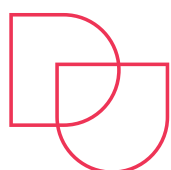# NAŠE MORE 2025

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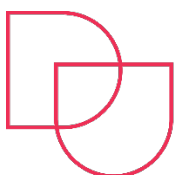
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CONTENT

ANALYSIS OF TECHNICAL ASPECTS OF OFFSHORE WIND FARM INSTALLATION IN THE ADRIATIC SEA

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Abstract

Due to climate change and growing electricity demand, the need for renewable energy sources has significantly increased. Therefore, offshore wind farms are gaining increased attention in Europe, with a currently installed 37 GW. The European Commission's ambition is to reach a capacity of at least 60 GW of installed energy from offshore wind turbines by 2030, and 300 GW by 2050. This leads to the need to plan offshore wind farms in locations that previously were not considered, such as the Adriatic Sea. Such a large increase in installed capacity and the construction of new wind turbines in a short period will have a strong impact on both the environment and the blue economy sectors. Therefore, it is necessary to choose optimal technical solutions by optimising decisions based on multiple goals. It includes maximisation of energy production, minimisation of the load on structures, minimisation of effects from individual wind turbines on wind farms, minimisation of costs for maintenance, minimisation of pollution from wind turbines and maximisation of energy usage, etc. This research presents an overview of the aforementioned goals and technical solutions, with an overview of the current status of the global implementation of those solutions in the context of the possibility of installing offshore wind farms in the Adriatic Sea. Potential challenges which specifically need to be considered will be highlighted in the context of two test locations in the Adriatic Sea chosen for the possible wind farm installation.

Keywords: offshore wind farms, renewable energy, Adriatic Sea

POSSIBILITIES FOR OFFSHORE WIND DEVELOPMENT IN ADRIATIC SEA

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Abstract

The Interreg-MED SPOWind (Spatial Planning for Offshore Wind Industry Development) project aims to unlock the offshore wind energy potential of the Mediterranean Sea. It overcomes challenges by developing a WebGIS tool for marine spatial planning, assisting stakeholders in selecting ideal locations and technologies. By establishing a maritime data hub and fostering transnational cooperation, SPOWind enhances coordination for sustainable energy production. The Adriatic Sea, characterized by its unique geographical and oceanographic features, offers both significant opportunities and considerable challenges for the development of offshore wind energy. This article investigates the possibilities for offshore wind deployment in the Adriatic, drawing extensively on the findings and methodologies of the Interreg-MED SPOWind project. A key focus is placed on assessing the technical potential for offshore wind, particularly in the context of deep seabed and the emerging viability of floating offshore wind technologies. We analyse how the SPOWind project's development of a multi-level and transversal marine spatial planning WebGIS tool assists in identifying optimal maritime locations and suitable technologies (Bottom fixed or Floating offshore wind turbines), thereby overcoming inherent morphological constraints (bathymetry, distance to coast). Furthermore, the abstract highlights the crucial legislative challenges impacting offshore wind expansion in the region. By integrating technical potential assessment with a proactive approach to legislative hurdles, this article demonstrates how the insights from the SPOWind project are instrumental in shaping a sustainable and coordinated framework for future offshore wind development in the Adriatic Sea.

Keywords: Offshore wind energy, GIS planning, Legal framework overview

EVALUATING RECYCLING POTENTIAL OF ZINK IN THE MONTENEGRIN MARITIME SECTOR

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Abstract

Steel and aluminum-based metals remain the most significant materials in shipbuilding, while a wide range of different alloys are used in the production of specific maritime equipment and systems. In the context of the Sustainable Development Goals (SDGs), increasing research is being given to develop specific metal recycling loops and circular economy models. This requires the implementation of advanced safety and environmental standards. Statistical office in Montenegro has established monitoring of key recyclable metals, including steel, aluminum, copper, bronze, and brass. However, despite intensive nautical activity and maintenance service facilities, data on zinc, widely used in galvanization and corrosion protection, are absent. The lack of information on zinc quantities necessitates further research on its potential resources in the maritime sector.

This paper aims to estimate the amount of zinc generated in the Montenegrin maritime industry and to assess its significance in the context of its recycling. The research methodology includes a review of the literature, direct collection of data on the generated amounts of zinc through the collection and selection in the maritime industry sector. Additionally, the chemical composition of the collected samples was characterized using scanning electron microscopy. The findings of this study represent an initial evaluation of zinc's potential to facilitate circular economy in the maritime industry. This study benefits Montenegrin maritime sector because it defines connections for the establishment of a recycling loop and specifies the potential of generated zinc.

