25th ANNUAL GENERAL ASSEMBLY

CHENNAI | INDIA

IAMU AGA 25

AMET University
Chennai, India

16th – 17th OCTOBER 2025

DISRUPTIVE TECHNOLOGIES AND INNOVATIONS TOWARDS SUSTAINABLE MARITIME PRACTICES

The International Association of Maritime Universities (IAMU)

Conference Book

THE NIPPON FOUNDATION

AMET UNIVERSITY
(Deemed to be University Under Section 3 of UGC Act 1956)

IAMU International Association of Maritime Universities

The International Association of Maritime Universities (IAMU)

The International Association of Maritime Universities (IAMU)

Conference Book

AMET UNIVERSITY

16th - 17th October, 2025

THE NIPPON FOUNDATION

AMET UNIVERSITY
(Deemed to be University Under Section 3 of UGC Act 1956)

IAMU
International Association of Maritime Universities

Program Editor

Dr. Deepa Rajesh

Vice-President (Academics)

AMET University, India

Chief Program Editor

Professor Boris Svilicic

Faculty of Maritime Studies

University of Rijeka, Croatia

"A publication of the International Association of Maritime Universities"

For the Publisher

AMET University, India

ISSN: 2706-6762 (Electronic Version)

Table of Contents

Preface

Welcome to the 2025 IAMU Conference
Disruptive Technologies and Innovations towards Sustainable Maritime Practices

It is my great honour, as the Chair of the International Program Committee and Program Editor for the International Association of Maritime Universities (IAMU) Annual General Assembly and Conference 2025 (AGA25), to welcome you to this year's distinguished gathering. The IAMU Conference continues its proud legacy of fostering global dialogue, collaboration and innovation in maritime education, training and research.

The 2025 theme, Disruptive Technologies and Innovations towards Sustainable Maritime Practices, captures the essence of the transformative wave redefining the global maritime landscape. It reflects our collective commitment to advancing digitalization, automation, artificial intelligence, clean energy transitions and smart technologies that will ensure a safer, more efficient and sustainable maritime future.

This year's conference stands as a powerful testament to the strength of academic scholarship and international collaboration within the global Maritime Education and Training (MET) community. It demonstrates how shared research and interdisciplinary engagement can accelerate the adoption of disruptive innovations and drive sustainability across the maritime sector.

The technical sessions pioneering research on sustainable shipping, digital innovation, maritime safety and forward-looking policy frameworks that will guide the industry toward decarbonisation and resilience. Through these scholarly exchanges, we aim to empower the next generation of maritime professionals with the skills, knowledge and foresight required to lead in an era of technological transformation.

A total of 146 abstracts were submitted by scholars from IAMU member universities around the world, reflecting both the breadth and depth of global maritime research. Following a meticulous evaluation by an international panel of reviewers, 140 abstracts are accepted successfully that passed the rigorous double-blind peer-review process, which included plagiarism and AI-content screening in strict adherence to IAMU publication standards. The final selection of 140 articles represents high-quality, original and thematically aligned contributions that advance knowledge in disruptive technologies, maritime innovation and sustainability.

On behalf of IAMU and the International Program Committee, I extend my heartfelt appreciation to all authors, reviewers, presenters and participants for your scholarly contributions and unwavering dedication to advancing sustainability in the maritime domain. My sincere gratitude also goes to the faculty and organizing team of the host institution AMET University and the IAMU Secretariat for their invaluable support and collaboration.

Together, we continue to champion innovation, knowledge exchange and global cooperation to ensure that disruptive technologies and sustainable practices steer the maritime industry smarter, greener and more resilient future.

Thank you and I wish you an inspiring and impactful conference experience.

Sincerely
Dr. Deepa Rajesh
Chair, International Program Committee & Program Editor for IAMUC 2025

Theme

Main Theme

Disruptive Technologies and Innovations towards Sustainable Maritime Practices

Sub Themes

- **Economic Aspect**
- **Environmental Aspect**
- **Policy Aspect**
- **Social Aspect**
- **Technology Aspect**

Organizing Committee AGA 25

Dr. J. Ramachandran
Chief Patron, AGA 25
Founder & Chancellor
AMET University, Chennai, India

Dr. Rajesh Ramachandren
Patron of AGA 25
President, AMET University
Chennai, India

Col. Dr. G. Thiruvasagam
President, AGA 25
Provost, AMET University
Chennai, India

Dr. Deepa Rajesh
Program Editor, AGA 25
Vice President
(Academics)
AMET University
Chennai, India

Dr. V. Rajendran
Vice Chancellor
AMET University
Chennai, India

Dr. V. Sangeetha Albin
Registrar
AMET University
Chennai, India

Capt. K. Karthik
Principal
AMET Institute of
Science and Technology
Chennai, India

Capt. Gopal Srinivas
Principal
AMET University
Chennai, India

Capt. V. Chandrasekhar
Principal
AMET City College
Chennai, India

International Program Committee (IPC)

Dr. Boris Svilicic
Chief Program Editor
Faculty of Maritime Studies
University of Rijeka
Croatia

Dr. Reza Emad
Australian Maritime College
University of Tasmania
Australia

Dr. Manel Grifoll
Barcelona School of
Nautical Studies
University of Catalonia
Spain

Dr. Graham Benton
Cal Poly Maritime Academy
USA

Dr. Samrat Ghosh
Australian Maritime College
University of Tasmania
Australia

Dr. Matthew Rooks
Faculty of Oceanology
Kobe University
Japan

Prof. Johan Bolmsten
World Maritime University
Sweden

Dr. Tina Peric
Faculty of Maritime Studies
University of Split
Croatia

Prof. Dr. Nafiz Arica
Rektör,
Piri Reis Üniversitesi
Turkey

Dr. Deepa Rajesh
Program Editor and
Vice-President (Academics)
Academy of Maritime Education
and Training (AMET) University
India

Local Executive Committee (LEC)

Dr. J. Ramachandran
Lead of LEC

Dr. Rajesh Ramachandren
Lead of LEC

Col. Dr. G. Thiruvasagam
General Chair LEC

Dr. Deepa Rajesh
General Chair LEC

Dr. V. Rajendran
Programme Chair

Dr. T. Sasilatha
Scientific Programme Chair

Capt. K. Karthik
Student Program Chair

Dr. M. Jayaprakashvel
Digital Chair

Dr. V. Sangeetha Albin
Digital Chair

Dr. R. Muthezhilan
Conference
Committee Assistant

Dr. J. Rengamani
Conference
Committee Assistant

IAMU ANNUAL GENERAL ASSEMBLY (AGA)

The Annual General Assembly (AGA) is a forum to allow the exchange of information, policy approvals, and the development and fostering of good relations and collaboration among IAMU member universities.

The Plenary Session, President's Forum, Project Presentations and IAMU Conference (IAMUC) are the main components of AGA. The IAMU Student Program (IAMUS) may be jointly organized by the host university.

PLENARY SESSION

The Plenary Session provides all staff of member universities with an opportunity to review activities of IAMU and to approve IAMU policies, programs and budget as recommended by the International Executive Board (IEB). The Chair of IAMU and the Executive Director, on behalf of IEB, report to the member universities on the decision of the IEB.

PRESIDENT'S FORUM

The President's Forum is a meeting in which the Presidents of IAMU member universities talk about issues especially on policy, direction, and activity of IAMU considering the academic relationship among member universities as well as the economic and technological developments in the international maritime community. The Local Executive Committee (LEC) of an AGA is responsible for organizing the President's Forum during the AGA.

PROJECT PRESENTATIONS

Each project coordinator/ representative of a research project shall make a project presentation in front of academic staff of member universities during the AGA, which is to improve the quality of the project.

IAMU CONFERENCE

IAMU Conference (IAMUC) provides academic staff of member universities with an opportunity to present the outcomes of their academic/ scientific research to the IAMU community. The LEC together with the International Program Committee (IPC) jointly organizes the IAMU Conference, including the selection of session topics and qualifying papers.

IAMU STUDENT PROGRAM

LEC of an AGA may organize the IAMU Student Program (IAMUS) during the AGA where students of member universities jointly participate in some events related to student's activities.

WELCOME TO AGA25

The Annual General Assembly (AGA) is the annual meeting of the International Association of Maritime Universities (IAMU). The International Association of Maritime Universities Conference (IAMUC), held annually as part of the AGA, brings together experts and official representatives of IAMU member universities from all over the world to discuss recent progress and future trends in Maritime education, training, research, and other matters within the scope of IAMU. AMET University is honored to host the 25th Annual General Assembly, IAMUC and IAMUS 2025.

This event aims to bring together global maritime leaders, academics, industry experts, and policymakers to exchange knowledge, share best practices, and foster international collaboration. The conference seeks to advance maritime education, training, research, and innovation, while strengthening partnerships that address emerging challenges and shape the future of the global maritime sector.

WELCOME TO AMET

The 25th Annual General Assembly will be a landmark event hosted by AMET University, India's first Maritime University, established in 1993. For over three decades, AMET has contributed to the maritime sector by producing skilled professionals, advancing research, and fostering innovations that serve not only India but the global maritime community. Maersk A.P. Moller, Denmark, one of the renowned and leading shipping companies of the world, have established a Centre of Excellence in collaboration with AMET University which is the first model of Centre of Excellence in the world established by a leading shipping company. Likewise, other leading shipping companies like V Ships, PIL, Fleet Management etc., are having Memoranda of Understanding and established their Centre for Training in our Campus.

HISTORICAL BACKGROUND OF THE CITY

Discover India's rich cultural heritage through maritime museums, Centres of Excellence, and industry collaborations. Experience the unique blend of multilingual and multicultural traditions that define India's maritime legacy. Chennai, the Gateway to South India, is a city where tradition and modernity blend seamlessly. From the UNESCO World Heritage Site of Mahabalipuram, known for its ancient rock-cut temples and Dravidian architecture, to the iconic Marina Beach, the world's second-longest beach, the city offers diverse experiences. Heritage landmarks like the Santhome Church and Kapaleeshwarar Temple reflect Chennai's deep spiritual and cultural roots, while the Government Museum showcases India's rich history and art. For cultural immersion, Dakshina Chitra brings alive the traditions and architecture of South India, and for nature lovers, the Arignar Anna Zoological Park offers a glimpse of biodiversity. Adding to its spiritual vibrance, ISKCON Chennai provides a peaceful retreat of devotion and meditation. Together, these attractions make Chennai a destination of history, culture, spirituality, and coastal beauty.

Reviewers

Vuong Nguyen Hoang | Martin Crees Morris |Thomas Bengtsson | Liza Nordfeldt | Jens Brauchli Jensen | Micheal Gluch | Dacosta Essel | Sandra Tminac | Karsten Wehner | Vlado Francic | Tuba Kececi | Maro Car | Lisa Bengtsson | Amr Moneer Ibrahim | Momoko Kitada | Gamal Ghalwash | R. Vettriselvan | Sopiko Dumbadze | Zurab Bezhanovi | Anca Sirbu | Joshua Shackman | Meric Karahalil | Bhavana Venkata Ramalingeswara Rao | G. Reza Emad | Hossam Eldin Gadalla | Anna Mujal-Colilles | Paschalia Divari | Helena Ukic Boljat | Alaa M. Morsy | Adel Tawfik | Ahmed Khalil T Awfik Barghash | Claudia Fuentes | Mamdouh Elmallah | Chuanyong Yang Yuan Gu | Ian Jenkinson | Mohammad Abbas | Graham Benton | Tina Peric | Johan Bolmsten | Andrea Russo | Alexander Tsetskhladze | Avtandil Gegenava | Firuza Varshanidze | F. Xavier Martínez de Osés | Firuza Varshanidze | Dimitrios Dalaklis | Gocha Gogitidze | Guram Futkaradze | Ireneusz Czarnowski | James Rogin | Matthew Rooks | Nino Kurshubadze | Valentina Sutalo | Kristine Zarbazoia | Maia Tugushi | Makvala Bekirishvili | Ha Tran | Roman Mamuladze | Axel Rafoth | Marcella Castells | Xavier Martinez | Cong My Truong | Svetlana Dimitrakieva | Iryna Bohomolova | Professor Maia Tugushi | Mads Ronn | Adam Kaizer | Aditi Kataria | Wei Liu | Nikola Vaptsarov | Tsiuri Kurshubadze | Zaza Shubladze | Brindusa Cristina Chiotoroiu | Adrian Sabau | Remus Zagan | Saki Yamashita | Christine Isakson | Donald Maier | Jordan Taylor | Van Quan Phan | Aditi Kataria | Xiu Xiao | Natalia Nikolova | Taili Du | Stig Eriksen | Sam Pecota | Margaret Ward | Hao Wang | Pham Thi Anh | Charlott Sellberg | Iryna Semeniuk Zumrutdal | Nafiz Arica | Lianbo Li | Junyan Zhang | Minh Tran | Junpo Liu | M Jahanzeb Butt | Mingyang Pan | Ninna Roos | Ming Zhong | Rosanda Mulic | Sun Peiting | Chuanyong Yang Yuan Gu | Besik Chkhikvadze | Cvetelina Velkova | Keven Paul | Peng Xu |Tingyu Wang | Hrvoje Dodig | Pham Anh | Yan Wang | Yen-Chiang Chang | Inga Zaitseva | Kadi Kasepõld | Nikon Vidjajev | Theodore Marr | Asanka Rajapakse | Esma Uflaz | Srdan Žuškin | Paul Szwed | Yoshiaki Kunieda | Carl Bengtsson | Hoang Vuong | Corina Varsami | Hesham Helal | Rabiul Islam | Anita Gudelj | Khanssa Lagdami | Jeric Bacasdoon | Mohamed Elhussieny | T Sasilatha | Akram Soliman Elselmy | Herbert Nalupa | Arivazhagan Dr | Rengamani Jaganathan | Stephen Kreta | Samrat Ghosh | Givi Tsitskishvili | Anne Pazaver | Herbert de Vera Nalupa | Olena Frolova | Claudia Barahona-Fuentes | Col. Dr. G. Thiruvasagam | Emeliza Estimo | Christiana Atanasova | Divyaranjani Ramadoss | Nermin Hasanspahic | Scott MacKinnon | Salman Nazir | Nguyen Dinh-Thuy-Huong | Ngo-Ho Anh-Khoi | Hevi Hardini | Monica Lundh | Karina Melikjanyan | James Downey | Cassia Galvao | Tamari Dolidze | Sheeja Janardhanan | Steve Kreta | Manel Grifoll | Mehrangiz Shahbakhsh | Ibrahim Ibrahim | Merica Sliškovic | Jianhua Liu | Jana Kegalj | Meenakshi K | Srinivasan R | Corina Varsami | Ruolan Zhang | Maja Covic | Wenjun Zhang | Johannes Kolind | Minna Keinänen-Toivola | Marcella Castells-Sanabra | Padmapriya J | Mukilarasan N

Venue

The IAMU Conference takes place in
Radisson Blu Resort, Temple Bay, Mamallapuram, India.

AGA25 | IAMUC Program Schedule

14th October, 2025 - Tuesday		
Time	**Event and Location**	
01:00 PM-04:00 PM	Early Registration Registration Desk in the Lobby at **Radisson Blu Temple Bay Resort, Mamallapuram, Chennai, India**	
07:00 PM-09:00 PM	Welcome Reception at Radisson Blu Temple Bay Resort Welcome Remarks **Dr. J Ramachandran** Founder and Chancellor, AMET University, Chief Patron of AGA25 Dinner at Savannah 1 Lawn	
15thOctober, 2025 - Wednesday		
09:00 AM	Registration	
09:30 AM-11:00 AM	**AGA25 Opening Ceremony** at Ballroom (Peninsula + Goldcoast)	
11:00 AM-11:30 AM	Group Photo	Coffee Break
11:30 AM-01:00 PM	**Presidents Forum** at Peninsula Hall	
01:00 PM-02:30 PM	**Lunch Break**	
02:30 PM-04:30 PM	**Plenary Session** (IAMU Members Only) at Goldcoast Hall	
04:30 PM-05:00 PM	Coffee Break	
05:00 PM-06:20 PM	IAMU Project Presentations: IAMU Research Projects at Peninsula Hall	
05:00 PM-05:10 PM	Opening for Project Presentation	Christian Matthews (Head of AAC)
05:10 PM-05:20 PM	The Global Maritime Professional utility of Extended Reality Education and Training: Benchmarking of the IAMU Member Universities	Johan Bolmsten
05:20 PM-05:30 PM	MINT_OCEAN: Machine INTelligence in ship weather routing: Application to extreme OCEAN conditions	Manel Grifoll
05:30 PM-05:40 PM	Competency Development for Hydrogen powered PEM Fuel Cell Ships	M Anandan
05:40 PM-05:50 PM	Evaluation of marine engineering education in respect to the digital	Çağlar Karatuğ
05:50 PM-06:00 PM	Sustainable Energy Advancement through Hydrogen in Shipping	Aya A. El Bauomy
06:00 PM-06:10 PM	Realistic estimation of Energy Saving Device efficiency gain	Andro Bakica
06:10 PM-06:20 PM	Integration of PV Systems and Power Optimization on Vessels	Nemanja Pudar
06:30 PM	Cultural Program	
07:30 PM	Welcome Remarks **Dr. Rajesh Ramachandren**, President, AMET University, Patron of AGA25	
	Cocktail Dinner at the Radisson Blu Resort Lawn	

16th October, 2025 - Thursday		
TIME	**SESSION A – PENINSULA HALL**	**SESSION B - GOLDCOAST HALL**
09:30 AM – 10:30 AM	**Dr. Graham Benton** **Cal Poly Maritime Academy, USA**	**Dr. T. Sasilatha** **AMET University, India**
09:30 AM – 09:50 AM	Luis Evidente and Emeliza Estimo Life Skills, Technological Awareness, and Attitude of Maritime Students Toward Emerging Technologies: Bases for A Proposed Academic Intervention Plan	Peter Ivar Sandell The future training needs for persons working in Remote Operation Center (ROC)
09:50 AM – 10:10 AM	Rincy Raju andDr. Yogamala H L H L Exploring Factors Influencing Workplace Wellbeing and Mental Health Among Indian Seafarers	Sunil Kumar Panda and Sanjeet Kanungo Finding importance of factors by statistical analysis of big data – maritime accidents happened in Indian waters
10:10 AM – 10:30 AM	Germán De Melo Rodríguez, Reza Ziarati, Heikki Koivisto, Januz Uriasz, Lakhvir Singh, AmirehsanBarzegarsedigh, Amir Lazempour and Aris Chronopoulos A Framework for Continuous Improvement in Safety at Sea	Xiaoling Zhu, Keming Ma, Yushan Huang, Qiyan Wang and Qizhe Wang A Study on the Linguistic Features of IMO Legal Proposals
10:30 AM – 11:00 AM	**COFFEE BREAK**	
11:00 AM – 12:00 PM	**Dr. Deepa Rajesh** **AMET University, India**	**Mathew Rooks** **Kobe University, Japan**
11:00 AM – 11:20 AM	Gholam Reza Emad, Saratkumar Narayanan, Momoko Kitada and Angelica Baylon Women in Maritime: Gender Equality, its Challenges and Opportunities	Junghwan Choi Regulatory Challenges and Future Directions in Cybersecurity for Maritime Autonomous Surface Ship(MASS)
11:20 AM – 11:40 AM	Igor Vorokhobin, Dmytro Zhukov, Igor Burmaka and Volodymyr Sikirin Traditional methods to determine the ships' position and Navigation Safety	Marin Hero, Peter Vidmar and Marko Perkovic Integrating System Dynamics Into Maritime Education for Green Shipping Corridors and Decarbonization Strategies
11:40 AM – 12:00 PM	Zorica Đurović and Milena Dževerdanović Pejović Enhancing Standardized VTS Communication Skills through Digital Educational Tools	Paul Szwed, Matthew Rooks and Gregory Sholdt Navigating Beyond Borders: Cultivating Affective Competencies in Future Global Maritime Professionals through Study Away Programs

16th October, 2025 - Thursday		
TIME	**SESSION A - PENINSULA HALL**	**SESSION B - GOLDCOAST HALL**
12:00 PM – 01:00 PM	**Dr. Johan Bolmsten** **World Maritime University, Sweden**	**Dr. V. Sangeetha Albin** **AMET University, India**
12:00 PM – 12:20 PM	Deepa Rajesh and Vettriselvan Rajasekaran Fostering Gender Equality in Maritime Innovation: Economic Growth and Sustainable Development	Du Juan and Zhu Xiaoling A Comparable Corpus-Based Study of Maritime Proposal Convergence Trends for Native Chinese and EnglishSpeakers
12:20 PM – 12:40 PM	Vicente Juan Torio and Myrna Matira Gamification in Maritime Education: Bridging Traditional and Innovative Approaches at MAAP-ASTC	Anatoli Alop, Katre Koit, Jarmo Kõster and Olev Tõnismaa Course of Navigation Risk Management in the Age of NEW Technologies: Teaching Principles and Practices
12:40 PM – 01:00 PM	Paul Szwed, Cassia Galvão, Srđan Vujičić, Huanxin Wang, Mahmoud El Baowab and Gamal Galwash What Competencies will be Required of Global Maritime Professionals in the Next Five Years?	Weronika Ceynowa and Adam Przybyłowski Exploring digital solutions in maritime transport - challenges in supply chain management on training vessels
01:00 PM – 02:30 PM	**LUNCH BREAK**	
02:30 PM – 03:30 PM	**Capt. Gopal Srinivas** **AMET University, India**	**Dr. Manel Grifoll** **Universitat Politècnica de Catalunya, Spain**
02:30 PM – 02:50 PM	Trudi Hogg, Samrat Ghosh and Benjamin Brooks Safe operator dependence on automation in MASS 1 and MASS 2: A systematic review on the interaction between perceived risk and trust calibration	T Sasilatha, Padmapriya J, Karthickmanoj R and Col Dr. Thiruvasagam G Artificial Intelligence based Species Identification in Underwater Ecosystems: Advancing Marine Biodiversity Monitoring
02:50 PM – 03:10 PM	Antonio Blazina and Lovro Maglic Advancing MET through technology: ROV education and training for seafarers	Gamini Lokuketagoda, Takashi Miwa, Muhammed Iraz and Nageetha Jayathilake Re-creating maritime incidents with engine room simulator
03:10 PM – 03:30 PM	Bharathi K and Satish Kumar S Analyzing the Eco-Benefits of Innovative Hydrogen Production Methods	Simone Dürr, Sheelagh Conlan, Juan Ahuir Torres, Martin Sharp, Eddie Blanco Davis, Tahsin Opoz, Hiren Kotadia, Bogdan Hnatiuc, Cristina Dragomir, Adrian Sabău, Simona Ghiță, Mihaela Hnatiuc, Yasin Arslanoğlu, Özkan Uğurlu, Refik Özyurt, Mani Jayaprakashvel, Radhakrishnan Muthezhilan and Vijayaraj Radha Facilitating greener education and cleaner shipping through the development of Novel bespoke micro textured metals to combat biofouling in niche areas on vessels
03:30 PM – 04:00 PM	**COFFEE BREAK**	
07:00 PM	**DINNER**	

17th October, 2025 - Friday		
TIME	**SESSION A - PENINSULA HALL**	**SESSION B - GOLDCOAST HALL**
09:30 AM – 10:30 AM	**Dr. Samrat Ghosh** **Australian Maritime College, Australia**	**Capt. Dr. K. Rajesh** **AMET University, India**
09:30 AM – 09:50 AM	Thangalakshmi S and Sivasami K Harnessing ocean energy: advancing marine renewable Technologies for sustainable coastal development	Johan Bolmsten, Jeric Bacasdoon, Claudia Barahona- Fuentes, Carolyn Graham, Kirtan Vakil and Tirth Vakil The Utility of Extended Reality in Maritime Education and Training: A Bibliometric Review
09:50 AM – 10:10 AM	Luka Vukić, Rino Bošnjak and Gorana Jelić Mrčelić Managing the risk of fire from electric vehicles on board ferries: an overview of current regulations and proposals	Tatsuro Ishida, Takashi Miwa, Sara Sato, Muhammed Iraz, Nageetha Jayathilake, Gamini Lokuketagoda and Ryotaro Takeda Study on Behavioral Characteristics of Engineers in Engine Room simulator Using Eye-tracking Measurement Devices
10:10 AM – 10:30 AM	Heikki Koivisto Reza Ema and Minna Keinänen-Toivola Sustainable Flow: Sustainable flow of goods and decreased CO2 emissions of transportation	Gea Miščević, Edvard Tijan and Saša Aksentijević Enhancing Cyber Resilience in Critical Maritime Infrastructures
10:30 AM – 11:00 AM	**COFFEE BREAK**	
11:00 AM – 12:00 PM	**Capt. K. Karthik** **AMET Knowledge Park, AMET-IST, India**	**Dr. Robyn Pyne** **Liverpool John Moores University, England**
11:00 AM – 11:20 AM	Chavdar Alexandrov, Iglika Ivanova-Slavova and Nikolay Ivanov Eco-activism and its impact on seaborne economic endeavours	Wahidul Sheikh, Reza Emad and T M Rabiul Islam Green Technologies and Evolving Role of Seafarers in the Future of Shipping Industry
11:20 AM – 11:40 AM	Knud Benedict, Michael Baldauf, Mario Gehrke, Maximilian Sternberg, Daniel Rostek and Matthias Kirchhoff Fast Time Simulation and Dynamic Manoeuvring Prediction – towards Integration of Disruptive Technology for Training of Navigators of the Future	T Sasilatha, Padmapriya J and Col Dr Thiruvasagam G Geo-Spatial Visualization of MBES and ROV Data to Explore the Submerged Port City of Poompuhar
11:40 AM – 12:00 PM	Rolando Alimen, Ernie Jay Teves, Agustin Bedia, Allan Roberto, Nerios Cortejo and Victor Ruperto Jaleco Automated Marine Sewage Treatment Plant (MSTP) using Ultraviolet Lights For Domestic Ships in the Philippines	Pritam Pattanaik, Prasheet Mishra, Vik Patra, Saswat Ranjan Barik and Pallab Das AI Powered Approach to Maritime Pirate Attack Detection

17th October, 2025 - Friday		
TIME	**SESSION A - PENINSULA HALL**	**SESSION B - GOLDCOAST HALL**
12:00 PM – 01:00 PM	**Dr. Reza Emad** **Australian Maritime College, Australia**	**Dr. M. Jayaprakashvel** **AMET University, India**
12:00 PM – 12:20 PM	Guladi Tkhilaishvili, Ketevan Tchanidze, Manuchar Loria, Sopiko Dumbadze and Teona Dzneladze E-Learning in Maritime Education, Challenges and Opportunities: Case Study of the Black Sea Countries	Prasheet Mishra, Pritam Pattanaik, Vik Patra, Saswat Ranjan Barik and Pallab Das A Comprehensive Fuel Management System for Ships Using AI and Web Integration
12:20 PM – 12:40 PM	Emzar Gvarishvili and Johan Bolmsten Enhancing Maritime English Proficiency Among Cadets in Georgia: An Action Research Approach to Developing a Tailored E-Learning Course	Capt. Ashok Pandey and Capt. K Karthik Arctic Navigation- Digital Voyage Planning & Management
12:40 PM – 01:00 PM	T. Sasilatha, Padmapriya J, Col Dr Thiruvasagam G and V. Sangeetha Albin Launching the AMET Marine Exploration Data Portal for Maritime Heritage Studies	Steven Baer, Salman Nazir and Kent SaloMaritime Education in a Rapidly Changing Arctic
01:00 PM – 02:30 PM	**LUNCH BREAK**	
	Capt. V. Chandrasekhar **AMET City College, India**	**Dr.J.Padmapriya** **AMET University, India**
02:30 PM – 02:50 PM	Thi Anh Tho Tran Settlement of Dispute Arising out of Blockchain-Based Smart Contract: A Revisit of Private International Laws in Maritime Convention Network	Mykhaylo Miyusov, Oleksandr Kryvyi and Dmytro Zhukov Dependence of the thrust and power of wind propulsors on the speed of the vessel
02:50 PM – 03:10 PM	Gholam Reza Emad, Mehrangiz Shahbakhsh and Mohsen Khabir Artificial Intelligence and its Transformative Impact in Shaping the Maritime Industry	Tamera Gilmartin Considerations on the Experience of Multilingual MET Students using Virtual Reality
03:10 PM – 03:30 PM	Katarzyna Skrzeszska and Dariusz Jellonnek The directions of changes in motivators for choosing a career at sea	Darko Glujic, Goran Vizentin, Goran Vukelić and Dario Ogrizovic Mixed reality firefighting simulator
		Kamalesh Kumar P, Dr. C. Vairavan and Ramaraju Sabapathy Multimodal CLIL and Sustainable Maritime Education: Leveraging Disruptive Technologies for Future Seafarers
03:30 PM – 04:30 PM	**Closing Ceremony at Ballroom (Peninsula + Goldcoast)**	
07:00 PM	**DINNER**	

