MET); legislation for educationalpractices; bottom-up approach; Education of Global Maritime Professionals

The maritime sector is a strongly legalised area due to its numerous international conventions. MET is also affected by numerous regulations and by a teaching standardisation through the STCW and IMO model courses (IMO, 2010). In addition, MET suffers the extra pressure of different types of audits such as the IMSAS (IMO Member State Audit Scheme) or national ones, which make the implementation of regulations static without allowing much room for pedagogical flexibility and creativity among practitioners. Traditionally, most legislative implementations have followed top-down approaches but bottom-up ones are not new in this area (Sampson & Zhao, 2003; Bolmsten & Kitada, 2020). The combination of the dual approach of top-down and bottom-up can be an effective alternative to implement goals and regulations while an increased participation and active involvement of practitioners help in transforming their attitudes, practices and work methods to achieve goals. This combination of approaches, with a special emphasis on bottom-up ones, also constitutes a good opportunity for METIs to respond to the need of educating Global Maritime Professionals (GMPs) and to mainstream gender in teaching. This would encourage and empower MET teachers to develop a more gender- sensitive training in their routine of work. This paper illustrates an example of this combined implementation methods through an innovation project to mainstream gender in teaching developed by Barcelona School of Nautical Studies (FNB-UPC).

The Catalan University Quality Assurance Agency (AQU) promoted a regulation for the incorporation ofthe gender perspective in tertiary education in Catalonia by 2021 and published the *General framework for the incorporation of the gender perspective in university teaching* (AQU Catalunya, 2018). In line with this, the Universitat Politècnica de Catalunya (UPC) approved the incorporation of the new transversal competence on gender in all degrees taught at the university and promoted a culture of equity and equality of opportunities forwomen fostering different projects within its community. The innovation project developed by the FNB-UPC pursues three major goals. Firstly, the creation of a web platform with resources for the incorporation of the gender perspective in their MET bachelor and master's degrees (available at https://igualtat.fnb.upc.edu/en). Secondly, a gender-specific training course for the teachers to design solutions that could help them to developthe necessary abilities to transform their curricula in a more gender-sensitive manner and incorporate the transversal competence of gender perspectives in their teaching. Thirdly, the incorporation of the gender perspective into three different courses during the initial semester of the 2022-2023 academic course as a case study. Therefore, the project included not only the provision and development of gender-equality resources andmaterials but also the delivery of specific gender-sensitive teacher training and the revision of the maritime curriculum considering elements such as competencies, objectives, contents, teaching methodology, classroom management, assessment and bibliographic references. The feedback and outcomes of this teaching innovation project are presented and can be archived on the project web platform as a guide and reference for other MET teachers. These gender-equality activities constitute a further example to

illustrate how bottom-up approaches are a valuable method to implement governmental and institutional legislation. In addition, this initiative served not only to empower the teaching staff at FNB-UPC to transform their teaching but also to create a sense of community by working together towards bridging the gap in maritime education.

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Artificial Intelligence in Maritime Education and Training: Friend and/or Foe?

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Keywords: Artificial Intelligence, AI, Maritime Education and Training, Chatbots, ChatGPT, Case Study

[Artificial Intelligence (AI) is rapidly demonstrating its utility and is starting to transform every walk of life – including business, health care, transportation, and national security to name a few. Similarly, it has already started to transform education. A recent study (Krstić, et al., 2022) conducted a meta-review of more than fifteen articles that explored applications and implications of AI in education. This paper will examine those studies and translate them to offer how AI may be used within the focused context of maritime education and training (MET). Specifically, it will offer suggestions on how AI can provide personalized guidance, support, or feedback to students and teachers in the educational process as it pertains to MET.]

"Maritime education is essential in providing the knowledge and skills required for safe and efficient operations at sea. However, maritime education can be challenging due to the complex and technical nature of the subject matter. With the use of ChatGPT, students can interact with the system through natural language, making learning more engaging and accessible. ChatGPT can provide instant feedback, answer questions, and offer personalized learning paths for students.

In addition, ChatGPT can help students prepare for exams and assessment by providing practice questions and simulations. It can also provide real-time updates on industry developments, regulations, and new technologies that affect the maritime industry. Furthermore, ChatGPT can aid in the development of communication skills required in the maritime industry, such as effective communication with crew members and shore-based personnel.

Overall, the integration of ChatGPTin maritime education has the potential to improve the learning experience for students, enhance their knowledge and skills, and prepare them for the challenges and opportunities in the maritime industry" (https://chat.openai.com/chat).

The above was written by ChatGPT when prompted to write an abstract on itself and maritime education. Clearly, applications such as this that use deep learning algorithms to understand and generate text have evolved to a sophisticated, and to some in higher education, a terrifying degree. Detractors of the (mis)use of AI point to the near-impossibility of detecting plagiarism in student work. Proponents suggest (as does the bot itself), that there ais potential not only for authentic learning to take place, but that this new technology can revolutionize MET itself. This paper will examine the implications of the use of AI in MET – as both a fatalistic and existentatial threat to critical thinking as well as the promise of new and liberatory methods of teaching.

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Evaluating skill requirements for maritime autonomous surface ships: a literature review

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Keywords: maritime autonomous surface ships; maritime education and training; Body of Knowledge

Themes categories: Breakthrough Technologies for Seafaring and MET

Abstract:

Shipping accidents used to cause catastrophic consequences. Among the reported shipping accidents, human error is the most important reason that causes shipping accidents. Many studies argue that around 80-90% of shipping accidents are either directly or indirectly caused by human error. To deal with the accidents caused by human error, maritime autonomous surface ships (MASS) have been attracting increasing attention in both the maritime industry and academia. International Maritime Organization (IMO) defines MASS as "ships which, to a varying degree, can operate independently of human interaction". A number of references state that the benefits of MASS include improving safety and security, more efficient human resource management, saving more operational costs, and being more eco-friendly. The biggest impact of the MASS development could be the required skills (Johansen, 2018). The navigational and engineering skills that need to be equipped are very different compared to conventional ship operations. How to offer a satisfied maritime education and training (MET) against MASS from the university/training centre and meet the need of the industry could be an issue. Although there have been a number of studies related to MASS (e.g., Chang et al., 2021; Li and Yuen, 2022), the research related to the necessary skills/MET for MASS is limited (e.g., Sharma and Kim, 2021). The operations of MASS and conventional ships are very different and thus there will be a demand for new and increased skills within the future maritime workforce. Universities and further education colleges are the barracks training students to fit the requirements of the industry. However, there are always some gaps between the industry-required skills and what students are taught.

In order to address the research gap, this research aims to identify and evaluate the future skills required in the context of MASS and the Body of Knowledge. By searching keywords combination {(maritime autonomous surface ships) OR (unmanned ships) AND (education and training)}, 25 papers are presented in the database of Scopus. After reviewing these 25 papers, a number of MASS MET categories are identified, including robotics and autonomation, navigation and positioning, sensor technology, software development, cybersecurity, maritime operations, communication and collaboration, and problem-solving and decision-making. Each category includes several METs. This study is a pre-step of a research which will evaluate the skill requirements for MASS. The further research will evaluate the importance of the skills requirements and analyse the gap between the industry and academia.