Keywords: corrosion, zinc, recycle loop, circular economy

RETROFITTING OPTIONS FOR EXISTING SHIPS: A CASE STUDY ON SULPHUR ABATEMENT TECHNOLOGIES

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Abstract

About 80% of goods transported by sea and events like the six-day blockage of the Suez Canal highlight the vulnerability of global supply chains. Despite its strategic role, vessels significantly contribute to air pollution. Regulatory bodies such as the International Maritime Organization and the European Commission have responded with regulations: IMO 2020 sulphur cap, 2023 IMO Strategy on GHG Reduction, IMO Net-Zero Framework and Fuel EU Maritime Regulation. These initiatives aim to reduce emissions and mitigate impacts on global warming and human health. While newbuilds are designed based on these regulations, the global fleet's average age exceeds 20 years. Existing vessels must adapt, and shipowners face difficult decisions: renewing the fleet, retrofitting existing ships or accepting penalties. For SO_x compliance, options include switching to marine gas oil or very low sulphur fuel oil, both more costly than heavy fuel oil or installing exhaust gas cleaning systems. This work presents a case study of a 1998-built cruise vessel facing such a decision near the end of its operational life. The baseline scenario is compared with two alternatives: installing scrubbers or switching to marine gasoil. Fuel consumption and emissions were calculated. Findings show that scrubbers reduce SO_x emissions but increase fuel consumption, raising other pollutant levels by 3.5% due to higher engine backpressure. Moreover, scrubbers only lower particulate matter emissions by 6.7%. In contrast, switching to MDO, which contains minimal sulphur, leads to a reduction across all emission types, with particulate matter emissions dropping to just 10% of those recorded when using scrubbers.

Keywords: sulphur abatement, air quality impact, retrofitting aging vessels

PORT, TERMINAL OR WATERWAY DETAILED DESIGN USING MODEL WIZARD

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Abstract

Detailed design of port, terminal or waterway, either on sea or river, requires area model to be made and tested on navigational simulator. The area model is made using specialized software, and in this case that is Transas Model Wizard. Model wizard enables user to make area model, using either AutoCad DWG file and/or from electronic charts and to modify them as the project requires. This process will result with detailed model of project area which can be used in Transas navigational simulator. That model then can be tested for various scenarios which will replicate real life conditions and the result can be used to modify the area model in such way that in real life would meet all conditions required by user.

Keywords: port design, model wizard, simulation

COMPARATIVE ANALYSIS OF BULK CARRIERS PORT STATE CONTROL INSPECTIONS

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Abstract

Although the maritime industry is considered sufficiently regulated, vessels are constantly monitored and inspected by the Flag State (FS) and Classification Societies (CS) or Recognised Organisations (RO). Nonetheless, accidents still occur. A key risk factor contributing to maritime accidents is the existence of substandard vessels. These pose a serious threat to the safety of maritime operations, making it crucial to keep them out of traffic until they comply with international maritime regulations. One of the methods used for detecting such vessels is the Port State Control (PSC) inspection. Therefore, analysing the deficiencies identified by PSC inspections and subsequent detentions may improve safety. Bulk carriers hold the largest share of the maritime market and are the second most common type of ship involved in maritime accidents. Therefore, this paper examines the deficiencies and detentions of bulk carriers identified by the PSC inspection, highlighting the most frequent ones. The analysis uses accessible data from inspections carried out under the Paris and Tokyo Memorandums of Understanding (MoU), as well as those conducted by the US Coast Guard (USCG) and the Australian Maritime Safety Agency (AMSA). Furthermore, this paper aims to analyse the deficiencies identified during bulk carrier PSC inspections across selected regions and assess whether variations exist in the most commonly detected deficiencies. The results obtained may be used to improve and standardise the PSC inspection regime worldwide.

Keywords: maritime safety, accident, substandard vessel, deficiencies, port state control

THE REBOUND OF THE CRUISE ACTIVITY AND ITS MULTI-IMPACTS

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Abstract

The cruise industry has grown significantly over the past few decades, becoming a major player in global tourism. This growth has brought about a range of economic, environmental, and social impacts. In this research, we examine the specific case of Port of Galveston, Texas, as a case study. Galveston cruise activity is growing annually and in recent times, Galveston has radically changed its relevance (from a secondary home port) to become a bustling hub for cruise activity, serving as a departure point for several major cruise lines. The COVID-19 pandemic highlighted the industry's vulnerabilities, leading to significant social and economic disruptions. As the industry recovers, there is a growing emphasis on sustainability and resilience to ensure long-term viability. As the time for a review of the port master plan approaches (the year 2025), several discussions have arisen about the net (financial) benefits and physical feasibility of the port to continue to expand its services and facilities to the cruise industry. While the port generates significant revenue through cruise-related activities, including passenger spending on accommodations, dining, and local attractions and supports numerous jobs in the region (from dockworkers to hospitality staff), it is becoming clear that it also poses significant environmental and social challenges. Studying the multiple impacts of the cruise industry is essential to understand its economic benefits, address environmental challenges, and ensure sustainable growth for the local community. This is an exploratory case employing analysis of secondary data, publicly available and audited at the source.