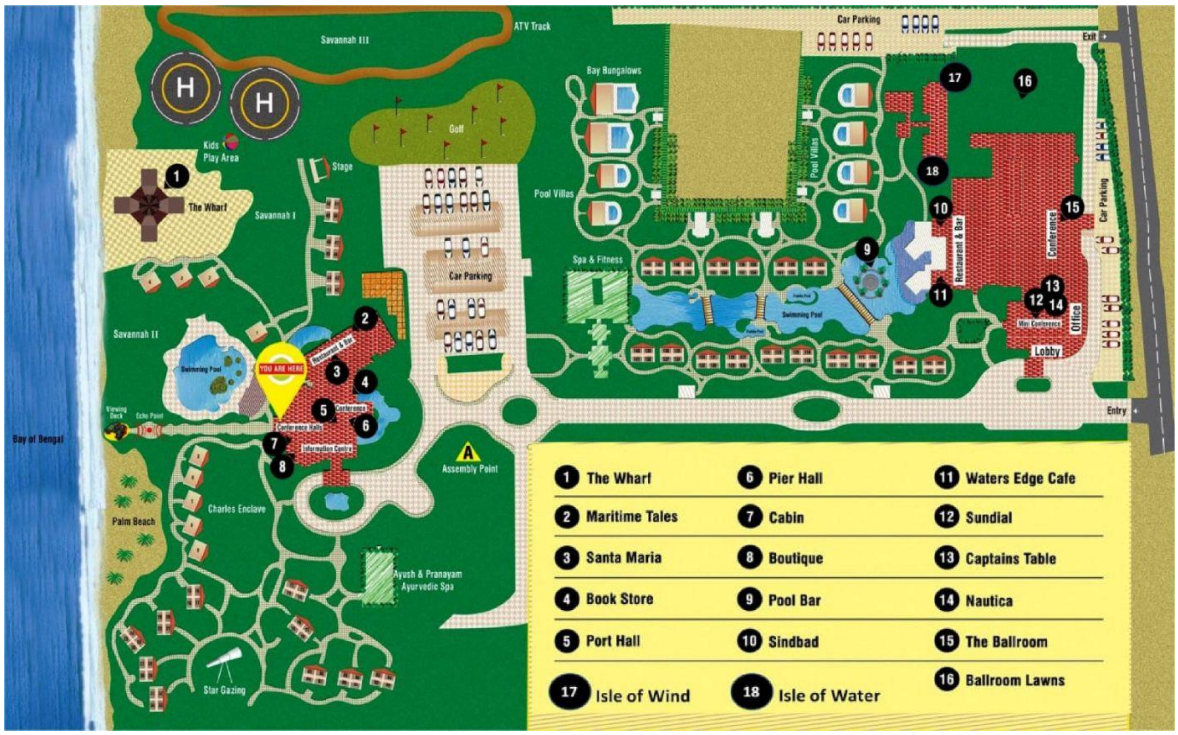
16th October, 2025 - Thursday	
Time - 9:00 AM – 4:00 PM	**Hall: NAUTICA**
POSTER PRESENTATIONS	
Policy Aspect	
Peter Ivar Sandell	Seafarers legal position when vessels are used for illegal activities against marine infrastructure
Social Aspect	
Pawel Kolakowski, Kamil Formela, Filip Bojić, Mislav Maljković and Lea Vojković	Understanding the Concept of Safe Distance in Maritime Navigation: Insights from Simulator-Based Training
Ilija Knežević, Nikola Marvučić, Nemanja Pudar, Ivana Čavor and Tatijana Dlabač	Implementation of Advanced Learning Methods in Maritime Education Through the UniTrain System for Enhancing the Teaching Practices of Process Measurement Variables
Klaas De Hert, Deirdre Luyckx and Helen Verstraelen	Future-Proofing Nautical Sciences: Curriculum Reform at the Antwerp Maritime Academy
Ms.J Christalin Janet and Dr.C.Vairavan	Reading between the Waves: Improving Maritime English Comprehension through Innovative Teaching Strategies
TechnologyAspect	
Daniel Daneci Patrau, Anastasia Elena Duse and Radu Ioan Hanzu-Pazara	A Potential Framework for the Analysis of Cyber Resilience through the Perpective of Hybrid Threats
Shamji V R and Faisal Alsaaq	Autonomous and AI-Driven Hydrography: Innovations for Sustainable Maritime Practices
Senka Šekularac-Ivošević, Dragana Milošević, Draško Kovač and Špiro Ivošević	Exploring a Framework for Maritime Education and Training Tailored to Professionals in Underwater Robotics
Dr.Lakshmi D, Manimegalai S, Padmashini R.K and Karthickmanoj R	Design of Hybrid Stand-Alone Power Generation System for Marine Applications
Kamelia Narleva, Yana Gancheva, Boyan Mednikarov and Marina Chesnokova	Social Aspects of Digitalization in the Maritime Industry
Loren Steve Glumalid	Faculty and Student Feedback on the use of Online Platform and Its Impact on the Academic Performance in Collision Regulation
Prasanna Kumar Rajakumaran	Maritime Rescue Drones
EnvironmentalAspect	
Nguyen Dinh-Thuy-Huong and Nguyen Thanh-Le	Rare procurements related to green energy sale in Vietnam shipping companies: explanations from street level bureaucracy theory
EconomicAspect	
Amit Mahajan, Emil Mathew and Anisha Banerjee	Predicting Aggregated Cargo Throughput of Major Indian Sea Ports with Bayesian Structural Time Series

Technical Tour

Visit to AMET Knowledge Park, AMET Institute of Science and Technology (AMET–IST), Maersk Centre of Excellence

18th October 2025: Exploring Maritime Heritage & Education		
Time	**Activity**	**Details / Location**
08:30 AM	Breakfast	Hotel
09:30 AM	Visit to Mahabalipuram (UNESCO World Heritage Site)	Explore ancient rock-cut temples like Shore Temple, Five Rathas, and Arjuna's Penance. A perfect blend of history, spirituality, and coastal beauty
01:00 PM	Lunch	AMET Knowledge Park, AMET Institute of Science and Technology (AMET–IST), Maersk Centre of Excellence
02:00 PM	AMET Knowledge Park AMET Institute of Science and Technology (AMET–IST) Maersk Centre of Excellence	Tour India's leading maritime university: • Full-mission simulators • AR/VR training labs • Seamanship labs • Engineering & electrical workshops • 150-acre green campus
03:00 PM	Drop at Hotel / Drop at Airport	End of program activities

Radisson Blu Temple Bay Resort, Venue Map



Program Schedule for Accompanying Persons

16th October 2025: South Indian Culture & Spiritual Heritage		
Time	**Activity**	**Details / Location**
08:30 AM	Breakfast	Hotel
10:30 AM	Visit to Valluvar Kottam	Valluvar Kottam - Honours Tamil poet Thiruvalluvar, showcasing his work in a grand chariot-shaped monument
11:30 AM	Museum	Showcases a rich heritage with ancient artefacts, sculptures, bronze idols, and South Indian cultural history
01:00 PM	**Lunch**	
03:00 PM	Santhome Basilica	Neo-Gothic church built over the tomb of St. Thomas the Apostle. An architectural and spiritual landmark near Marina Beach
04:00 PM	Vivekananda Illam and Marina Beach	Vivekananda Illam showcases Swami Vivekananda's legacy; Marina Beach, India's longest, offers scenic beauty and cultural vibrance
06:00 PM	Return to Hotel	Refresh before Evening Events
07:00 PM	Dinner	Hotel
17th October 2025: Shopping, History & Beach Vibes		
Time	**Activity**	**Details / Location**
08:30 AM	Breakfast	Hotel
10:00 AM	Visit to Jain Navagraha Temple	A peaceful spiritual site dedicated to Jain Tirthankara and Navagrahas; known for its serene environment and intricate architecture
10.30 AM	Visit to Dakshina Chitra Heritage	Cultural village on ECR, showcasing South Indian art, architecture, crafts, and heritage homes
01:00 PM	**Lunch**	
02:00 PM	Phoenix Mall	Phoenix Mall is a premier shopping destination offering top brands, dining, and entertainment under one roof Modern mall featuring global brands, diverse dining, multiplex cinema, and vibrant shopping
06:30 PM	Return to Hotel	Refresh before Evening Events
07:30 PM	Dinner	Hotel

Economic Aspect

Exploring Digital Solutions in Maritime Transport - Challenges in Supply Chain Management on Training Vessels

Weronika Ceynowa[1], Adam Przybyłowski[2]
[1]*Doctoral School, Gdynia Maritime University, 81-87 Morska Str., 81-225 Gdynia, Poland*
[2]*Faculty of Navigation, Department of Transport, Gdynia Maritime University, 81-87 Morska Str., 81 225 Gdynia, Poland*

Keywords: ICT tools, digital transformation, supply chain management, GMU training vessels

Efficient supply chain management is a critical component of maritime transport, including the operation of training vessels. However, current supply processes often suffer from inefficiencies, leading to delays, excessive orders, and poor resource management, impacting both operational costs and overall transport efficiency. This study focuses on a detailed analysis of the existing supply and procurement processes regarding Gdynia Maritime University (GMU) training vessels. The research aims at identifying key barriers and possible solutions to make the supply chain management more digitalized, effective and therefore sustainable.

A mixed-methods approach was used to evaluate the processes, including interviews with GMU Maritime Operations Department personnel and crew members, document analysis, and comparisons with best practices from other maritime institutions and private shipping operators. Additionally, a case study of the digital DYLLI platform - originally developed by authors for the HoReCa industry- was examined to explore whether such a tool can help to address identified issues and improve transport related processes in training vessel operations.

The findings highlight significant gaps in communication between shipboard personnel and GMU procurement offices, leading to inaccurate order forecasting and unnecessary expenditures, ultimately affecting the efficiency of the entire vessel operations processes. This research lays the groundwork for digital innovations, pinpointing specific areas where automation and increased transparency could contribute to enhancing efficiency and sustainability. By systematically mapping the current state of supply processes on training vessels, this study provides a reference point for further research and testing of digital solutions in maritime transport leading to minimizing waste, etc. Also, future work may focus on iterative testing of potential digital tools, ensuring their alignment with real-world user needs and the challenges associated with maritime transport sustainability.

Predicting Aggregated Cargo Throughput of Major Indian Sea Ports with Bayesian Structural Time Series

Amit Mahajan [1,*], Emil Mathew [2] and Anisha Banerjee[3]

[1]*Indian Maritime University, Kolkata Campus, West Bengal, Pin – 700088, India*
[2]*Indian Maritime University, Chennai Campus, Tamil Nadu, Pin – 600119, India*
[3]*Indian Maritime University, Kolkata Campus, West Bengal, Pin – 700088, India*
[*]*Corresponding author: amitmahajan@imu.ac.in; Tel.: +91-8240085423.*

Keywords: Cargo Throughput; Major Indian Port; Bayesian Structural Time Series;

One of the important indicators of port activity is Cargo Throughput [1]. The port activity is important as port acts as nodal point of global supply chain of various commodities and to remain competitive globally, the ports are increasingly facing more pressure. Ports facilitate movement of diverse categories of cargo such as Petroleum, Oil and Lubricants (POL), Food grains, Fertilizer, Coal, Containers etc. In the existing literature, most of the analysis are port specific with different forecasting models been employed such as exponential smoothing, autoregressive integrated moving average, neural networks, machine learning [1]. This article considers the monthly overall Cargo Throughput of all major ports of India from January 2022 to December, 2024 in order to get a comprehensive view of major port systems. The aggregated forecast exhibits more stability and has less volatility which is prominent in individual port level [1].

In this study, the multivariate forecast model of aggregated Cargo Throughput of all major ports of India is developed. It is intended to analyze how aggregated Cargo Throughput is affected by Macroeconomic variables Consumer Price Index, Exchange Rate (Rupees/US Dollar) and Manufacturing Purchasing Managers' Index (Manufacturing PMI). The macroeconomic variables have been selected based on existing literatures [2], [3]. The Bayesian Structural Time Series (BSTS) method has been adopted for forecasting.

BSTS model is used for extraction of trend, seasonality of the time series of aggregated Cargo Throughput. Both the components are modelled as additive one. Bayesian Structural Time Series is better because of feasibility of inclusion of spike and slab prior over a set of predictor variables [4]. The spike and slab prior and Markov Chain Monte Carlo prevent selection of spurious set of predictors. So the biggest advantage of BSTS lies in a more robust and automated system of inclusion of predictors [4]. The regression component consists of contemporaneous predictors which are also included for better forecasting. The spike and-slab prior distribution on regression coefficients are employed to capture inclusion probability of predictors. In the structural times series, y_t denotes the value of the observation at time t. The model is represented by a pair of equations, $y_t = Z_t^T \alpha_t + \varepsilon_t \quad \varepsilon_t \sim N(0, H_t)$;……..(1) $\alpha_t+1 = T_t \alpha_t + R_t \eta_t \quad \eta_t \sim N(0, Q_t)$……..(2). The equation 1 is known as observation equation and equation 2 is known as transition equation. Z_t, T_t, and R_t consist of a mix of known values (often 0 and 1), and unknown parameters and αt is unobserved latent state. The time series of aggregated Cargo Throughput is stationery as indicated by Augmented Dickey-Fuller Test. Fig. 1 below shows the individual state components i.e. trend, seasonality and regression components of the model. The fuzziness of the plot is due to inclusion of marginal posterior distribution at each point. The trend is linear with incremental upward slope which indicates small changes in Cargo Throughput over time, and the seasonality is very less. The regression component explains insignificant amount of variation in the Cargo Throughput. Fig. 2 below exhibits posterior predictive distribution of aggregated Cargo Throughput for the future months.

References

Dionicio Morales-Ramírez, Maria D. Gracia, Julio Mar-Ortiz (2025). Forecasting national port cargo throughput movement using autoregressive models, Case Studies on Transport Policy, Volume 19, 2025, 101322, ISSN 2213-624X, https://doi.org/10.1016/j.cstp.2024.101322.

Yasmine Rashed, Hilde Meersman, Christa Sys, Eddy Van de Voorde, Thierry Vanelslander (2018). A combined approach to forecast container throughput demand: Scenarios for the Hamburg-Le Havre range of ports, Transportation Research Part A: Policy and Practice, Volume 117, 2018, Pages 127-141, ISSN 0965-8564, https://doi.org/10.1016/j.tra.2018.08.010.

Eskafi, M., Kowsari, M., Dastgheib, A., Ulfarsson, G. F., Stefansson, G., Taneja, P., & Thorarinsdottir, R. I. (2021). A model for port throughput forecasting using Bayesian estimation. Maritime Economics & Logistics, 23, 348-368.

Scott, S. L., & Varian, H. R. (2014). Predicting the present with Bayesian structural time series. International Journal of Mathematical Modelling and Numerical Optimisation, 5(1-2), 4-23.

Settlement of Dispute Arising out of Blockchain-Based Smart Contract: A Revisit of Private International Laws in Maritime Convention Network

Thi Anh Tho Tran [1,*]

[1]*University of Transport Ho Chi Minh City, Vietnam*
** Corresponding author: anhtho.tran@ut.edu.vn; Tel.: +84 913016177*

Keywords: DOA; on-chain dispute settlement; emerging PIL

Blockchain technology is increasingly recognized for its potential to enhance transparency, security, and efficiency in the maritime industry, particularly in cargo tracking, freight payment systems, and the management of shipping documentation. However, its integration raises significant legal considerations, especially concerning the admissibility of blockchain records as evidence in maritime disputes. Taking smart contract, which is self-executing contracts encoded on blockchain to automate processes, such as, freight payments and cargo tracking, as an notable example, the author shall discuss current admiralty issues remaining in existing international maritime conventions, through which assess whether it is necessary to establish a new theoretical concept of decentralised autonomous jurisprudence applicable to those disputes.

Eco-Activism and its Impact on Seaborne Economic Endeavours

Chavdar Alexandrov [1,*], Iglika Ivanova – Slavova [2] and Nikolay Ivanov [2]
[1] *Nikola Vaptsarov Naval Academy - Varna, Bulgaria*
[2] *Technical University - Varna, Bulgaria*
[*] *Corresponding author: ch.alexandrov@nvna.eu; Tel.: +359-88-751-8891.*

Keywords: environmentalism; eco-activism; seaborne economics; environmental awareness

Environmental awareness is a key issue in the modern world. Nowadays people understand the importance of having responsible sustainable industry. As a result, drilling companies have been under major pressure to maintain sustainability. It is no surprise that modern world cannot reject its need of fossil fuels, they cannot disappear overnight from our industrial and public lives. There are, however, activist organisations, seeking a way to keep a closer look on how rich corporations keep up to their sustainability programs and how effectively they put them in place. This vigilance has pushed environmentalists to undertake more and more aggressive campaigns in order to raise awareness of the risks of drilling, use of fossil fuels as well as other environmental issues. One of the most popular and widely known campaigns is "Safe the Arctic" Campaign of the Greenpeace organisation. However, "Save the Arctic" is not the only endeavour Greenpeace has been developing in recent years. By analysing the collected data, the article is aiming to explore further the origins of this opposition as well as the legal aspects of similar incidents. The main purpose of the research is to reveal how probable is a major sea accident and to examine the available precaution measures to sea practitioners at present.

In order to evaluate the effect the environmentalists' campaigns have on shipping industry, a desktop research has been done to pinpoint their main objectives and strategy. Since Greenpeace has demonstrated a sound and well-planned activity, especially in recent years, for the purpose of this article their actions have become the main focus.

Modern environmentalism can trace its origins back to the early 19th century. With the development of the technical revolution more and more people saw the potential danger of pollution the future generations were facing. During the post-war period, in 1962, the American biologist Rachel Carson published her book "Silent Spring". In it she rose the question on how people use pesticides and how they affect both human and wildlife health. As a result, in 1970 the USA created the "United States Environmental Protection Agency". The direct impact of the book was the ban from use of the DDT pesticide in the USA, followed by other parts of the world. The awareness the book created gave the start of the first environmental organisations in the American continent, the most notable being the Greenpeace and the Friends of the Earth.

Greenpeace, along with other environmental action groups, which are committed to the pursuit and implementation of peaceful protest, in their activities can still be highly damaging and sometimes potentially dangerous. The man impact is mostly financial, however, if not dealt with correctly, there is a high possibility of severe reputational damage. All environmental organisations are legally and politically sophisticated, and supported with a professional and dogged media and PR campaign. It is highly likely that they will be able to turn any situation, occurrence, incident or comment (real or perceived) to their advantage.

Our research, however, shows that the number of security companies, involved in this particular area of expertise, is limited. This may be due to the fact that such attacks are neither too many, nor pose a direct threat to the merchant endeavour or human life. If there was an incident involving harm or loss of life, it would be accidental and not intentional. There are, however, other not so obvious risks, which deserve attention. The main effects on shipping, some of which may seem hidden, include:

- Loss of time (and revenue) on a drilling campaign. It can easily be recognised as an immediate and quantifiable cost when becoming involved with protesting environmentalists.
- Deliberate or (in most cases) accidental damage to the rig's systems/structure, which is a distinct possibility during an environmentalist boarding, that leads to the costs for repair and replacement. Even when no apparent damage was caused during the incident, an inspection on the integrity and functionality of the rig's systems will have to be done post-boarding in order to ensure that they are serviceable and safe to operate. This usually includes a health, safety and Dropped Object Prevention Scheme survey, in the cases when protestors have been (or are suspected to have had access to) areas above the working decks of the rig – which naturally leads to further delay and expense.

- In the cases of a prolonged protest, biological hazards may be generated, which may include human and food waste, used medical supplies etc. Due to the ecological focus of these groups, it could be assumed that correct cleaning and disposal of such materials will be followed, but it should not be taken as a guarantee. It may be necessary for a biological hazard survey and/or cleaning to be done.
- As soon as they make contact with the rig's structure, the protestors may be considered to be under the health and safety care of the company. Every possible effort must be made in ensuring that no harm comes to them (which includes no attempt to cause them harm).
- Health and Safety legislation can be different depending on the flag state of the vessel/platform involved. The UK law for example, states in Section 3 of the Health and safety At Work Act 1974 that an employer is responsible for the safety of anybody on their property – including "trespassers" (which in this case means stowaways). There are also similar provisions included in EU regulations pertinent to any European flagged ship. The law of the flag state must be carefully examined for similar provisions.
- The company Health and Safety policy always includes a commitment to mitigation of the impact of any foreseeable hazards in the relevant workplace. An environmentalist boarding can be considered in this context. There could be a protestor injuring him/herself on the facility. Such a case may have an impact of safety record, insurance, the client and the reputation of the company
- SOLAS provisions suggest that the protesters would be entitled to lifesaving assistance should they come onto difficulty before, during or after a (failed) boarding attempt. If the actions of the rig/vessel have any part in the cause of this distress, legal ramifications are quite likely.
- As mentioned above, Greenpeace and other large environmental organisations usually have a well-developed network of in-house legal support, so prosecution is likely if any harm comes to their protestors. Regardless of whether the position is legally defensible or not, most likely it will involve a lengthy, expensive court case which will produce many opportunities for reputational damage to the targeted company.
- Most environmentalist organisations prefer to use social and other media to publicise their objectives and to denigrate their opponents. Most likely, their operations will be filmed and carefully recorded. Any hints of mistreatment or other acts that could be interpreted negatively are likely to be widely publicised and again may be used for negative publicity of the targeted company.
- A high level of media coverage is likely to follow such an event, which means a great consideration must be given to the wider security risk that this may present. The "peaceful" protesters in this instance can widely publicise and highlight security gaps and weaknesses, physical and procedural in nature. This may be capitalised upon by terrorist, piratical criminal entities who wish to exploit the same weaknesses for more nefarious ends, which may include robbery, hijack or a terrorist attack. A comprehensive review of security measures must be done, and preventing the publication of detailed photographs and video evidence of how to board the platform. Such publications, even if following different objectives, may give pirates and/or terrorists an invaluable resource detailing how to conduct an attack.

It is obvious that in most cases acts of boarding conducted by environmentalists are not intended to be malicious or aggressive towards crew or structure. Even so, their occurrence is a problem for the company targeted, since they induce significant delays, expenses as well as substantial security risk. It is important for crews to be instructed accordingly in order to minimize the negative impact of the incident. A risk assessment should be conducted in order to identify possible scenarios and relative actions. All the above-mentioned risks have been assessed according to their severity in table 1.

The risk posed on shipping participants by environmentalists' boardings could be incorporated into the Ship Security Plan and the ISM shipboard Safety Management Manual. Since the nature of the environmentalist attacks is not a direct security issue but has the potential to quickly escalate into one, the crew and officers are to be dully instructed to act with caution, without showing any aggressive behaviour, avoiding any possible escalation of the situation. They must bear in mind the fact that there may be provocations and should focus mainly on avoiding negative publicity following the incident. For the purpose of this research, the advisory notes from Allmode Limited (a Ship Security advisor and provider) were examined. They contain precise procedure steps for owners in order to assist their onboard officers and crew into taking the right decisions for securing safety of all human life, technical procedures and last but not the least - the environment.

References

D. M. Schwartz, Environmental terrorism: Analyzing the concept. Journal of Peace Research., 35(4), pp. 483–496 (1998)
E. Posluszna, Environmental and Animal Rights Extremism, Terrorism, and National Security, 1st Edition – (2015)
K. Burrows, & P. Kinney, Exploring the climate change, migration and conflict Nexus. International Journal of Environmental Research and Public Health, 13(4), pp. 443-459 (2016)
J. Jarboe, The Threat of Eco Terrorism, FBI report 12 Feb 2002, see https://archives.fbi.gov/archives/news/testimony/the-threat-of-eco-terrorism
A. Preston, Eco Terrorism in The Southern Ocean: A Dangerous Byproduct of the Tangled Web of the International Whaling Conventions and Treaties, Whittier Law Review, United States, vol. 34, pp. 117 – 140, (2012)
Allmode Security Services: Advisory: 042 (Environmental Activism) Dealing With Environmental Activism, 10 April 2015, see https://www.onboardonline.com/ocean/conservation/dealing-with-environmental-activism-at-sea/
IMO Maritime Safety Committee Circulars, MSC.1-Circ.1333 - Recommendations to Governments for preventing and suppressing piracy and armed robbery against ships. (Secretariat), MSC.1/Circ.1333 (26 June 2009)
L. Pai, Six Activists Released After Detention on Palm Oil Tanker Issue, 19 Nov 2018, see https://www.marinelink.com/news/greenpeace-activists-released-detention-444188
A. Petrig, Routledge Handbook of Maritime Security, "Human Rights And Law Enforcement At Sea", pp. 153 – 164, (2022)
J. Helmick, Intermodal Maritime Security Supply Chain Risk Mitigation, Chapter 14 "In-transit threats and risk management, pp. 259-280, (2021)
M. McNicholas, Maritime Security: An Introduction, (Butterworth-Heinemann, 2nd Edition - March 19, 2016)
C. Bragdon, Transportation Security, (Butterworth-Heinemann, 1st Edition - July 11, 2008)
European Court of Human Rights, Case of Morice vs France, 23 April 2015, Strasbourg, see http://juri.ro/static/files/2015/septembrie_2015/16/CASE_OF_MORICE_v._FRANCE.pdf
N. Dimitrov, Ch. Alexandrov, M. Todorov, Cyber Security Analysis of Maritime Surveillance Systems, (IAMU AGA 2021 Conference, Alexandria, Egypt, 26 October 2021), pp. 463 – 471
J. Vestby, Climate variability and individual motivation for participating in political violence, Global Environmental Change 56, pp. 114 – 123 (2019)

Environmental Aspect

Re-Creating Maritime Incidents with Engine Room Simulator

Gamini Lokuketagoda[1,*], Takashi Miwa[2], Muhammed Iraz [1] and Nageetha Jayathilake [1]

[1] *Australian Maritime College, Australia*
[2] *Kobe University, Japan*
[*] *Corresponding author: Gamini.Lokuketagoda@utas.edu.au Tel.: +61-438-354-452.*

Keywords: maritime incidents, engine simulator, situational awareness, Dali

After a major maritime accident, affected parties conduct thorough investigations to find reasons which caused these incidents ranging from machinery failure, design faults to human error. In the process we always put the facts together and ask the questions: What if this was done in this situation? Why couldn't the engineers think of this as a solution to this disaster or to mitigate the consequences?

A recent most example in this sphere of activities is the container ship MV Dali which struck Francis Scott Key bridge in Baltimore, Maryland, USA, in March 2024 after an electrical machinery failure. (NTSB May 2024). Unlike in the past, where the investigators cannot re-create an accident / incident to a certain acceptable degree with simulation, the modern-day investigators can re-create history with cutting edge technology available with new engine room and / or navigation simulators. The analysis of an incident by carefully re-creating it with available facts may lead to further possibilities that can be explored towards solutions to issues surrounding the incident.

This paper explores how engine room simulator technology can be used innovatively to re-create situations citing some well-known marine accidents that caused damages amounting to millions of dollars and loss of lives. The paper has no intention to undermine the investigation that were conducted in a very professional manner by the relevant authorities. The intention of the paper is to bring about in a publication, hitherto unexplored methodology of re-creating marine incidents/accidents through simulation and reaching new heights of marine accident investigations. It further opens new avenues for students' learning of situational awareness to take timely action to strengthen safety of ships and people on-board.

Unlike in the past now we have evidence from Voyage Data Recorder (VDR) installed on-board ships, that records the engine and rudder commands given by the Master or Pilot and responses made by the engineers in a definite timeline that can be analysed to strengthen the investigations towards an authentic outcome that will help to mitigate future incidents of similar nature.

The paper also emphasizes on the importance of the situational awareness both navigation officers and the engineer officers must share in the event of a complex issue such as the one that unfolded on the fateful night of March 2024 on board the container ship Dali sailing out of Baltimore harbour.

References

National Transportation Safety Board (2024) Marine Investigation Preliminary report DCA24MM031, Contact of Containership Dali with the Francis Scott Key Bridge and subsequent bridge collapse.

Automated Marine Sewage Treatment Plant (MSTP) Using Ultraviolet Lights for Domestic Ships in the Philippines

Rolando A. Alimen[1,*], Ernie Jay A. Teves[2], Agustin A. Bedia[3], Allan A. Roberto[4], Nerios S. Cortejo[5], and Victor Ruperto B. Jaleco[6]

[1,2,3,4,5&6]*John B. Lacson Foundation Maritime University-Molo, Philippines*
[*] *Corresponding author: rolando.alimen@jblfmu.edu.ph; Tel.: (33)336-54-49*

Keywords: marine sewage treatment plant (MSTP); ultraviolet lights; treated waste liquid; MARPOL 73/78 Annex IV Guidelines; and RA 9275 (Clean Water Act)

This prototype invention aimed to develop and design the Automated Marine Sewage Treatment Plant (AMSTP) to address the domestic ships which do not have a sewage treatment plant (STP). This AMSTP was designed based on acceptable value or standards of predetermined treated waste liquid quality as set in MARPOL (Marine Pollution) 73/78 Annex IV guidelines. This AMSTP used ultraviolet (UV) lights and a coliform sensor to monitor the waste liquid quality. The study was anchored in the theoretical frameworks of MARPOL (Marine Pollution) 73/78 Annex IV Regulation (Pollution Regulation for Sewage) and RA (Republic Act) 9275 (Clean Water Act). The study site was John B. Lacson Foundation Maritime University (JBLFMU)-Molo, Iloilo City, Philippines. The method of this study was a laboratory experiment using several samples from the AMSTP that were submitted for laboratory testing of the Engineering Department of Central Philippine University (CPU). This study was initially funded by the Department of Science and Technology (DOST)-PCIEERD for one year (2023-2024). The invention was submitted for several testing for its operation and application. Maritime and ship applications of this study will be used by domestic ships and sea-crafts in treating their disposal wastes plying Iloilo-Guimaras Strait. MARINA (Maritime Administration) will use this study to make decisions about maritime policies and regulations.

Sustainable Flow: Development of a Digital Tool to Reduce CO_2 Emissions

Heikki Koivisto [1,*] and Gholam Reza Emad [2]
[1] *Satakunta University of Applied Sciences, Finland*
[2] *Australian Maritime College, University of Tasmania, Australia*
[*] *Corresponding author: Heikki.koivisto@samk.fi Tel.:* +00-358-44-7103674

Keywords: Digitalisation, CO2 emissions, Digital tool, sustainability

Although shipping is the most energy-efficient mode of transport, however it accounts for about 3% of global CO2 emissions. Authorities predicted that if no changes are made and emissions continue to grow at current rates, by 2035 carbon dioxide emissions from the shipping sector will increase nearly by 25%. In response to demand for decarbonisation and reducing of its greenhouse gas emissions digitalisation are assigned as signpost for the future development of maritime industries. Investing in the technology and digital solutions considered to be the way to reduce the greenhouse gas emissions and to promote the green transition in maritime logistics. According to the European Commission on Green Development, digital technologies have a crucial role to play in achieving environmental goals to make the climate neutral by 2050. Digitalisation can provide unprecedented opportunities to develop sustainable and at the same time competitive business solutions for maritime industries. A key to sustainable digitalisation is to maintain a balance between human well-being, environment, and economic interests of industries. Sustainable digitalisation emphasizes on the development of digital tools to achieve environmental goals, i.e. technology as a leverage for positive environmental outcomes and sustainable development.

This paper reports on the outcomes of a pilot project that aims to utilize sustainable digitalisation to reduce the CO2 emissions of seven ports in the Central Baltic area. The 'Sustainable Flow' project's goal is to develop a digital tools for stakeholders to gradually decrease their emission to the targeted level. The project also will create a framework for energy saving and production of renewable energy in the targeted ports. The paper will elaborate on the process and challenges involved with the development of the open-source digital tool which will be publicly available on the completion of the project.

References

UN Conference on Trade and Development: Review of Maritime Transport 2024 (17.1.2025)

UN Sustainable Development Programme: Sustainable Digitalization (20.1.2025)

International Maritime Organization: 2023 IMO Strategy on Reduction of GHG Emissions from Ships

Acknowledgements

Sustainable Flow project is co-funded by Interreg Central Baltic programme for the duration of 1.5.2023 to 31.5.2026 with a budget of 3.4 m€.