Enforcement Effectiveness of International Maritime Instruments based on PSC Inspection

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Keywords: effective enforcement; international maritime instruments; grey Euclidean correlation model; Ship detention; port state control;

The transboundary characteristic of the international shipping industry determines that the safety and security at sea and the marine environment protection can only effectively be ensured under the uniform implementation and enforcement of the international maritime regulations. Port State Control (PSC) plays a critical role in the enforcement of the instruments enacted by International Maritime Organization (IMO) onboard ships. If the instruments are not well implemented and complied with by a ship, then IMO's mission is impossible to be achieved and thus safe shipping cannot be guaranteed. This paper proposes a quantitative analysis of the effectiveness of ships implementing IMO instruments based on the grey Euclidean correlation model. The instruments which Paris MoU refers to during PSC inspections are selected for the analysis. Through the analysis of ship detention data from 2009 to 2020 in the Paris MoU region, the ship's overall enforcement effectiveness of IMO instruments is obtained. The results show that detained ships have worst enforcement effectiveness of SOLAS Chapter I to IV and MARPOL Annex I. Based on the results, flag state, Recognized Organizations (RO), port state and other relevant parties can effectively manage the ships and improve the ships' performance during PSC inspections so that safe shipping can be guaranteed. This paper provides a sound guidance for the parties responsible for the effective enforcement of IMO instruments.

Use of modern technologies in maritime safety training at Nikola Vaptsarov Naval Academy

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Keywords: maritime safety, COLREGS, training, electronic platforms, simulators

Background

Shipping is perhaps the most important industry in the world, carrying over 90% of goods in the world trade but at the same time is also among the most dangerous, with one of the main dangers being the risk of collision. In the latest analysis of EMSA 343 (almost 60%) out of all 573 investigated incidents were caused byignorance or non-compliance with the Regulations.

At Nikola Vaptsarov Naval Academy the COLREGS are studied twice in the undergraduate curriculum and in order to increase the effectiveness of training, innovative means are actively used as well - the electronicplatform e-COLREGS and navigation simulators.

ELECTRONIC PLATFORM e-COLREGS

The platform has been developed for 2 levels of training – for initial training (the basic level) and for advanced training. The level for initial training consists of more than 280 scenarios explaining how to use theRules in real-life situations. Each scenario consists of a description of the situation and an explanation of whichrule(s) to apply and why. When appropriate, the scenarios are accompanied by a “bird's eye” video, a bridge view, a radar screen view and an electronic navigation chart view. In the advanced level there are 18 complex scenarios between more than two ships and with necessity to apply multiple rules. In both levels the participants can self-assess their knowledge by test of randomly generated questions or scenarios.

USE OF NAVIGATION SIMULATORS

Recently, the importance of simulators in the education of students of technical specialties has been constantly growing, and they have become an indispensable part of their training. There are a total of 40 navigation simulators at the Nikola Vaptsarov Naval Academy, 8 out of which are full-mission simulators (class "A" according to the DNV classification) with 360° visualization, and the remaining 32 have the same software, but with a partial visualization of 120°. They fully replicate the bridge configuration of an real vessel, with engine and rudder controls and all navigational aids. Virtually all shipping scenarios (even these that could hardly happen in real life) can be played out on simulators, on any type of ship.

The main use of simulators in COLREGS training is maneuvering for safe passing according to the Rulesin various areas with certain specifics or with heavy traffic. Students will have to apply the Rules repeatedly: make a correct assessment of the situation and recognize dangerous targets by determining the elements of their movement and the parameters of the passing, then make the right decision and maneuver when necessary - give way, reduce their speed or to stop the vessel if necessary to pass safely. The exercise can be extremely complicated when such an overtaking maneuver has to be planned with several ships (sailing on different courses) at the same time or is carried out in conditions of restricted visibility.

The instructor has the option to include other ships as targets to maneuver in the area in a certain set way orone of the training bridges may be assigned a task to maneuver against the rules in order to check and assess the response of the other bridges in order to avoid collision. He can also introduce a fault in one of the ship'scontrollers and assess how the students react.

CONCLUSION

The use of the e-COLREGS platform and navigation simulators undoubtedly help to establish a new approach in teaching collision prevention rules, especially taking into account young people's preferences for using electronic devices and new technologies. This definitely makes the topic more interesting and attractive for them. Ease of use and convenient interface make the platform and simulators a valuable aid in student learning. This is the opinion of the majority of them.

Seafarers' Education: ISM Code and STCW Convention Interrelation

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Keywords: ISM Code, STCW Convention, maritime education and training, maritime cyber technologies

The rapid development of new technologies in the shipping industry, especially cyber technologies, significantly influences competences that a seafarer must have in order to perform on-board jobs in a high quality and safe manner. Although the standards for conducting all the essential shipboard operations and procedures for dealing with emergencies have been adopted by the introduction of the International Safety Management (ISM) Code, seafarers' education on the implementation of the Code itself and associated procedures has not yet been determined as a mandatory requirement.

STCW Convention, as the mandatory instrument guiding MET, does not explicitly demand education related to the ISM Code requirements, themes, accompanying procedures and relevant practice on-board vessels and in shipping companies worldwide. Nowadays, companies/owners, in order to meet market demands and relevant industry safety standards, have to invest in their own non-formal seafarers' education by using in-house training and various workshops.

In order to bridge the gap between the competences provided by formal education and current industry needs for the personnel trained for ISM Code understanding, one of the obvious measures could be the mandatory implementation of the appropriate ISM Code related topics in the formal MET programs. Furthermore, another urgent topic for raising awareness of the MET system is risk management. Maritime cyber security risk is just recently recognized as a risk in shipping and it is implemented into the ISM Code requirements since it may cause significant shipping-related, operational, safety and security failures.

The paper discusses the application and importance of ISM Code, its modifications over the years and its relation with STCW educational and training requirements. On the basis of the surveys that encompass seafarers and companies, this paper also presents and proposes the relevant ISM related competences and knowledge that seafarers should adopt.

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People-Centred Clean Energy Transition: The Role of Maritime Education and Training

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Keywords: People-Centred Clean Energy Transition, maritime education and training (MET), Global Maritime Professionals (GMP), just transition, maritime decarbonization

A growing interest in shifting towards clean energy is a global and cross-sectoral issue to address climate actions. This is also the case for the maritime industry where alternative and renewable energy as fuels to propel ships are recognized as a necessary transition in sustainable green shipping. Osterkamp et al. (2021) argues that clean energy transition in shipping is still in the emergence phase where at least 5% share of safe and scalable zero-emission fuels (SZEF) is required by 2030 to achieve a successful transition. While such transitions tend to focus on technologies to promote environmental and economic sustainability, social sustainability should also be underscored.

The International Energy Agency (IEA) coined a concept of "People-Centred Clean Energy Transitions (PCCET)" that "all clean energy transitions should be truly people-centred and inclusive, and that this is essential to the success of energy system transformation at the pace and scale required to deliver global ambition for climate change mitigation" (IEA, 2022). This definition opens up a new research paradigm of how education can support "people-centred and inclusive" clean energy transition within the maritime sector. It is timely to discuss this concept in the context of maritime education and training (MET) as seafarers' new competence on alternative fuels is part of the ongoing comprehensive review of the STCW Convention and Code during the Human Element, Training, and Watchkeeping (HTW) Sub-Committee at the International Maritime Organization (IMO).

This paper explores the role of MET to support the concept of PCCET from social sustainability perspectives. This study was inspired by the principles of "just transition" which contribute to three elements of sustainability (i.e., environmental, economic, and social) (Just Transition Centre 2017) and education is recognized as a tool for "just transition". Hence, the method of this study is to align the concept of PCCET to the existing framework of Global Maritime Professionals (GMP), enabling the IAMU community to participate in PCCET through the promotion of GMP in MET. GMP prescribed in the Book of Knowledge (BoK) (IAMU 2019) provides guidance to educate future maritime professionals. GMP BoK, however, does not specifically refer to "clean energy" or similar terms but rather limited to generic, "environmental awareness, sustainability and stewardship" as No. 25 of knowledge, skills, and attitudes (KSA) under the category of "IV. Professional – Soft Skills".

By adopting a concept mapping method, the paper identified key linkages between PCCET and GMP as a driver to promote social sustainability perspectives when educating GMP. New values created through PCCET are in line with several KSAs of GMP and the paper concludes that promoting GMP in MET will help the process of PCCET. The study has a limitation up to the conceptual level of understanding the role of MET in PCCET, however the result would increase the applicability of GMP into an emerging maritime context where the potential of MET can also be expanded.