Keywords: cruise, economic impact, port-city, sustainable development, USA

AN ANALYSIS OF ECDIS DISPLAY MODES USAGE AT SEA AND ITS IMPLICATIONS TOWARDS NAVIGATION SAFETY: INSIGHTS FROM A SURVEY

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Abstract

The Electronic Chart Display and Information System (ECDIS) is designed to enhance navigational safety and assist Officers of the Watch (OOWs) in performing their duties. However, the system also introduces specific challenges, including interface complexity and information overload, which may contribute to navigational errors and, consequently, maritime incidents. During voyage planning and navigation, excessive graphical and textual information can clutter the display, increasing the cognitive workload of the OOW. This issue is particularly pronounced when navigating confined waters at night, where distinguishing symbols and markings against the night-mode colour palette presents an additional challenge. Age-related visual deterioration is a well-documented factor in maritime operations, yet its implications for ECDIS usability remain underexplored. To assess the extent to which OOWs utilize dedicated mode presentations (day display during the day, dusk display at twilight, and night display at night), this study analysed responses from the Navigat-E (Navigation with ECDIS and Beyond) survey. A total of 154 active seafarers participated in the study. The results reveal notable variations in the selection of display modes at night, often deviating from the recommended settings depending on the specific phase of voyage planning or execution. One key finding highlights a potential issue concerning the relationship between contrast perception and colour vision, as well as discrepancies in the interpretation of system displays. Furthermore, existing maritime colour vision tests were found to be insufficient in assessing seafarers' ability to interpret modern ECDIS colour palettes, posing a risk of symbol misinterpretation and information oversight. The study concludes with recommendations for targeted improvements in display usability, colour testing standards, and training methodologies, emphasizing their relevance to all OOWs, irrespective of age.

Keywords: maritime navigation, voyage planning, colour and contrast vision, ishihara test, safety of navigation

"SEAFAIRIES": STRUGGLES AND UNPLEASANT EXPERIENCES OF GAY SEAFARERS; TRANSFORMING LEARNED HELPLESSNESS TO LEARNED OPTIMISM

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Abstract

This qualitative study investigates the experiences of Filipino gay seafarers, focusing on the challenges they face in a predominantly male working environment in the maritime industry. Through narrative inquiry and online in- depth interviews, the research explores the participants' struggles including discrimination, bullying, and the pressure to conform to heteronormative standards, which often lead to feelings of learned helplessness. The findings revealed a complex interplay between identity management and the pursuit of acceptance, highlighting the emotional toll of concealing one's true self in an unwelcoming environment. Despite these adversities, the study uncovered a journey towards learned optimism, showcasing the resilience and strength of community support among gay seafarers. Participants emphasized the importance of financial security and family aspirations as motivating factors in overcoming challenges. The research calls for an increased advocacy for inclusivity and recognition of diverse identities within the maritime sector, aiming to foster a safe and supportive atmosphere for all seafarers. By providing insights into the lived experiences of LGBTQ+ individuals in maritime contexts, this study contributes to the broader discourse on diversity and inclusion, offering recommendations for industry stakeholders to promote a more equitable workplace for gay seafarers.

Keywords: gay seafarers, unpleasant experiences, learned helplessness, learned optimism, maritime industry

PORT BALLAST WATER MANAGEMENT OPTIONS UNDER NEWLY EFFECTIVE REGULATIONS

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Abstract

The management of ballast water is a key measure in protecting marine ecosystems from the spread of invasive species. While shipboard ballast water treatment systems are the primary method of compliance with the mandatory D-2 standard currently in force, ports should be prepared to offer alternative solutions as a contingency measure in cases where onboard systems fail. This study outlines three practical port-based ballast water treatment possibilities: stationary shore-based, mobile land-based and barge-mounted systems. These alternatives enable regulatory compliance, continuity of port operations, and environmental protection, especially in light of the increasing expectations placed on ports to support ballast water compliance within the current international regulatory framework.

Keywords: invasive aquatic species, ballast water management, IMO d-2 standard, port-based ballast water treatment systems

CHARTING NEW WATERS: EXPLORING LEGAL AND POLICY GAPS IN MARITIME WELFARE AND SEAFARERS' RIGHTS

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Abstract

The maritime industry, a critical pillar of global trade, is fundamentally reliant on the labour and welfare of seafarers. Significant legal and policy gaps persist despite international conventions and national regulations to safeguard their rights. This research explores the systemic inadequacies in maritime welfare and seafarers' rights, examining how these gaps undermine seafarers' well-being and compromise the naval sector's sustainable growth. The study qualitatively combines empirical and doctrinal methodologies. A critical analysis of foundational international agreements, such as the Maritime Labour Convention, 2006 (MLC), and national legislation, such as the Merchant Shipping Act, 1958 (India), establishes a theoretical foundation. Case studies, interviews with shipping industry professionals, and reviews of papers from organisations such as the International Labour Organisation (ILO) and the International Maritime Organisation (IMO) are the foundation of empirical observation. Profound shortcomings in enforcement frameworks, occupational health regulations, and the availability of mental health services are exposed by the study. Also, increased automation and green laws, including IMO 2023 goals for emissions, create new challenges, commonly overlooking the human factor. The study emphasises the need for Proposals like establishing a global maritime welfare fund and implementing regional frameworks to complement the MLC, such as a harmonised legal framework with emerging issues like integrating mental health policies, fair distribution of wages and digital welfare tools. The report advocates for the maritime industry, which appreciates economic development and human dignity, by addressing these imbalances.