Rare Procurements Related to Green Energy Sale in Vietnam Shipping Companies: Explanations from Street Level Bureaucracy Theory

Nguyen Dinh-Thuy-Huong [1,*], Nguyen Thanh-Le [2]
[1] *Vietnam Maritime University, Vietnam*
[2] *Maritime Law Education and Consultants Center, Vietnam*
[*] *Corresponding author: huongndt.hh@vimaru.edu.vn; Tel.: +84-98-352-8010.*

Keywords: Vietnam; green energy; procurement; street level bureaucracy

The green energy transition is considered globally as evident development in maritime industry. Furthermore, Vietnam engaged that toward 2050, the carbon dioxide must be cut to zero emission. Under the circumstances that the actual procurement law code has been applicable for all manners of procurement, the authors try to explain why there are rare green energy procurements in Vietnamese fleet by using the analytic framework from M. Lipsky. Therefore, the role of officers, personnel in the relationship with their shipping companies and the other stakeholders will be focused on.

Analyzing the Eco-Benefits of Innovative Hydrogen Production Methods

K.Bharathi[1]*, S.Satish Kumar[2], A.Suresh[3], S.B.Charan[4], S.Devaraj[5]
[1,2] *Associate Professor, Department of Marine Engineering AMET Deemed to be University, Kanathur, Tamil Nadu, India.*
[3] *Associate Professor, Department of Marine Engineering AMET Deemed to be University, Kanathur, Tamil Nadu, India.*
[4,5] *Student, Dedepartment of Mechanical Engineering*
Sri Venkateswara College of Engineering, Chennai, Tamil Nadu, India
* *Corresponding author: bharathieee@ametuniv.ac.in*

Keywords: Decarbonization, Energy Storage. Hydrogen production, Innovative technologies, Environmental assessment, Sustainability, Eco-benefits, Comparative analysis, Renewable energy, Green hydrogen, Carbon footprint, Life cycle assessment (LCA).

As a carbon-free fuel for a range of industrial and energy uses, hydrogen has emerged as a possible solution to the growing demand for clean energy. This study offers a thorough analysis of the environmental effects of cutting-edge hydrogen generating techniques. It starts with a summary of the technologies used to produce hydrogen today, contrasting more recent, environmentally friendly approaches like water electrolysis, biomass gasification, and photo catalysis with more traditional ones like Steam Methane Reforming (SMR). Since the widespread use of hydrogen technology needs to be in line with international sustainability targets, the significance of evaluating environmental effects is underlined. The methods of environmental impact assessments (EIAs) and life cycle assessments (LCAs), which are essential instruments for assessing the sustainability of various hydrogen production processes from the extraction of raw materials to end-use, are a major emphasis of this article. The study illustrates the trade-offs of traditional and novel approaches in terms of resource use, cost-effectiveness, carbon emissions, and energy efficiency. In order to demonstrate the practical effectiveness and ecological impact of novel approaches, case examples are incorporated. Notwithstanding the advancements, a number of obstacles and constraints are noted, such as high energy requirements, problems with scaling, and economic feasibility. In order to guarantee the long- term sustainability of hydrogen as a crucial part of the global energy transition, the paper concludes by examining future directions for developing hydrogen production technologies and highlighting the necessity of integrated solutions that combine technological advancements and renewable energy sources.

References

Althabaiti, S.A., Khan, Z., Bawaked, S.M., Al-Sheheri, S.Z., Mokhtar, M., Malik, M.A., & Narasimharao, K. (2023). PtOx-Deposited Fe_3O_4-ZnO/TiO_2 Nanocomposites for Photocatalytic Hydrogen Production under Visible Light. Journal of Environmental Chemical Engineering, 11, 110615. [CrossRef]

Amorelli T, Hernández H, Lonza L, Naumanen M, Walton J, Wietschel M. (2004) "Assessing the international position of EU's research and technological development & demonstration (RTD&D) on hydrogen and fuel cells", ESTO Publications, Joint research center, internet download: http://esto.jrc.es/detailshort.cfm?ID_report = 1298..

Antonio Scipioni, Alessandro Manzardo, and Jinyue Yan (2017) "Hydrogen Economy: Supply Chain, Life Cycle Analysis, and Energy Transition for Sustainability," (Elsevier, 2017).

Martin Wietschel, Philipp Seydel (2007) "Economic impacts of hydrogen as an energy carrier in European countries, International Journal of Hydrogen Energy" 32 (2007) 3201–3211.

R. Karthickmanoj, S. Aasha Nandhini et all. (2024) "Multi Sensor Data Fusion and Video Streaming Based Mine Safety Monitoring System Through IP", Journal of Engineering science and technology, Vol. 19 (1) pp 77 – 85.

Ayhan Demirbas (2017) "Future hydrogen economy and policy, Energy Sources, Part B: Economics, Planning, and Policy" (2017) 1556-7249.

Andreas Züttel, Arndt Remhof, Andreas Borgschulte and Oliver Friedrichs (2010) "Hydrogen: the future energy carrier, philosophical transactions of royal society", (2010) 368, 3329–3342.

K. Bharathi and M. Sasikumar, (2016) "Voltage compensation of smart grid using bidirectional intelligent semiconductor transformer and PV cell," Indian Journal of Science and Technology, vol. 9, no. 3, pp. 1–8, Feb. 2016.

R. Anto Pravin, X.S. Asha Shiny et all. (2024) "Congestion aware clustered WSN based on an improved ant colony algorithm", Measurement: Sensors, ELSEVIER, Vol.34, August 2024
K. Bharathi and M. Sasikumar, (2021) "Fuzzy-Pid controller in voltage regulation based bidirectional converter using solar energy generation", Journal of Green Engineering, vol. 11, 2021.
S.Satish Kumar, S. B. Mohan et all, (2024), "Effect of GA Based PID Controller in Bidirectional Converter", International Journal of Power Electronics and Drive System (IJPEDS), Vol.15 (3) pp no 1757-1766.
M.SasiKumar, T.Sasilatha et all (2024), "Comparative analysis of various modulation techniques for cascaded multilevel inverter by implementing P&O algorithm", Journal of Engineering science and technology (JESTEC), Vol.19 (2), pp 187-196.
K. Bharathi and M. Sasikumar, "Power flow control based on bidirectional converter for hybrid power generation system using microcontroller," Microprocessors and Microsystems, vol. 82, p. 103950, Apr. 2021, doi: 10.1016/j.micpro.2021.103950.
Dan Millison and Kee-Yung Nam (2024), "Emerging Hydrogen Energy Technology ", And Global Momentum", asian development bank NO. 96 September 2024 .
Samson Olaitan Jeje , Tawanda Marazani, Japheth Oirere Obiko ,Mxolisi Brendon Shongwe (2024), "Advancing the hydrogen production economy: A comprehensive review of technologies, sustainability, and future prospects" International Journal of Hydrogen Energy, Volume 78, 12 August 2024, Pages 642-661.
Ling, B., Wang, Z., Zhang, J., He, Y., Zhu, Y., & Cen, K. (2023). Comprehensive Comparative Analysis of Open- Loop and Closed-Loop Iodine-Sulfur Thermochemical Cycles for Hydrogen Production. International Journal of Hydrogen Energy, 48, 14941–14953. [CrossRef]
Sadeghi, S., & Ghandehariun, S. (2023). Environmental Impacts of a Standalone Solar Water Splitting System for Sustainable Hydrogen Production: A Life Cycle Assessment. International Journal of Hydrogen Energy, 48, 19326–19339. [CrossRef]
Weidner, T., Tulus, V., & Guillén-Gosálbez, G. (2023). Environmental Sustainability Assessment of Large-Scale Hydrogen Production Using Prospective Life Cycle Analysis. International Journal of Hydrogen Energy, 48, 8310–8327.
Razi, F., Hewage, K., & Sadiq, R. (2023). A Comparative Exergoenvironmental Evaluation of Chlorine- Based Thermochemical Processes for Hydrogen Production. International Journal of Hydrogen Energy, 48, 37108– 37123.
Safari, F., & Dincer, I. (2020). A Review and Comparative Evaluation of Thermochemical Water Splitting Cycles for Hydrogen Production. Energy Conversion and Management, 205, 112182.
R. Anto Pravin, X. S. Asha Shiny, V. Baby Vennila, S. Ramasamy, R. Uma Mageswari, "Adaptive Rendezvous Based Congestion Control Using Optimized Bio-Inspired Algorithm for Clustered WSN", Ingénierie des Systèmes d' Information, Vol.29, issue 6, pp 2391-2398, 2024.
Karaca, A.E., & Dincer, I. (2023). Development of a New Photoelectrochemical System for Clean Hydrogen Production and a Comparative Environmental Impact Assessment with Other Production Methods. Chemosphere, 337, 139367.
Wu, H., Alkhatami, A.G., Farhan, Z.A., AbdalSalam, A.G., Hamadan, R., Aldarrji, M.Q., Izzat, S.E., Yosif, A.A., Hadrawi, S.K., Riyahi, Y., et al. (2023). Recent Developments in Hydrogen Production: Efficiency Comparison of Different Techniques, Economic Dimensions, Challenges, and Environmental Impacts. Fuel Processing Technology, 248, 107819.
Mannaa, M.A., Qasim, K.F., Alshorifi, F.T., El-Bahy, S.M., & Salama, R.S. (2021). Role of NiO Nanoparticles in Enhancing the Structural Properties of TiO_2 and Its Applications in Photodegradation and Hydrogen Evolution. ACS Omega, 6, 30386–30400.
K. Bharathi and M. Sasikumar, "Fuzzy-Pid controller in voltage regulation based bidirectional converter using solar energy generation," Journal of Green Engineering, vol. 11, 2021.
K. Bharathi and M. Sasikumar, "Power flow control based on bidirectional converter for hybrid power generation system using microcontroller," Microprocessors and Microsystems, vol. 82, p. 103950, Apr. 2021, doi: 10.1016/j.micpro.2021.103950.
Ozbilen, A., Dincer, I., & Rosen, M.A. (2012). Life Cycle Assessment of Hydrogen Production via Thermochemical Water Splitting Using Multi-Step Cu-Cl Cycles. Journal of Cleaner Production, 33, 202–216.
Suleman, F., Dincer, I., & Agelin-Chaab, M. (2015). Environmental Impact Assessment and Comparison of Hydrogen Production Methods. International Journal of Hydrogen Energy, 40, 6976–6987
Norouzi, N. (2022). Hydrogen Production in the Light of Sustainability: A Comparative Study on Hydrogen Production Technologies Using the Sustainability Index Assessment Method. Nuclear Engineering and Technology, 54, 1288–1294.
Suresh A., Rashmi M.R., Sasilatha T.,Rajavel R, "Cascaded h-bridge multilevel inverter based d-statcom using goertzel algorithm", Journal of Engineering science and technology, Vol.18 (6) pp no 48-57, 2023.

Facilitating Greener Education and Cleaner Shipping through the Development of Novel Bespoke Micro textured Metals to Combat Biofouling in Niche Areas on Vessels

Simone Dürr [1,*], Sheelagh Conlan [1], Juan Ahuir Torres [1], Martin Sharp [1], Eddie Blanco Davis [1], Tahsin Opoz [1], Bogdan Hnatiuc [2], Simona Ghiță [2], Mihaela Hnatiuc [2], Yasin Arslanoğlu [3], Özkan Uğurlu [4], Refik Özyurt [4], Mani Jayaprakashvel [5], Radhakrishnan Muthezhilan [5], Vijayaraj Radha[5] and Cristina Dragomir [2]

[1] *Liverpool John Moores University, United Kingdom*
[2] *Maritime University of Constanta, Romania*
[3] *Istanbul Technical University, Turkey*
[4] *Ordu University, Turkey*
[5] *AMET, India*
[*] *Corresponding author: s.t.durr@ljmu.ac.uk.*

Keywords: Biofouling, Environmentally Friendly Antifouling, Maritime Education and Training (MET), Participatory Research.

Biofouling, the unwanted biological growth on ships, causes increase of fuel costs, emissions, corrosion, and transfers non-native invasive species. As a result of updated international regulations, biofouling guidelines were improved, while training for maritime personal and students became essential. The aim of the project was to determine the antifouling efficacy of novel textures and plasma in different marine environments while engaged with knowledge exchange between project partners, outside the project with a Biofouling Network and knowledge transfer to maritime education and teaching (MET). Participatory field research in the project formed the tools for the case study demonstrating training and knowledge transfer in the fields of biofouling and antifouling. The first step was a 2-day workshop using an interactive approach to gauge the average understanding, to deepen the topic and exchange knowledge between all partners. The second step was site-specific training by a specialist at the partner sites. Finally, the partners were able to transfer their knowledge to members of the Biofouling Network and to students at one of their institutions. The positive outcomes of training and knowledge exchange between partners may facilitate an opportunity to expand the approach beyond the project partners.

References

Cornwall A, Jewkes, R (1995) What is Participatory Research. Soc Sci Med 42(12):1667-1676.
Dürr S., Thomason JC (2010) Preface. In: Dürr S, Thomason JC (eds) Biofouling, Wiley-Blackwell, Oxford, UK, ppXIII-XVII.
IOC-UNESCO and GEF-UNDP-IMO GloFouling Partnerships (2024) Best Practices in Biofouling Management. Vol. 3: Biofouling prevention and management in offshore renewable energy infrastructure and construction. Paris, IOC-UNESCO and IMO. (IOC Technical Series, 174).
Nguyen T, Graham ID, Mrklas KJ et al (2020) How does integrated knowledge translation (IKT) compare to other collaborative research approaches to generating and translating knowledge? Learning from experts in the field. Health Res Policy Sys 18:35.
Poloczanska ES, Butler AJ (2010). Biofouling and climate change. In: Dürr S, Thomason JC (eds) Biofouling, Wiley-Blackwell, Oxford, UK, pp 333–348.
Roque A, Wutich A, Quimby B, Porter S, Zheng M, Hossain MJ, Brewis A (2022) Participatory approaches in water research: A review. WIREs Water 9(2):e1577.
Schultz MP, Bendick JA, Holm ER, Hertel WM (2011) Economic impact of biofouling on a naval surface ship. Biofouling 27(1):87-98.
Siqiang L, Kun H, Quanlan L et al (2024) Innovative integration of the "W + Flipped Classroom" and "B + BOPPPS" teaching models for enhanced learning outcomes. BMC Med Educ 24:1050.
Wahl M. (1989) Marine epibiosis. I. Fouling and antifouling: some basic aspects. Mar Ecol Prog Ser 58:175- 189.

Harnessing Ocean Energy: Advancing Marine Renewable Technologies for Sustainable Coastal Development

Thangalakshmi S [1, *], Sivasami K [2]

[1] *School of Marine Engineering and Technology, Indian Maritime University, Mumbai Port Campus, Maharashtra, India, ORCID: 0000-0003-4523-9210*

[2] *School of Marine Engineering and Technology, Indian Maritime University, Kolkata Campus, Kolkata, India, ORCID: 0000-0002-4576-6988*

[*] *Corresponding author: stlakshmi@imu.ac.in*

Keywords: Ocean Energy; Marine Renewable Technologies (MRTs); Sustainable Coastal Development; Wave and Tidal Energy; Offshore Energy.

Oceans worldwide contain enormous untapped energy sources in the form of waves, tides, currents, and temperature differences. This study investigates the potential of utilizing this vast ocean energy through the development of marine renewable technologies (MRTs) to promote sustainable coastal growth. It assesses the latest advancements in MRTs, such as wave energy converters, tidal turbines, ocean thermal energy conversion systems, and technologies that harness salinity gradients. The research evaluates the technical obstacles and economic feasibility of these technologies, considering factors like efficiency, dependability, cost-effectiveness, and environmental consequences. Additionally, it explores how MRTs can be incorporated into coastal infrastructure and their role in fostering resilient and sustainable coastal communities. The study underscores the significance of regulatory frameworks, global partnerships, and public education in encouraging widespread adoption of ocean energy technologies. By tackling key challenges and opportunities, this research aims to lay the groundwork for a future where clean and sustainable ocean energy significantly contributes to meeting the increasing global energy needs while safeguarding marine ecosystems and supporting the prosperity of coastal areas.

References

White, J. K. (2024). The Truth about Energy: Our Fossil-fuel Addiction and the Transition to Renewables. Cambridge University Press.

Bello, U., Livingstone, U., Abdullahi, A. M., Sulaiman, I., & Yahuza, K. M. (2021). Renewable energy transition: a panacea to the ravaging effects of climate change in Nigeria. Aceh International Journal of Science and Technology, 10(3), 182-195.

Hanspal, M. S. (2024). IMPACT OF INDIAN ENERGY POLICY ON ENVIRONMENT AND CLIMATE CHANGE: LEGAL AND POLICY INSIGHTS. Available at SSRN 5095182.

Wibisono, R. B. (2024). YOUTH-GOVERNMENT COLLABORATION IN MARITIME DEVELOPMENT: A PATHWAY TO A SUSTAINABLE JAKARTA. Jurnal Kebijakan Pemerintahan, 61-85.

Mehan, A., & Casey, Z. S. (2023). Blue Infrastructures: An Exploration of Oceanic Networks and Urban–Industrial– Energy Interactions in the Gulf of Mexico. Sustainability, 15(18), 13699.

Koumentakos, A. G. (2019). Developments in Electric and Green Marine Ships. Applied System Innovation, 2(4), 34. https://doi.org/10.3390/asi2040034

Trenberth, K. E. (2022). The changing flow of energy through the climate system. Cambridge University Press.

Ruan, X., Sun, H., Shou, W., & Wang, J. (2024). The impact of climate change and urbanization on compound flood risks in coastal areas: a comprehensive review of methods. Applied Sciences, 14(21), 10019.

Mathew, J. T., Inobeme, A., Etsuyankpa, B. M., Adetunji, C. O., Tanko, M. S., Abdullahi, A., ... & Dolapo, I. (2025). Potential of Marine Resources for Generation of Clean and Green Energy: A Path Towards Sustainable Future. In Biomass Valorization: A Sustainable Approach towards Carbon Neutrality and Circular Economy (pp. 293-313). Singapore: Springer Nature Singapore.

Majumder, M. Z. H., Shampa, M. T. A., Islam, M. A., Deowan, S. A., & Hafiz, F. (2024). Marine renewable energy harnessing for sustainable development in Bangladesh: A technological review. Energy Reports, 11, 1342-1362.

Chen, Q., & Yin, X. (2025). Sustainable Coastal Energy Development: Integrated Modeling of Renewable Energy Sources for Optimal Economic and Environmental Performance. Energy, 134504.

Simbolon, R., Sihotang, W., & Sihotang, J. (2024). Tapping Ocean Potential: Strategies for integrating tidal and wave energy into national power grids. GEMOY: Green Energy Management and Optimization Yields, 1(1), 49-65.

Jafarizadeh, H., Yamini, E., Zolfaghari, S. M., Esmaeilion, F., Assad, M. E. H., & Soltani, M. (2024). Navigating challenges

in large-scale renewable energy storage: Barriers, solutions, and innovations. Energy Reports, 12, 2179-2192.
Fernandez, J. (2024). Sustainable Energy Technologies: Advancing Renewable Energy Systems. MZ Computing Journal, 5(1), 1-19.
Ocean Engineering, M. (n.d.). Makai's OTEC projects. Retrieved February 10, 2025, from https://www.makai.com/contact-us/ . Accessed 10 February 2025
Salinity Gradient Technologies – PAMEC.Energy Association. (n.d.). https://pamec.energy/about-pamec/our- scope/salinity-gradient/. Accessed 10 February 2025
Tidal Currents - Currents: NOAA's National Ocean Service Education. (n.d.). https://oceanservice.noaa.gov/education/tutorial_currents/02tidal1.html . Accessed 10 February 2025

Artificial Intelligence based Species Identification in Underwater Ecosystems: Advancing Marine Biodiversity Monitoring

T.Sasilatha[1,*], Karthik Manoj[2], PadmaPriya[3] and Col G Thiruvasagam[4]
[1,2,,3,4] *Academy of Maritime Education and Training Deemed to be University, India*
[*] *Corresponding author: deaneeem@ametuniv.ac.in; Tel.:* +91 9444752994.

Keywords: marine resources, computer vision, image segmentation, underwater, data sets

This study promotes the exploration of marine resources and conservation in sustainable manner contributing towards Sustainable Development Goal 14. Marine ecosystem plays a crucial role in human well-being, social and economic development, and the global environmental balance that sustains life on Earth. These underwater resources will provide natural resources, including medicines, food, raw materials and energy resources. This article explores the deep neural network model for identification, classification, and monitoring of underwater species. By leveraging advanced AI techniques, the study seeks to enhance marine biodiversity detection and monitoring. The objective of this paper is to investigate the potential of vision-based object identification algorithms in underwater environments using diverse datasets. Underwater computer vision faces significant challenges, including distortion and attenuation caused by light propagation in water, as well as complex and dynamic operating conditions. Effective image segmentation and recognition models are used in the robust algorithmic design to ensure accurate and reliable species identification in the depth of 1000m below the sea levels of Arabian sea scenarios.

References

Alzayat Saleh, Marcus Sheaves, Mostafa Rahimi Azghadi - Computer vision and deep learning for fish classification in underwater habitats:A survey : 22 March 22. wileyonlinelibrary.com/journal/faf

Kristian Muri Knausg, Arne Wiklund, Tonje Knutsen Sørdalen, Kim Tallaksen Halvorsen, Alf Ring Kleiven, Lei Jiao, Morten Goodwin - Temperate fish detection and classification: a deep learning based approach : 15 December 20 https://doi.org/10.1007/s10489-020-02154-9

lshdaifat, N. F. F., Talib, A. Z., & Osman, M. A. (2020). Improved deep learning framework for fish segmentation in underwater videos. Ecological Informatics, 59, 101121.– https://doi.org/10.1016/j.ecoinf.2020.101121

Cutter, G., Stierhoff, K., & Zeng, J. (2015). Automated detection of rockfish in unconstrained underwater videos using haar cascades and a new image dataset: Labeled fishes in the wild. In Proceedings -2015 IEEE Winter Conference on Applications of Computer Vision Workshops, WACVW 2015, pp. 57–62.

Policy Aspect

The Future Training Needs for Persons Working in Remote Operation Center (ROC)

Dr Peter Sandell [1,*]
[1] *Novia University of Applied Sciences, Finland*
[*] *Dr Peter Sandell: peter.sandell@novia.fi; Tel.:* +358-50-4731222.

Keywords: STCW convention; Remote Operation Center; Simulator training, Problem Based Learning, Challenge Based Learning

This article discusses the future requirements for the training and qualifications of persons working in the Remote Operation Center (ROC) in autonomous shipping. Whether the training will be regulated by the STCW convention or whether such regulation will take place in a separate convention has not yet been specified. Based on previous research, it can be concluded that people need to understand navigation and regulations, and increasingly also have basic engineering skills and knowledge of fire protection systems and other emergency procedures. In some respects, the skills currently required of master mariners may also be abandoned and may be considered to be transferred to a land organization or shipping company. Nevertheless, they can be centralized, for example, to various commercial or legal experts in connection with the ROC. These include, for example, tasks related to cargo stowage planning and electronic transport documents, which have been the responsibility of the mates and masters on a vessel. With regard to training methods, the use of simulator training should be increased and intensified, as it provides practical training and can compensate for the lack of experience at sea. Simulator training can also increasingly be used to training relating to autonomous vessels in managing fault situations and accidents. According to the research results, two different points of view were presented: future individuals working in ROC´s should be either navigation specialists or IT engineers. Traditionally, the pedagogical models of maritime education in Finland have been based on PBL (problem- based learning), but the demands of increasing engineering competence also require the introduction of CBL (challenge based learning) models in education.

References

Ahvenjärvi, S. 2016. “The Human Element and Autonomous Ships.” TransNav: International Journal on Marine Navigation and Safety of Sea Transportation 10 (3): 517–521. doi:10.12716/1001.10.03.18.

Morariu A. R ,Tsvetkova A, Sandell, P, Salokannel J, Bolbot V , Saarni J, Isoaho J, Virtanen S. 2025. “A Challenge Based Education Framework for Autonomous Shipping. “manuscript submitted for review.

Saha, R. 2023. “Mapping competence requirements for future shore control center operators” Maritime Policy & Management, 50:4, 415-427.

Sandell, P, Salokannel J, Morariu A. R ,Tsvetkova A, Bolbot V , Saarni J, Isoaho J, Virtanen S. 2025. “Defining Challenge Based Learning and Education in the Autonomous Shipping Context”. manuscript submitted for review.

Sandell P, 2024. “Autonomous Vessels and AutoMare EduNet – National Revolution of Maritime Education in Digivisio 2030 Platform. “Proceedings of the International Association of Maritime Universities Conference in Cope Cod, AGA 24.

Seafarers Legal Position when Vessels are used for Illegal Activities against Marine Infrastructure

Dr Peter Sandell [1,*]

[1] *Novia University of Applied Sciences, Finland*

[*] *Peter Sandell: peter.sandell@novia.fi; Tel.:* +358-50-473-1222.

Keywords: Seafares Criminal Liability; Sabotage; Underwater marine cables, Anchoring, UNCLOS

Between years 2023 and 2025, there has been a significant amount of damage in both the Baltic Sea and off Taiwan, in which either gas, electricity or telecommunications marine underwater cables have suffered either severe damage or been completely cut off. The anchors of the vessels have been identified as the sole cause of these damages. The authorities of the countries bordering the Baltic Sea have started seizing vessels and imposing a travel ban on vessels crews pending investigations and possible criminal proceedings. The most recent two cases are the Eagle S vessel (registered in Cook Islands) for Finland and the Vezhen vessel (registered in Malta) for Sweden. The both incident have occured during one moth only in December 2024-January 2025.

This article focuses on these incidents off the coasts of Finland and Sweden and analyses the applicability and application of both international and national law when ships, their owners/operators and crews are suspected of sabotage, as well as aggravated interference with telecommunications. The ability of coastal states to intervene in the activities of vessels is based on both the UNCLOS Convention and national criminal law. In international waters, the provisions of international law concerning the state of necessity may also be applied, the conditions for the application of which are explained in the article. These enable the authorities to intervene in the operation of the vessel even when the vessel is outside territorial watersor economic zone. The criminal penalties for the ship's crew can be serious because of the suspicion of a serious crime. Prison sentences for such crimes are always unconditional, so the captain and crew members can face years in prison if found guilty. Shipping companies may also be sentenced to the criminal liability (liability of legal persons) for their actions, if it can be shown that the shipping company is aware of or has approved the activities. The compensation of damages is generally directed to shipowner or operator, but also seafarers liabilty for damages is an element which can be subject that arises in connection to criminal proceedings if they are found liable.

References

Bäckén, P. 2023. Svensk straffrättslig jurisdiktion på havet. Svenska Sjörettsföreningens Skriftserie nr.84. 2023. Hakapää, K. 2010. “Uusi kansainvälinen oikeus.” Talentum Helsinki 2010.

Thjoernelund M, 2009. “State of Necessity as an Exemption from State Responsibility for investment” Max Planck University, Yearbook of United Nations Law, Volume 13 2009, 423-480.

Wetterstein, P. 2024. “Balticconnector-incidenten – möjlig ersättningsskyldighet och dess förverkligande” JFT 5–6/2024 s. 516–551.

Life Skills, Technological Awareness, and Attitude of Maritime Students toward Emerging Technologies: Bases for a Proposed Academic Intervention Plan

Luis G. Evidente[1], Emeliza T. Estimo[2*]
[1]*John B. Lacson Foundation Maritime University, Philippines*
[2]*John B. Lacson Colleges Foundation, Philippines*
[*] *Corresponding author: emeliza.estimo@jblfmu.edu.ph; Tel.:* +63-947-187-9935.

Keywords: life skills; technological awareness; emerging technologies, maritime education, academic plan

In the modern digital age, the automation of shipboard operations has become increasingly prevalent, prompting leading maritime organizations such as the International Maritime Organization (IMO), International Association of Maritime Universities (IAMU), and International Chamber of Shipping (ICS) to express concerns regarding the preparedness of current and future seafarers (The Day of the Seafarer, 2023). Maritime Higher Education Institutions (MHEIs) are now tasked with equipping students not only with technical skills but also essential life skills—often referred to as "soft skills"—to navigate the challenges posed by emerging technologies and digitalization (Prajapati et al., 2017; Dimochkino, 2022; Chala & Bouranta, 2021; STCW 2010). As the maritime industry transitions toward greater automation and digital literacy, MHEIs must address the gap between technological advancements and existing curricula while preparing students to become "Global Maritime Professionals" (GMP) equipped with both technical expertise and interpersonal skills (IAMU). Understanding students' life skills and technological awareness is crucial for their professional development, highlighting the need for MHEIs to adapt their training programs to ensure that future seafarers are ready to meet the industry's evolving demands.

This study aimed to assess the level of life skills, technological awareness, and attitudes toward emerging technologies among maritime students in selected MHEIs offering the Bachelor of Science in Marine Transportation (BSMT) and Bachelor of Science in Marine Engineering (BSMarE) programs. The survey included 3552 students from seven Maritime Higher Institutions (MHEIs). Statistical tools such as Mean, Standard Deviation, One-way ANOVA, the Scheffe test, t-test for Independent Samples, and Pearson's r were used to analyze the data. The results indicated that maritime students possessed a high level of life skills, a high level of technological awareness, and a highly positive attitude toward emerging technologies. Furthermore, significant differences in life skills, technological awareness, and attitudes toward emerging technologies were observed when students were grouped according to MHEI, Program, and academic year level. The study also found a moderate positive relationship between students' life skills, technological awareness, and attitudes toward emerging technologies. These findings suggest the importance of preparing students mentally and technically for the inevitable introduction of technological innovations in the shipping industry.

References

Chala, F. M., & Bouranta, N. (2021). Soft Skills Enhance Employee Contextual Performance: The Case of the Maritime Industry. *KnE Social Sciences*, 126–138. https://doi.org/10.18502/kss.v5i9.9890

Chen, P. S.-L., Cahoon, S., Pateman, H., Bhaskar, P., Wang, G., & Parsons, J. (2018). Employability skills of maritime business graduates: Industry perspectives. *WMU Journal of Maritime Affairs*, *17*(2), 267–292. https://doi.org/10.1007/s13437-018-0140-9

dimochkino. (2022, January 21). *Life Skills: Definition, Examples, & Skills to Build | HIGH5*. HIGH5 Strengths Test. https://high5test.com/life-skills/

Prajapati, R., Sharma, B., & Sharma, D. (2017). Significance Of Life Skills Education. *Contemporary Issues in Education Research (CIER)*, *10*(1), Article 1. https://doi.org/10.19030/cier.v10i1.9875

The Day of the Seafarer 2023. (n.d.). Retrieved January 19, 2025, from https://www.martide.com/en/blog/the- day-of-the-seafarer-2023

Wagner, N., & Włochowicz, P. (2021). Attitude of employees towards emerging technologies used in intralogistics. *Procedia Computer Science*, *192*, 3184–3193. https://doi.org/10.1016/j.procs.2021.09.091

Finding Importance of Factors by Statistical Analysis of Big Data – Maritime Accidents Happened in Indian Waters

Sunil Kr Panda[1,*], Sanjeet Kanungo [2]

[1] *Indian Maritime University – Mumbai Port Campus, India*

[2] *Tolani Maritime Institute, India*

[*] *Corresponding author: skpanda@imu.ac.in; Tel.:* +91-9503800958

Keywords: Maritime accident factors; Factor Analysis; Logit regression, bibliometric, importance of factors,

This paper aspects are TECHNICAL evaluation towards sustainability.