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English as teaching language at SIMAC

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Keywords: Implementing EMI, Internationalization, pedagogic- and didactic approach to teaching in English

Theme of the IAMUC: Education of Global Maritime Professionals

Abstract:

This paper examines realistic ways to implement more EMI (English Medium Instruction) i.e. teaching in English at the maritime academy SIMAC as a path to a higher degree of internationalization in the educations offered. The purpose being to improve and develop the English competences of students and thereby expand their career- and job opportunities as well as to strengthen the international obligations and image of SIMAC.

This report is based on both existing material and surveys as well as a quantitative and qualitative collection of data among SIMAC's professors and students, and experiences from other university colleges and academies. The recommendations and findings are therefore mainly applicable to SIMAC and similar university colleges and academies nationally which offer primarily maritime education on comparable levels.

The results of the analysis reveal a rather low level of teaching in EMI at SIMAC, however a more extensive use of educational material in English. Therefore, the potential for implementing and offering more subjects with instructions in English is present and the results of the questionnaires points to English as teaching language being most relevant in the last 3 semesters of the offered studies in Maritime Engineering i.e 5, 6 and 8 plus semester 5 and 7 within Maritime Nautical Science. Furthermore, elective subjects, subjects with an international relevance/focus and communicational subjects are highlighted as suitable for EMI implementation in contrast to subjects with a clear Danish and national bias.

The analysis shows that students have a positive approach to EMI and they are significantly more positive than the professors at SIMAC in their approach to EMI. Most students find their English language and proficiency skills adequate and are generally, in their own opinion, ready to receive lectures and classes in English. On the other hand, teachers and professors are less confident than the students in terms of English fluency and tend to question if they have sufficient language skills to conduct lectures fully in English. However, the professors have significant confidence in their ability to convey, organize and carry through lectures i.e. pedagogically and didactically they feel confident and able. The teachers, in contrast however, assess the students' general readiness for EMI as insufficient which concludingly reveals an interesting difference in perception from students and teachers regarding general readiness for EMI. The results of the analysis are also quite clearly states that if implementing EMI in more subjects and on a larger scale there is a need for supporting initiatives like language courses, help centres for students as well as teachers for production of material, assignments etc. in written, formal English and for longer preparation time for both teachers and students. Furthermore, the implementation should be part of a conscious, well-planned strategy in which resources are allocated, teachers are involved in the planning process, teachers' participation is voluntary and alternatives like Danish/English mix and parallel range of subjects offered in both English and Danish should be available. EMI pedagogic and didactic approaches require a special attention from teachers and possibly upgrading to ensure a continued quality of the

subjects and learning objectives.

Concludingly, the recommendations for implementing EMI at SIMAC contains a line of elements. Therefore, the implementation of a wider range of subjects taught in English demands a sincere investment and commitment from all parts of the organization.

The Impact of Master's Programs in Logistics on Career Development and Professional Outcomes

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Keywords: Logistics, Master's programs, Professional outcomes

Background: Higher education in logistics has been the subject of extensive research over the years, with numerous studies investigating various aspects of logistics education, including teaching methodologies, participants, outcomes, and limitations. These studies have often utilized a combination of qualitative and quantitative research methods to overcome the challenges associated with measuring the impact of education on career development and the lack of standardization in curricula. Despite the numerous studies conducted in this area, the findings are mixed and reveal both areas of consensus and disagreement. However, a consensus has emerged that logistics education plays a crucial role in preparing students for careers in the logistics industry. Despite this consensus, several areas still require further research, particularly concerning assessing the impact of logistics education on career development. Higher education in logistics is becoming increasingly relevant and provides students with more excellent career opportunities. As such, it is a priority for universities offering logistics programs to ensure the education they provide is high quality and that graduates will be fully prepared for their chosen careers. The curriculum of these programs must be regularly reviewed and updated to keep pace with the dynamic changes in the logistics industry. In addition to providing students with up-to-date knowledge, it is also essential to provide them with hands-on experience and opportunities to apply their knowledge in real-world settings. This requires close collaboration between academia and industry to ensure that logistics education programs are relevant and practical.

Objective: This study aims to analyze and evaluate the effectiveness of master's programs in logistics, focusing on their compliance with business requirements and the impact on graduates' career development and professional outcomes. The study aims to answer questions related to preparing students for the workforce and the value placed on their education by employers in the logistics industry.

Methods: The research methodology for this study includes a survey of recent graduates of master's programs in logistics from the Nikola Vaptsarov Naval Academy in Bulgaria, as well as interviews with industry experts and employers hiring logistics specialists. The results of the surveys were analyzed using Factor Analysis XLSTAT statistical software to identify patterns and relationships between the data. In addition, the study utilized qualitative methods, such as interviews with industry experts, to gain a deeper understanding of the experiences of graduates and the perspectives of employers in the logistics industry. The combination of qualitative and quantitative research methods provides a comprehensive understanding of the effectiveness of master's programs in logistics and their impact on career development and professional outcomes.

Results: The results of the survey of recent graduates of master's programs in logistics from the Nikola Vaptsarov Naval Academy in Bulgaria showed that the majority of graduates believe their education prepared them well for the demands of the industry. However, they expressed some concerns regarding the need for more practical experience. The study found a strong relationship between the quality of education and career outcomes, with graduates who considered their education to be of high quality more successful and obtaining higher-paying positions in their field.

Employers were found to value and prioritize hiring graduates with in-depth knowledge, practical experience, and problem-solving skills. These results indicate that curricula must be regularly reviewed and updated to prepare future logisticians for the challenges of a rapidly changing business environment.

The study suggests that providing students with more opportunities for hands-on experience and real-world application of the theories learned during their education is crucial in increasing the effectiveness of master's programs in logistics. The findings of the interviews with industry experts and logistics employers supported the survey results, with many highlighting the importance of practical experience and problem-solving skills in preparing students for careers in logistics. These experts also emphasized the need for continued collaboration between academia and industry to ensure that higher education programs remain relevant and effective in preparing students for the workforce.

In general, the results of this study suggest that while master's programs in logistics are effective in preparing students for careers in the industry, there is still room for improvement. The need for regular review and updating of curricula to ensure they prepare students for the challenges of the rapidly changing business environment is a key recommendation from this study. The importance of practical experience and real-world application of theories learned during education, as well as the value placed on these skills by employers, was also highlighted in the results.

Conclusion: The findings of this study provide valuable insights into the current state of higher education in logistics and the challenges faced by the industry. The results highlight the importance of practical instruction in preparing students for successful careers in the field and emphasize the need for ongoing collaboration between academia and industry to ensure that higher education programs in logistics remain relevant and practical. This information can inform decision-making for stakeholders in the logistics industry, academia, and students alike, ultimately shaping the future of logistics education and ensuring its relevance in meeting the demands of the rapidly evolving industry.

Impact of the strictness of the order in the Naval Academy on the building of resilience in the trainees

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Keywords: resilience, strictness of the order, learning environment, mediational analysis.

A high level of resilience and its development in the training process is essential for the future naval officers. Therefore, the question is always relevant to what extent the learning environment has an impact on building the trainees' resilience. The military-educational environment is specific, it is characterized by a high degree of structuredness in terms of time allocation and the activities of the cadets studying in it. The purpose of the conducted research is to determine the impact of the strictness of the order on the development of resilience in the trainees at the Naval Academy. In order to achieve the goal, the following tasks are set: 1) Conducting a study with trainees from the ship specialities. 2) Conducting a study with two categories of trainees – civilians and cadets, studying in a different level of structured environment and establishing the degree of influence of the strictness of the order on the development of resilience in the trainees; 3) Checking the model of interaction and influence between the factors "strictness of order", "positive relationships" and "resilience".