Keywords: maritime welfare, seafarers' rights, maritime labour convention, legal gaps, fatigue and stress

RISK MANAGEMENT IN MARITIME EDUCATIONAL INSTITUTIONS, CHALLENGES AND RESTRICTIONS

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Abstract

Risk management represents a key challenge for maritime educational institutions, which face specific regulatory requirements and standards. This paper analyzes the issue of risk management in institutions engaged in the education and training of seafarers (Maritime Education and Training institutions – MET), with a particular focus on the Faculty of Maritime Studies Kotor as a case study. Such institutions in Montenegro are required to comply with legal regulations applicable to all higher education institutions in the country, such as the Law on Higher Education and the standards prescribed by the Agency for Control and Quality Assurance of Higher Education (AKOKVO), as well as with specific laws and regulations in the maritime domain. Due to these regulatory obligations – especially those related to the implementation of international standards such as the STCW Convention (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers) and the ISO 9001:2015 standard – additional risks may arise in the management process. The paper considers, on one hand, risks that the institution can directly influence through internal measures, and on the other hand, external risks that are beyond its control. The objective of this paper is to identify and analyze key risks – both internal and external (risk register), highlight management challenges, and propose potential strategies to minimize their impact on the effective functioning of the Faculty of Maritime Studies Kotor.

Keywords: risk management, MET, educational process, legal regulations

MULTILINGUALISM IN SEAFARING

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Abstract

Seafaring as a profession cannot be considered a national issue. Seafarers work in a global environment, surrounded by various cultures and languages. How do we achieve exact communication in such situations? Experts suggest a unique, intelligible, simple language to avoid misunderstandings and ambiguities. Professors employed at MET institutions have always followed the recommendations of IMO authorities. The English language is not an exception to the rules. At the University of Dubrovnik, we have always paid great attention to the internationally accepted and unavoidable English language. English has been taught at the Nautical Department of the University of Dubrovnik for more than a hundred and fifty years. Historical records show that the first teachers of the English language were Master Mariners. They acquired their knowledge of English by traveling aboard different vessels worldwide. Nowadays, priority is seen in the number of hours dedicated to the English Language and also by the position of the subject always in front of other subjects, and the examinations always preceding other disciplines, which is evidenced in the text of the syllabus on our web page. Much discussion has been held regarding the importance of Maritime English and the usefulness of Lingua Franca for proper communication among participants in a maritime adventure. As a teacher of the Maritime English - Nautical Department, I have encountered various levels of knowledge of the English language and also various nationalities that arrive in Dubrovnik to study here through international exchanges of students. This paper will focus on a survey of the Second Year Nautical Department classes. The respondents were given the questionnaire with questions about their multilingual backgrounds. It is expected that the analysis will reveal that it is indispensable to use EMI (English Medium Instruction type of English). EMI has been on the increase at the universities (especially at Master Level Degrees), because of the internationalization of the European and world universities.

Keywords: maritime english, English Medium Instruction (EMI), multilingualism

FUEL GAS SUPPLY SYSTEM OF THE ME-GI TWO-STROKE SLOW-SPEED DIESEL ENGINE IN THE LNG TANKER

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Abstract

This paper discusses the newest technologies and the operation principle of the ME-GI two-stroke slow-speed engine MAN B&W 5G70ME-C9.5-GI that is mounted on today's LNG tankers. The company MAN Diesel & Turbo has developed the MEGI (M-type, Gas Injection, Electronically Controlled) type of marine engines using both fuel oil and fuel gas. The liquified gas boil-off is compressed through the fuel gas supply system FGSS and injected into the engine cylinder combustion chambers at 300 bar and 45oC. In addition to safe and reliable operation on gas, the ME-GI (M-type, Gas Injection, Electronically Controlled) marine engine has significantly reduced CO_2 emissions by 20-25%, NOx by up to 80%. The main purpose of the FGSS is to supply fuel gas to the cylinders at the correct pressure, in accordance with the engine load. The proper operation of this dual-fuel engine requires the injection of the pilot fuel, i.e. a small amount fuel oil which is self-ignited. As the engine starts running, the fuel gas (secondary fuel) is injected into the combustion chambers. The engine is always first started on fuel oil. The engine runs both on fuel oil and fuel gas with equal efficiency. The engine can operate on up to a maximum of 95% fuel gas and 5% fuel oil. The 5% fuel oil is used as pilot fuel to control the ignition of both fuel oil and fuel gas in the combustion chamber.