Factor analysis of data is a part of big data analysis which is regarded as a disruptive technology used to extract valuable insights of Maritime accident data. This data analysis done in two different sets. This work consists of two sub streams, first to find the factors and later to implement the factors. Initially the bibliometric analysis done to obtain the important and often discussed factor variables. Later the involvement of these variables in real time accidents analysed and their influence is found out.

Bibliometric analysis of the big data regarding the maritime accident and incidents is carried out to find out the influential variables that has studied in the literature. A total of 5865 studies collected from Scopus were subjected to analysis. Later they were filtered to find the factors for accidents 1. capsize and sinking, 2. collision, 3. fire on board and 4. grounding of ships.

For statistical analysis of four type accidents afore mentioned total 5865 publications subjected to data filtration that obtained 641, 1902, 768 and 673 relevant literatures respectively. By using VOSviewer software factor-term relationship found and later filtered in reference to frequency of occurrences and relevance. KMO and Bartletts test provided the sampling adequacy as 0.883, 0.799, 0.906 and 0.781 respectively with significance value less than 0.001. The data subjected to factor analysis with varimax rotation. Correlation matrix in each case reveal that there exists a good correlation (value greater than 0.5) between technical factors and vessel operability standard factors, between organizational, rule, regulatory control related factors with vessel operability standard factors. After checking the KMO values data is processed for neural network analysis in multilayer perceptron, keeping 70% cases for training and rest 30% for testing. The data subjected to factor analysis with varimax rotation. The factors obtained were grouped into 9 categories (G1 to G9) such as ship related factors, cargo related factors, technical condition related factors, vessel operability factors, environment response factors, navigation and work culture related factors, human element factors, route and passage related factors and strategy and regulatory factors. The weightage of the factors found out.

Exploring Factors Influencing Workplace Wellbeing and Mental Health among Indian Seafarers

Dr.Yogamala HL[1,*] and Ms.Rincy Raju[2]
[1] *Indian Maritime University, India*

.

Keywords: *Occupational wellness, Mental Health, Workplace Well-being, Maritime Industry*

Occupational well-being is essential to maintain physical and mental health, ensure safe operations, and promote overall quality of life. However, research on the factors behind occupational health and mental well-being of Indian Seafarers is limited. The main objective of this study is to undertake a comprehensive exploration into the intricacies of occupational wellness and its consequential impact on mental well-being. This paper posits a conceptual paradigm demarcating the intricate interdependencies among constructs employing a conceptual framework to elucidate their connection, substantiated by the antecedent research and existing literature. The study revealed that the influence of social isolation, long exposure to extreme climatic conditions, heightened stress and anxiety, and multiculturalism coupled with the dearth of respite catalyzes the occupational challenges faced by maritime professionals. Findings from this conceptual scrutiny significantly impact diverse stakeholders and policymakers, notably, the Ministry of Shipping, providing them with an opportunity to enhance strategic initiatives concerning human capital addressing the dynamics of mental health.

A Study on the Linguistic Features of IMO Legal Proposals

Xiaoling Zhu [1*], Keming Ma [2], Yushan Huang[3], Qiyan Wang[4], Qizhe Wang[5]
[1] *Shanghai Maritime University, China*
Corresponding author: zhuxiaoling@shmtu.edu.cn; Tel.: +86-18930526600

Keywords: IMO Legal Proposals, Corpus, Linguistic Features, Chinese Discourse

As a means of information exchange, proposals are part of the daily work of IMO. By submitting proposals, IMO member states and related organizations can discuss relevant industry standards and legislative norms to ensure the normal operation of international shipping.

As a Category A member of IMO, China's influence on the shipping industry is deepening, and at the same time, it is also striving for greater representation in IMO. However, existing researches in China have only scratched the surface in terms of their linguistic characteristics, failing to provide a detailed and systematic stylistic analysis. Other relevant researches have reviewed the quantity and content of the proposals submitted by various countries to IMO, finding that the number of proposals submitted by China was small and there had been no contribution on some topics. In order to help China improve its proposal writing ability and enhance the visibility of the stylistic features of proposals, this paper utilizes data collection and analysis software such as Python, LancsBox, and AntConc to study the linguistic features of proposals from various countries. Three corpora are established: PRCN, a corpus of China's legal proposals submitted to IMO in the past ten years; PRCAUKA, a comparative corpus of legal proposals from five countries, namely, Canada, the United Arab Emirates and the United States, and the U.S.; and RCANC, a reference corpus from American National Corpus. The paper conducted a comparative analysis of the corpora in terms of lexical density, lexical diversity, word length, word frequency, collocation, sentence length, sentence type, sentence readability, and the use of conjunctions to rhetoric, articulation, and stylistic patterns.

It is found that the linguistic features of IMO legal proposals are as follows: first, at the lexical level, the frequency of function words in the proposals is higher, and the content words are mostly related to the legal agreements and maritime conventions; second, at syntactic level, the proposal sentences are mostly non-simple declarative sentences, and although they are shorter than sentences in RCANC, their readability score of is lower than that of RCANC; third, at the textual level, the proposals can be classified into four categories: report-based, general, information-based and comment-based. They frequently use grammatical cohesive devices such as reference and conjunction to avoid repetition, and to be more logically organized. It is hoped that these findings can provide some suggestions for improving the writing and translation quality of proposals and enhancing China's influence in IMO.

References

Baker M (1995) Corpora in translation studies: An overview and some suggestions for future research. Target. International Journal of Translation Studies 7(2):223 - 243

Butler Christopher (1985) Statistics in Linguistics. Oxford: Basil Blackwell

Fang Y (2015) A Study on Grammatical Cohesion in IMO Proposals. Dalian Maritime University, Dalian Han X (2012)

Stylistic Features of IMO Proposals. Dalian Maritime University, Dalian

Hu K (2016) Introducing corpus - based translation studies. Berlin: Springer

Hu X (2021) Corpus Stylo - statistics: Methods and Applications. Beijing: Foreign language teaching and research press

Hu Z (2017) Linguistics: A Course Book (Fifth Edition). Beijing: Beijing University Press

Huang L (2009) Exploring the Stylistic Perspective of Translation Studies. Foreign Language Teaching 30(05):104 - 108. DOI:10.16362/j.cnki.cn61 - 1023/h.2009.05.006

Jinchao Sun (2016) Reflections on the Compilation of Proposals for International Maritime Organization Meetings. Navigation Technology, November 2016, Issue 6:71 - 74

Jiang B (2014) 高质量提案对国际海事组织立法的影响力. 水运管理 (06):25 - 26+38. doi:10.13340/j.jsm.2014.06.024

M.Tadros, M.Ventura, C.Guedes Soares (2023) 国际海事组织船舶能效提案及其影响综述（英文）. Journal of Marine Science and Application (04):662 - 680

Sinclair J (1991) Corpus Concordance Collocation. Oxford University Press, New York, 31 Sun D
(2010) 国际海事组织 A 类理事国提交提案情况统计分析. 中国海事 (08):68 - 70

Sun D (2012) 2011 年国际海事组织 A 类理事提交提案分析. 中国海事 (01):61 - 62

Sun J (2018) Some consideration on the drafting of IMO meeting proposal. China Maritime Safety, 08:55 - 57. doi:10.16831/j.cnki.issn1673 - 2278.2018.08.022

Wang K, Hu X (2008) 基于语料库的翻译汉语词汇特征研究. 中国翻译 (06):16 - 21+92

Wang Yalan (2015) A Report on the Translation Practice of Adverbial Clauses in Maritime Convention Amendment Proposals. Foreign Languages Institute of Dalian Maritime University, Dalian

Xu G (2016) 为国际海事标准制定贡献“中国智慧”. 中国海事 (12):16 - 17. doi:10.16831/j.cnki.issn1673 - 2278.2016.12.005

Yalan Wang (2015) A Report on the Translation Practice of Adverbial Clauses in Maritime Convention Amendment Proposals. Foreign Languages Institute of Dalian Maritime University, Dalian

Yu Y (2021) Analysis on the Proposals Submitted by China to IMO and Associated Recommendations. China Maritime Safety, 11:64 - 66. doi:10.16831/j.cnki.issn1673 - 2278.2021.11.021

Zhang H (2017) 以提案为例探索中国海事增强国际影响力的对策 中国水运 (21):31 - 33. doi:10.13646/j.cnki.42 - 1395/u.2017.11.010

Zhou Y (2024) The Writing Standards of International Maritime Organization Document in English. China Maritime Safety, 11:66 - 69. doi:10.16831/j.cnki.issn1673 - 2278.2024.11.019.

Motivation to Work in the Merchant Fleet: Historical Determinants and Current Trends

Katarzyna Skrzeszewska [1,*], Dariusz Jellonnek [1]

[1] *Gdynia Maritime University, Poland*
[*] *Corresponding author: k.skrzeszewska@wznj.umg.edu.pl; Tel.: +48-602-330-546*

Keywords: Polish seafarers; maritime studies; seafarer profession trends

At the turn of the 20th and 21st centuries, Polish seafarers were one of the most numerous European nations working at sea. For the last several years, statistics on the number of Polish seamen have been showing a downward trend. At the same time, the size of the merchant fleet managed from Poland is at a similar level to that of the Polish state-owned merchant fleet in its heyday (1970s and 1980s). The explanation is quite simple- many seafarers, after finishing their career at sea, take up work ashore. Their unique maritime knowledge and experience make them experts in managing ships of Polish and foreign shipowners. Transferring from work at sea to work ashore and taking up a job as a ship manager or fleet operator allows to maintain unique know-how regarding fleet operation in Poland. However, the vacant positions on the ships are not filled with Polish officers. The number of students at Polish maritime universities and the percentage of graduates of maritime universities deciding to work at sea are decreasing.

The study, the results of which are presented in the article, analyzed the reasons for the previous popularity of work at sea among Poles and the reasons why this trend was reversed. To achieve the aim of the study, literature research was carried out to obtain appropriate preparation for conducting interviews with seafarers who decided to pursue a career at sea at the end of the last century. The knowledge obtained in this way about the motivation for choosing such a career path was compared with the expectations of young people currently making decisions about their future. Using a survey questionnaire, research was conducted among first-year students of the Faculties of Navigation and Mechanical Engineering of the Gdynia Maritime University. The first study took place in the fall of 2015, after less than a decade - a second study was conducted in the spring of 2024, based on the same survey questionnaire. The obtained results allowed for the formulation of conclusions regarding the reasons/motives for choosing maritime studies, students' awareness of the nature of work on modern merchant ships, as well as the perception of the role that modern seafarers play in the global and national economy. Comparison of research results indicated certain trends in the perception of the seafarer profession by the generation currently making choices about their future profession.

The research was carried out using several methods: desk research was conducted using the NVivo12 program and supported by the VOS viewer application. The interview was a structured interview in order to obtain specific information necessary to achieve the purpose of the study. The survey was conducted based on a questionnaire on the population of first-year students of the Gdynia Maritime University.

The conducted research allowed for the following conclusions to be drawn: the motivations for taking up work at sea have changed dramatically in the last quarter of a century. The reasons for working at sea at the turn of the century are now largely obsolete. Currently, most young people choosing maritime fields do not know the specifics of work at sea. The most frequently indicated motivators in both 2015 and 2024 are: the opportunity to explore the world combined with work, job security and relatively high earnings. The most important conclusion from the conducted research is that knowledge about work at sea in the minds of students is knowledge based on an older model of functioning of maritime shipping perceived in a traditional way, associated with high opportunity costs. What encouraged earlier generations to work at sea is of little importance today. At the same time, the lack of knowledge about the development of the maritime economy and new ways of using the seas and the related employment opportunities on ships is the main reason for the decreasing interest in maritime studies and the decreasing number of Polish seafarers on the global labor market.

A Framework for Continuous Improvement in Safety at Sea

German de Melo Rodriguez[1], Reza Ziarati[2], Heikki Koivisto[3], Januz Uriasz[4], Lakhvir Singh[2], Amirehsan Barzegarsedigh[2], Amir Lazempour[5], Aris Chronopoulos[6]

[1]*Faculty of Nautical Studies of Barcelona, Spain.*

* *Corresponding author: german.de.melo@upc.edu; Tel.: +00-34-627947688.*

[2] *Centre for Factories of the Future, United Kingdom*

[3]*Satakunta University of Applied Sciences, Finland*

[4]*Institute of Maritime Technology, Maritime University of Szczecin, Poland*

[5]*Centre for Factories of the Future, Sweden*

[6]*IDEC S.A., 96, Iroon Polytechniou Avenue, 18536 Piraeus, Greece*

Keywords: ISM Code, safety management, maritime accidents, port state control.

Safety is not an absolute condition or phenomena nor is it static. It evolves with human behaviour, technological advancement, and organisational practices. This paper explores maritime safety challenges, focusing on fitness for purpose versus compliance, learning from accidents, training strategies and standards, risk analysis methods, and from ship audits and inspections. This paper proposes a framework for continuous improvement in safety practices, drawing on lessons from International Safety Management (ISM) Code implementation and innovative training solutions being explored in a new EU funded project called OPTIMISM.

References

Uflaz, E., Akyuz, E., Arslan, O. and Celik, E. (2022), A quantitative effectiveness analysis to improve the safety management system (SMS) implementation on-board ship, Safety Science, 2022.

Bhattacharya, S., (2009), The Impact of the ISM Code on the Management of Occupational Health and Safety in the Maritime Industry, School of Social Sciences, Cardiff University, Ph.D. 2009.

Guidance for Auditors to the ISM Code, ACS Rec. 1996/Rev.5 2019.

Ick-soo Mok, Enrico D'agostini and Dong-keun Ryoo (2023), A validation study of ISM Code's continual effectiveness through a multilateral comparative analysis of maritime accidents in Korean waters - Paris MoU (2022). Inspection Results Deficiencies. Retrieved from: https://www.parismou.org/inspection-search/inspection-results-deficiencies

Karakasnak, M., et a., (2018), ISM Code implementation: an investigation of safety issues in the shipping industry, World Maritime University, WMU Journal of Maritime Affairs, 17:461–474, CrossMark, 2018

Ghosh, S., Abeysiriwardhane, A., (2012), The influence of information technology on the implementation of the International

Ziarati et al. (2017), Avoiding Collisions At Sea – Pareto Analysis, proceedings of IAMU, 2017

Ziarati et al. (2019), Preventing Collisions at Sea, Proceedings of IAMU (2019)

De Melo Rodriguez et al. (2024), Pareto Analysis of ISM Code Deficiencies, Proceedings of the International Association of Maritime Universities Conference, 2024.

Ziarati et al. (2024) Safety at Sea and Maritime Environment Protection with Special References to Human Factors, MT'24. 10th International Conference on Maritime Transport, Barcelona, June 5-7, 2024.

Acknowledgements

Project OPTIMISM is co-founded by the Erasmus+ program; project number: KA220-HED-FD0E6C99.

Engineering Gender Equality: Challenges and Opportunities for Women in Maritime

Gholam Reza EMAD [1,*], Saratkumar Narayanan [1] , Momoko Kitada [2], and Angelica Baylon [3]

[1] *University of Tasmania, Australian Maritime College, Australia*
[2] *World Maritime University, Sweden*
[3] *Maritime Academy of Asia & the Pacific (MAAP), Philippines*
[*] *Corresponding author: reza.emad@utas.edu.au ; Tel.:* +61-469-731-787.

Keywords: Gender equality, Maritime industry, Women seafarers, Digitalization, Seafaring

The global maritime industry, traditionally dominated by men, faces significant challenges in achieving gender equality. Reports reveal that women represent less than 2% of the global seafaring workforce (IMO 2022). This highlights barriers to recruitment, retention, and career advancement for women. The recent advancement of technology onboard ships offers the possibility to alleviate some of these barriers and provide incentive for women to pursue seagoing careers (Narayanan et al 2023; Emad, Shahbakhsh 2022). However, challenges such as safety concerns, wage disparities, cultural biases, and family responsibilities continue to hinder women's full participation in the industry. This study aims to fill existing knowledge gaps by examining what needs to be done to safeguard women's participation in maritime careers. This study utilized systematic literature review as method and analyzed the effect of factors such as the role of technology and socio- demographic influences on women's participation. The findings provide insights for fostering a more equitable and inclusive industry, contributing to global efforts toward promoting gender equality, achieving sustainable development, and creating a future-ready maritime workforce. The study aligns with the United Nations' Sustainable Development Goal 5, IMO's Women in Maritime Program, and the IAMU Tasmanian Statement, aiming to promote sustainable equitable maritime operations. The findings will assist policymakers, industry, and maritime education and training (MET) institutions, including the International Association of Maritime Universities (IAMU) members in designing and implementing strategies to ensure more women are attracted to and employed in seagoing jobs.

References

International Maritime Organization, IMO (2022). Driving Diversity in Maritime Through Data, IMO-WISTA Women in Maritime Survey Highlights Current Gender Diversity Across The Sector and Sets a Benchmark for Progress https://www.imo.org/en/MediaCentre/PressBriefings/pages/WIM-Survey-2021-report.aspx

Narayanan SC, Emad GR, Fei J (2023) Key factors impacting women seafarers' participation in the evolving workplace: a qualitative exploration, Marine Policy, 148

Emad G, Shahbakhsh M (2022) Digitalization transformation and its challenges in shipping operation: the case of seafarer's cognitive human factor. In: Katie Plant and Gesa Praetorius (eds) Human Factors in Transportation. AHFE Open Access, vol 60. AHFE International, USA, pp 6484–6690

Acknowledgements

"The materials and data in this publication have been obtained through the support of the International Association of Maritime Universities (IAMU) and The Nippon Foundation in Japan."

Integrating System Dynamics into Maritime Education for Green Shipping Corridors and Decarbonization Strategies

Marin Hero [1], Peter Vidmar [2] and Marko Perkovič [3,*]

[1] *Faculty of Maritime Studies and Transport, University of Ljubljana, Slovenia*
[*] *Corresponding author: marko.perkovic@fpp.uni-lj.si Tel.:00386-41-344-569.*

Keywords: Decarbonization, System Dynamics, Maritime Education, Container Shipping, Alternative Fuels, Slow Steaming, Regulatory Compliance, Emission Reduction

The shipping industry plays a central role in global trade. Large container ships operate on the long-haul corridors between Asia and Europe, transporting enormous amounts of cargo (UNCTAD 2023) while contributing significantly to greenhouse gas emissions. In response to climate change and increasing pressure from regulators, efforts to reduce the carbon footprint of shipping have gained momentum and led to the development of green shipping corridors — designated routes that use alternative fuels, energy efficiency measures, and advanced digital tools to significantly reduce emissions (ONCS & AIPL 2023). These initiatives are a decisive step towards sustainable shipping. However, their successful implementation requires employees with expertise in alternative fuels, voyage optimization, emissions monitoring, and operational adjustments to new regulatory frameworks.

This study examines how these new environmental and technological challenges can be effectively integrated into shipping education and training programs. A particular focus is placed on simplified System Dynamics modelling as a pedagogical tool to improve students' understanding of the complex interrelationships involved in shipping decarbonization. Using a case study of container ship transportation from Asia to Europe, the study demonstrates how simplified models can simulate fuel consumption, emissions, regulatory compliance, and economic trade-offs along these critical trade routes. By incorporating real-world scenarios, students can analyze the impact of operational decisions on overall emissions and assess the feasibility of low- carbon strategies such as slow steaming, the adoption of alternative fuels, and digital voyage optimization.

The challenge is translating these highly technical and policy aspects into engaging and practical learning experiences for maritime students to ensure they are prepared for the rapidly evolving regulatory and operational landscape. Educators can use system dynamics modelling to introduce a structured yet intuitive approach to understanding the non-linear relationships (Duggan 2016) that influence sustainable shipping practices. The study proposes a framework for incorporating interactive simulation tools into maritime education to bridge the gap between theoretical knowledge and real-world applications. The results show the importance of integrating environmental awareness, digitalization, and decision-making skills into educational programs to ensure that future maritime professionals can actively contribute to the decarbonization of the shipping industry.

References

ABS. (2023). An approach to green shipping corridor modeling and optimization. American Bureau of Shipping. Available at: https://ww2.eagle.org/en/news/green-shipping-corridor-modeling.html [Accessed 12 May 2025].

Andersson, K., & Márquez Salazar, C. (2015). *Methanol as a marine fuel*. FCBI Energy. Available at: https://www.methanol.org/wp-content/uploads/2018/08/FCBI-Marine-Fuel-Report-REVISED.pdf [Accessed 12 May 2025].

Alamoush, A.S., Ballini, F., & Ölçer, A.I. (2020). *Ports' technical and operational measures to reduce greenhouse gas emission and improve energy efficiency: A review*. Marine Pollution Bulletin, 160, 111508. https://doi.org/10.1016/j.marpolbul.2020.111508

Alfa Laval, Hafnia, Haldor Topsoe, Vestas, & Siemens Gamesa. (2020). *Ammonfuel – An industrial view of ammonia as a marine fuel*. Available at: https://www.topsoe.com/hubfs/DOWNLOADS/DOWNLOADS%20-

%20White%20papers/Ammonfuel%20Report%20Version%2009.9%20August%203_update.pdf [Accessed 12 May 2025].

Champkin, J. (2020). *Focus on fuel. Cranes Today*, 10 July. Available at: https://www.cranestodaymagazine.com/analysis/focus-on-fuel-8020451/ [Accessed 10 May 2025].

Dongqi Crane. (n.d.). *Rail mounted container gantry crane*. Available at: https://www.dqcranes.com/port-crane/rail-mounted-container-gantry-crane.html [Accessed 10 May 2025].

Duggan, J. (2016). An Introduction to System Dynamics. In System Dynamics Modeling with R (pp. 1-24). Cham: Springer International Publishing. DOI: 10.1007/978-3-319-34043-2_1.

Electricity Maps. (2025). *Live 24/7 CO_2 emissions of electricity consumption – 72-hour hourly data*. Available at: https://app.electricitymaps.com/map/72h/hourly [Accessed 12 May 2025].

Ewing, T. (2023). The real cost of net zero ports. *MarineLink*, 26 September. Available at: https://www.marinelink.com/news/real-cost-net-zero-ports-508312 [Accessed 12 May 2025].

FreightWaves Staff. (2019). Georgia Ports Authority orders 20 RTG cranes. *FreightWaves*, 9 April. Available at: https://www.freightwaves.com/news/georgia-ports-authority-orders-20-rtg-cranes [Accessed 10 May 2025].

GP Storage Containers. (2023). *Reefer container power consumption per hour: Key insights and practical tips.* Available at: https://www.gpstoragecontainers.com/reefer-container-power-consumption-per-hour.php [Accessed 10 May 2025].

International Maritime Organization (IMO). (2023). 2023 *IMO strategy on reduction of GHG emissions from ships (MEPC.377(80)). MEPC 80/17/Add.1, Annex 15*. London: IMO. Available at:
https://wwwcdn.imo.org/localresources/en/MediaCentre/MeetingSummaries/MEPC/Documents/MEPC%2080-17-Add-1%20-%20Report%20Of%20MEPC%20On%20Its%20Eightieth%20Session%20(Secretariat).pdf [Accessed 6 May 2025].

International Transport Forum. (2021). *Container port automation: Impacts and implications* (ITF Policy Papers, No. 96). OECD Publishing. Available at: https://www.itf-oecd.org/sites/default/files/docs/container-port-automation.pdf [Accessed 10 May 2025].

Jugović, A., Sirotić, M., Poletan Jugović, T., & Žgaljić, D. (2025). *Green shipping corridors: A bibliometric analysis of policy, technology, and stakeholder collaboration*. Applied Sciences, 15(6), 3304. https://doi.org/10.3390/app15063304

McBride, K., Mukai, C., & Heinze, D. (2020). Hybrid RTGs on the path to zero-emissions. *Port Technology International*, Edition 90. Available at: https://www.porttechnology.org/wp-content/uploads/2020/01/AECOM-3.pdf [Accessed 10 May 2025].

MHE Bazar. (2024). BYD 7-ton heavy duty lithium forklift truck with fast charger (ECB70B). Available at: https://www.mhebazar.in/electric-li-ion-forklift/byd-7-ton-heavy-duty-lithium-forklift-truck-with-fast-charger-7000kg-ecb70b-370 [Accessed 12 May 2025].

Nolan, S. (2024). BYD unveils EYT 2.0 electric yard tractor at IAA 2024. *EV Magazine*, 17 September. Available at: https://evmagazine.com/news/byd-unveils-eyt-2-0-electric-yard-tractor-at-iaa-2024 [Accessed 12 May 2025].

Oceans North Conservation Society & Arup International Projects Limited (2023). Canadian Green Shipping Corridors: Preliminary Assessment – Final Report. London: Arup International Projects Limited. Available at: https://arup.com (Accessed: 17 March 2025)

Pashkevich, N., Haftor, D., Karlsson, M., & Chowdhury, S. (2019). *Sustainability through the digitalization of industrial machines: Complementary factors of fuel consumption and productivity for forklifts with sensors*. *Sustainability*, 11(23), 6708. https://doi.org/10.3390/su11236708

Port of Los Angeles. (2017). *Everport Container Terminal Improvements Project Draft EIS/EIR – Section 3.5: Greenhouse Gas Emissions.* Los Angeles Harbor Department. Available at: https://kentico.portoflosangeles.org/getmedia/f5cca52c-d915-4fd0-a4ab-3d2ab1a0e061/10_everport-deis-eir_sec-3-5_greenhouse-gases_april2017 [Accessed 10 May 2025].

Port of Los Angeles Harbor Department. (2024). *The Port of Los Angeles Advanced Yard Tractor Deployment and Eco-Drive Freight Advanced Traveler Information System Drayage Truck Efficiency Project (CEC-600-2024-007).* California Energy Commission. Available at: https://www.energy.ca.gov/sites/default/files/2024-03/CEC-600-2024-007.pdf [Accessed 10 May 2025].

Ruedig, A. (2024). Guide to commercial EV charging station cost & installation. *GreenLancer*, 30 April. Available at: https://www.greenlancer.com/post/guide-commercial-electric-vehicle-charging-stations [Accessed 12 May 2025].

Saanen, Y., & Soto Pascual, G. (2020). *How smart technologies increase terminal performance*. TBA Group. Available at: https://www.konecranes.com/sites/default/files/2021-06/TBA%20Group%20-%20How%20smart%20technologies%20increase%20terminal%20performance.pdf [Accessed 10 May 2025].

Semchukova, V., Polemis, K., Abdin, Z., Solanki, B., & Cary, S. (2024). *Hydrogen infrastructure analysis for port applications*. National Renewable Energy Laboratory. Available at: https://www.nrel.gov/docs/fy25osti/91396.pdf [Accessed 12 May 2025].

Sisson, M. (2017). Electric yard tractors: Weighing the costs and benefits. *Port Technology International*, Edition 75, pp. 68–69. Available at: https://www.porttechnology.org/wp-content/uploads/2019/05/068-069_Electric_Yard_Tractors_Weighing_the_Costs_and_Benefits.pdf [Accessed 12 May 2025].

Spasić, V. (2024). GEN Energija: Krško 2 would cost at least EUR 9.3 billion at 1,000 MW. *Balkan Green Energy News*, 30 May. Available at: https://balkangreenenergynews.com/gen-energija-krsko-2-would-cost-at-least-eur-9-3-billion-at-1000-mw/ [Accessed 10 May 2025].

Terminalift LLC. (n.d.). *TL Electric Reach Stacker*. Available at: https://www.terminalift.com/listings/5003353-tl-electric-reach-stacker [Accessed 12 May 2025].

Thunder Said Energy. (2024). *Wind and solar: cost of grid interconnection*. Thunder Said Energy. Available at: https://thundersaidenergy.com/downloads/wind-and-solar-costs-of-grid-inter-connection/ [Accessed 12 May 2025].

Twidale, S. (2025). Britain considering linking with EU carbon market. *Reuters*, 20 March. Available at: https://www.reuters.com/world/uk/britain-considering-linking-with-eu-carbon-market-2025-03-20/ [Accessed 12 May 2025].

United Nations Conference on Trade and Development (2023). Trade and Development Report 2023: Growth, Debt and Climate – Realigning the Global Financial Architecture. Geneva: United Nations. Available at: https://shop.un.org/ (Accessed: 17 March 2025)

Acknowledgements

The authors acknowledge the financial support of the Slovenian Research and Innovation Agency (Grant No. L7-60164).

Regulatory Challenges and Future Directions in Cybersecurity for Maritime Autonomous Surface Ship (MASS)

Junghwan Choi [1*]
[1] *Law School, Dalian Maritime University, China*
[*] *First author: junghwanchoi@dlmu.edu.cn; Tel.:* +86-186-4080-8276

Keywords: MASS, Cybersecurity, IMO, Cyber-seaworthiness, Cyber Risk Management

The adoption of Maritime Autonomous Surface Ships (MASS) is transforming the global shipping industry, delivering operational, environmental, and safety advantages. However, this technological leap brings with it a host of cybersecurity vulnerabilities. This paper analyzes the evolving international regulatory framework for MASS cybersecurity, identifies current obstacles, and suggests policy measures for more effective governance. The discussion highlights the urgency of establishing enforceable international standards, updating legal conventions to reflect digital threats, and strengthening both risk management and insurance practices to safeguard autonomous vessels.

References

Choi, Junghwan, and Jiancuo Qi (2023) "Regulating Cyber Security of Maritime Autonomous Surface Ship: New Challenges and Improvements. JE Asia & Int'l L. 16. https://doi.org/10.14330/jeail.2023.16.2.02

IMO Doc. MSC-FAL.1/Circ.3/Rev.1. Guidelines on Maritime Cyber Risk Management. https://wwwcdn.imo.org/localresources/en/OurWork/Facilitation/Facilitation/MSC-FAL.1-Circ.3-Rev.1%20-%20Guidelines%20On%20Maritime%20Cyber%20Risk%20Management%20(Secretariat).pdf

BIMCO (2022). The Guidelines on Cyber Security Onboard Ships. https://www.bimco.org/about-us-and-our-members/publications/the-guidelines-on-cyber-security-onboard-ships

IMO Doc. MSC 98/23/Add.1. https://wwwcdn.imo.org/localresources/en/OurWork/Security/Documents/Resolution%20MSC.428 (98).pdf.