The object of research are civilian students and cadets at the Naval Academy. The study was conducted with 473 people. The data were collected with the following psychological tools: State Trait Resiliense Inventory, Method for studying the adaptation of the individual to the environment, Method for evaluating the social environment. The results were processed with statistical programs SPSS-19, PROCESS version 4.0 for SPSS.

The obtained results show that the learning environment at the Naval Academy, the requirements and order imposed by the institution itself increase the level of resilience of the trainees through the creation and maintenance of positive relationships. No differences were found between the two categories of trainees, which can be explained by the leading role of the academic staff, commanders, academy employees in imposing and following the rules in the training process. The conducted analyzes allow the formation of a mediator model (Figure 1), which illustrates the influence of the environment on the development of resilience as a personal characteristic in cadets.

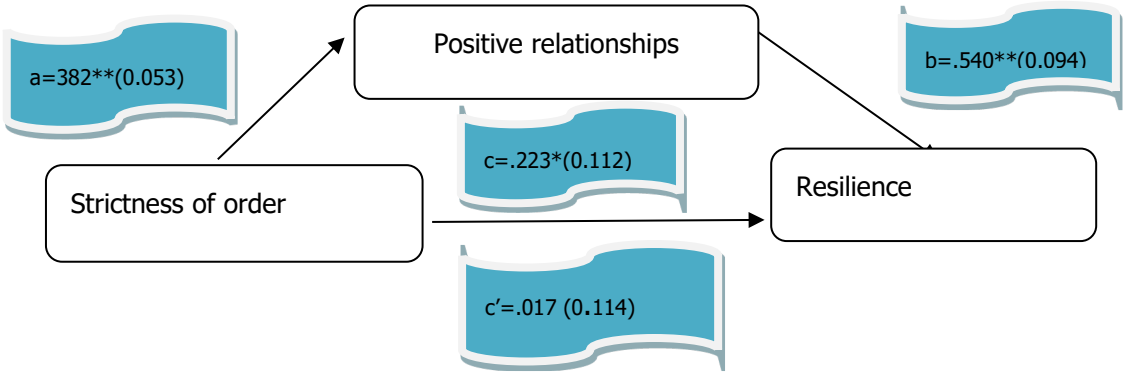

Figure 1 *A mediational model of the interactive effects of order severity on the development of students' resilience - unstandardized regression coefficients and standard errors (in parentheses).*

** *p< .001*

** $p < .05$*

In the analysis of the data , the existence of a statistically significant indirect effect of the strictness of the order on the development of the students' resilience is established. The results show that the requirements of the educational environment - the imposed rules, have an impact on the development of the students' resilience, through the existing positive relationships. Positive relationships mediate this relationship. Combining the requirements of the two characteristics of the environment: rigor and positive relationships, leads to an increase in the resilience of the trainees at the Naval Academy.

Techniques of Shortening in Maritime English

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Keywords: shortening, classification, clipping, blending, abbreviation

This study aims to offer a classification of shortened terms and terminological phrases in Maritime English using the lexico-semantic method. It is based on examples excerpted from learning materials designed for cadets and students at Varna Naval Academy, all of them compiled in the Learner's English-Bulgarian Maritime Dictionary and forming a large corpus representative of the domain they are used in. Shortening here is chosen as an umbrella term for initialisms, acronyms, clippings and blends. The topic is worth discussing because it reveals techniques of shortening in maritime English thereby raising learners' awareness to a variety of English they are going to face in their future work in a multinational environment.

The study focuses on the techniques of forming compressed terms in Maritime English. It begins with a theoretical background which states the purpose, method and corpus used to reach the relevant conclusions. It substantiates the use of an umbrella term for all types of short forms.

Further on, the study explores types of shortenings and offers a classification covering compression resulting from clipping, blending and abbreviation. Overall, it identifies

- two types of clipped forms concerning individual terms and multi-word terms
- seven types of blending based on Plag's rule.

Abbreviations are grouped according to two principles – techniques of shortening and areas of application. The typology is illustrated with a large number of examples from the corpus.

The paper finishes off with recommendations how to teach and practice shortened forms and appropriate conclusions on the topic.

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Introducing Maritime Educational Standard for Mitigation of Infectious Diseases Spread on Large Passenger Ships

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Keywords: large passenger ships; cruise industry; infectious diseases; educational standard

Infectious diseases in large passenger ships can easily be spread if effective measures for detection and control are not in place. The COVID-19 pandemic revealed the inability of existing policies and protocols of large passenger ships to effectively detect and respond to emerging diseases other than gastrointestinal illness (Klein 2021). Multiple COVID-19 outbreaks on passenger ships have been detected with reports of 54 ships identified as infected in the first four months of pandemic (da Silva 2021). The economic impact of the pandemic to the cruise industry was devastating, with an estimated loss of $50 billion USD in economic activity just in 2020 (CLIA 2023). An integrated approach addressing prevention, mitigation and management (PMM) of infectious diseases is, therefore, essential. One segment in that approach is developing education programs addressing these PMM tasks and aimed at future seafarers, i.e. students of maritime universities. However, to be able to develop such programs, a common educational standard is needed first.

Educational standards define the knowledge and skills students should possess at critical points in their educational path. This paper presents an effort to introduce educational standard for mitigation of infectious diseases spread on large passenger ships. To establish such standard, a literature review was performed on large passenger ship epidemiology as well as the needs of key stakeholders in cruise industry (Zagan et al. 2014). An assessment of current medical educational standard for future seafarers was performed. Gaps are detected and, base on this, mandatory knowledge and skills identified with a clear list of learning goals and outcomes. This educational standard serves as a roadmap for creating a competency-based curriculum, identifying instructional methods, establishing evaluation methods and ensuring continuous improvement of mitigation measures of infectious diseases spread on large passenger ships.

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Engagement of Students in Maritime Operations – An Exploration into Cultivating Cultural Connection Across Majors at a Maritime University

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Keywords: student engagement; marine transportation; maritime professionals, interdisciplinary, maritime university

Abstract. The California State University Maritime Academy is located on the Carquinez Strait, in northern San Francisco Bay, California, USA. The University has seven undergraduate majors, only two of which are license-track, where students train for future careers as credentialed seagoing mariners. There is a cultural disconnect between license-track majors and those who are not pursuing a license. The faculty are committed to improving the campus culture and quality of education for all students, whether they are future mariners or maritime professionals. This study seeks to build a deeper maritime cultural connection while enhancing the educational experience for students in non-licensed majors by introducing them to tenets of marine transportation. We hope to demonstrate increased interest in learning and maritime knowledge through exposure to previously unfamiliar concepts.

This study increases access to maritime technology and equipment for students in International Business and Logistics, Global Studies and Maritime Affairs, and Oceanography. We are calling upon students in these majors to participate in existing Marine Transportation courses and the universities' Small Boat Program, a club which operates small boats over the weekends. To prepare students to be fully engaged, we host informational pre-briefs on the use of onboard equipment, such as radar/ARPA, propulsion machinery, meteorological instruments, and other operationally-significant devices.

Student knowledge is assessed prior to attendance and upon completion, through a twenty-question test which includes questions on program learning objectives as well as impression of learning. The twenty-question test is also administered to students who do not participate in this educational program, to serve as a control group.

While the research is still underway, this paper describes the steps taken to develop and implement the program, and a report on initial findings. We suggest that all maritime universities identify groups of students who would benefit from exposure to content across majors and outside of additional coursework, for greater maritime cultural connection and overall quality of education at the university. Additionally, we believe this could greatly improve understanding and familiarity with at-sea operations and broaden the depth of knowledge in a variety of global maritime professions.

Research on Seafarers' Depression, Anxiety, Safe Working Factors and Anamnesis

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Keywords: Seafarers; Mental Health; Working Environment, Anamnesis

Seafarer is considered to be a highly stressful and high-risk occupation in terms of physical and mental exhaustion(Gu et al., 2020). To explore the relationship between depression, anxiety, safe working factors and anamnesis of seafarers, we investigated these variables with a sample of 234 seafarers in China.