Keywords: ME-GI, boil-off gas, dual fuel, fuel gas supply system

RAISING COASTAL MARITIME ECOSYSTEM CONSCIOUSNESS: THE IMPACT OF MANGROVE CSR PROGRAMS ON SMES PERCEPTION OF ECOSYSTEM IN SEMARANG

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Abstract

Harmonious life between humans and nature today is increasingly filled with various complex challenges. Industrialization and free trade seem to provide opportunities for everyone to be able to do business as widely as possible. However, what must be understood collectively as human beings is how we can compensate for the damage to nature caused by its activities. Many people in Indonesia do not yet understand the meaning and role of the presence of various plants in the surrounding ecosystem. This is identical to what is called "Plant Blindness" (Wandersee and Schussler). The problem of the limited understanding of the community about the meaning and role of the existence of plants in the ecosystem is one of the factors that is quite crucial for the author's empirical hypothesis in the increasingly intensive exploitation of nature and the conversion of natural ecosystems. The understanding of the Indonesian people about the various plants that live around them is always interpreted in an exploitative manner and their benefits for humans directly and lacks understanding of their role in an ecosystem as a whole. With awareness of the ecological impacts caused by the damage to the mangrove ecosystem, it is important for the author to move to provide a real example for the community as a pioneer of small-scale businesses that contribute to the conservation of the mangrove ecosystem on the coast of Semarang City by inviting community groups of mangrove activists to jointly protect the maritime ecosystem for an environmentally friendly future.

Keywords: ecosystem, plant blindness, mangrove, environment, CSR

A SYSTEMATIC REVIEW OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN PORT MANAGEMENT AND OPERATIONS

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Abstract

The growing use of Artificial Intelligence (AI) marks a transformative shift in port operations and management. AI is increasingly recognised as a strategic tool to optimise processes, reduce costs, and promote operational sustainability. This article presents a systematic literature review conducted following the PRISMA protocol, aiming to synthesise evidence on AI's impact in the port sector. The review focuses on: (i) presenting the main AI applications implemented in ports, and (ii) identifying knowledge gaps for future research. Existing reviews on AI in port operations typically focus on areas such as safety, risk management, smart port development, and Machine Learning (ML) applications in maritime environments. While these studies highlight AI's broad potential and the complexity of ongoing research, they also demonstrate the need for a comprehensive synthesis of the existing knowledge. For this review, 30 peer-reviewed articles published between 2021 and early 2025 were analysed. The findings show that AI applications are effective in areas like vessel scheduling, berth allocation, and predictive maintenance, leading to significant improvements in operational efficiency and reductions in environmental impact. The study concludes that AI integration in ports is an established trend with strong potential to revolutionise maritime logistics. However, further research is required to address issues such as system interoperability, cybersecurity, and the development of tailored implementation strategies for diverse port environments.

Keywords: artificial intelligence, port operations, port management, systematic review

INTERNATIONAL SAFETY MANAGEMENT CODE IN MARITIME EDUCATION AND TRAINING

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Abstract

Considering the significance of the maritime economy in facilitating global trade and advancing globalization, it is crucial to ensure, as much as possible, safe, efficient, and environmentally friendly maritime transportation without accidents. Even though and despite continuous and considerable efforts made by the International Maritime Organization (IMO) towards technical progress and the recommendations to enhance safety at sea, a significant number of accidents continue to happen. Many studies indicate that human factor is the primary cause of most accidents at sea, constituting a substantial percentage. To reduce the number of accidents caused by human factor, the International Safety Management Code (ISM) was introduced, aiming to obtain an understandable safety culture. To properly implement the requirements of the ISM Code, it is essential to understand the importance of acquiring knowledge of the Code, starting with formal education. The aim of the research is to examine and analyse students' understanding, familiarity and knowledge of the ISM Code. Based on the results, guidelines for improving the significance of the ISM Code in Maritime Education and Training (MET) are provided.

Keywords: ISM Code, maritime education and training, safety at sea, human factor

A FEW NOTES ON THE IMPACT OF IRREGULAR WAVES ON SHIP COLLISION AVOIDANCE AND EVASIVE MANEUVER PLANNING

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Abstract

In times of increased automation of maritime transportation and an upcoming technological shift caused by the introduction of autonomous ships and systems, an accurate prediction of a vessel's motions and maneuvers is of utmost importance for the sake of its safety. Because a ship operates in a complex environment characterized by the presence of irregular waves, their impact on the ship's response should be thoroughly analyzed and considered, not only in terms of stability-related issues but also in collision-avoidance applications. Therefore, this study summarizes current achievements in considering the impact of stochastic realization of irregular waves and its impact on a ship's operation, especially on the collision-avoidance problem. The issue of the required sample size in taking into account the nature of wave action is addressed, along with an analysis of the ship motion distribution and parameters describing her maneuverability. Potential applications in the form of predictive models employing Bayesian Networks are also presented. Such models could be developed in the future into onboard Decision Support Systems, assisting a watchkeeping officer or operational system in more accurate planning of evasive maneuvers with respect to wave stochastic realization and hull response resulting from its impact.