Directive (EU) 2016/1148 of the European Parliament and the Council of 6 July 2016. Concerning Measures for a High Common Level of Security of Network and Information Systems across the Union. https://eur-lex.europa.eu/ legal-content/EN/TXT/PDF/?uri=CELEX:32016L1148&rid=2.

BIMCO, Cyber Security Clause 2019. https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/cybersecurity-clause-2019.

Choi, Junghwan and Sangil Lee(2022). Legal Status of the Remote Operator in Maritime Autonomous Surface Ships (MASS) under Maritime Law,52 (4) Ocean Dev. & Int'l L. 446. https://doi.org/10.1080/00908320.2022.2036276.

Social Aspect

Navigating Beyond Borders: Cultivating Affective Competencies in Future Global Maritime Professionals through Study Away Programs

Paul Szwed [1], Matthew Rooks [2], and Gregory Sholdt [2*]
[1] *Massachusetts Maritime Academy, USA*
[2] *Kobe University Graduate School of Maritime Sciences, Japan*
[*] *Corresponding author: gsholdt@maritime.kobe-u.ac.jp; Tel.: +81-78-431-6266.*

Keywords: Maritime Education and Training (MET), Learning Outcomes Assessment, Affective Domain, Cultural and Diversity Awareness, International Study

Preparing our students to become future global maritime professionals necessitates innovative programs fostering the competencies outlined in the *Global Maritime Professional Body of Knowledge* (2019). These competencies span the cognitive, affective, and psychomotor domains, yet maritime education and training (MET) has historically centered on cognitive outcomes, while focus on affective and psychomotor learning is still emerging. Recognizing the interdependence of all three domains (e.g., Clark & Fiske, 1982), this study examines affective learning development through a three-week short-term study tour involving students from a U.S. maritime academy visiting a Japanese MET institution (Sholdt & Rooks, 2024). The program included classroom activities, lectures from expert researchers, industrial site visits, cultural experiences, and cross-cultural engagement. U.S. students aimed to enhance cultural awareness, maritime knowledge, and leadership, while the host Japanese students sought to develop their English communication skills, gain valuable intercultural experience, and explore new perspectives of their field. For the U.S. students, learning was assessed using a variety of techniques. Affective learning was assessed using pre- and post-testing of cultural intelligence (CQ), including the following capabilities: "drive" (affective openness), "knowledge" (cognitive understanding), "strategy" (meta-cognitive preparation), and "action" learning (behavioral adaptation) (Ang, van Dyne, Rockstuhl, 2015). Results indicated significant learning gains. In particular, students' gain in affective CQ "drive" was most notable (see figure 1 – the steepest slope indicates the strongest gain, where almost two-thirds of the variation is explained by linear best fit, R^2=0.6414). Qualitative analysis of reflection papers and reaction data from participants also demonstrates significant positive gains in affective learning for both the U.S. and Japanese students. This paper also highlights the transformative role of "study away" programs – educational experiences outside students' standard environments (Namaste & Sturgill, 2020) – in fostering competencies across learning domains. Recommendations are offered to support MET curricula seeking to implement similar programs in advancing the development of global maritime professionals, particularly in the area of affective learning.

References

Ang S, van Dyne L, & Rockstuhl T (2015) Cultural intelligence: Origins, conceptualization, evolution, and methodological diversity. *Handbook of Advances in Culture and Psychology*, 273-323.

Clark M & Fiske T (1982) *Affect and cognition*. Erlblum: Sussex.

International Association of Maritime Universities (2019) *Global Maritime Professional Body of Knowledge.* IAMU: Tokyo.

Namaste N & Sturgill A (2020) *Mind the gap: Global learning at home and abroad*. Routledge, Taylor, & Francis: New York.

Sholdt G & Rooks M (2024) Developing a short-term study tour program: Maximizing benefits for host university students. *Proceedings of the International Association of Maritime Universities Conference*, Buzzards Bay, MA USA, 91-96.

What Competencies will be Required of Global Maritime Professionals in the Next Five Years?

Paul Szwed [1*], Cassia Bömer Galvão [2], Srđan Vujičić [3], Wang Huanxin [4], Mahmoud El Sayed El Baowab [5], and Gamal ahmed Galwash [5]

[1] *Massachusetts Maritime Academy, USA*
[2] *Texas A&M University at Galveston, USA*
[3] *University of Dubrovnik, Croatia*
[4] *Dalian Maritime University, China*
[5] *Arab Academy of Science, Technology and Maritime Transport, Egypt*
[*] *Corresponding author: pszwed@maritime.edu, Tel.: +1-508-830-5000*

Keywords: Global Maritime Professional, Competencies, Digitalization, Decarbonization, Diversity

Theme: Policy Aspect

Purpose: The purpose of this study was to identify the most important competencies of global maritime professionals for the next five years.

Methods: A survey was developed based upon the previous survey used in creating the original *Global Maritime Professional Body of Knowledge, 2019*. It was updated based upon an extensive review of the literature since the original survey was conducted in 2018. The online survey was administered via email to approximately 700 potential respondents (including those at all 79 IAMU member universities and all 88 of the non-governmental organizations with consultative status at the International Maritime Organization) in February to April 2024.

Results: 239 surveys were returned. 190 surveys were usable, after removing duplicates and partially completed responses. This represents an approximate response rate of 46.4% from IAMU members and 7.5% from IMO NGOs. Competencies such as decision making, critical thinking, and lifelong learning were consistently rated as most important. Adaptability and resilience emerged as a new competency from the previous survey. See table 1 for a summary of the survey results. Four methods were used to rank the competencies – average rating, percentage rated above respondent's modal rating, percentage rated as absolutely important, and percentage rated as at least important. It should also be noted that rankings resulting from these four methods are highly correlated ($\rho>0.95$). Additionally, there were no significant statistical differences among any of the demographic groups.

Conclusions: The basic competencies for global maritime professionals have remained relatively stable, at least from when originally identified in 2018 until now. Competencies vary slightly depending upon which "mega-trend" context was considered (digitalization, decarbonization, or diversity). Additionally, emphasis should be roughly equally devoted to developing outcomes in the affective, cognitive, and psychomotor domains. The results of this survey will be used to inform the revision of the focus areas in the second edition of the Global Maritime Professional Body of Knowledge. Additionally, MET universities and other training providers may find the results useful as they adjust their programs to prepare global maritime professionals for the future.

Understanding the Concept of Safe Distance in Maritime Navigation: Insights from Simulator-Based Training of Fresh Navigators

Pawel Kolakowski [1,*], Kamil Formela [1] Filip Bojić [2], Mislav Maljković[2] and Lea Vojković [2]

[1] *Gdynia Maritime University - Faculty of Navigation, Poland*
[2] *University of Split - Faculty of Maritime Studies, Croatia*
[*] *Corresponding author: p.kolakowski@wn.umg.edu.pl; Tel.: +48585586112*

Keywords: COLREG, Safe Distance, MET, Human Factor, Ships Bridge Simulator

Safe distance is a fundamental concept in maritime navigation, directly impacting the safety of vessel operations. This study aims to investigate how novice navigation students, trained in the International Regulations for Preventing Collisions at Sea (COLREG) but lacking practical experience, interpret and apply the concept of safe distance. Conducted at two European Maritime Universities - Gdynia Maritime University (Poland) and University of Split (Croatia), the research employs bridge simulator exercises to evaluate performance in crossing and head-on scenarios. Participants were divided into two groups: one with full autonomy to interpret safe distance and another required to adhere to a procedural guideline. Results indicate significant differences in decision-making behaviors between groups, revealing how procedural constraints influence adherence to safety protocols. Additionally, cultural and institutional variations in training appear to affect students' interpretation and application of the rules.

This research is valuable for maritime educators, regulatory bodies, and safety practitioners. It provides actionable insights into the effectiveness of current training programs and their alignment with real-world expectations. By exploring how young navigators perceive and adapt to procedural requirements, this study contributes to the broader understanding of human factors in maritime safety. The findings underscore the importance of balancing theoretical knowledge with adaptive practical skills in navigation training. Future work will explore longitudinal impacts and adaptive behaviors in real- world contexts.

Enhancing Standardized VTS Communication Skills through Digital Educational Tools

Zorica Đurović [1,*] and Milena Dževerdanović Pejović [2]
[1] *University of Montenegro, Faculty of Maritime Studies Kotor, Montenegro*
[2] *University of Montenegro, Faculty of Maritime Studies Kotor, Montenegro*
[*] *Corresponding author: zoricag@ucg.ac.me; Tel.:* +382-69-381-531.

Keywords: communication, digital education, instructional videos, VTS, DigiMar

The safety of navigation is highly dependent on human factors, which are significantly influenced by the effectiveness of communication. Recognizing this, the maritime industry has long pursued standardization in communication protocols to ensure consistency across the global maritime domain. However, routine maritime exchanges between shore-based service operators and ship crews frequently deviate from these standardized protocols (Bostrom 2020, Dževerdanović Pejović 2013, Jurkovič 2022, Brcko Satler and Jurkovič 2024). This challenge resulted in an international collaborative ERASMUS+ project titled *Digital Education for Maritime Communication* (DigiMar) involving Maritime English instructors and maritime safety agencies.

One of the project outcomes has been the development of 20 open-access instructional videos designed for Vessel Traffic Service (VTS) operators. These videos are categorized into five sections: Introduction, Establishing the Context, VTS Phraseology, Clarity of Speech, and Ambiguity. In response to recommendations from maritime safety agencies, additional case study videos are currently in development. To enhance accessibility and usability, the videos are accompanied by scripts, facilitating their integration into both higher education curricula and professional training programs. External users participated in the evaluation process, and the materials have been made publicly available.

The project has highlighted numerous challenges and inconsistencies in the application of standard maritime communication protocols. While the instructional videos adhere to the guidelines set by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), the International Telecommunication Union (ITU), and the Standard Marine Communication Phrases (SMCP), these standards—established decades ago—require reconsideration in light of contemporary operational realities.

Furthermore, the development of digital educational materials required balancing protocol adherence with pedagogical, practical, and technological considerations. The instructional videos were designed to be concise, fostering language economy in external VHF communications between VTS operators and ship crews. Each video integrates phonetic, lexical, pragmatic, and cognitive elements, ensuring both linguistic precision and pedagogical effectiveness for learners across different geographical regions.

The overarching objective of the project is to address linguistic, cultural, and technological challenges involved in standardizing VHF communication. One of the anticipated final outcomes is the formulation of recommendations for the revision and further harmonization of existing maritime communication protocols. In the next phase, the project will focus on the development and evaluation of open-access speech-recognition-based maritime communication chatbots, further advancing the digitalization of maritime communication training and practice.

References

Boström M (2020) Mind the Gap! A quantitative comparison between ship-to-ship communication and intended communication protocol. Safety Science, 123, 1-8. https://doi.org/10.1016/j.ssci.2019.104567.

Brcko Satler T and Jurkovič V (2024) Solving maritime communication challenges with Digimar: A practical approach, 10th International Conference on Maritime Transport, Barcelona, June 5-7, 2024.

Dževerdanović-Pejović M (2013) Discourse of VHF communication at sea and the intercultural aspect. International Journal of Traffic and Transportation Engineering, 3(4), 377- 396. https://doi.org/10.7708/ijtte.2013.3(4).03 .

Jurkovič, V. (2022). Authentic Routine Ship-Shore Communication in the Northern Adriatic Sea Area – a corpus analysis

of discourse features. English for Specific Purposes, 68, 47–59.

Acknowledgement

This research is co-funded by the ERASMUS+ Program of the European Union.

Fostering Gender Equality in Maritime Innovation: Economic Growth and Sustainable Development

Dr.Deepa Rajesh [1,*], Dr.R.Vettriselvan [2] and Col. Dr. G. Thiruvasagam [2]

[1] *Academy of Maritime Education and Training (AMET Univeristy), Chennai, India*
[*] *Corresponding author: vettriselvan.r@ametuniv.ac.in; Tel.: +91-9788161399.*

Keywords: Gender Equity, Maritime Innovation, Economic Growth, Sustainable Development, Women Empowerment

The shipping industry is one of the most important elements of the global economy as it performs a large part of the world's commerce and carries the freight. There are however challenges that the sector is grappling with at the moment with regards to sustainability, environmental impact as well as technological change. The effects of traditional gender roles regarding inform or "silent" disruption to industries have been mostly missed out on. This paper focuses on how policies for gender equality in the maritime sector can in turn lead to innovation as well as economic development in a sustainable model. Though the demand for cleaner technologies has been increasing to counter straining environmental issues, the percentage of women in the maritime industry is extremely low and their involvement in leadership positions, R&D and innovation is also minor. This gender gap is seen as a very missed opportunity in enhancing the outcomes of the industry as well as practices that are sustainable. By analyzing existing global policies and frameworks that aim to promote gender equality, the paper demonstrates that increasing women's participation in the maritime sector not only fosters a more diverse and inclusive workforce but also accelerates the development and adoption of sustainable maritime technologies. The first section of the paper focuses on the importance of gender-inclusive policies that encourage women's involvement in maritime education, research, and innovation. Access to equal opportunities in these areas has the potential to enhance creativity and innovation, which are crucial for solving the industry's pressing environmental issues. Policies that support women's entrepreneurship in maritime innovation, as well as those that promote their leadership in decision-making roles, can help shape a more resilient industry that is better equipped to address challenges such as climate change, resource depletion, and pollution. The second section examines how gender equality directly impacts economic growth within the maritime sector. Inclusive leadership fosters an environment where diverse perspectives contribute to more comprehensive and effective solutions. The involvement of women in the development of green technologies, such as eco-friendly vessels and energy-efficient systems, can drive new economic opportunities and create sustainable job growth. By increasing women's representation in the maritime workforce, the industry benefits from a broader pool of talent, enhancing its capacity to innovate and adapt to changing market demands. Furthermore, the paper highlights the role of women in driving the transition to sustainable practices. Gender equality not only enhances operational efficiency but also encourages the development of policies that align with the United Nations' Sustainable Development Goals (SDGs). Women are often at the forefront of environmental advocacy and can play a pivotal role in ensuring that technological advancements in the maritime industry are aligned with global sustainability objectives. As such, fostering gender equality is not only a matter of social justice but also a strategic approach to achieving the industry's sustainability goals. In conclusion, this paper argues that integrating gender equality into maritime innovation and leadership is a key driver for achieving long-term economic and environmental success. By removing barriers to women's participation in the maritime industry and promoting inclusive policies, the sector can unlock new pathways for innovation, economic growth, and sustainability. The findings suggest that gender-inclusive approaches are essential for creating a more equitable, prosperous, and sustainable maritime industry that is prepared for the challenges and opportunities of the future.

Implementation of Advanced Learning Methods in Maritime Education through the UniTrain System for Enhancing the Teaching Practices of Process Measurement Variables

Ilija Knezevic [1, *], Nikola Marvucic [1], Nemanja Pudar [1], Ivana Cavor [1] and Tatijana Dlabac [1]

[1] *University of Montenegro, Faculty of Maritime Studies Kotor, Kotor, Montenegro*
[*] *Corresponding author: ilijak@ucg.ac.me; Tel.:* + 382 32 303 184

Keywords: process measurements, education, learning methods, Electro-Technical Officers

Onboard ships, many process measurement variables (PMV) are continuously performed and supervised, and they are essential for the control and monitoring of different ship's systems. Monitoring parameters which are involved in these measurements are temperature, flow, level, pressure, speed, mass, density, etc. Each PMV requires the application of appropriate process sensors (PS) and measuring equipment to ensure accurate and reliable monitoring of fundamental ship processes. A proper understanding of the functionality and operating principles of these PS, as well as the technologies used for their integration and data processing, is crucial for the education of future Electro-Technical Officers (ETO) and Marine Engineers (ME).

The modern maritime industry requires the integration of advanced learning methods into educational processes to enable students to acquire essential practical knowledge alongside theoretical foundations. In this context, the use of sophisticated laboratory and simulation tools, such as the Lucas Nülle UniTrain System (UTS) for Temperature/Pressure/Force (TPF) measuring processes, represents a significant step forward in modernizing the teaching practice of process measurements. On this way, students have opportunity to work with experimental modules that include the calibration of an instrumental amplifier, analysis of errors in temperature measurements, operation with various temperature sensors (NTC, Pt100, KTY, thermocouple), as well as the use of strain gauges and the Wheatstone bridge (WB) for force and torque measurements and analysis.

The paper provides a detailed presentation of the laboratory exercises conducted on the UTS, including measurement methods and results analysis, which contribute to a better understanding of the calibration process, implementation and the characterization of various PS. Additionally, the paper presents an overview of the Basic Process Measurements (BPM) that are monitored onboard for the purpose of managing fundamental ship processes, establishing a direct connection between theoretical foundations, laboratory experiments, and real-world applications in the maritime industry.

References

Dunn, W. C. (2006). *Introduction to Instrumentation, Sensors, and Process Control*. Artech. https://ieeexplore.ieee.org/abstract/document/9100842/

Fraden, J. (2016). *Handbook of Modern Sensors*. Springer International Publishing. https://doi.org/10.1007/978-3-319-19303-8

Koprivica, B., Milovanovic, A., & Dlabac, T. (2018). An approach to cold junction compensation and identification of unknown thermocouple type. *Revue Roumaine Des Sciences Techniques - Serie Électrotechnique et Énergétique*, *63*, 277–282.

Sen, P. C. (2021). *Principles of electric machines and power electronics*. John Wiley & Sons.

Traditional methods to determine the ships' position and Navigation Safety

Prof. Dr. Capt. Igor Vorokhobin, Director of the Institute of Navigation NU OMA
Prof. Dr. Capt. Igor Burmaka, Head of Ships handling Department, Institute of Navigation, NU OMA
PhD, Associated Professor, Volodymyr Sikirin, Head of Navigation Department, Institute of Navigation, NU OMA
Capt. Dmytro Zhukov, Senior Lecturer, NUOMA

National University "Odessa Maritime Academy"

Odessa, 65052, Ukraine

vorokhobin@onma.edu.ua, burmaka1964@gmail.com, sikirin.v@gmail.com, dsz@onma.edu.ua

Keywords: Navigation safety, STCW Convention, MET, celestial navigation

The Russian-Ukrainian military conflict has shown the vulnerability of ship electronic navigation systems used in navigation. The Global Positioning System (GPS) may incorrectly display the vessel's coordinates both due to blocking of satellite signals by means of electronic warfare and due to cyber-attack, spoofing attack on the satellites themselves. The Electronic Cart Display Information System (ECDIS) coupled with the GPS will also incorrectly display the vessel's position and area around. The same problems we can occur with Automation Information System (AIS) data. Therefore, proper training of future navigation officers in traditional methods of determining the ship's position is gaining new momentum. The STCW Code includes celestial navigation, visual methods of determining the vessel's position and dead reckoning among the mandatory competencies for officer in charge of a navigational watch:

- Celestial navigation – Ability to use bodies to determine the ship's position
- Terrestrial and coastal navigation – Ability to determine the ship position by use of: landmarks, aids to navigation, including lighthouses, beacons and buoys, dead reckoning, taking into account winds, tides, currents and estimated speed.
- Thorough knowledge of and ability to uses nautical charts, and publications, such as sailing directions, tide tables, notices to mariners, radio navigational warnings and ship's routing information.

However, the sextant, as the main instrument of celestial navigation, is not a mandatory navigational instrument according to the SOLAS Convention. The widespread use of ECDIS has led to the fact that junior deck officer cannot determine the ship's position using traditional navigation methods.

The article considers to the possibility of adapting traditional navigation methods (celestial and visual) for use in modern conditions without GPS information and training cadets/students for work on such equipment.

References

STCW Convention, www.imo.org

Miyusov, M., Zhukov, D. MET in Ukraine in time and after of Russian invasion
Proceedings of the International Association of Maritime Universities Conference, 2022, http://archive.iamu- edu.org/wp-content/uploads/2023/11/AGA22_Proceedings_IAMUC_2022.pdf

"National Risk Estimate: Risks to U.S. Critical Infrastructure From Global Positioning System Disruptions," Department of Homeland Security, 2011, https://rntfnd.org/wp-content/ uploads/DHS-National-Risk-Estimate-GPS-Disruptions.pdf

AIS data from a maritime risk analytics company, Confidential Source.

Reforming the Nautical Sciences Curriculum for Future Maritime Needs

Klaas De Hert

Antwerp Maritime Academy, Belgium Klaas.de.hert@hzs.be; Tel.: +32-03-205-6430.

Keywords: curriculum reform; maritime education; maritime industry; MET

The Antwerp Maritime Academy conducted a survey to evaluate the current Nautical Sciences curriculum in light of emerging industry trends and disruptive technologies. The survey employed a mixed-methods approach, combining quantitative and qualitative data collection techniques. Participants were asked to complete structured questionnaires that included both closed-ended and open-ended questions, designed to capture their insights on key industry challenges, curriculum relevance, and future training needs. Engaging a wide range of stakeholders—including industry representatives, alumni, and former students—through direct mailing, alumni networks, and social media, the study aimed to align the curriculum with future demands and ensure relevance in a rapidly evolving maritime sector.

Quantitative findings highlighted the necessity for well-trained nautical professionals equipped with soft skills and the ability to address challenges such as cybersecurity, remote shipping technologies, artificial intelligence, and alternative fuels. For instance, stakeholders emphasized the critical need for comprehensive training in cybersecurity protocols to combat increasing threats to shipboard systems. Additionally, the growing adoption of remote shipping technologies was cited as requiring officers to develop advanced technical skills for operating and maintaining autonomous or semi-autonomous vessels. Finally, the shift toward alternative fuels, such as LNG and hydrogen, was highlighted as a pressing issue, necessitating in-depth knowledge of new propulsion systems and their environmental impacts. Qualitative analysis of stakeholder input emphasized the importance of interdisciplinary learning, practical training, and adaptability in maritime education.

The insights gained from this study will serve as the foundation for a strategic curriculum reform, with a focus on defining "learning pathways" to create a future-proof program. These learning pathways will be designed to integrate core technical competencies, such as advanced navigation and engineering skills, with cross- disciplinary modules on emerging technologies like artificial intelligence and alternative fuels. Additionally, they will emphasize the development of soft skills, such as leadership, communication, and adaptability, to prepare students for dynamic maritime roles. Preliminary ideas for these pathways include tailored tracks for sustainability, autonomous systems operation, and cybersecurity specialization, ensuring that graduates are equipped to address industry-specific challenges effectively. This initiative aligns with the broader objective of sustainable maritime practices by equipping graduates to navigate the technological and environmental disruptions shaping the industry's future. By integrating key elements of the International Maritime Organization's sustainability goals, such as reducing greenhouse gas emissions and promoting energy efficiency, the reformed curriculum will actively contribute to global efforts in achieving sustainable shipping.

E-Learning in Maritime Education, Challenges and Opportunities: Case Study of the Black Sea Countries

Tkhilaishvili Guladi[1], Tchanidze Ketevan[1], Loria Manuchar[1], Dumbadze Sopiko[1], Dzneladze Teona[1]

[1] *Batumi State Maritime Academy, Georgia*

* *Guladi Tkhilaishvili: g.tkhilaishvili@bsma.edu,.ge, Tel.:* +995 591 00 52 92

Keywords: *E-Learning, Maritime Education, Digitalization, AI, VR and AR implementation.*

The article deals with the challenges and opportunities of implementing electronic learning (E-Learning) in maritime education on the case study of the Black Sea countries (Georgia, Bulgaria, Romania, Turkey and Ukraine). In general, E-Learning offers flexible and innovative learning methods that contribute to the modernization of maritime education. The research focuses on digital transformation, innovative teaching methods (Virtual Reality VR, simulation technologies and Augmented Reality AR), electronic platforms, quality assurance, cyber security, big data analysis and artificial intelligence (AI) in E-Learning.

The objective of the study is to evaluate the challenges and opportunities of implementing e-learning in the maritime sector. The research includes a comparative analysis of best practices in higher education institutions of the Black Sea countries to identify effective strategies for successful integration of E-Learning.

The research methodology is complex and includes a literature review, quantitative and qualitative data analysis. Data collection through online surveys, focus groups, and best practice analysis. SWOT, TOWS, and a comparative and in-depth analysis are conducted as well.

The research revealed that the main challenges in the implementation of E-Learning are the lack of technological infrastructure, staff training, digital competencies of students and quality control mechanisms. At the same time, the research identified significant opportunities related to the use of E-Learning to improve the quality of maritime education, increase accessibility and introduce innovative methods.

The conclusions and recommendations of the research aim to promote the modernization of maritime education and train qualified personnel. The study also provides valuable information to educational institutions, policy makers, and industry representatives in developing strategies for effective e-learning implementation.

References

Gagnidze, I. (2019). Digital Platforms in Maritime Education: Enhancing Collaborative Learning. Journal of Maritime Studies, 12(3), 45-58.

Mallam, S. C., Nazir, S., & Renganayagalu, S. K. (2019). Rethinking Maritime Education, Training, and Operations in the Digital Era: Applications for Emerging Immersive Technologies. Journal of Marine Science and Engineering, 7(12), 428. https://doi.org/10.3390/jmse7120428

Narleva, K., & Gancheva, Y. (2023). The Role of Maritime Education in Digitalization. Pedagogika- Pedagogy, 95(6s), 132–140. https://doi.org/10.53656/ped2023-6s.12

Scanlan, J., Hopcraft, R., Cowburn, R., Trovåg, J. M., & Lützhöft, M. (2022). Maritime Education for a Digital Industry. Maritime Safety Innovation Lab. Retrieved from https://maritimesafetyinnovationlab.org/wp-content/uploads/2022/08/Maritime-Education-for-a-Digital- Industry.pdf

Sharma, S. (2021). Impact of Emerging Technologies on Maritime Education and Training. [Master's thesis, World Maritime University]. WMU Dissertations. https://commons.wmu.se/cgi/viewcontent.cgi?article=3256&context=all_dissertations

Tchanidze, K. (2020). Simulation-Based Learning in Maritime Training: A Case Study. Maritime Education Research Journal, 8(2), 123-137.

Tkhilaishvili, G. Loria, M. (2022). From Enterprise Resource Planning (ERP) to Universities Resource Planning (URP). Proceedings of the International Association of Maritime Universities Conference. ISSN:2706-6754 E-ISSN:2706-6762 https://www.scopus.com/sourceid/21101125509?origin=resultslist

Reading between the Waves: Improving Maritime English Comprehension through Innovative Teaching Strategies

J Christalin Janet[1] and C.Vairavan[2]

[1]*Research Scholar, Department of English, Academy of Maritime Education and Training Deemed to be University, Kanathur, Chennai, India, christalinjanet@gmail.com*

[2]*Associate Professor, Department of English, Academy of Maritime Education and Training Deemed to be University, Kanathur, Chennai, India vairavaneng@gmail.com*

Keywords: Maritime English, Reading Comprehension, Vocabulary Acquisition, Authentic Materials, Statistical Analysis

Maritime English proficiency is a crucial skill for Nautical Science cadets, as it ensures effective communication and operational safety in international shipping. However, many students struggle with reading comprehension and specialized maritime vocabulary due to the technical nature of maritime discourse. This study, conducted at AMET University, investigates the effectiveness of using maritime magazine news articles as an instructional tool to enhance reading comprehension and vocabulary acquisition among cadets. Initially, 320 students were assessed, and based on performance, 80 students with the lowest scores were selected for the study. A pre-test was conducted to measure their baseline comprehension and vocabulary proficiency. The intervention phase involved an eight-week instructional program integrating maritime magazine news articles, followed by structured reading activities, discussions, and vocabulary exercises. After the intervention, a post-test was administered to evaluate improvements. The collected data was analyzed using SPSS software, employing statistical measures such as mean, mode, standard deviation, variance, and a paired-sample t-test to determine the significance of the results. The findings revealed a substantial improvement in reading comprehension and vocabulary acquisition, with the mean post-test scores significantly higher than pre-test scores (p-value < 0.001). Additionally, qualitative feedback from students indicated increased confidence and engagement with maritime texts. The study underscores the importance of integrating real-world maritime materials into language instruction and recommends adopting authentic industry resources to enhance English proficiency among maritime students. The results advocate for a curriculum shift toward contextualized learning approaches, leveraging industry-relevant texts to bridge the gap between theoretical knowledge and practical application.

Maritime Education in a Rapidly Changing Arctic

Steven Baer [1,*], Salman Nazir [2] and Kent Salo [3]

[1] *Maine Maritime Academy, USA*

[2] *University of Southeastern Norway, Norway*

[3] *Chalmers University of Technology, Sweden*

[*] *Corresponding author: steven.baer@mma.edu; Tel.:* +1 207-380-7469

Keywords: Arctic; curriculum; pedagogy; STCW;

Climate change is causing rapid, accelerating, and potentially permanent reductions in Arctic sea ice, with most of the Arctic Ocean predicted to have only small regions of multiyear ice remaining by the summer of 2050 (Jahn et al., 2024). It is likely that the Arctic will become seasonally navigable before the end of the decade as observations of sea ice consistently show more intense melting than even the most dire models (Cao et al., 2022). As the Arctic becomes "ice-free" in the coming decade, polar shipping routes will become viable between Asia and the east coast of the United States, along with Europe (Melia et al., 2016), saving shipping companies more than 3,000 nm and up to two weeks of travel time, with all the attendant fuel and labor cost savings. Along the Siberian coast, maritime traffic has already allowed large LNG facilities to utilize sea routes in the Kara Sea. Shipping through the Norwegian EEZ has increased by >40% in the past decade (Berkman et al., 2022). Even so, ships and mariners must still be able to deal with low temperatures and sea ice, in addition to high winds and related wave heights, low visibility and shallow, stochastic bathymetry (Aksenov et al., 2017; Ghosh and Rubly, 2015; Wang et al., 2022). Outside of Russia, most Arctic nations have a small number of aging icebreakers, and there is limited infrastructure and emergency response capabilities in the region.

There are limited pedagogical approaches to Arctic maritime navigation, ecological sciences, and socioeconomic (i.e. business, legal, political, ethical) concerns. Outside of Russia, there are very few training programs for future Arctic mariners, despite STCW guidelines stating the need for specialized ice navigators, who have "the knowledge, the understanding and proficiency required for operating a ship in Arctic ice-covered waters". We will present on our research into using common best practices and curricular approaches to a navigable Arctic. This includes use of classroom tools and ship simulators, along with educational modules that cover the sociopolitical and environmental issues that will arise when ships start taking advantage of an open Arctic Ocean.