Descriptive Analysis, T-Test, Correlation Analysis and Hierarchical Regression Analysis were conducted, and found that compared with the scores of Chinese norm, mental health of seafarers who took part in the survey continued to be significantly poorer. Specifically, seafarers' depression and anxiety scores were both significantly higher than that of Chinese norm (Depression of SCL-90: Chinese norm 1.50±0.59, seafarers 1.88±0.82, t=7.172, p<0.001; Anxiety: Chinese norm 1.39±0.43, seafarers 1.68±0.87, t=5.064, p<0.001).

Correlation analysis showed that depression and anxiety were both positively correlated with noise(r=0.312, p<0.01; r=0.282, P<0.01), vibration (r=0.392, p<0.01; r=0.377, p<0.01), work in tight spaces (r=0.277, p<0.01; r=0.300, p<0.01), working alone (r=0.380, p<0.01; r=0.415, p<0.01), lack of personal protactive equipment (r=0.262, p<0.01; r=0.266, p<0.01), sharp objects (r=0.365, p<0.01; r=0.342, p<0.01), smoke(r=0.182, p<0.01; r=0.222, p<0.01), physical injuries(r=0.395, p<0.01; r=0.470, p<0.01), viruses and diseases(r=0.502, p<0.01; r=0.492, p<0.01), seasickness(r=0.238, p<0.01; r=0.238, p<0.01), homesickness (r=0.367, p<0.01; r=0.353, p<0.01), mobbing(r=0.466, p<0.01; r=0.445, p<0.01), not allowed to get off the ship even when in port(r=0.222, p<0.01; r=0.208, p<0.01), high cholesterol (r=0.207, p<0.01; r=0.235, p<0.01), high blood pressure (r=0.167, p<0.05; r=0.232, p<0.01), heart problems (r=0.249, p<0.01; r=0.296, p<0.01), sleep disorder(r=0.417, p<0.01; r=0.383, p<0.01), liver problems (r=0.286, p<0.01; r=0.289, p<0.01), have been diagnosed with depression (r=0.428, p<0.01; r=0.437, p<0.01) and have been diagnosed with anxiety (r=0.449, p<0.01; r=0.455, p<0.01). Also, anxiety was positively related to diabetes(r=0.176, p<0.01).

Regression Analysis demonstrated that working alone, viruses and diseases, mobbing, sleep disorder, liver problems and have been diagnosed with anxiety had a significant positive effect on depression(β=0.144, p<0.05;β=0.231, p<0.01;β=0.148, p<0.05;β=0.131, p<0.05;β=0.134, p<0.05;β=0.166, p<0.01). Further, working alone, chemicals, physical injuries, viruses and diseases, homesickness, high blood pressure, liver problems, have been diagnosed with anxiety affected anxiety significant positively (β=0.197, p<0.01;β=0.135, p<0.05;β=0.170, p<0.01;β=0.200, p<0.01;β=0.127, p<0.05;β=0.154, p<0.01;β=0.117, p<0.05;β=0.154, p<0.05).

These findings provided not only empirical evidence about current seafarers' mental health, but also valuable guidance for implementing interventions aimed at enhancing seafarers' mental health and strengthening shipping safety.

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Session
Policy Aspects

BoK-STCW-TRB Triumvirate Course Mapping for Learning Outcome Matrix of BS Marine Engineering Program

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Keywords: course mapping, curriculum development, global maritime professional, maritime education andtraining, book of knowledge

The European Maritime Safety Agency (EMSA) has raised several deficiencies in the maritime education and training in the Philippines since 2006. Among which, the most notable include the nonspiral, nonholistic, and outdated approach to the maritime curriculum being implemented in the country (EMSA, 2019). This led to the endangerment of job opportunities for 28,874 Filipino seafarers aboard European vessels and the potential removal of the country from the IMO whitelist (EMSA, 2018). In line with the improvement made by all stakeholders to upgrade the level of maritime education and training globally, the International Association of Maritime University (IAMU) has released the Book of Knowledge (BoK) for Global Maritime Professionals toserve as a guide for maritime higher education institutions (MHEIs) to develop learning outcomes for more competent, modern, and holistic maritime officers. However, several member universities have difficulty using and implementing the BoK which led to an abysmal adoption rate of the BoK. Another issue looming in MHEIsis the low completion rate of cadets with regards to their Training Record Book (TRB). This is due to limited opportunities for shipboard training, several types of vessels, and absence of a shipboard training structure. To address these looming problems with the application of the BoK, this study has developed a triumvirate mapping that uses all the elements of the STCW Convention, the BoK by IAMU, and the TRB of GlobalMET. The resulting framework will serve as a guide in crafting the learning outcomes of the courses for a holistic, STCW-compliant, and shipboard-related education and training.

The methodology employed a qualitative design of exploratory nature wherein the STCW Table was cross- referenced and analyzed with the BoK and the TRB. First, the level of achievement matrix was mapped for operational-level competency to create a learning outcome matrix for the cognitive, affective, and psychomotor domains from the BoK. Once the level of achievement was mapped, the specific intended learning outcomes were determined for the three domains and the four main focus area groups. The intended learning outcome matrix was cross-mapped and analyzed with the STCW map per course which creates a multilevel matrix for each competency and KUP in the STCW Table. Lastly, the tasks indicated in the TRB were cross-referenced and analyzed with the STCW-BoK matrix. Tasks indicated in the TRB were analyzed with reference to the methods for demonstrating competence column in Table A-III/1 of the STCW Code. This resulted to a three- axis table wherein the intersection of the BoK intended learning outcome, TRB Tasks and the STCW Knowledge, Understanding, and Proficiency served as the guidelines in the crafting of a holistic, shipboard- related, and STCW-compliant learning outcomes for the particular course.

This resulted in a new framework that will guide curriculum developers in crafting an effective, holistic, and compliant program for maritime education and training. The triumvirate mapping provides an easy guideline for MHEIs to utilize the BoK for the development of the learning outcomes of the different courses. In addition, the triumvirate mapping addressed the issues with regards to the incomplete TRB tasks of cadets and the three domains of learning. Consequently, the maritime program in the Philippines will be at par with the global standards with a three-pronged approach to cadet development and attaining the competence requiredby the STCW.

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Table 1. A sample triumvirate mapping of one marine engineering course

BoK ILO	**asic Construction and Operation Principles of Various Pumps**		**asic Construction and Operation Principles of Air Compressors**	**asic Construction and Operation Principles of Heat Exchanger**
Cognitive Domain				
Explain the relevant mathematical principles				
Affective Domain				
Choose key relevant information from the general humanities and social sciences and relate such information to maritime professional practice				
Psychomotor Domain				
Identify maritime actions that involve complex movement patterns and choose correct action(s) among various options to meet operational requirements of efficiency and safety as per international requirements				
	Make a simple sketch of a centrifugal pump showing various components	Make a simple sketch of various positive displacement pumps onboard, showing various components	Make a simple sketch of an air compressor showing various components	Make a simple sketch of a heat exchanger showing various components

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Exploring possible content and structure of a quality maritime master program in Denmark

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Keywords: maritime education; master programme; grounded theory; lifelong learning

Education of maritime professionals is a crucial component of the maritime industry, which plays an important role in the economic and social development of the world. Denmark is a maritime nation, with a long-standing tradition of seafaring and maritime trade to this day. This heritage leads one to believe that educational programmes at all levels are in abundance, however this is not the case (Jensen, 2021).

The field of maritime education in Denmark is primarily represented by undergraduate or vocational programs at the professional bachelor level and below. Master level programs are few and do not have maritime studies as the main focus point (Jensen, 2021). Furthermore, most master level programmes that exist in Denmark require an academic bachelor's degree for enrolment, which many seafarers do not have. To accommodate the ambition of lifelong learning as well as the demand for high quality candidates in the maritime industry this paper explores how a maritime master program should be constructed to accommodate industry demand, academic standards as well as individual candidates' ambitions and needs (Ng et al., 2009).