Keywords: stochastic wave realization, irregular waves, ship safety, collision avoidance, ship's motion prediction

FINANCIAL PERFORMANCE OF FISHING COOPERATIVES IN THE REPUBLIC OF CROATIA

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Abstract

Fisheries are a strategic sector of the economy in the Republic of Croatia and an important driver of development, particularly in the Adriatic Croatia, with fishing cooperatives representing a significant business segment within it. A fishing cooperative is a specific type of cooperative whose primary activity is fishing, while the activities of its members include commercial fisheries, farming, and processing of fishery products, including their placement on the market. In accordance with specific regulations, fishing cooperatives in the Republic of Croatia must contribute to the ecologically sustainable exploitation and protection of marine biological resources and ecosystems, strengthen the competitiveness of producers in fisheries and aquaculture, improve market transparency by providing relevant information to consumers and ensuring product traceability, secure market stability through production planning and supplying consumers with quality and healthy food, improve skills, working conditions and occupational safety, encourage innovation aimed at the development of the blue economy, and foster both national and international cooperation. The aim of this study was to determine the financial performance and business stability of fishing cooperatives in the Republic of Croatia in the period from 2018 - 2023. A financial analysis was conducted on nine active fishing cooperatives over the analysed period. Financial performance was assessed using indicators of liquidity, activity, leverage, efficiency and profitability, while business stability was evaluated using the revised Altman Z-score model for privately held companies. The results of the financial analysis indicate relatively sound financial performance and business stability for the majority of fishing cooperatives throughout the analysed period.

Keywords: fishing cooperative, financial analysis, performance, business

PORT INFRASTRUCTURE AS A DETERMINANT OF CARGO HANDLING EFFICIENCY AND DEMURRAGE RISK

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Abstract

The condition and capacity of port infrastructure are key factors determining the efficiency of cargo handling operations and can directly influence the occurrence of demurrage. This study examines the impact of road infrastructure providing access to the port, the characteristics of the approach routes, the strategic positioning of berths, and the capacity of existing facilities. Their influence on vessel stay duration is assessed, along with the likelihood of demurrage charges arising from insufficient infrastructural support. Using data from a regional terminal, the analysis focuses on berth utilization patterns, the performance of portal cranes of varying specifications, and the effectiveness of supporting cargo-handling systems. Findings reveal that imbalances in infrastructure usage, limitations in access and operational zoning, and aging equipment can significantly extend vessel dwell time and increase the risk of demurrage. The study underscores the importance of coordinated infrastructure planning and targeted improvements to enhance port efficiency and mitigate operational delays.

Keywords: port infrastructure, handling capacity, cargo operations, demurrage, logistics efficiency

IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE IN THE RAILWAY TRANSPORT AND ITS EFFECT ON PORT EFFICIENCY

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Abstract

With the latest advancements in the field of Artificial Intelligence there could be a significant increase in the efficiency of different parts of the transport system. The purpose of the current paper is to analyse the weak points of the railway transport, where artificial intelligence is suitable for implementation, as well as the current limitations of the AI technology. We are going to analyse the available data on transport operators, who have already implemented Artificial intelligence into their transport systems, as well as the thoughts and opinions of those who plan to implement AI in their transport operations in the near future. The main goal of this current publication is to summarize strong and weak points of artificial intelligence which can be implemented in the railway transport system, and the possible effects it can have on port efficiency.

Keywords: types of artificial intelligence, transport system, railway transport, port efficiency

EFFECT OF INTRODUCING ARTIFICIAL INTELLINGENCE IN LOGISTIC SYSTEMS AND PROCESSES, POSSIBILITIES FOR DEVELOPMENT AND IMPROVEMENT

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Abstract

Nowadays, when we talk about modern systems, it is almost impossible not to consider introducing artificial intelligence into any process in order to facilitate and improve it. Logistics, being a highly complex matter, involving different systems and chains of supply, makes no difference. Our paper aims at pinpointing those aspects of artificial intelligence which may be the most beneficial for the improvement of logistic systems. We are going to analyse data regarding practitioners' opinion, ones who have already implemented Artificial intelligence into their systems as well as those who are planning to include it into their processes into near future. Our main goal is to summarize strong and weak points of artificial intelligence in logistics, possible development and evolution. Without claiming to be experts in artificial intelligence development and code, we are analysing it more as professional users rather than developers.

Keywords: artificial intelligence, logistics, development, analysis

DIGITALIZATION OF MARITIME LOGISTICS: A NEW MANAGEMENT METHODOLOGY IN THE AGE OF AUTOMATION

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Abstract

The accelerated digital transformation of logistics processes is significantly reshaping the maritime industry, particularly in the management of complex and dynamic supply chain systems. This paper explores new methodological approaches to maritime logistics management in the context of increasing automation and digitalization of business processes. The aim is to develop an integrated management methodology based on the application of advanced digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), blockchain and digital twins. The proposed management model focuses on enhancing operational efficiency, transparency, and adaptability of logistics systems, with particular emphasis on resilience in the face of global disruptions. Through a theoretical framework and a case study, this research contributes to a better understanding of the role of digital tools in optimizing maritime logistics operations and lays the groundwork for the further development of smart logistics systems in the maritime sector.