References

Aksenov Y, EE, Yool A, Nurser AJG, Williams TD, Bertino L, Bergh J (2017) On the future navigability of Arctic sea routes: High-resolution projections of the Arctic Ocean and sea ice. Marine Policy 75: 300-317.

Berkman PA, Fiske GJ, Lorenzini D, Young OR, Pletnikoff K, Grebmeier JM, Fernandez LM, Divine LM, Causey D, Kapsar KE, Jørgensen LL (2022) Satellite record of pan-Arctic maritime ship traffic. NOAA technical report OAR ARC; 22-10. https://doi.org/10.25923/mhrv-gr76

Cao Y, Liang S, Sun L, Liu J, Cheng X, Wang D, Chen Y, Yu M, Feng K (2022) Trans-Arctic shipping routes expanding faster than the model projections. Global Environmental Change 73: 102488.

Ghosh S, Rubly C (2015) The emergence of Arctic shipping: issues, threats, costs, and risk-mitigating strategies of the Polar Code. Australian Journal of Maritime & Ocean Affairs 7(3): 171–182.

International Maritime Organization (2018) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

Jahn A, Holland MM, Kay JE (2024) Projections of an ice-free Arctic Ocean. Nature Reviews Earth & Environment 5: 164-176.

Wang C, Ding M, Yang Y, Wei T, Dou T (2022) Risk assessment of ship navigation in the Northwest Passage: Historical and projection. Sustainability 14: 5591.

Mixed Reality Firefighting Simulator

Darko Glujic [1,*], Goran Vizentin [1] and Goran Vukelic [1]

[1] *University of Rijeka, Faculty of Maritime Studies, Croatia*
[*] *Corresponding author: darko.glujic@pfri.uniri.hr; Tel.:* +385-51-338-411.

Keywords: firefighting drill; VR firefighting; VR nozzle

In compliance with SOLAS regulations, fire drills must be conducted monthly, simulating realistic scenarios and addressing critical onboard risk areas. The sequence begins with activating the fire alarm, prompting crew members to assemble at designated muster stations. Assigned firefighters then proceed with suppression and rescue efforts, while reserve personnel provide support as required. If initial containment measures prove ineffective, the fixed fire extinguishing system is engaged (ACM Web3D 2024).

VR fire scenarios, coupled with CFD simulations have already proven to be more realistic than standard game scenarios (Results in Engineering 2024). Furthermore, mixed reality training and task solving has proven to be up to 3 times faster than traditional methods of training (Mimica et Al)! Hence, use of mixed reality firefighting training could improve crew procedural learning and overcome improvisation during drills, where, for example, fire is substituted with paper that states FIRE. Overall experience of fire drills can be more immersive and more satisfying if VR is used. To create mixed-reality firefighting drill scenarios, some special, dedicated equipment is needed. VR goggles capable of mixed reality features are a must, but the firefighting nozzles that are recognized by VR goggles add an significant improvement to overall experience. While VR goggles are found commercially available, there is no firefighting nozzle compatible with them.

Here, special alterations were made to a commercially available firefighting nozzle, that included design, engineering and 3D printing components for VR controller to fit inside the nozzle and for the nozzle lever to activate it. Those two combined make a powerful tool for mixed reality firefighting scenarios enabling firefighting drill participants to see the fire in the desired environment if water is pouring out of the tuned firefighting nozzle. A less computer hardware demanding version can be used in any space, while a more scientific version, which employs CFD model of the fire needs workstation grade computer as hardware backup and needs to be pre modelled and pre calculated for every space individually.

References

Musaab H. Hamed-Ahmed, Paula Fraga-Lamas, and Tiago M. Fernández-Caramés. 2024. Towards the Industrial Metaverse: A Game-Based VR Application for Fire Drill and Evacuation Training for Ships and Shipbuilding. In Proceedings of the 29th International ACM Conference on 3D Web Technology (Web3D '24). Association for Computing Machinery, New York, NY, USA, Article 11, 1–6. https://doi.org/10.1145/3665318.3678229

Darko Glujic, Goran Vukelic, Dean Bernecic, Goran Vizentin, Dario Ogrizovic,Coupling CFD and VR for advanced firefighting training in a virtual ship engine room,Results in Engineering, Volume 24, 2024, 103025, ISSN 2590-1230, https://doi.org/10.1016/j.rineng.2024.103025.

Mimica, Ratko & Zeljkovic, Ivana & Settler, Vincent & Köster, Nina & Gąsiorek, Adam & Neufeld, Michal. (2024). Technology Evaluation of Augmented and Mixed Reality Systems in Shipbuilding Processes: Preliminary Report. 10.3233/PMST240047.

Gamification in Maritime Education: Bridging Traditional and Innovative Approaches at MAAP-ASTC

Vicente Juan D. Torio [1], Myrna Dumayas-Matira [2]

[1] *Maritime Academy of Asia and the Pacific, Philippines*
[*] *Corresponding author: vicentejuan.torio@maap.edu.ph; Tel.:* +63-928-171-8465.

Keywords: maritime education; diverse student needs; engagement and retention; blended learning

Maritime education is essential for preparing students for careers in the maritime industry, traditionally relying on instructor-led training, practical experience, and classroom instruction. With the increasing focus on modernizing educational approaches, this study evaluates the effectiveness of traditional teaching methods compared to innovative strategies—particularly the blending of both and the integration of gamification as an engagement tool—by measuring student performance through pre- and post-tests, assessing knowledge retention rates, and analyzing student engagement levels.

Using a quasi-experimental mixed-methods design, the study compares the performance, engagement, and retention of students taught through traditional lecture-based methods and those exposed to innovative, technology-enhanced strategies, specifically digital gamified learning activities. These activities included point-based challenges, where students earned points for completing tasks or demonstrating mastery; leaderboards, which displayed rankings to foster a sense of competition and motivation; and interactive quizzes, which provided immediate feedback through dynamic, game-like formats to reinforce learning. Results show that although both groups exhibited improvements, the experimental group—where digital gamification elements and blended learning approaches were integrated—demonstrated significantly higher engagement, better knowledge retention, and a greater proportion of students achieving Outstanding scores. Furthermore, both students and instructors expressed a strong preference for a blended learning environment that incorporates structured digital gamification, citing increased motivation, enjoyment, and enhanced interactivity as major benefits. To further enhance maritime competence, the study recommends integrating gamification techniques into the STCW competence tables to align with modern learning strategies and industry demands. Additionally, ongoing professional development, greater emphasis on practical applications, and curriculum adjustments are suggested to balance traditional, gamified, and innovative methods effectively. This blended and gamified approach offers a more effective and engaging model for maritime education, better preparing students for real-world applications.

References.

Brown, R., & Taylor, S. (2023). Modern Approaches in Maritime Training: Trends and Innovations. Maritime Education Press.

Buenaobra, Nissi Abigail, Dela Cerna Jr., Ephrem, Go, Christian Noe3 , Ramos III, Sergio (2018). Impact of Virtual Reality in Maritime Education and Training: The Case of the Maritime Academy of Asia and the Pacific. Maritime Academy of Asia and the Pacific

International Maritime Organization (IMO). (2020). Standards of Training, Certification and Watchkeeping for Seafarers (STCW). IMO Publishing.

Jasmine Therese Mejia, Janabelle Quiazon & Ganitano, Angel (2019) Effectiveness of Technology-Based Learning vs Traditional-Based Learning on Mathematics. https://www.researchgate.net/publication/349159005

Kappel, C. (2019). Traditional Maritime Education: Methods and Practices. Nautical Education Journal, 15(3), 45-60. Lee, J., Wang, M., & Singh, R. (2022). Digital Transformation in Maritime Education: A Review. Journal of Maritime Technology and Training, 29(4), 112-130. Impact of emerging technologies on maritime education and training: a phenomenological study. https://commons.wmu.se/cgi/view

Mezirow, J. (1991). Transformative Dimensions of Adult Learning. San Francisco: Jossey-Bass.

Montenegro-Rueda, Marta, José Fernández-Cerero, José María Fernández-Batanero 1ORCID and Eloy López-Meneses (2021). Impact of the Implementation of ChatGPT in Education: A Systematic Review. https://www.researchgate.net/profile/

Piaget, J. (1976). The Child and Reality: Problems of Genetic Psychology. New York: Basic Books.

Rogers, E. M. (2003). Diffusion of Innovations (5th ed.). New York: Free Press.

Smith, L., & Jones, A. (2021). Interactive Learning Tools in Maritime Training: An Overview. International Journal of Marine Studies, 18(2), 78-95.

Steven C. Mallam, Salman Nazir & Sathiya Kumar Renganayagalu (2019). Rethinking Maritime Education, Training, and Operations in the Digital Era: Applications for Emerging Immersive Technologies. https://www.mdpi.com/2077-1312/7/12/428

Terengganu Muqaddas Abid, Mohammed Ismail Russtam Suhrab Icon, Noor Apandi Osnin, Wan Mohd Nor Sani Wan Nik &Muhammad Hammad (2024). Assessing the impact of self-e-learning, classroom teaching, and simulation training on learning of COLREG: a survey-based analysis among maritime students at the Universiti Malaysia. https://www.researchgate.net/profile/

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Cambridge, MA: Harvard University Press.

An Analogical Corpus-Based Study of Maritime Proposal Convergence Trends for Chinese and English Native Speakers

Juan Du[1,*], Xiaoling Zhu[2]

Shanghai Maritime University, China

** Corresponding author: 202330810129@stu.shmtu.edu.cn; Tel.: +86-18247966856, zhuxiaoling@shmtu.edu.cn; +86-18930526600*

Keywords: maritime proposals; linguistic features; MEPC; maritime translation; corpus

To enhance China's voice and influence on the international maritime arena, it is becoming increasingly important for China to strengthen the authority and professionalism of its maritime proposals. This study establishes an analogous corpus with some proposals submitted by China and the United States to the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO). Guided by Toury's translation norm theory, it compares the linguistic features of maritime proposals written by native English speakers and native Chinese speakers, with the aim of providing references for China in writing and translating maritime proposals. This paper presents a comparative analysis of the two countries' proposals at the lexical, syntactic and chapter levels, and finds that the proposals submitted by China show a convergence trend towards the preferences of native English speakers in terms of lexical richness, sentence structure and chapter logic. This suggests that native Chinese speakers are increasingly incorporating the language habits of native English speakers into their writing process, making the proposals closer to international standards in language style and expression.

References

Wang, X. (2023) Language features and translation of petroleum science and technology English based on a corpus. Guangdong Chemical Industry, 50(01), 110-113+116.

Xiong, B. (2016) Lexical features and translation of English for tourism based on a corpus. Journal of Huazhong Normal University (Humanities and Social Sciences), 55(05), 94-103.

Zhang H (2017) Exploring strategies for enhancing China's international maritime influence through proposals. China Water Transport 11(11):31-33

Zhao, Z. G. (2014) Language characteristics and translation of English maritime official documents. Journal of Shanghai Maritime University, 35(02), 89-94.

Huang, L. B. (2023) A study on the integration trend of translated Chinese and original Chinese based on a comparable corpus. English Studies, (02), 40-53.

Laviosa, S. (1998) Core patterns of lexical use in a comparable corpus of English narrative prose. Meta, 43(4), 557-570.

Sun J (2016) Reflections on the compilation of proposals for International Maritime Organization meetings. Navigation Technology 6:71-74

Hu K (2016) Introducing Corpus-Based Translation Studies. Springer, Berlin

Wang Y (2015) A Report on the Translation Practice of Adverbial Clauses in Maritime Convention Amendment Proposals. Foreign Languages Institute of Dalian Maritime University, Dalian

Zhou, Y. (2024). Writing standards for IMO proposal documents in English. China Maritime Safety,(11), 66-69.

Sun, J. (2018). Considerations on drafting IMO meeting proposals. China Maritime Safety, (8), 55-57.

Course of Navigation Risk Management in the Age of New Technologies: Teaching Principles and Practices

Anatoli Alop 1,*, Katre Koit 1,*, Jarmo Kõster 1 and Olev Tõnismaa 1
1 Estonian Maritime Academy of Tallinn University of Technology, Estonia
** Anatoli Alop: anatoli.alop@taltech.ee; Tel.: +372-51-451-35.*
** Katre Koit: katre.koit@taltech.ee; Tel.: +372-53-432-597..*

Keywords: autonomous and remote-controlled ships; remote-controlled ships piloting; navigation risk management course; problem-based learning; digital shipping simulation

The introduction of autonomous and remote-controlled ships brings with them fundamentally new needs, opportunities and risks in ship navigation and requires ensuring smooth cooperation with other maritime systems. One of the most important challenges is providing appropriate training to the ship's officers and, more broadly, to specialists in other maritime sectors, who are faced with the challenge of ensuring a successful transition to digitized shipping. To achieve this goal, the Estonian Maritime Academy of Tallinn University of Technology has developed and launched the course "Navigation Risk Management". The developed course must provide relevant knowledge and skills not only to ship officers, but also to other maritime workers - for example, remote control center operators, pilots, port operators, as well as rescue ship and helicopter crews, etc. The teaching process of the course is largely aimed at solving practical exercises, i.e. the problem-based learning methodology. The simulator programs and exercises have been developed for this course that allow predicting and playing through possible situations by including in the teaching process both simulations, and a digital twin created based on a real training ship. Continuing education courses are also created based on the course.

References

Ahvenjärvi S (2016) The human element and autonomous ships. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, Vol. 10, No. 3. https://doi.org/10.12716/1001.10.03.18

Demirel E (2022) The prospective posture of maritime education in support of smart shipping. JMTE, 26-39. https://doi.org/10.53464/JMTE.01.2022.04

Galierikova A (2019) The human factor and maritime safety. Transportation Research Procedia 40 (2). 13th International Scientific Conference on Sustainable, Modern and Safe Transport, 1319-1326. https://doi.org/10.1016/j.trpro.2019.07.183

Negenborn RR, Goerlandt F, Johansen TA, Slaets P, Valdez Banda OA, Vanelslander T, Ventikos NP (2023) Autonomous ships are on the horizon: here's what we need to know. Nature, 615, 30-33. https://doi.org/10.1038/d41586-023-00557-5

Nilson LB (2010) Teaching at its best: A research-based resource for college instructors (2nd ed.). San Francisco, CA: Jossey-Bass.

Porathe T (2021) Human-automation interaction for autonomous ships: decision support for remote operators. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, Vol. 15, No. 3, 511-515. https://doi.org/10.12716/1001.15.03.03

Porathe T (2024) Autonomous ships: a research strategy for human factors research in autonomous shipping. Advances in human aspects of transportation. AHFE 2021. Springer, Cham., 479-486. https://doi.org/10.1007/978-3-030-80012-3_55

Vakil SS (2022) Overview of autonomous ships classification. J. Inst. Eng. India Ser. C 103, 889–893. https://doi.org/10.1007/s40032-022-00847-3

Technology Aspect

Managing the Risk of Fire from Electric Vehicles on Board Ferries: An Overview of Current Regulations and Proposals

Luka Vukić [1, *], Rino Bošnjak [1] and Gorana Jelić Mrčelić [1]

[1] *University of Split, Faculty of Maritime Studies, Croatia*

[*] *Corresponding author: luka.vukic@pfst.hr; Tel.:* +385-98-549-849.

Keywords: electric vehicles; ferry transport; fire risk; regulation overview; Croatia.

Given the recent growth of the electric vehicle (EV) fleet and the increasing safety concerns associated with the carriage of EVs on passenger ferries, there is a need to provide an overview of the current procedures and guidelines to be implemented by shipping companies under the ISM Code. The study aims to identify the main regulatory gaps and best practices to improve the safe transportation of EVs on board ferries, but also to highlight the key challenges and safety measures in view of the fire risk posed by the ignition of Li-ion batteries. The present study focuses on Croatian coastal shipping and underlines the lack of general and specific technical guidelines for the safe transportation of EVs on ships that could be adopted by the relevant classification society. Currently, there are no binding IMO regulations, while the general regulations are limited and sparse, providing only a common set of standards. The methodology of this paper involved the systematic analysis of the normative framework, applicable government and industry guidelines and recommendations that address the fire risks associated with EVs. The results of this study show that the relevant legislator needs to adopt the prescribed safety measures towards the classification society in its jurisdiction to make them mandatory for shipping companies. The safety measures integrated into the transportation of EVs would ensure adequate risk mitigation of potential fire hazards and allow the adoption of specific operational guidelines for the detection, suppression and extinguishment of fire accidents caused by EVs on board.

A Potential Analysis Framework on the Hybrid Threats Response Management

Daniel Daneci-Pattrau[1,*] and Anastasia Elena Duse[2]
[1] *Constanta Maritime University, Romania*
[2] *Constanta Maritime University, Romania*
[*] *Corresponding author: daniel.daneci@cmu-edu.eu; Tel.:* +40745152762

Keywords: hybrid threats, hybrid war, weakness, cyber resilience

In the new context of the security defined by hybrid manifestations exhibited by the international actors, resilience and security are not incompatible concepts. In this analysis framework, resilience should not be seen as an alternative to national security, but quite the opposite - an innovative method to ensure it. This potential new perception of security should be much more flexible and allow the deterrence and resistance against hybrid adversities by use of a wide range of tools resulting from the interconnection of the civil (public and private) and military sectors.

The complexity of the hybrid threats manifestation forms tests the reaction capacity of the public institutions and the existing connection between society and authorities. For this reason, in the threat pre-manifestation phase, the acknowledging of the danger and strengthening the partnership between public institutions and civil society are key for the social resilience consolidation.

The increase of hybrid patterns as of late, reveals, on the one hand, the multitude of combinations of methods and means used by the aggressors for the achievement of their strategic objective, which, in fact, portraits the quintessence of the hybrid war - and, on the other hand, the need to deepen the combined, institutional and academic efforts to tackle the issue of responding to the new types of security threats.

This article focuses on this last objective and aims to develop a possible analysis framework concerning the hybrid threats response management. Such a model could contribute to a better understanding of the concepts we operate with – hybrid threats, national resilience and security culture – and of the elements of interdependence that result from their convergence.

The rising of cyber-attacks, especially in light of recent events, and the strengthening of responses in this respect, turned *cyber resilience* into the new favorite expression of security analysts. Why this is not just a new trend but, on the contrary, a concept that will redefine the way we look at the security and continuity of businesses, especially in the field of critical infrastructure but also others, is an objective proposed to be achieved through this article.

Study on Behavioral Characteristics of Engineers in Engine Room simulator Using Eye-tracking Measurement Devices

Tatsuro Ishida [1*], Takashi Miwa [1], Sara Sato [1], Ryotaro Takeda [1], Muhammed Iraz [2], Nageetha Jayathilake [2] and Gamini Lokuketagoda[2]

[1] *Graduate School of Maritime Sciences, Kobe University, Japan*
[2] *Australian Maritime College, Australia*
[*] *Corresponding author: t-ishida@maritime.kobe-u.ac.jp; Tel.: +81-78-431-6333.*

Keywords: Engine room simulator (ERS), Eye-tracking Measurement, Animated Machinery, MET

Engine Room Simulator (ERS) has been used quite extensively on Maritime Education and Training (MET) for over a couple of decades in order to improve seafarers' practical skills. Required skills for engineer is known as technical skills and non-technical skills. Technical kills for watch keeping and machinery operation and maintenance are improved by several simulators such as PC-based ERS and full- mission ERS. Regarding the Full-mission ERS, reality is required for acclimating trainees to an actual engine room environment. Technology improvement comply with these demands of reality. For example, there are virtual reality engine room simulator which indicate 3D image of engine room or some full- mission ERS consist with actual picture images and also animated pictures for several machineries to improve understanding of trainees' technical skills. Non-technical skills for maritime training include assertiveness, decision-making, communication, situation awareness, and team coordination. These non-technical skills are defined in STCW code A-III/1 as knowledge, understanding and proficiency (K.U.P) for competence of maintain a safe engineering watch. These non- technical skills are evaluated as Engine-room resource management (ERM) and engine room simulator is included in method for demonstrating competence. Then the requirements concerning ERM have been introduced as mandatory requirements for engineers, and a complete implementation is required on January 1, 2017. Also, Oil Companies International Marine Forum (OCIMF) introduced Ship Inspection Report Program (SIRE) 2.0 on September 2024, which requires content of human resource as behavioral characteristics of engineers to achieve safety operation of operating vessels. From these back grounds, improvement on engine simulator and evaluation method of behavioral characteristics for engineers' non-technical skills such as situation awareness are required for shipping company and maritime education and training institutes.

This study aims to evaluate trainees' technical skills of machinery maintenance and behavioral characteristics such as situation awareness are measured by improving our engine plant simulator to create and add animated machinery images. Our engine plant simulator consists of a separated engine room with monitor displays to mimic the engine plant system. Each valve, piping lines and machineries are displayed to operate M/E, D/G Eng, Boilers, purifier, etc. However, details of machinery are not including in this engine plant simulator. We created several types of animated machinery images for training materials. Trainee will operate and observe these training materials and measure eye-movement by using eye-tracking measurement devices. Trainee are choose by difference of onboard experience to evaluate machinery understanding and knowledge of machinery operation. Also, data of eye-movement are evaluated as situation awareness. From education and training viewpoint, eye-movement data evaluation indicated the improvement of trainee who have basic machinery knowledge. From technological view point, several types of animated machinery images are evaluated from result of trainees eye-movement data to discussed for improvement of engine room simulator.

References

International Maritime Organization (2010) Standards regarding engine department. Convention on Standards of Training, Certification and Watchkeeping for Seafarers. London

Safe operator dependence on automation in MASS 1 and MASS 2: A systematic review on the interaction between perceived risk and trust calibration

Trudi Hogg [1*], Samrat Ghosh [2] and Benjamin Brooks [2]
[1] *Australian Maritime College, University of Tasmania, Australia*
[*] *Corresponding author: trudi.hogg@utas.edu.au Tel.:* +61-3-6234-9597.

Keywords: human-automation interaction; maritime autonomous surface ships; perceived risk; trust calibration

Seafarer roles are evolving with the transition towards Maritime Autonomous Surface Ships (MASS), as automated systems increasingly assume decision-making functions, redefining human responsibilities. This raises critical questions about human factors such as trust in automation and cognitive bias, which will influence the safety of MASS (Mallam, Nazir, & Sharma 2020). Despite reduced onboard human presence, human involvement with appropriately calibrated trust towards automation remains essential across all levels of autonomy. Trust in automation predicts appropriate dependence, yet poor trust calibration—manifesting as over-trust or under-trust—can lead to safety-critical failures (Hoff and Bashir 2015). There is pressing need for practical training solutions to maintain and recover trust calibration, particularly in complex, high-risk situations. The safety and resilience of MASS will rely not only on system intelligence and design but will also remain heavily dependent on the training and competence of human operators (Veitch 2022).

Perceived risk influences an operator's willingness to depend on automation (Hoesterey & Onnasch 2022), yet conceptual and methodological inconsistencies have led to fragmented findings that limit the application of existing research on the risk-trust interplay during human-automation interactions (Stuck, Tomlinson & Walker 2022). A theoretically robust framework is essential to analyse and empirically measure trust calibration in high-risk scenarios. To enhance human-automation collaboration in dynamic scenarios across all degrees of MASS autonomy, understanding and modelling the relationship between perceived risk and trust in automation is critical to reduce incidents caused by misuse or disuse of automation. The findings of this systematic review will identify gaps in maritime research, highlighting the need for empirical studies to investigate how perceived risk affects human trust in automation which will further inform proactive strategies, regulations, and policies that ensure safe and effective human-MASS integration.

References

Hoesterey S, Onnasch L (2023). The effect of risk on trust attitude and trust behavior in interaction with information and decision automation. Cognition, Technology & Work, 25(1), 15-29. https://doi.org/10.1007/s10111-022-00718-y Accessed 18 November 2024

Hoff K, Bashir M (2015) Trust in automation: Integrating empirical evidence on factors that influence trust. Human factors 57 (3):407-434. https://doi.org/10.1177/0018720814547570 Accessed 18 November 2024

Mallam S, Nazir S, Sharma A (2020) The human element in future Maritime Operations - perceived impact of autonomous shipping. Ergonomics 63 (3):334-345. https://doi.org/10.1080/00140139.2019.1659995 Accessed 18 November 2024 Stuck R, Tomlinson B, Walker B (2022) The importance of incorporating risk into human-automation trust. Theoretical Issues in Ergonomics Science 23(4):500-516 https://doi.org/10.1080/1463922x.2021.1975170 Accessed 18 November 2024

Veitch E (2022) A systematic review of human-AI interaction in autonomous ship systems. Safety Science 152:105778. https://doi.org/10.1016/j.ssci.2022.105778. Accessed 18 November 2024

Considerations on the Experience of Multilingual MET Students using Virtual Reality

Tamera Gilmartin, PhD [1]
[1] *SUNY Maritime College*
[*] *Tamera Gilmartin: tgilmartin@sunymaritime.edu; Tel.:* +01-303-803-4809.

Keywords: virtual reality, maritime education and training, multilingual students, cultural influence

Virtual Reality (VR) has been found to be a beneficial experience-based learning platform for education. This disruptive technology has the potential to create new opportunities and enhance Maritime Education and Training (MET) programs around the world as it is highly motivating for students while also being relatively affordable when compared to full mission simulation or real-world experience. However, most of the research completed on best practices and design for VR based experiential learning has been focused on monolingual, English only, speaking participants. Since most mariners worldwide are multilingual, this gap in research has created the potential for misinformed design practices for those creating and using VR learning resources.

This paper discusses the implications on future use of disruptive technology considering the findings from an interpretive phenomenological (Heidegger et al., 1962) study that explored the experience of both monolingual and multilingual MET students when using a VR Learning Experience. This study used interviews, observations, and think-aloud responses to interpret the experience of students at two MET institutions, one in the United States and the other in Croatia. While focusing on the self-view of the participant's experiences, this study identified that although the participants did not recognize an influence of language upon their experience, individual cultural and personal backgrounds did influence the way the participants approached and interpreted their experience using the VR Learning Experience.

References

Heidegger, M., Macquarrie, J., & Robinson, E. (1962) Being and Timme. Harper & Row.

Enhancing Cyber Resilience in Critical Maritime Infrastructures

Gea Miščević [1,*], Edvard Tijan [1] and Saša Aksentijević [1]
[1] *University of Rijeka, Faculty of Maritime Studies, Croatia*
[*] *Corresponding author: gea.miscevic@pfri.uniri.hr*

Keywords: critical maritime infrastructure; cyber resilience; resilience criteria

The resilience of critical maritime infrastructure is one of the key priorities in today's maritime industry, ensuring operational continuity, business flow, and security. Therefore, it is essential to continuously update existing resilience models, frameworks, and standard operating procedures, adapting them to evolving risks and threats. As cyber threats continue to evolve, the resilience of critical maritime infrastructure needs to be continuously enhanced, and efforts should be directed toward advancing technological solutions to strengthen resilience. Critical maritime infrastructure operates as an integrated system with mutual component codependency. As a result, cyber incidents can trigger a chain reaction causing a progressive impact affecting multiple interconnected elements.

Cybertechnologies have become essential to the operation and management of numerous systems which are critical to the safety and security of shipping and the protection of the marine environment (IMO 2022). Therefore, International Maritime Organization (IMO) has recognized the increasing cyber risks in the maritime sector and introduced guidelines to enhance cybersecurity management. This increased digital integration however comes with significant operational, technical, and security-related risks, which if not tackled in a timely manner can potentially lead to major disruptive results in the industry (Progoulakis et al. 2023).

The adoption of technologies, such as Artificial Intelligence, 5G, Big Data, Internet of Things, robotics, and satellite technologies, is being used for new maritime advancements, e.g., autonomous vessels and rapid inspection of ports' critical infrastructures. These innovations are further accompanied by new physical and cyber threats (RUSI Europe 2023).

To effectively mitigate cybersecurity risks in a timely and sufficient manner, entities responsible for critical infrastructure management should accurately identify potential risks, collect and analyze data, and exchange the best practices among experts rather than focusing solely on reactive responses. This paper will define the key criteria for assessing resilience in critical maritime infrastructures.

References

International Maritime Organization (2022) Guidelines on maritime cyber risk management. MSC-FAL.1/Circ.3/Rev.2. IMO, London

RUSI Europe (2023) Cybersecurity in maritime critical infrastructure. RUSI, Brussels.

Progoulakis I, Nikitakos N, Dalaklis D, Christodoulou A, Dalaklis A, Yaacob R (2023) Digitalization and cyber-physical security aspects in maritime transportation and port infrastructure. Smart Ports and Robotic Systems, Studies in National Governance and Emerging Technologies. https://doi.org/10.1007/978-3-031-25296-9_12

Green Technologies and Evolving Role of Seafarers in the Future of Shipping Industry

Wahidul SHEIKH[1], Gholam Reza EMAD [1*] and T M Rabiul ISLAM [1]

[1] *University of Tasmania, Australian Maritime College, Australia*

[*] *Corresponding author: reza.emad@utas.edu.au; Tel.:* +61-469-731-787.

Keywords: Green shipping; Decarbonisation; Seafarer training, Maritime Education and Training (MET), Human element

Shipping industry is experiencing a profound transformation driven by the progressive adoption of green shipping technologies. Innovations such as energy-efficient propulsion systems, renewable energy integration, and emissions monitoring tools are redefining the operational paradigms onboard vessels. However, the effective implementation of these technologies heavily depends on the adaptability of seafarers and their renewed skills and competency. This paper introduces the current and emerging green technologies in shipping, and employes concept mapping technique to explore how the integration of these technologies reshape the onboard activities and the essential competencies required for seafarers. Concept mapping provides a structured approach to visually represent the interrelationships among the evolving green shipping technologies and the resultant changes in operational practices. The findings highlight the critical importance of environmental stewardship, compliance proficiency, and leadership capabilities in addition to technical expertise for seafarers. Furthermore, the study underscores the necessity of adaptation of enhanced training programs, interdisciplinary collaboration, and targeted investment to upskill seafarers for the successful implementation of Green Shipping Practices (GSPs). By leveraging concept mapping, this study contributes to a deeper understanding of the human dimension in ocean sustainability. The results can be used as a guidance for policymakers, maritime educators, and industry stakeholders to advance GSPs and help IMO achieving its decarbonization goals under United Nations Sustainable Development Goal (UNSDG) 13.

Artificial Intelligence and its Transformative Impact in Shaping the Maritime Industry

Gholam Reza EMAD [1,*], Mehrangiz Shahbakhsh [1]
[1] *University of Tasmania, Australian Maritime College, Australia*
[*] *Corresponding author: reza.emad@utas.edu.au; Tel.:* +61-469-731-787.