This paper uses a qualitative grounded theory approach (Charmaz, 2000; Strauss, 1987) to explore how a master's program could be constructed to meet the needs of all stakeholders in the maritime field. The study is based on data from interviews conducted with experts in the Danish maritime industry and in the Scandinavian maritime educational systems. The aim was to gain insight into the possible curricular content and practical structure of a master's program, that would be appropriate, for further education in the maritime field for professional bachelor's in general and seafarers in particular.

Seven significant categories important to the construction of a maritime master's program in Denmark are identified. These categories are barriers, broad and deep duality, maritime domain awareness, motivating circumstances, networking, non-maritime knowledge, and theory/praxis balance. The categories are synthesized and connected to each other to form a substantive theory (see figure 1).

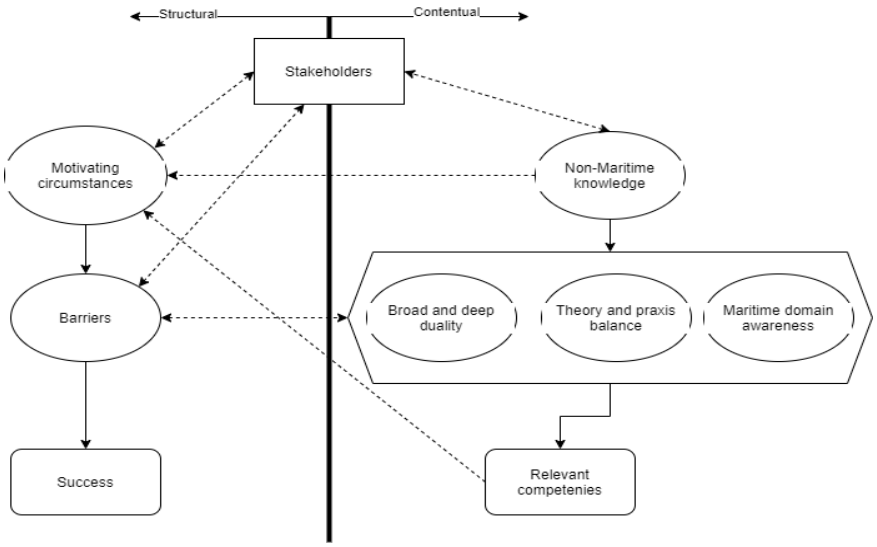

Figure 1. Theory model

The theory developed in this study emphasizes the importance of striking a balance in many of the aspects that emerged, especially important is the balance of theory and praxis. Balances or dialecticism (Bartunek & Rynes, 2014) as a concept are a key parameter when developing a relevant quality maritime education program. The study also highlights the importance of networking in creating an environment conducive to learning and professional identity. Additionally, the study found that non-maritime knowledge is valuable in developing well-rounded maritime professionals and this knowledge often is considered maritime when applied in a maritime context. The structure of the programme is mostly related to mitigating barriers of candidates such as the "mortgage trap" (Barnett et al., 2006). The study indicates that flexibility in programme structure might have a positive effect on such barriers. While the study has been made in Danish context, the results likely to transfer well in a global context due to the focus on in-depth understanding of the categories of the theory and their connections.

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Factors impacting curricula in maritime simulator education

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Keywords: Maritime education and training; simulator education; curriculum

The nature of the competencies that maritime students need to work successfully in the industry has undergone significant change, requiring higher education providers to adapt. Simulation is a vital educational practice of the maritime education and training (MET) curriculum. Simulators are mandatory for certain parts of the curriculum for MET due to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) (IMO, 2010). The STCW Code has both guidance and constraints for the MET curriculum, which may lead to wide variability in the implementation. In accordance with the STCW Code, the education should follow these internationally agreed criteria and incorporate the prescribed standards or levels of knowledge, understanding and demonstrated skill (IMO, 2010).

Numerous studies in maritime higher education aim to understand how educational practices can be improved to facilitate effective learning (De Oliveira et al., 2022; Salman & Hjelmervik, 2017; Scanlan et al., 2022; Sellberg, 2016; Sharma et al., 2018). The European Association for Quality Assurance in Higher Education (ENQA) has released standards and guidelines for quality assurance, which ensure that students take an active role in the learning process (ENQA, 2015). In addition, the Norwegian Qualification Framework (NQF) highlights the importance of looking at what students know, what they are able to perform, and what they are capable of doing as a result of their educational experiences (NQF, 2014).

The curriculum is the foundation for the teaching-learning process to reconstruct the human experience, including instructional strategies, teaching methods, learning resources, lesson plans, evaluation and assessment, and staff development (Duncan & Frymier, 1967; Johnson Jr, 1967; Krug, 1957). Even though these definitions have existed for a long time, many still believe that "curriculum" refers to a basic lesson plan, whereas it is more complex and multifaceted than a mere list or series of lessons. Many other factors affect student learning inside and outside the classroom. Therefore, understanding how these factors interact is crucial for any educator in the field. In this study, a diagram presented in Figure 1, illustrating the relationships between factors that impact curricula was created building on the research by Glatthorn and Jailall (2000) and using the definitions of curricula types found in the relevant literature. (Bartkus et al., 2012; Bergqvist & Bergqvist, 2017; Gholami et al., 2016; Kelly, 2009; Lee & Matusovich, 2016; Wilson, 1997).

It is necessary for MET institutions to keep step with the changes in the maritime industry to prepare their students for one of the most safety-critical industries in the world. The question we address is: what factors have an impact on curricula in MET? The diagram in Figure 1 is used as a reference to explore maritime simulator education. This paper will propose strategies for developing a maritime simulator curriculum to facilitate effective learning to ensure students acquire the necessary competence.