Keywords: maritime logistics, digitalization, management, automation, Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, Big Data, sustainability

DIGITALIZATION AND SMART PORT INNOVATIONS IN COASTAL MARINAS FOR SUSTAINABLE NAUTICAL TOURISM: A CASE STUDY OF ACI CLUB INITIATIVES

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Abstract

Digitalisation tools like Internet of Things sensors, AI analytics and cloud-based management platforms allow for real-time monitoring of safety, resources and berth occupancy in current marinas. The smart port concept involves integration of ICT infrastructures, automation of processes and data driven decision-making, and has also been extended to marinas for optimizing operations, improving eco-sustainability and enriching user experience. ACI's marina network has led Croatia's digital transformation, installing smart metering infrastructure and IoT sensors at flagship locations such as Marina Rovinj to automate energy and water management and to optimize visitor services. From its ongoing underwater robotics pilot at Marina Skradin to the upcoming implementation of smart infrastructure at Marina Rijeka, it is clear ACI has a carefully considered and complete digital provisioning plan which includes both software platforms and hardware innovations. By comparison, ACI is right in-line with advancements being made by IGY Marinas, D-Marin and MDL Marinas; all of whom use similar digital and sustainability initiatives on substantial level. Stakeholders should focus the scaling of environmental monitoring technologies across all ACI marinas and create European Union supported public-private partnerships to foster the deployment of digital infrastructure upgrades. Future research needs to assess the long-term implications of smart systems on operational performance and sustainability indicators and consider user acceptance and interoperability models for marina digital ecosystems.

Keywords: digitalization, smart port systems, smart marinas, digital sovereignty, sustainable nautical tourism

IMPACT OF BLACK CHARTER ON NAUTICAL TOURISM IN THE REPUBLIC OF CROATIA

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Abstract

One of the most important services provided in nautical tourism is the charter service. Charter includes the service of using vessels with or without crew, with or without the provision of accommodation and/or food services, for the purpose of rest, recreation and cruising of sailors. Charter tourism in recent years has recorded an annual visit of over 550,000 charter guests who achieve almost 4 million overnight stays in the Republic of Croatia. Charter tourism also includes almost 3,000 charter companies, which in 2024 had a charter fleet of over 7,500 vessels. Unfortunately, the charter industry also has its negative side, namely the renting of vessels without fulfilling legal obligations ("black charter"). In this scientific paper, an analysis of relevant elements of nautical charter in the Croatia was carried out, and the shortcomings of this activity were highlighted. Special attention was made on negative impact not only on the main stakeholders operating on the charter market, but also on the general safety and supervision of maritime traffic, and finally the state budget itself. The main goal of the research is to determine the impact that the black charter has on nautical tourism in the Croatia and how its negative consequences can be mitigated or completely suppressed. The paper will also propose a set of activities aimed at making the charter market more transparent, safer, legal and sustainable for all its stakeholders, and making the Croatia as an attractive tourist destination more attractive, organized and competitive.

Keywords: nautical tourism, charter company, boat rental, black charter

INFLUENCE OF COUNTY PORT AUTHORITIES ON MARITIME PASSENGER TRAFFIC IN THE REPUBLIC OF CROATIA

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Abstract

On the Croatian Adriatic coast, in seven coastal counties, there are over 450 ports open to public traffic of county and local importance, which are managed by 22 county port authorities. Numerous national and international maritime lines in regular and occasional passenger traffic operate through most of these ports. Given that the Republic of Croatia is a country with 50 permanently inhabited islands that need to be continuously connected by transport, and is naturally an extremely attractive tourist destination visited by a large number of tourists during the summer months, the establishment of safe, reliable and high-quality maritime passenger traffic is of exceptional importance. Therefore, the role of county port authorities as the bearers of sustainable development of ports open to public traffic of county and local importance is extremely crucial in the maritime passenger system of the Republic of Croatia. This scientific paper will conduct research on the level of influence that county port authorities have on the development of maritime passenger traffic in the Republic of Croatia and what activities they can directly influence its development.

Keywords: maritime passenger traffic, county port authorities, ports open to public traffic, ports management

THE ANALYSIS AND IMPORTANCE OF SECURITY FOR THE DEVELOPMENT OF TOURIST TRAFFIC IN COASTAL DESTINATIONS - CASE STUDY PRIMORJE-GORSKI KOTAR COUNTY

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Abstract

This scientific paper deals with the insufficiently researched topic of tourism security with an emphasis on the case of Primorje-Gorski Kotar County. Tourism is, without a doubt, the most important economic sector in the Republic of Croatia and is also an indisputable driving force for employment and GDP growth, and it also contributes significantly to social changes in all spheres. For the purposes of this scientific paper, it is necessary to define tourism more closely as a social, cultural and economic phenomenon that involves the movement of people to countries or places outside their usual environment for personal or business/professional purposes. The very fact that tourism involves the movement of people to a place outside their place of residence raises the question of what are the most important elements that attract tourists to a particular destination. In terms of tourism, since it is an industry that is extremely sensitive to external factors such as various security threats, such as: theft, fraud and similar violations, all of them disrupt the normal functioning of the tourism sector because their outbreak negatively affects the image of tourist countries, which is then reflected in their entire economy. Croatia ranks first among the EU member states in terms of the share of international tourism revenue in GDP, and therefore it is extremely important for it to maintain the image of a very safe tourist country. This paper will analyse safety in Primorje-Gorski Kotar County, with special emphasis on safety on the county's beaches.