Keywords: Artificial Intelligence; Maritime Industry; Human Factor; Autonomous Vessels; Sustainability Theme category: Technological aspect

The maritime and shipping industries have been reshaped over time by technological advancement stemmed from industrial revolutions. Fueled by rapid advancements in artificial intelligence (AI) technologies, these changes are expected to accelerate (Shahbakhsh, Emad, & Cahoon 2021). This article explores the transformative potential of AI in enhancing operational efficiency, predictive maintenance, and sustainability within the sector. As the call for greener and more sustainable and efficient shipping intensifies, AI applications such as route optimization, predictive maintenance, and real-time data analytics will play a significant role in revolutionizing logistics and operational decision-making (Xiao, 2024). Case studies showcasing successful AI implementations in shipping industry illustrate the measurable impact on operational efficiency and profitability (Mearsk 2024). As the industry moves towards the Double D trend—digitalization and decarbonization—alongside greater autonomy, the development of autonomous vessels represents a groundbreaking shift toward the full realization of Maritime Autonomous Surface Ships (MASS). These innovations not only streamline maritime operations but also address critical issues such as crew safety and seafarers shortages. Furthermore, AI-driven solutions are essential for achieving sustainability goals, enabling companies to reduce emissions and improve fuel efficiency. However, the integration of AI in maritime operations raises important considerations, including the need for new regulations and ethical standards. As the maritime industry experiences both vertical and horizontal integration towards Double D trend, strong collaboration among stakeholders is crucial for navigating existing and emerging challenges. This article provides a comprehensive overview of the current landscape and prospects of AI in maritime and shipping industry in the field such as economic impacts, safety enhancements, and sustainability initiatives. Ultimately, embracing these technologies is imperative for stakeholders aiming to thrive in an increasingly competitive and environmentally conscious maritime sector. This article posits that AI is not merely a technological advancement but a transformative force reshaping the future of maritime shipping and its workforce.

References

Shahbakhsh, M., Emad, G., & Cahoon, S. (2021). Industrial revolutions and transition of the maritime industry: The case of Seafarer's role in autonomous shipping, Asian Journal of Shipping and Logistics. https://doi.org/10.1016/j.ajsl.2021.11.004

Maersk. (2024). How can generative AI drive logistics transformation? https://www.maersk.com/insights/digitalisation/2024/01/03/how-can-generative-ai-drive-logistics-transformation. Accessed 3 Feb 2025

Xiao, G., Yang, D., Xu, L., Li, J., & Jiang, Z. (2024). The application of artificial intelligence technology in shipping: A bibliometric review. Journal of Marine Science and Engineering, 12(4), 624. https://doi.org/10.3390/jmse12040624

Autonomous and AI-Driven Hydrography: Innovations for Sustainable Maritime Practices

V.R. Shamji [1,*], Faisal Alsaaq [2]
[1,2] *Faculty of Maritime Studies, King Abdulaziz university, Jeddah, Saudi Arabia*
[*] *Corresponding author: svidyanandan@kau.edu.sa; Tel.:* +966 12 695 2000

Keywords: *Autonomous Hydrography; Artificial Intelligence; Sustainable Maritime Practices; Smart Navigation; Marine Data Analytics*

The rapid advancement of autonomous technology and artificial intelligence (AI) in hydrography has transformed maritime data collection, analysis, and navigation, leading to more efficient and environmentally sustainable maritime operations (Specht et al. 2021). This study explores the role of autonomous surface vessels (ASVs), AI-powered bathymetric mapping, and real-time data analytics in hydrographic surveying, highlighting their potential to enhance safety, reduce costs, and minimize environmental impact (Lin et al. 2022). AI-driven processing technologies, such as CARIS Mira AI, significantly enhance the efficiency of hydrographic surveys by automating sonar data filtering, feature extraction, and bathymetric anomaly detection—reducing the need for manual post-processing while improving accuracy (Pavlis & Romeiser 2019). Traditional hydrographic surveying relies heavily on manual operations and human intervention, often resulting in inefficiencies, high operational costs, and potential safety risks (Marrable et al. 2020). In contrast, AI-powered autonomous hydrographic systems can continuously monitor and map marine environments with minimal supervision, delivering precise and timely geospatial information.

Cloud-based AI processing tools, such as CARIS Mira AI, enable real-time refinement of hydrographic data, improving maritime decision-making and alleviating computational bottlenecks (Table 1). Recognizing these advancements, the Hydrographic Survey Department at the Faculty of Maritime Studies has actively adopted AI-driven data processing methods to enhance survey accuracy, efficiency, and environmental sustainability. As illustrated in Figure 1, AI-driven hydrographic solutions can improve survey accuracy by up to 92%, lower operational costs by 50%, and increase survey efficiency by 60% compared to traditional approaches (IHO & Nippon Foundation-GEBCO Seabed 2030 Project, 2021). These comparisons underscore the significant improvements in efficiency and cost-effectiveness gained through AI-powered hydrography over conventional methods (Specht et al. 2021; Lin et al. 2022).

AI-powered hydrography offers significant operational benefits, reducing survey duration, processing time, and overall data errors (IHO & Nippon Foundation-GEBCO Seabed 2030 Project, 2021; Specht et al. 2021; Lin et al. 2022). By leveraging real-time hydrographic data, autonomous vessels can improve navigation safety, enhance fuel efficiency, and support sustainable marine ecosystem management. Case studies from recent autonomous hydrographic survey missions highlight the effectiveness of AI-driven approaches in detecting underwater hazards, improving nautical chart accuracy, and bolstering climate resilience efforts (International Hydrographic Organization 2017).

The findings suggest that adopting AI-driven hydrographic solutions is critical for achieving global maritime sustainability goals (WMU Journal of Maritime Affairs 2020). However, challenges such as regulatory compliance, cybersecurity risks, and the need for standardized AI implementation must be addressed for broader adoption. This research highlights the importance of collaboration among academia, industry, and international maritime organizations to drive innovation and ensure the responsible use of AI in hydrography.

References

International Hydrographic Organization (2017). Information on IHO standards related to ENC and ECDIS. Version 1.1. IHO, Monaco.
IHO & Nippon Foundation-GEBCO Seabed 2030 Project (2021). Mapping the World's Oceans: The Role of Autonomous Systems and AI. https://seabed2030.org

Specht C, Specht M, Dąbrowski PS, Nowak M (2021). Artificial Intelligence in Hydrography – Challenges and Opportunities. Sensors 21(12): 4113. https://doi.org/10.3390/s21124113
Lin T, Wang X, Wu J (2022). AI-Driven Hydrographic Surveying Using Autonomous Surface Vehicles: A Review of Recent Advances. Journal of Marine Science and Engineering 10(4): 521. https://doi.org/10.3390/jmse10040521
Marrable JA, Greig A, Calder BR (2020). Enhancing Hydrographic Data Processing through Machine Learning Approaches. The Hydrographic Journal 157: 16-22.
Svilicic B, Rudan I, Jugović A, Zec D (2019). Cybersecurity Testing of Shipboard Chart Radar. Proceedings of the International Association of Maritime Universities Conference, Tokyo, Japan, 129-134.
Walling SA, Hill JC (2014). Elementary Marine Navigation. Cambridge University Press, Cambridge.
Pavlis EC, Romeiser R (2019). Satellite Altimetry and AI in Hydrography: A Synergistic Approach. Journal of Geodesy 93(5): 789-812. https://doi.org/10.1007/s00190-019-01247-6
WMU Journal of Maritime Affairs (JoMA) (2020). WMU Journal of Maritime Affairs, Submission guidelines. Springer Nature. https://www.springer.com/journal/13437/submission-guidelines

Dependence of the thrust and power of wind propulsors on the speed of the vessel

Mykhaylo Miyusov [1, *], Oleksandr Kryvyi[1] and Dmytro Zhukov[1]

[1] *National University "Odessa Maritime Academy", Ukraine*

* *Corresponding author: rector@onma.edu.ua*; *Tel.* +38 050 316 4578

Keywords: wind propulsor, thrust and power, speed of the vessel, wind speed and direction.

The IMO Strategy for Decarbonization in Shipping, adopted at the 80th IMO MEPC session in 2023, encourages the use of alternative energy sources, in particular wind-assisted propulsion systems. A special feature of auxiliary wind propulsors (WP) is their joint operation with the traditional propulsion plant, which ensures the transfer of effective power from the main engines to the propellers.

An increase in the speed of the vessel causes a change in the speed and direction of the apparent wind, and, as a result, aerodynamic forces on the WP. Therefore, there is a need to conduct a study of the thrust and power of WP of different types from the speed of the vessel at different wind parameters, abstracting from the specific type of vessel. In this work, based on the proposed approach, mathematical modeling of aerodynamic forces and power of WP depending on the relative speed of the vessel (in relation to the true wind speed) and the direction of the true wind is carried out. A significant dependence of the energy output of WP on the value of ship speed is shown. It has been established that the feasibility of using WP mainly depends on wind conditions on the supposed sea routes. The dependences of the thrust and power of WP on the relative speed of the vessel at different values of the WP aerodynamic quality have been obtained. The dependences of the relative speed of the vessel at which the maximum power of the WP is achieved on its aerodynamic quality and the direction of the true wind are also obtained. It is shown how the WP thrust and power depend on the relative speed of the vessel on the fordewind course. The relationships between the true wind direction and the relative speed of the vessel are found, at which the WP power will reach its maximum value at different value of the aerodynamic quality. Considering that under different wind conditions the speed of the vessel, which corresponds to the WP maximum power, is different, it turns out to be expedient to find the average values of the power at given probabilistic characteristics of the wind conditions on the sea route, as a function of the average speed of the vessel.

References

Miyusov M.V., Krivoy O.F. (2003) Methods of Working Mode Optimization of Ship Propulsion Complex // Ship Power Plants: Sc.-Tech. Col. No 8., Odessa: ONMA, P. 39-48

Mykhaylo Miyusov, Oleksandr Kryvyi and Dmytro Zhukov. (2024). Wind-assisted propulsion system operating mode optimization. The 24th IAMUC. Proceedings of the International Association of Maritime Universities (IAMU) Conference. Massachusetts Maritime Academy, 7-12 Oct 2024, p. 323 – 328

Kryvyi O.F., Miyusov M.V. (2016) Mathematical model of movement of the vessel with auxiliary wind-propulsors. Shipping & Navigation. 26: 110-119

Kryvyi O. F, Miyusov M. V. (2019) Mathematical model of hydrodynamic characteristics on the ship's hull for any drift angles. Advances in Marine Navigation and Safety of Sea Transportation. CRC Press: 111-117. https://doi.org/10.1201/9780429341939

Kryvyi O., Miyusov M. (2021) Construction and Analysis of Mathematical Models of Hydrodynamic Forces and Moment on the Ship's Hull Using Multivariate Regression Analysis. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 15 (4): 853-864. doi:10.12716/1001.15.04.18

Kryvyi O., Miyusov M., Kryvyi M. (2023) Construction and Analysis of New Mathematical Models of the Operation of Ship Propellers in Different Maneuvering Modes. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 17 (1): 853-864. doi:10.12716/1001.17.01.09

Kryvyi O., Miyusov M. V., Kryvyi M. (2023) Analysis of Known and Construction of New Mathematical Models of Forces on a Ship's Rudder in an Unbounded Flow. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 17(4), 831-839. DOI:10.12716/1001.17.04.09

Miyusov M.V. (1996) Modes of operation and automation of motor vessel propulsion system with wind propulsors. Odess

Exploring a Framework for Maritime Education and Training Tailored to Professionals in Underwater Robotics

Senka Šekularac-Ivošević [1*], Dragana Milošević [1], Draško Kovač [1], Špiro Ivošević [1]

[1] *University of Montenegro, Faculty of Maritime Studies Kotor, Montenegro*

[*] *Corresponding author: senkas@ucg.ac.me; Tel.:* +382 32 303 184

Keywords: underwater robotics; maritime education and training (MET); remotely operated vehicle (ROV) professionals

The contemporary maritime industry is experiencing a profound transformation of its operational paradigms, necessitated by the advent and integration of disruptive technologies, including digitalization, decarbonization, and intelligent systems. These advancements demand highly skilled professionals adept in the management of sophisticated technologies. The transition toward automation and the utilization of digital tools requires a redefined skill set for future maritime professionals, emphasizing competencies such as data management, comprehension of automated systems, AI-supported decision-making, and proficiency in high- tech environments. This paper predominantly concentrates on the formulation of programs and competences specifically tailored for professionals of remotely operated vehicle (ROV), aligning educational frameworks with these technological innovations.

The methodological approach employed in this paper is SWOT analysis, which facilitates an examination of the current application of underwater robotics within the maritime sector. This analytical framework elucidates the strengths, weaknesses, opportunities, and threats associated with the use of robotics, thus providing a comprehensive overview of the field. The research critically evaluates existing curricula, training initiatives, and academic master's programs, while considering technological, environmental, safety, security and social challenges pertinent to the deployment of underwater robotics.

The findings of this research delineate specific learning outcomes, thematic areas, and essential competencies requisite for ROV professionals. Special emphasis is placed on the acquisition of new skills and knowledge catalyzed by advancements in robotics, with a focus on ensuring that these competencies align with international standards to adequately address the demands of the maritime labor market.

Implications drawn from this paper indicate that the role of ROV professionals necessitates an integration of knowledge spanning marine science, technology, engineering, mathematics, and social sciences, particularly in the domains of teamwork, time management, and communication. This interdisciplinary approach aspires to cultivate professionals who embody competencies in maritime operations, thereby enhancing operational efficiency, environmental protection, safety and security standards. The emergent professional profile capitalizes on robot based learning frameworks tailored to the preferences of a rising generation, characterized by a propensity for experiential learning and strong digital acumen.

Future research endeavors, derived from the insights of this paper, should be directed toward the development of curricula that synergistically combine theoretical knowledge with practical applications. This includes the incorporation of virtual reality (VR) simulations for ROV training, which would combine cutting-edge technological tools with educational methodologies to facilitate safe and effective skill acquisition. Such innovative training modalities are expected to empower participants with foundational knowledge in underwater robotics, while simultaneously fostering transferable skills such as analytical thinking, innovation, and interdisciplinary collaboration, thereby equipping them to confront diverse scientific and industrial challenges within the framework of maritime society 5.0.

References

Demirel E (2020) Maritime Education and Training in the Digital Era. Universal Journal of Educational Research 8(9): 4129-4142, DOI: 10.13189/ujer.2020.080939.

Mancer TL (2010) A Vocational Education Training Model for ROY Pilots and AUV Operators. Master thesis. Faculty of Engineering and Applied Science, Memorial University of Newfoundland, Newfoundland.

Marxer R, Hugel V, Prud'Homme KP, Batista P, Marti Aviles JV, Pascoal A, Sanz PJ, Schjølberg I (2021) Marine and Maritime Intelligent Robotics (MIR). OCEANS 2021: San Diego – Porto, San Diego, CA, USA, 1-8, doi: 10.23919/OCEANS44145.2021.9706122.

Rahman SMM (2019) Metrics and Methods of Evaluating Learning Outcomes in Robot-Based STEM Education. 32nd Florida Conference on Recent Advances in Robotics, May 9-10, Florida Polytechnic University, Lakeland, Florida.

Sahoo SK, Choudhury BB, Dhal PR (2024) Exploring the Role of Robotics in Maritime Technology: Innovations, Challenges, and Future Prospects. Spectrum of Mechanical Engineering and Operational Research. Volume 1, Issue 1, 159- 176, https://doi.org/10.31181/smeor11202414.

Wright GA, Hurd RC, Hacking KS, Truscott T (2014) Using ROVs to Teach a Blended STEM Curriculum. 121st ASEE Annual Conference & Exposition, June 15-18, Indianapolis, IN.

Yim TS, Woo KT, Chin LT (2024) Promoting Inclusive Education through Virtual Underwater Robotics Experience: Enhancing STEM Learning and Collaboration with Real-World Applications. IEEE Global Engineering Education Conference (EDUCON), Kos Island, Greece, 1-5, doi: 10.1109/EDUCON60312.2024.10578740.

Zande J, Brown C (2008) ROV Competition Helps Students Develop Technical Skills and Build Marine Technical Workforce [Education]. IEEE Robotics & Automation Magazine, 15(1), 18–20. doi:10.1109/m-ra.2007.914923.

Multimodal CLIL and Sustainable Maritime Education: Leveraging Disruptive Technologies for Future Seafarers

Kamalesh Kumar P [1], Dr.C.Vairavan [2] and Ramaraju Sababathy S [3]

[1] *AMET University, India*

Corresponding author: kamalesh2kumar@gmail.com; Tel.: +919363563741.

Keywords: Multimodal CLIL, Maritime Education, AI-driven Learning, Augmented Reality, Sustainability

The rapid digitalization of the maritime industry necessitates a transformative approach to maritime education that integrates language learning, technical training, and sustainability principles. This study investigates the application of Multimodal Content and Language Integrated Learning (CLIL) in Sustainable Maritime Education, focusing on the role of disruptive technologies such as AI-driven adaptive learning systems, augmented reality (AR), and digital simulations. A mixed-methods research design was employed to evaluate the effectiveness of technology enhanced CLIL in fostering maritime cadets' language proficiency, technical competency, and sustainability awareness. Findings indicate that multimodal CLIL significantly improves engagement, comprehension, and knowledge retention, equipping future seafarers with the necessary skills for modern maritime operations. AI-driven adaptive learning enhances personalized instruction, AR simulations provide immersive technical training, and digital platforms facilitate real-time language acquisition. These technological advancements contribute to a more effective and sustainable pedagogical model that aligns with global maritime standards. The study underscores the need for maritime academies to integrate multimodal CLIL with disruptive technologies to develop future-ready seafarers. Further research is recommended to explore long-term impacts and scalability across diverse maritime training institutions.

References

Álvarez Rodríguez, J. (2022). Sustainable maritime education and green shipping practices. Journal of Maritime Studies, 10(3), 215-230.

Bailey, D. R., & Lee, A. R. (2020). Learning motivation and multimedia-assisted language learning. Sustainability, 12(14), 5590.

Berns, A., Palomo-Duarte, M., Dodero, J. M., & Valero-Franco, C. (2016). Exploring the effects of a serious game on Spanish students' vocabulary learning and motivation. Computer Assisted Language Learning, 29(6), 1234–1249.

Borg, S. (2018). Teachers' beliefs and classroom practices. In A. Burns & J. C. Richards (Eds.), The Cambridge guide to learning English as a second language (pp. 75–83). Cambridge University Press.

Chen, C. M., & Chung, C. J. (2008). Personalized mobile English vocabulary learning system based on item response theory and learning memory cycle. Computers & Education, 51(2), 624–645.

Chen, Z. (2025). Fostering disciplinary literacy in technical education through CLIL. Technical Education Review, 34(2), 45-60.

Chun, D. M. (2016). The role of technology in SLA research. Language Learning & Technology, 20(2), 98–115.

Dalton-Puffer, C. (2011). Content and language integrated learning: From practice to theory. Cambridge University Press.

Deng, F., & Zou, Q. (2016). A study on whether the word frequency effect exists in second language vocabulary acquisition. Frontiers in Psychology, 7, 1833.

Dudeney, G., & Hockly, N. (2016). Literacy and technology in language teaching. Oxford University Press.

Ellis, R. (2009). Implicit and explicit learning, knowledge, and instruction. In R. Ellis, S. Loewen, C. Elder, R. Erlam, J. Philp, & H. Reinders (Eds.), Implicit and explicit knowledge in second language learning, testing and teaching (pp. 3–25). Multilingual Matters.

Fadel, C., Bialik, M., & Trilling, B. (2015). Four-dimensional education: The competencies learners need to succeed. Center for Curriculum Redesign.

Galván, F. (2012). Virtual reality and maritime education: Enhancing training with simulation technologies. Maritime Training Journal, 18(1), 60-72.

Gee, J. P. (2007). What video games have to teach us about learning and literacy (2nd ed.). Palgrave Macmillan.

Godwin-Jones, R. (2018). Second language vocabulary learning: A digital revolution. Language Learning & Technology, 22(1), 1–13.

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. Computer Assisted Language Learning, 27(1), 70–105.
Gutiérrez-Colón, M., & Andujar, A. (2020). AI-driven learning platforms in maritime education. International Journal of AI in Education, 15(4), 104-121.
Hatta, S. (2021). AR-based simulations in maritime training: Enhancing spatial awareness and procedural knowledge. Journal of Educational Technology, 22(3), 159-172.
Hu, Y., & Zhang, L. (2024). Technology-driven multimodal learning in maritime education: A case study. Maritime Technology Education Review, 10(2), 30-42.
Hüttner, J. (2020). AI in sustainability education: Bridging maritime training with environmental consciousness. Journal of Maritime Education and Sustainability, 6(1), 81- 97.
Jewitt, C., Bezemer, J., & O'Halloran, K. (2016). Introducing multimodal analysis. Routledge.
Kic-Drgas, I., & Jurkovič, A. (2024). The integration of sustainability principles in maritime education through CLIL. Sustainability in Maritime Education, 8(4), 100-114.
Krashen, S. D. (1982). Principles and practice in second language acquisition. Pergamon Press.
Kazura, M. R., Suhrab, M. I. R., & Othman, C. W. M. N. C. W. (2024). Enhancing maritime education and training (MET) through virtual and augmented reality: A voyage into immersive learning. Journal of Maritime Research, 21(2), 339–348.
Miyusov, M. V., Nikolaieva, L. L., & Smolets, V. V. (2022). The effectiveness of immersive learning in maritime education and training. Transactions on Maritime Science, 11(2), 1–22.
Mayer, R. E. (2020). Multimedia learning (3rd ed.). Cambridge University Press.
Naranjo Villacrés, S. (2021). Gamification and digital storytelling in technical education: Enhancing engagement through multimodal learning. Educational Technology and Society, 24(2), 57-70.
Reinders, H., & Benson, P. (2017). Research agenda: Language learning beyond the classroom. Language Teaching, 50(4), 561–578.
Selwyn, N. (2016). Education and technology: Key issues and debates. Bloomsbury Academic.
Stockwell, G. (2012). Computer-assisted language learning: Diversity in research and practice. Language Teaching, 45(4), 409–422.
Sweller, J. (2011). Cognitive load theory. Springer.
Vanderplank, R. (2016). Captioned media in foreign language learning and teaching. Palgrave Macmillan.
Wang, X., Muñoz, C., & Yang, Y. (2024). Effective strategies for implementing CLIL in vocational education. Journal of Vocational Education Research, 39(1), 99-112.
Warschauer, M. (2020). New forms of digital learning for language education. Language Learning & Technology, 24(3), 1–9.
Widodo, H. P. (2011). Integrating augmented reality and multimodal learning in maritime education: Bridging theory and practice. Journal of Maritime Education and Training, 9(2), 125-138.
UNCTAD. (2022). Sustainable maritime practices and education: Aligning cadet training with global sustainability goals. United Nations Conference on Trade and Development.

Maritime Rescue Drones

Prasanna Kumar Rajakumaran[1]
[1] Indian Maritime University, India

* Corresponding author: prasanna.r@imu.ac.in; Tel.: +91-9677093569.

Keywords: Man overboard; Rescue; Drone; UAV; Thermal image.

Ships are an essential transportation mode for the movement of goods all over the world. As of today, the vessels are navigated in the oceans by their crew members, from the captain of the vessel to ordinary seamen. Crew members are performing their day's operations and maintenance of various machinery fitted on the deck today. They do surface preparation and coating as a part of hull maintenance. These activities were integrated with the hazard of crew members falling overboard. If the activity is planned without care, the crew member is exposed to the sea. Along with the aforementioned risks, cruise ship passengers who are unaware of them may also drown if they are not kept safe.

According to a recent survey, MOB incidents on US coasts account for 24% of marine accidents that end in fatalities (Boat US, 2012). The authors were unable to locate specific data on the death rate for MOB occurrences internationally; however, research (Selmy, A. S., 2016) suggests that an average of 1000 people go overboard every year. These figures are significant; however, they only provide the mortality rates rather than detailed information on the event mechanisms.

When someone is determined to go over the side, the control center is notified, and immediate rescue operations start. With the available technology, rescue boats secured on the deck of merchant vessels or cruise liners are launched into the sea along with dedicated seafarers assigned to this task. The present method of rescue increases the risk level by adding a few more people who are also exposed to the sea. In some cases, the weather and sea conditions at the time of incidents do not permit the launch of a rescue boat, affecting the survival rate of the victim in question.

Originally developed for the military and aerospace industries, drones have found their way into the mainstream because of the enhanced level of safety and efficiency they bring. These robotic UAVs operate without a pilot and with different levels of autonomy. A drone’s autonomy level can range from remotely piloted to advanced autonomy, which means that it relies on a system of sensors and LiDAR detectors to calculate its movement. Drones are incredible, as evidenced by UAVs with a payload of upwards of 500 pounds (226 kg). Although the average drone might carry a few kilograms, plenty of heavy hitters for professional drone pilots have a higher weight capacity, sometimes around 25 kg.

The invention of the unmanned aerial vehicle (UAV) made significant changes in every field of operation, including maritime. UAVs are being used for cargo hold inspections, engine room assessments, fuel tank inspections, security, and surveillance, as well as search and rescue missions. At present, small drones are used to perform tank inspections to reduce the risk to seafarers on ships.

Maritime Search and Rescue with Drones:

Maritime drones are increasingly deployed for search and rescue operations. They can rapidly reach distressed individuals, reducing response times and saving lives. In some cases, drones are equipped with life-saving flotation devices that can be deployed to help conscious victims, improving overall safety. The security of maritime search and rescue UAVs during extended operations is a top priority. Identifying security risks and addressing weak links in their operation is essential. Ongoing research focuses on enhancing the security of these vehicles during long-distance missions.

The ocean is a very unpredictable space. Humans have been constantly trying to conquer it for ages. Many have lost their lives due to getting overboard from ships or due to rough weather. The three main factors that can kill you are drowning, predators, and hypothermia. So, it’s clear that in order for a man overboard to survive, we have to rescue and retrieve him as soon as possible. Even in modern days of seafaring, man overboard, man getting

lost at sea, or even death is a regular happening.

This paper aims to provide a solution for this problem with modern technology. Let us assume a scenario in which a man has gone overboard, fallen into the open sea unnoticed, and is probably unconscious. The vessel had covered a certain distance before the crew realized the incident.

References

Boat U.S, 2012
Selmy, A. S., 2016

The Extended Reality Utility in Maritime Education and Training: a systematic literature review

Johan Bolmsten [1,*], Jeric Bacasdoon [1,2], Claudia Barahona-Fuentes [3], Carolyn Graham [4], Kirtan Vakil [5], Tirth Vakil [5], and Shri K. Anbazhagan[6]

[1] *World Maritime University, Sweden*
[2] *Maritime Academy of Asia and the Pacific, Philippines*
[3] *Barcelona School of Nautical Studies, Universitat Politecnica de Catalunya, Spain*
[4] *Caribbean Maritime University, Jamaica*
[5] *Hindustan Institute of Maritime Training, India*
[6] *Indian Maritime University, India*
[*] *Corresponding author: jb@wmu.se; Tel.:* +0046-40-356384.

Keywords: extended reality; augmented reality; virtual reality, mixed reality, maritime education and training

Purpose

Extended Reality (XR), encompassing Virtual Reality (VR), Augmented Reality (XR), and Mixed Reality (MR) technologies, is rapidly evolving and holds the potential to transform Maritime Education and Training (MET). These cutting-edge technologies are being integrated into MET to enhance technical competencies as per the International Convention on Standards of Training, Certification, and Watchkeeping Convention 1978, as amended (STCW) requirements. However, a systematic interrogation of the educational utility of XR applications within MET is absent from the literature. This study aims to investigate the utility of XR in MET.

Method

The methodology adopted to identify relevant publications on the use of XR applications for educational purposes consists of a systematic literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which ensures a rigorous selection, inclusion, and reporting of studies. With this purpose, a Boolean search was carried out in two leading interdisciplinary databases, i.e., Web of Science (www.webofscience.com) and Scopus (www.scopus.com).

Findings

After the analysis and the categorisation of articles, all the eligible full-text articles were further analysed to frame the research areas covered in this review, namely, how XR improves simulations, practical skills, and theoretical knowledge in MET. Additionally, the review demonstrates the benefits of XR adoption, such as enhancing experiential learning, innovative teaching approaches, addressing training constraints, providing cost-effective, safer alternatives to traditional methods, and improving remote collaboration among participants. It also identifies barriers to XR integration, including technological readiness and acceptance, infrastructure needs, and instructor training.

Value

The findings offer a comprehensive understanding of XR's potential in enhancing MET. They provide actionable recommendations for integrating XR into MET curricula and inform educational policymakers and MET institutions on the opportunities and considerations for incorporating XR into teaching practices, ultimately fostering more effective and immersive training experiences in the maritime industry.

Fast Time Simulation and Dynamic Manoeuvring Prediction – towards Integration of Disruptive Technology for Training of Navigators of the Future

Knud Benedict [1,*], Michael Baldauf [1], Mario Gehrke [1], Max Sternberg [1], Daniel Rostek [1], Matthias Kirchhoff [2]

[1] *Hochschule Wismar, University of Applied Sciences – Technology, Business and Design, Department of Maritime Studies, Systems Engineering and Logistics, Rostock-Warnemünde, Germany*

[2] *ISSIMS GmbH / Rostock-Warnemünde, D-18119 GERMANY*

[*] *Corresponding author: knud.benedict@hs-wismar.de ; Tel.: +49-178-280-4484.*

Keywords: Ship-handling, Dynamic Manoeuvring Prediction, Fast-time simulation, Combined Simulator Operation, Maritime Pilotage and VTS Operator Training

Maritime universities, academies and training institutions providing sufficiently qualified and well-trained mariners to serve shipping companies all over the world. Usually, graduates from MET institutions continue their professional career after their work on board in the many various maritime sectors ashore, including classification societies, manufacturers of bridge equipment, MET institutions as well as the national waterway and shipping administrations but also serving as marine pilots or VTS operators. All those institutions of the secondary market value the seafaring experience and professional expertise of those mariners. Nowadays numerous new shore-based services, as e.g. Vessel Coordination Centers of large port terminals or the Remote- Control Centers of Maritime Autonomous Ships (MASS) are under development and about to be established respectively. However, the secondary market is increasingly running out of applicants meeting the traditional profiles of an experienced navigator well prepared and ready to take over the tasks and duties of marine pilots or of an VTS operator.