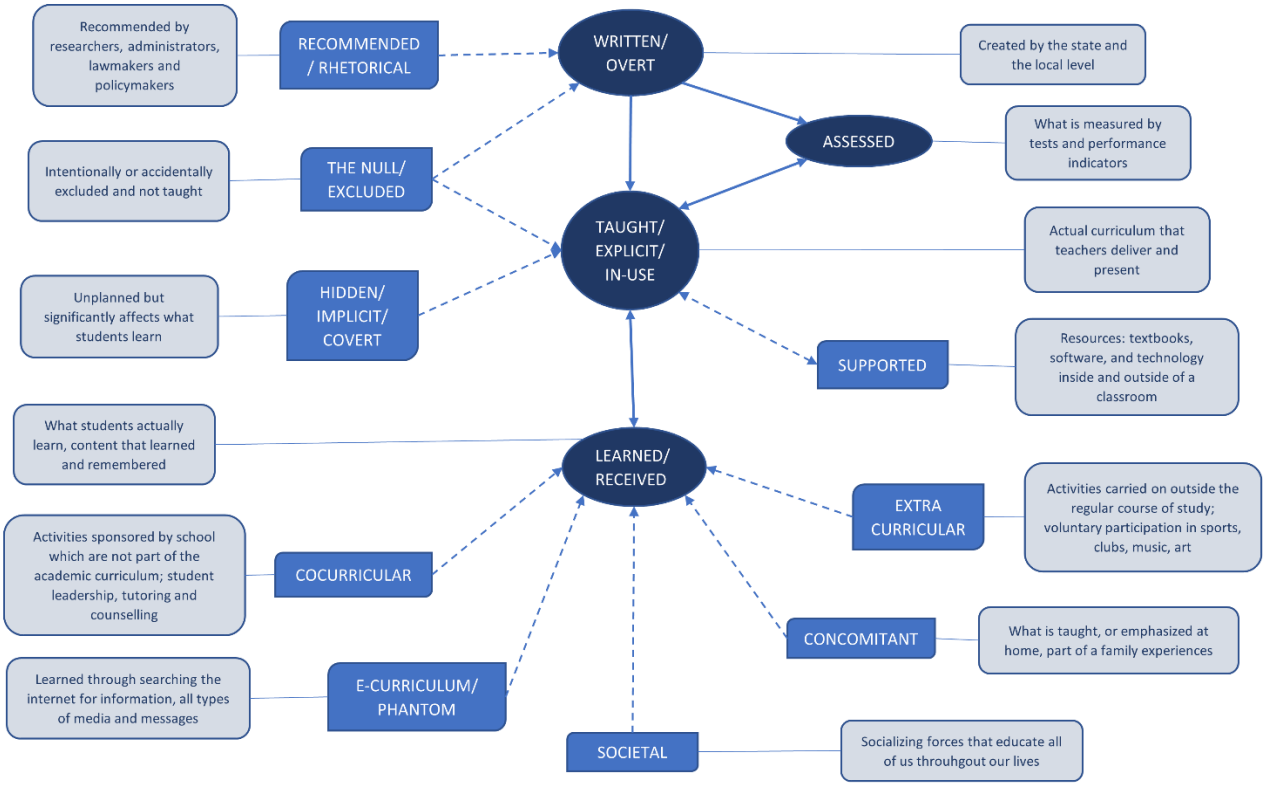

Figure 1. Factors and relationships that potentially influence curriculum effectiveness.

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Assessing the Challenges to the International Convention of Standards of Training, Certification and Watchkeeping in the Era of Digitalization and Automation

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Keywords: digitalization; automation; STCW

Industry is now understanding better the operational and technical disruptions implicit to the emergence of digitalisation and automation in future shipping operations. The International Maritime Organisation (IMO) has had a lens on these developments, promoting its e-Navigation (IMO 2008) and MASS (IMO 2018) concepts regarding future challenges and needs of the shipping industry. To date, most of the attention has been directed at technology readiness levels and system integrations. More practically, consideration of how to integrate with the human factor, emerging vocational roles and operator competencies has largely been ignored.

A holistic, comprehensive visioning needs to consider both technical and non-technical aspects within this new complex socio-technical landscape. While there are IMO working groups focused on regulatory considerations, less foresight and attention has been placed on the recruitment and retention of persons employed in the future Shipping 4.0 reality. This includes those entering the profession (i.e., Nautical Studies students), existing seafarers (i.e., continuing professional education) and the pedagogical professionals (i.e., instructors) The impacts upon these stakeholder gaps have been identified (WMU, 2019; MacKinnon and Lundh, 2019).

These education-based objectives can only be achieved if there is alignment between standards such as the International Convention of Standards of Training, Certification and Watchkeeping for Seafarers (STCW) and the context of the environment (i.e, system technologies) typically delivered through third party vendors. A relevant example of poor human integration within a system is the design of the Electronic Chart Display and Information System (ECDIS) for navigation support (MAIB & DMAIB, 2021). Mismatches between the operator and the technology create conflict in the ¨*work as imagined*¨ (by the technology developers) and the ¨*work as performed*¨ (by maritime operators). While it might be thought that this is a fault of the technology developers, complicit are regulators, educators, and service providers in the perpetuation of these problems. These outcomes have created a situation that can ultimately increase the cognitive workload, create deviations in workflow/best practices and cause performance error escalation towards incidents and accidents.

There are many assumptions that the introduction of AI-driven technologies will ease the decision-making burdens of command, control, and communications in complex systems (Bradshaw et al, 2013). Specific to navigation and traffic safety, it has been proposed that the introduction of automation and artificial intelligence technologies could:

1. increase performance through automation intervention;
2. decrease operator workload;
3. require less operator knowledge;
4. create more flexibility in task procedures;
5. reduce operator error.

However, these supposed putative benefits may come at a cost to navigation safety!

This paper aims to elucidate the paradigm shift that will drive a rescoping of the educational and training outcomes related to the introduction of digitalisation and (low level) automation. The paper will describe an appropriate human-centred approach to assess stakeholder needs and knowledge development. This work will build upon activities related to the review of the STCW Convention and Code (IMO 2023, Sub-Committee on Human Element, Training and Watchkeeping, 9th Session (Item 7) and will consider the following recommendations:

i. address the impact and possibilities of digitalization and emerging technologies on ships and ship operations;

ii. address the impact and possibilities from the implementation and use of digitalization and emerging technologies in seafarers' education, training and certification;

iii. ensure that the Convention and Code are fully aligned with the IMO standards on ship's operation, construction and equipment;

iv. take into account different approaches to organizing and structuring education, training and certification, including formats of delivery of training.

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A Delphi Study to Formalize Tacit Knowledge on Maritime Collision Avoidance and Inform Training.

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Keywords: Collision Avoidance; Maritime Educational Training, Bridge Resource Management, Situation Awareness.

As the world rebounds from the COVID-19 pandemic, the demand is expected to climb for maritime shipping and subsequently trained seafarers, despite the already strained number of trained Officers of the Watch (OOWs) (UNCTAD, 2021; WMU, 2019). Compounding this problem, training a new OOWs can take between 12 and 36 months (Canadian Coast Guard 2022). Further, research has shown that novice OOWs when compared to experienced OOWs lack the same ability to exercise effective Bridge Resource Management (BRM) and build and maintain good situation awareness (SA) (Atik, 2019; Chauvin et al., 2008; Chauvin et al., 2009; Chauvin, 2011). This distinction in experience is important as effective BRM and SA are key to maritime safety; poor SA can lead to an increase in human error and maritime accidents (Atik, 2019). The objective of the research is to gather tacit knowledge from maritime subject matter experts (SMEs) on how they establish good SA for collision avoidance for the purpose of formalizing these mental models into training tools. The research is founded in Endsley's (1995) model of SA within a maritime context. Such that, the perception of elements (level 1 SA), refers to recognizing the current position, course, and speed of the vessel. Comprehension of elements (level 2 SA) refers to understanding the expected position, course, and speed. Projection of elements (level 3 SA) refers to anticipating and maneuvering one's own vessel as they relate to other vessel traffic.

Here we use a human centered approach to understand maritime operations and report the findings from a Delphi study design to answer the question: Can consensus be reached between domain experts to create a training tool to increase situational awareness for collision avoidance amongst new watchkeeping officers? Questionnaires in the Delphi process will be informed by Endsley's theory on SA and will tie professional SME opinions on BRM to academic SA theory. This research will focus on a Canadian maritime SME population with at least 5 years' of OOW experience, specifically, master mariners, harbour pilots, and maritime course instructors. Participants will be asked to complete multiple rounds of questionnaires managed remotely through Qualtrics software. The initial round will collect demographic information and gather the SMEs opinions of goals, factors, and information requirements related to SA for collision avoidance as well as ask questions on the utility and reliability of bridge equipment. As part of the Delphi process, the results of each round will inform the development of later rounds (e.g., each round of questions will build off the participants' responses) until consensus is achieved. Statistical tests will be used to determine consensus or disagreement before moving on to further rounds (Dajani et al., 1979; van der Grocht, 2012). Once a list of key goals and processes is generated by consensus, the list will be member checked by a separate panel of SMEs.

If consensus can be gained amongst the SMEs, the expected outcome is a validated tool that shows the formalized processes for determining the goals and information requirements to establish good SA in collision avoidance. The resulting formalized processes from this research have the potential to assist trainee OOWs in developing BRM schema for the efficient use of bridge equipment and lead to improved situation awareness. Consequently, the formalized processes could shortcut the time to expertise (Endsley, 2018) and be used to change OOW training programs to address the growing demand for seafarers. Additionally, SME validated information requirements for collision avoidance may help the development of human centered Artificial Intelligence (AI) decision support software and Maritime Autonomous Surface Ship (MASS) programming.