Maritime education and training have to be continuously amended and adapted to meet the needs and demands of shipping companies. Also, for purposes of modernization maritime education and training has to take into account latest technological developments relevant for safe, sustainable and efficient ship operation. Furthermore, MET institutions are challenged to develop completely new education programs and study courses to meet the challenges of the changing conditions on the maritime labor market

In this paper, the authors will introduce approaches to develop new study courses and training methods as alternative ways to accompany and educate future navigators potentially becoming marine pilots, VTS operators or even an operator in a remote-control centre of MASS.

Exemplary case studies of course modules including simulation-based manoeuvre training using applied fast time simulations for ships' motion predictions and full dynamic manoeuvre planning as well as complex simulation scenarios of combined full mission ship-handling and VTS-simulation exercises will be presented. The first experiences, students and instructors' feedback are identified and summarized and pros and cons will be discussed.

Geo-Spatial Visualization of MBES and ROV Data to Explore the Submerged Port City of Poompuhar

T.Sasilatha[1,*], J.Padmapriya[2] and Col G Thiruvasagam[3]
[1,2,3] *Academy of Maritime Education and Training Deemed to be University, India*
[*] *Corresponding author: deaneeem@ametuniv.ac.in; Tel.:* +91 9444752994.

Keywords: Port city, geo spatial, Multi beam echo sounder, ROV, under water exploration, Maritime data portal

The main objective of this article is to explore the maritime activity and the trade routes from the ancient submerged harbour Poompuhar. Poompuhar is a port city during Chola dynasty in Tamil Nadu, southern part of India, which was vanished due to natural disasters, sea level changes or tectonic movements of earth surface. Digitally reconstructing the maritime harbour is essential to preserve the cultural heritage and for the archeological research. The Sangam literature describes the location of the Poompuhar Port, habitation and town planning. This Study discover the hidden remains at the offshore region using the Multi Bean echo Sounder Data (MBES) and Remote operated vehicle (ROV) data acquired by the Sagar Tara vessel of National Institute of Ocean Technology (NIOT), funded by Department of Science and Technology (DST), Govt of India. The submerged Port City is mapped based on the ancient Tamil Sangam literature and the MBES data. The MBES Data is preprocessed and the submerged structures are visualized to reconstruct the ancient shoreline and its past geographical features.

The findings from the MBES Data and the GIS visualization (Fig 1& 2) strongly support the existences and the cultural history of the ancient port city Poompuhar. Integrating AI driven Geospatial analysis with the underwater ROV Data processing (Fig 3 &4)clearly identified significant findings such as Dockyards, warehouses, Docks and harbour colony where foreign trades and merchants stayed.

References

AS Gaur, Sunderesh “Underwater exploration off Poompuhar and possible causes of its submergence” published 1998.

Ramasamy, S.M., Saravanavel, J., Palanivel. K., Kumanan, C.J. and Rajasekar, D. 2020: Discovery of submerged harbour using GEBCO and MBES data, 30 km in the ofshore region of ancient port city Poompuhar, South India. Current Science, 119(3): 526-534.

Ramasamy SM, J. Saravanavel. C. J. Kumanan and S. Guansekaran “Coordinates and chronology of the ancient port city of Poompuhar, South India” published 2018.

S.Tripati, Gopal Parthiban,Kamlesh H Vora, Sundress,”Lead Ingots from a shipwreck off Poompuhar, Tamilnadu,East coast of India: Evidence for Overseas Trade and their Significance”,Published 2003.

Arafat Mohmmed M , Palanivel K, Kumanan C.J 3 Saravanavel J. 4 and Ramasamy SM “Geo spatial mapping and 3D Gis based visualization of subsurface structures “ published Jun 2011.

Advancing MET through technology: ROV education and training for seafarers

Antonio Blažina [1,*] and Lovro Maglić [1]

[1] *Laboratory for Marine Technologies, Faculty of Maritime studies, University of Rijeka, Croatia*

[*] *Corresponding author: antonio.blazina@pfri.uniri.hr; Tel.:* +385917941070.

Keywords: Maritime education and training; ROV operations; Underwater ship inspection

As the maritime industry continues to evolve with rapid technological advancements, the majority of maritime educational and training (MET) programs and associated courses that meet the STCW requirements are often insufficient to fully prepare seafarers for certain modern ship operations. MET must adapt to prepare future seaferers with the necessary skills for a successful career at sea while ensuring the sustainability of global shipping and enhancing safety, security, and environmental protection.

One of the emerging routine operations onboard ships is the regular in-water survey of the ship's hull. This operation is being incorporated in the ship's Safety Management System (thus directed by the Company) and performed by the ship's crew. The goal of such operations is to monitor the condition of the hull (fouling degree, corrosion degree, possible damages, etc.) to plan its maintenance in an efficient way and support the Class surveys. These operations are usually carried out with small inspection class underwater Remotely Operated Vehicles (ROVs) while the ship is at anchorage or berth.

Unlike for working class ROVs used in offshore industry, there is no course or MET program developed and adapted for seafarers for the operation of inspection-class ROV for ship hull inspections. Introducing ROV training as part of the standard maritime education program would enhance seafarers' proficiency in smart technology, underwater robotics and digital solutions. By integrating adequate competencies, future maritime professionals will be better prepared to adapt to technological advancements and industry demands in that respect.

Through international cooperation, particularly within the IAMU network, the development of ROV training would contribute to raising educational standards while making maritime careers more attractive to younger generations.

The research project for Young Academic Staff in FY2024, titled „ROV education and training for seafarers"aims to assess the current use of inspection-class ROVs by seafarers, particularly for in-water hull inspections. It seeks to evaluate existing gaps and challenges in their use and to identify the theoretical knowledge and practical skills required for safe and efficient ROV operations. This was achieved through a literature review, in-depth interviews with target groups and pilot in-water hull inspections performed by authors. The in-depth interviews involved inspection class ROV manufacturers, shipping companies and seafarers who already use ROVs on board their ships. The pilot in-water hull inspections performed by authors were conducted under several ships in the port of Rijeka and Kraljevica.

The research results include the systematically presented experience, challenges and guidelines shared by seafarers, ROV manufacturers and the authors regarding the knowledge and skills required to perform in-water hull inspections. The main contribution of this research is the proposed training syllabus, which outlines the identified knowledge and skills necessary to achieve the required competencies.

Design of Hybrid Stand-Alone Power Generation System for Marine Applications

Lakshmi Dhandapani[1*], S. Manimegalai[1], Padmashini Rajesh kumar[1] and Karthickmanoj Ravichandran[1]

[1]*AMET Deemed to be university, India*

** Corresponding author: lakshmi.d@ametuniv.ac.in; Tel.:9444105767*

Keywords: PV Array, Wind Turbine, DFIG, DC Microgrid, MATLAB Software, MPPT, ANFIS.

Rapid urbanization and wide usage of electric appliances cause voltage shortage. In upcoming years, this will impact economic growth of a nation. To fade out this problem and increase the power generation is essential. The traditional method of power generation will be less effective to compensate load demand in future. So, there is a need of proposing an alternative to replace conventional method of power generation.

In recent, renewable resources gained attention among researchers because of its plenty of advantages such as eco- friendly, cost-effective, lower installation cost, easy to implement, etc. The widely used renewable resources are solar, wind, geo- thermal, hydro and tidal. Among that solar and wind energy resources are considered as adequate to fulfil the needs in future. Bothe resources have great potential to produce and deliver enormous value of power. This study focuses on developing a renewable resource powered (i.e. solar and wind energy) stand-alone system to deliver required power towards the load without any shortage. Though the selected resources have positive impacts, it is necessary to consider the negative impacts of the system. The PV array cannot generate voltage at peak level when climatic condition is not suitable. As like PV array, the wind turbine could fail if there is any variation in speed of wind-blown. To keep in mind of above facts, the proposed system is designed. The ANFIS MPPT tracking system contributing to this research would support PV array to track maximum power and generate huge voltage. To alter the functionality and to boost the performance of wind energy conversion system (WECS), the Doubly Fed Induction Generator (DFIG) is recommended. It can operate at lower and higher speed range which is the main reason the proposed system would perform well. The modified DC-DC converter linked with the PV array regulates the voltage generation as per the load demand. The switching angle of proposed converter is controlled by PID controller. Any interruption caused in power generation has been compensated by the energy storage system. The simulation study of the proposed study is done using MATLAB software and the results are evaluated.

References

Udit Mittal, Gunjan Varshney, Amit Kumar Roy,Abhilasha Pawar. 2020. Design and Modeling of Hybrid Power Generation System using Solar PV and Wind Turbine. International Conference on Intelligent Control and Computation for Smart Energy and Mechatronic Systems 25-26 September 2020 | JSSATE NOIDA INDIA.

Year End Review of Ministry of Power (up to November 2023). Posted On: 02 JAN 2024 5:08PM by PIB Delhi.

Firas Basim Ismail Alnaimi, Hussein A. Kazem, Ariff Bin Alzakri, and Abdulaziz Mohammed Alatir. 2024. Design and implementation of smart integrated hybrid Solar Darrieus wind turbine system for in-house power generation. Renew.Energy Environ. Sustain. 9, 2 (2024).

Atiqah Hamizah Mohd Nordin, Ahmad Maliki Omar. 2011. Modeling and simulation of Photovoltaic (PV) array and maximum power point tracker (MPPT) for grid-connected PV system. 2011 3rd International Symposium & Exhibition in Sustainable Energy & Environment (ISESEE).

Mostafa R. Mostafa, Naggar H. Saad, Ahmed A. El-sattar. 2020. Tracking the maximum power point of PV array by sliding

mode control method. Ain Shams Engineering Journal, Volume 11, Issue 1, March 2020, Pages 119-131.
Seyed Hossein Hosseini, Amir Farakhor, Saeideh Khadem Haghighian. 2013. Novel algorithm of MPPT for PV array based on variable step Newton- Raphson method through model predictive control. 2013 13th International Conference on Control, Automation and Systems (ICCAS 2013),
S M Muyeen, Ahmed Al-Durra, Junji Tamura. 2011. Variable speed wind turbine generator system with current controlled voltage source inverter. July 2011Energy Conversion and Management 52:2688 - 269452:2688 – 2694, DOI:10.1016/j.enconman.2011.02.001
A. Gaillard, P. Poure, S. Saadate, M. Machmoum, 2009. Variable speed DFIG wind energy system for power generation and harmonic current mitigation. Renewable Energy, Volume 34, Issue 6, June 2009, Pages 1545-1553.
H.T. Jadhav, Ranjit Roy. 2013. A comprehensive review on the grid integration of doubly fed induction generator. International Journal of Electrical Power & Energy Systems, Volume 49, July 2013, Pages 8-18.
Ayman Al-Quraan, ORCID andMuhannad Al- Qaisi. 2021. Modelling, Design and Control of a Standalone Hybrid PV- Wind Micro-Grid System. Energies 2021, 14(16), 4849; https://doi.org/10.3390/en14164849.

A Comprehensive Fuel Management System for Ships Using AI and Web Integration

Prasheet Mishra [1, *], Pritam Pattanaik [1], Vik Patra[1], Saswat Ranjan Barik[1] and Pallab Das[1]

[1] *School of Maritime Studies, Centurion University of Technology and Management, India*
[*] *Corresponding author: prasheet,mishra@cutm.ac.in; Tel.:* +91 9437416992.

Keywords: Deep Learning, Fuel Consumption Prediction, Artificial Neural Networks, Maritime Operations, Sustainability, Ship Fuel Management

This study provides a fuel consumption prediction system that make use of deep learning models applied to usage of fuels of main engine in shipping vessels. The system aims to improve sustainability in marine logistics, save operating costs, and increase fuel economy. Real-time ship operating data, comprising of shaft torque, rudder angle, engine RPM, speed over land, wind speed, draft conditions, wave height, and direction were utilized to create the dataset used for training and evaluation. To predict fuel usage, deep learning models, such as Convolutional Neural Networks (CNN), Gated Recurrent Units (GRU), Long Short-Term Memory (LSTM) networks, and Artificial Neural Networks (ANN) were used.

Based on performance evaluation of ANN model an R^2 score of 0.95 is achieved. This demonstrates a high degree of accuracy in fuel consumption prediction. With an R^2 value of 0.85, the LSTM model performed admirably well but fell short of the ANN in terms of effectiveness. Similarly, GRU delivered a great performance with an R^2 value of 0.90, whereas CNN was less successful with an R^2 value of 0.80. The study created a web application that incorporates fuel consumption prediction algorithms. This strategy makes sure that crew members can quickly monitor trends in fuel consumption of main engine in shipping vessel.

References

Uyanik T, Arslanoglu Y, and Kalenderli O (2019) Ship fuel consumption prediction with machine learning. Proceedings of the 4th International Mediterranean Science and Engineering Congress, Antalya, Turkey, 25-27.

Wieslaw T, and Rudzki K (2020) Applying artificial neural networks for modelling ship speed and fuel consumption. Neural Computing and Applications, Vol 32, 17379-17395.

Kim H, Park M, and Lee J (2023) A study on the prediction of fuel consumption of bulk ship main engine using explainable artificial intelligence. Journal of Navigation and Port Research. Vol 47, 182-190.

Pavlos K, Themelis N, Zaraphonitis G, Spandonidis C, and Giordamlis C (2019) Ship fuel consumption prediction using artificial neural networks. Proceedings of the Annual meeting of Marine Technology conference proceedings, Athens, Greece, 46-51.

Zhihui H, Jin Y, Hu Q, Sen S, Zhou T, and Osman M T (2019) Prediction of fuel consumption for enroute ship based on machine learning. IEEE Access Vol. 7, 119497-119505.

AI-Powered Approach to Maritime Pirate Attack Detection

Pritam Pattanaik[1], Prasheet Mishra[1,*], Vik Patra[1], Saswat Ranjan Barik[1] and Pallab Das[1]

[1]*School of Maritime Studies, Centurion University of Technology and Management, India*
** Corresponding author: prasheet,mishra@cutm.ac.in; Tel.: +91 9437416992*

Keywords: Piracy prevention, Maritime security, Real-time threat detection, AI-based surveillance, Autonomous surveillance systems.

The continuous surveillance of maritime vessels across oceanic regions, assisted by technologies such as AIS, satellite-based tracking, and radar systems, has enabled real-time monitoring of vessel movements. However, these traditional systems cannot often immediately detect unusual behaviour or probable pirate attack. They primarily focus on tracking vessel movements. This study proposes an AI-based pirate attack detection system using the YOLOv11 model to enhance maritime security. It uses real-time method to identify possible dangers such as illegal boat approaches, unusual human behaviour, and the presence of weapons. The YOLOv11 model was trained using a carefully selected dataset. To ensure strong model performance, this dataset includes a variety of illumination settings, climatic conditions, and marine activities. With a 95% detection accuracy, the trained model proved to be a reliable real-time vessel identification and danger detection unit. In order to avoid pirate attack and other marine related dangers, the system easily connects with the current monitoring infrastructure, improving situational awareness and facilitating quick reaction actions. This approach sets a new benchmark for real-time maritime threat detection by offering a robust and efficient solution for pirate attack prevention and vessel protection.

References

Marko P, Gucma L and Feuerstack S. (2024) Maritime security and risk assessments. Journal of Marine Science and Engineering. Vol.12, 1-12

Yijia Z, Sheng W, Jiang J, Jing N, Wang Q, and Mao Z. (2020) Priority branches for ship detection in optical remote sensing images. Remote Sensing, Vol.12, 1196.

Iancu B, Soloviev V, Zelioli L, and Lilius J. (2021) ABOships - an inshore and offshore maritime vessel detection dataset with precise annotations. Remote Sens. 2021, 13, 988.

Jaja O G, Robert D E, and Tamunodukobipi D T. (2024) Machine learning-enhanced maritime pecurity: predictive modelling for piracy attacks in high-risk waters. International Journal of Modern Innovations and Knowledge, Vol.5, 50-60.

Tesic J, Tamir D, Neumann S, Rishe N & Kandel A. (2020) Computing with words in maritime piracy and attack detection systems. Lecture Notes in Computer Science 434-444

Faculty and Students' Feedback on the use of Online Platform and Its Impact on the Academic Performance in Collision Regulation

Loren Steve G. Glumalid[1]
[1]*John B. Lacson Foundation Maritime University (Arevalo), Inc., Philippines*
[*]*Corresponding author: lorensteve.glumalid@jblfmu.edu.ph; Tel.:* +63-917-825-4851

Keywords: online learning; academic performance; Collision Regulation; survey; one group pretest-posttest

The COVID-19 pandemic led to widespread school closures, prompting a shift to online learning. This change aligned with e-learning theory, which draws from cognitive science and Connectivism, emphasizing technology's role in enhancing education. In response to school closures due to pandemic, JBLFMU adopted JeL (JBLFMU E-Learning), an online platform, to deliver maritime education, including the Collision Regulation course. This study examined faculty and student feedback on JeL during the first semester of 2021–2022, using surveys and a One Group Pretest-Posttest design. Participants included three instructors and 165 first-year BSMT students. Analysis methods included thematic analysis, t-tests, and effect size calculations. Results showed that instructors considered JeL effective, and students found teaching methods appropriate, though some reported occasional technical issues. Most students demonstrated strong retention of the Collision Regulation topics. The study concluded that JeL was effective for online delivery of Collision Regulation, as shown by a significant improvement in posttest scores. It is recommended that JeL shall continue to be used, with technical enhancements to improve performance.

References

Li C, Lalani F (2020) The COVID-19 Pandemic has Changed Education Forever. This is How. https://www.weforum.org/agenda/2020/04/co ronavirus-education-global-covid19-online-digital-learning/
David L (2015) "E-Learning Theory (Mayer, Sweller, Moreno)," in Learning Theories. https://www.learning-theories.com/e-learning-theory-mayer-sweller-moreno.html
Sweller J, Van Merriënboer J J G, Paas F (2019) Cognitive architecture and instructional design: 20 years later. Educational Psychology Review, 31(2), 261–292.
He H, Egbert J, Roe M (2021) E-Learning Theory.
https://opentext.wsu.edu/theoreticalmodelsforteachingandresearch/chapter/e-learning-theory/

Social Aspects of Digitalization in the Maritime Industry

Kamelia Narleva [1], Yana Gancheva [1,*]

[1] *Nikola Vaptsarov Naval Academy, Bulgaria*

[*] *Corresponding author: y.gancheva@naval-acad.bg ; Tel.:* +359-88-466-9570.

Keywords: digitalization; maritime industry; innovation; sustainability; workforce transformation

The maritime industry, as a critical component of the global trade and logistics, undergoes a profound transformation driven by technological advances, changing social challenges and increasing pressure for sustainability. The technological innovations (blockchain, IoT, AI, automation) transform maritime and logistics operations, making the industry a critical part of the global digital economy. In light of the increasing technological pressure, this publication explores the multifaceted social consequences of the technological innovations in the maritime industry. As a result of in-depth interviews and subsequent factor analyses, contemporary social challenges in the maritime industry are identified: the change of traditional roles, job rotation and, most importantly, the need for systematic, continuous and planned training, qualification and reskilling. The main conclusions from the conducted empirical research highlight the growing social inequalities between developed and emerging markets and ports, as well as the importance of regulatory frameworks for the social and ethical development of the maritime industry. The publication concludes by offering applicable recommendations to support stakeholders towards a sustainable, social maritime future.

References

Atanasova C (2023) Transforming Maritime Education for A Digital Industry. Strategies for Policy in Science and Education, 2023, Volume 31, Number 6s – Special Issue, pp. 9-18. ISSN 1310-0270 (Print); ISSN 1314-8575 (Online), https://www.ceeol.com/search/journal-detail?id=1679

Bourhriba O (2024) Digital transformation in the maritime industry. Policy Center for the New South. https://www.policycenter.ma/publications/digital-transformation-maritime-industry

Conev I, Koritarov T (2024) Alternative educational models for sustainable development of maritime education. Industrial Growth Conference 27 – 29 September 2024, Nessebar, Bulgaria, Publisher: Az-buki National Publishing House, pages 258-268, ISSN 2738-7267, https://doi.org/10.53656/igc-2024.24

EUROPEAN COMMISSION (2020) Directorate-General for Mobility and Transport, Study on social aspects within the maritime transport sector – Executive summary, Publications Office, ISBN: 978-92-76-20273-8. https://data.europa.eu/doi/10.2832/77451

Narlev Y (2022) Modern entrepreneurship approaches. Varna, Economy and Economic Theory: Problems and Interactions, Conference Proceedings, pp. 86-92, ISBN 978-954-21-1133-7 (online).

OECD (2019), OECD Skills Outlook 2019: Thriving in a Digital World, OECD Publishing, Paris, https://doi.org/10.1787/df80bc12-en.

OECD (2024), OECD Digital Economy Outlook 2024 (Volume 2): Strengthening Connectivity, Innovation and Trust, OECD Publishing, Paris, https://doi.org/10.1787/3adf705b-en .

Scientific Foresight Unit (STOA) (2021) Digital Automation and the Future of Work, STUDY Panel for the Future of Science and Technology, Brussels. PE 656.311. ISBN: 978-92-846-7281-3, doi: 10.2861/826116, QA-02-20-871-EN-N. https://www.europarl.europa.eu/stoa/en/document/EPRS_STU(2021)656311

Tabrizi B, Lam E, Girard L, Irvin V (2019) Digital transformation is not about technology. Harvard Business Review 13:1–6. https://www.transputec.com/wp-content/uploads/2021/07/digital-transformation-is-not-about-technology.pdf

UNCTAD (2018) Trade and Development Report: Power, Platforms and the Free Trade Delusion. United nations publication. Sales No. E.18.II.D.7, New York and Geneva. ISBN 978-92-1-112931-1, eISBN 978-92-1-047322-4, ISSN 0255-4607. https://unctad.org/system/files/official-document/tdr2018_en.pdf

Maritime Traffic in the Bering Strait - Sustainable Pathways through Integrated Ecosystem based Management and Digital Voyage Planning

Dr. Ashok Pandey[1,*], Capt. K. Karthik[2]

[1]*Massachusetts Maritime Academy, USA*
[2]*AMET, India*
[*]*Corresponding author: apandey@maritime.edu; Tel.: +1-413-801-1185*

Keywords: Arctic, navigation, sustainability, ecosystem-based management, digital.

Driven by the effects of climate change and declining sea ice, the Arctic is witnessing a significant rise in maritime traffic which creates risks to Arctic coastal communities and ecosystems. International scientific bodies identify Indigenous Knowledge (IK) as a good approach to ecological diversity and management that demands sustainable practices.

Given the navigational complexities of high latitude navigation in conducting Arctic ship traffic routing; ecosystem-based management (EBM) in close collaboration with IK and digital route planning may lead to enhanced decision-making capability for mariners and stakeholders.

The exponential rise in maritime traffic due to industrialization across the Arctic region needs to be sustainably managed and regulated because maritime transport bears a positive correlation to economic activities in a region. Integrating co-produced knowledge and coastal community perspectives into the future digital route optimization model (D-ROM) for the Bering Strait region will facilitate the development of a framework that balances environmental, societal, economic, and cultural aspects, thereby fostering sustainable ecosystems and resilient coastal communities. The ice navigator needs the waypoints when confronted with sea ice and all the challenges of high latitude navigation in a remote location with little infrastructure and communication. The D-ROM output is essentially a set of waypoints depicting the 'least cost' path for the vessel to traverse. The waypoints are a set of geographical coordinates that may be plotted instantly either on the ECDIS or the nautical paper charts for voyage planning purposes while the vessel is underway. While the mariner on board may be the biggest beneficiary of the integrated EBM, other stakeholders such as ship operators, port authorities, insurance companies, ice breakers, search and rescue organizations may benefit from the information provided. The D-ROM is a good first step towards risk mitigation and decision making in ice. It is, however, not intended to replace the judgment of the shipmaster and may act as an enhanced decision-making tool for risk management in a desolate region fraught with dangers.

References

Alaska climate impact assessment https://www.adaptationclearinghouse.org/resources/alaska-climate-impactassessment-commission-2008, Accessed May 29, 2025
Alaska sea ice data https://www.weather.gov/afc/ice accessed 6.13.2025
AMAP https://www.amap.no/documents/doc/amap-assessment-2013-arctic-ocean-acidification/881 accessed June 10,2025
AMSA, https://www.pame.is/images/03_Projects/AMSA/AMSA_2009_report/AMSA_2009_Report_2nd_print.pdf, Accessed May 29,2025
Arctic Tourism https://www.pame.is/projects-new/arctic-shipping/pame-shipping-highlights/415-arctic-marine-tourism, Accessed June 5, 2025
CAFF: https://www.caff.is/work/topics/ebm/ Accessed June 10 2025
IPCC, AR6:https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_CCP6.pdf.Accessed May 29, 2025
Kawerak: https://kawerak.org/ Accessed June 10, 2025
NOAA: https://arctic.noaa.gov/report-card/report-card-2024/. Accessed May 25, 2025
NSIDC https://nsidc.org/sipn Accessed June 9, 2025
PAME: https://pame.is/projects/ecosystem-approach/arctic-large-marine-ecosystems-lme-s. Accessed 6 June 2025
USCMTS: https://www.cmts.gov/Topics-Projects/Resilience/ Accessed June 9, 2025
Yamamoto-Kawai https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010GL045501 accessed June 10, 2025

Enhancing Maritime English Proficiency among Cadets in Georgia: An Action Research Approach to Developing a Tailored E-Learning Course

Emzar Gvarishvili, Johan Bolmsten

[1] *Batumi Navigation Teaching University, Georgia*
Emzar Gvarishvili: Em.gvarishvili@bntu.edu.ge Tel.: +995 598 12 53 53.
[1] *World Maritime University, Georgia*
Johan Bolmsten: jb@wmu.se Tel.: +46 70 301 23 05

Keywords: Maritime English; e-learning; action research; MET; language proficiency

This study addresses the gap in Maritime English proficiency among Georgian cadets by developing and evaluating a context-specific, asynchronous e-learning course. Using an action research methodology, two iterative cycles were conducted: the first engaged stakeholders—crewing agents, maritime educators, and cadets—to identify challenges and inform the course design; the second involved extended use by cadets who used the platform as a way to enhance their skills by incorporating it into their learning schedule . The platform itself incorporated behaviourist, cognitivist, and connectivist educational principles and focused on technical terminology, communication skills, and interview preparedness. Feedback, from both stakeholders and cadets who actually used the platform, demonstrated that the course improved cadets' confidence, retention, and engagement with Maritime English. Asynchronous access and mobile compatibility proved especially effective for cadets balancing studies with external responsibilities. The findings suggest that tailored digital solutions can enhance language training in non-English speaking MET environments and offer a scalable model for similar maritime nations.

References

Bauk S, Kapidžić-Duraković S, Škurić M (2013) On-line communication in maritime English learning and teaching. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation 7(1):19–24. https://doi.org/10.12716/1001.07.01.02

Bolmsten, J., Manuel, M. E., Kaizer, A., Kasepõld, K., Sköld, D., & Ziemska, M. (2021). Educating the Global Maritime Professional—a case of collaborative e-learning. WMU Journal of Maritime Affairs. doi:10.1007/s13437-020-00224-w

Dittrich Y, Rönkkö K, Eriksson J, Hansson C, Lindeberg O (2008) Cooperative method development: Combining qualitative empirical research with method, technique and process improvement. Empirical Software Engineering 13:231–266. https://doi.org/10.1007/s10664-007-9050-4

Downes S (2008) An introduction to connective knowledge. In: Hug T (ed) Media, knowledge and education – exploring new spaces, relations and dynamics in digital media ecologies. Innsbruck University Press, Innsbruck, pp 77–102

Hafita I, Wahyudin A, Sari IP (2024) Enhancing Maritime English proficiency through e-learning: The case of OceanTG.com platform. Journal of Marine Education and Training 12(1):45–58

Standard Marine Communication Phrases (SMCP), Resolution A.918(22). International Maritime Organization, London

Piaget J (1952) The origins of intelligence in children. International Universities Press, New York

Reason P, Bradbury H (2008) The SAGE handbook of action research: Participative inquiry and practice. SAGE Publications, London

Roediger HL, Putnam AL, Smith MA (2011) Ten benefits of testing and their applications to educational practice.

Psychology of Learning and Motivation 55:1–36. https://doi.org/10.1016/B978-0-12-387691-1.00001-6

Siemens G (2005) Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning 2(1):3–10

Skinner BF (1957) Verbal behavior. Appleton-Century-Crofts, New York

Sokolov A, Belash O, Kravtsov D (2017) Farwater: Ukrainian e-learning platform for maritime education. Proceedings of IAMUC, Varna, 173–178

Trenkner P (1998) Maritime English—a world-wide challenge. Proceedings of the IMLA Conference, Turkey, 21–29 UNCTAD (2023) Review of Maritime Transport 2023. United Nations Conference on Trade and Development, Geneva.

Launching the AMET Marine Exploration Data Portal for Maritime Heritage Studies

T.Sasilatha[1,*], J.Padmapriya[2], Col G Thiruvasagam[3], V.Sangeetha Albin[4]

[1,2,3,4] *Academy of Maritime Education and Training Deemed to be University, India*

[*] *Corresponding author: deaneeem@ametuniv.ac.in; Tel.:* +91 9444752994.

Keywords: Maritime data portal, Maritime heritage, Multi beam echo sounder, ROV, underwater exploration

AMET Marine Exploration Data Portal is designed to serve as a valuable resource for researchers, policy makers and maritime enthusiast by offering an interactive and data driven approach to explore Poompuhar's rich maritime history and ecological significance. The portal serves a platform for the archaeologists, researchers, mariners to utilize the resources, methodology in exploring the underwater maritime ancient heritage sites across the world. The study explores the reconstruction of ancient maritime heritage site Poompuhar, an ancient port city flourished with intercontinental trade in Chola Dynasty till 200 CE. The sangam tamil literatures Silapathikaram, Manimekalai mentioned the local systems and their civilizations. This research involves underwater surveys and photography by remotely operated vehicles (ROV) and sensor based geodynamic techniques such as Multi beam echo sounder (MBES) to bring out the comprehensive information on the time series evolution and extinction of the port city Poompuhar.

AMET UNIVERSITY
(Deemed to be University Under Section 3 of UGC Act 1956)
CHENNAI | TAMILNADU | INDIA

25th ANNUAL GENERAL ASSEMBLY
14th-18th OCTOBER, 2025

Further details

Academy of Maritime Education and Training (AMET)
135, East Coast Road, Kanathur - 603112 | Chennai | India

+91 94447 52994 | aga25@ametuniv.ac.in

President, AGA25

Dr. G. Thiruvasagam | Phone: +91 95661 12211

Program Editor, AGA25

Dr. Deepa Rajesh | Phone: +91 80563 81238

Gallery

For photos, please refer

https://aga25.ametuniv.ac.in/gallery/

https://aga25.ametuniv.ac.in/gallery/