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Improve E-learning in Maritime Education and Training action research in the Vietnam Maritime Context

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Keywords: E-learning, maritime education and training (MET), teaching approaches, learning theories, bottom-up approach

Background: In the contemporary era, along with the rapid development of technology, e-learning has emerged as a formal form of education with many potentials. In Maritime education and training (MET), the trend of using e-learning is increasing. COVID-19, as a disruptive factor, has accelerated this tendency.

Purpose: The research aims to explore innovative online teaching approaches that are applicable in the MET context, contributing to the process of adapting to e-learning of MET institutions.

Methods: The study takes the form of action research. Forty-seven students and two lecturers were recruited using a convenient sampling strategy. The researcher collaborated with participants (i.e., lecturers and students) conducting three-phase action research cycle (see figure 1) in the Ho Chi Minh University of Transport:(1) Observe and conduct interviews to gain understanding about the current e-learning state, (2) Deliberate changes and implement new teaching methods, (3) Interviews to evaluate the results. The qualitative data solicited from the interviews were transcribed, translated, and analyzed using thematic analysis. The observation data and recordings of current e-learning classes, research classes were critically examined to enrich the thematic analysis results. The thick description technique was also employed to highlight the characteristics of each theme and the complex relationships between them.

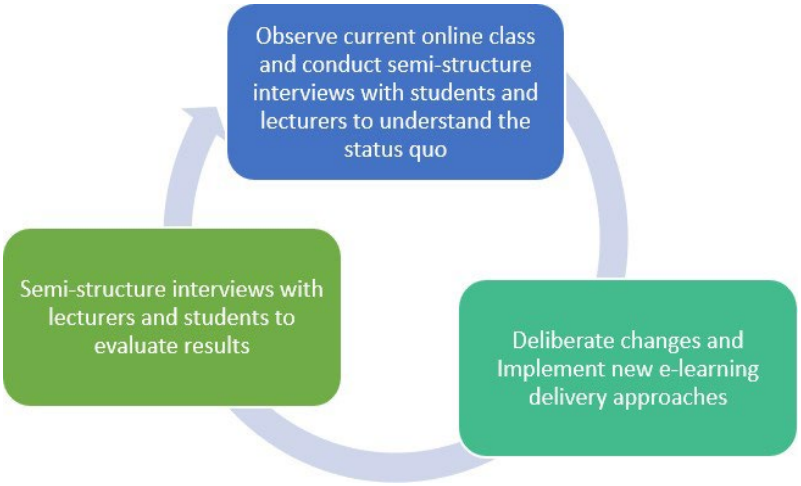

Figure 1. Action research cycle.

Findings: The thematic analysis of phase one yielded three overarching themes: Opportunities, Challenges,and Needs, reflecting the current state from the perspective of lecturers and students. E-learning was well- accepted by participants (See figure 2).

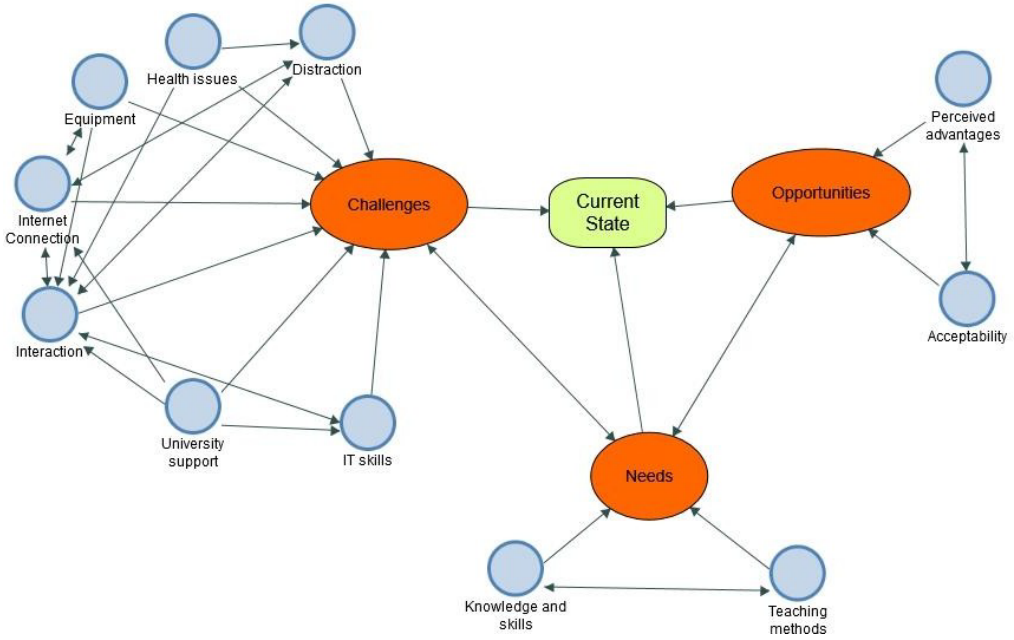

Figure 2. Phase one's findings.

However, numerous challenges (i.e., interaction, IT skills, internet connection, university support, distraction, equipment) and needs (i.e., knowledge and skills, teaching approaches) are highlighted. The thematic analysis of phase three yielded five main themes. The results highlighted the importance of interaction in e-learning class, student-centered approaches, selection of content, alignment of Intended Learning Outcomes (ILO), teaching approaches, assessments, and the concern of students' background.

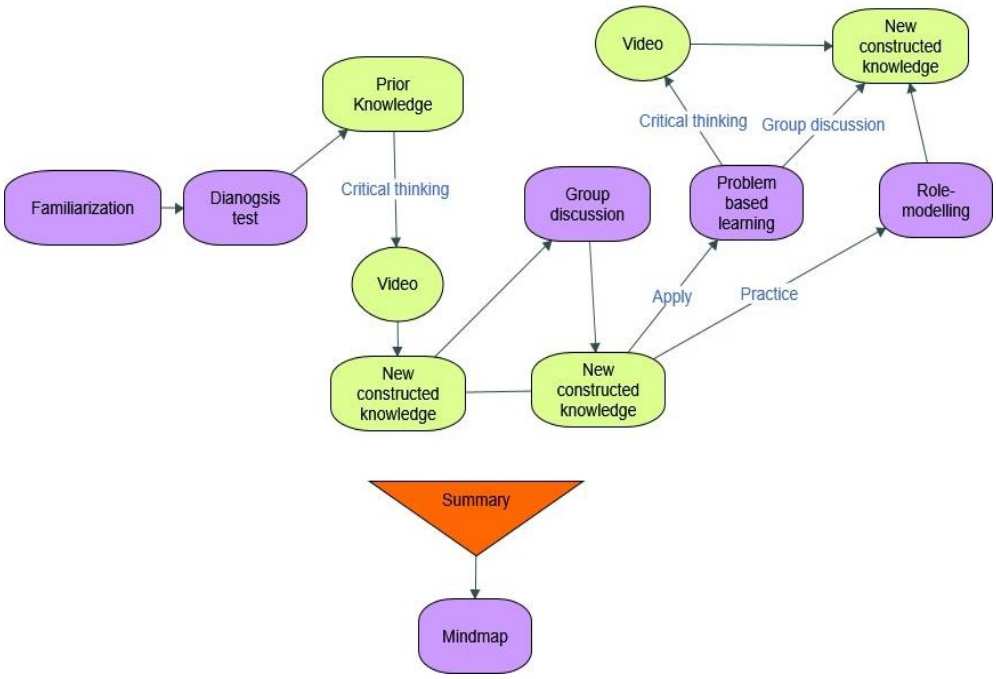

Figure 3. Innovative change – constructivist teaching activities

Value: The research complements the current literature of e-learning in MET, adding further details on the challenges and benefits of e-learning in the maritime context. Further, the study proved the applicability of the constructivist approaches in MET with consideration of ILO and assessment

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