Keywords: safety, tourism, sea beaches, Primorje-Gorski Kotar County, passenger flows, concessions

CHALLENGES OF REGULATING THE UNMANNED VESSELS

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Abstract

Maritime transport is going through vast changes – new technologies emerge every day. This demands the regulations to keep up with the ongoing changes in the real world – be it vessel automation, use of remote pilots or even completely unmanned AI guided vessels. All of these will need to be regulated at some point and somehow. At the same time, laws and regulations are usually retrospective and in maritime field, usually written after some major accidents. Though proactive laws have been discussed for quite some time, especially in respect of safety, the use of new technologies, and especially the combination of several of them, for example unmanned, completely automated vessels using AI guidance and new fuels, bring with them additional challenges – how to be proactive about something that does not exist yet without stopping the innovation? International Maritime Organization has adopted a five-tier model for developing new regulations, goal-based standards. In this article, the authors analyse the possibilities to create proactive regulations for unmanned, AI guided cargo vessel within the existing framework, comparing it to the work done with another novel technology, wing-in-ground vessels. Authors showcase that all regulations for new, innovative technologies need to be carefully considered as of not to be too rigid but leave space for innovation.

Keywords: maritime new technologies, unmanned vessels, wing-in-ground crafts, regulations, standards

ADVANCED MANUFACTURING METHODS IN THE SHIPBUILDING INDUSTRY

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Abstract

Modern technologies, such as 3D printing, have become widely available and relatively inexpensive, enabling their use not only in large enterprises but also by private users. Thanks to their easy availability and intuitive operation, people can use these devices without specialist training. As a result, this technology is gaining importance in all industries as they dynamically develop their production processes. However, despite a wide range of applications in various industries, the shipbuilding industry still uses it to a limited extent. This paper explores the potential of advanced manufacturing methods, including 3D printing and other innovative technologies. It indicates possible directions of their application in the shipbuilding industry, both in the context of shipbuilding and operation and maintenance.

Keywords: 3d printing, advanced manufacturing, spare parts, repairs

THE IMPACT OF A NAVIGATOR'S TEMPERAMENT ON MARITIME TRANSPORTATION SAFETY: AN EMPIRICAL STUDY USING FULL-MISSION BRIDGE SIMULATOR

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Abstract

Despite the upcoming technological shift, safety of maritime transportation remains critically dependent on human performance, including the cognitive and behavioural characteristics of a navigator. Current risk management frameworks prioritize technical competencies and vocational skills overlooking the role of stable and suitable personality traits such as temperament and its impact on operational outcomes. Therefore, this study explores how a navigator's temperament relates to key performance safety indicators during simulated bridge operations, taking into account the participant's roles as well as their cognitive performance. The research involved 84 senior maritime students who participated in full-mission bridge simulation exercises. Their temperament was assessed with the Formal Characteristics of Behaviour–Temperament Inventory (FCB-TI) technique. Situational awareness (SA) was measured in two different ways, namely subjectively with the Situation Awareness Rating Technique (SART), and objectively with the Situation Awareness Global Assessment Technique (SAGAT). Operational performance, in turn, was evaluated using a custom-developed Penalty Assessment Technique (PAT). The findings revealed that the role played by the navigator within the bridge team did not produce statistically significant differences in SA or their performance. However, temperament had a clear, measurable, and non-uniform impact on both these aspects. Certain temperament types were associated with better cognitive performance and fewer safety violations under specific conditions. The results obtained highlight the potential benefits of integrating navigator's temperament assessments into crew selection and bridge team composition processes. A more tailored, person-centered approach to maritime training and resource management could better align individual predispositions with operational demands, ultimately reducing human errors at sea.

Keywords: human factors,situational awareness, MET, maritime safety

RISK ASSESSMENT AND HUMAN FACTORS IN ENCLOSED SPACE ENTRY: THE SHARP LADY CASE

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UDK 656.61:331.45

Abstract

Enclosed space entry is one of the most hazardous operations aboard crude oil tankers, where unsafe atmospheres pose significant risks to crew safety. This paper presents a case study of a fatal enclosed space entry accident on the crude oil tanker *Sharp Lady*, analyzed using the Human Factor Analysis and Classification System for Marine Accidents (HFACS-MA). The incident involved entry into a cargo tank with hydrocarbon levels far exceeding safety limits (26% LEL), resulting in one fatality and serious injury. Using the HFACS-MA methodology, the study identifies contributing factors across multiple levels, including organizational influences, unsafe supervision, preconditions, and unsafe acts. Key findings highlight deficiencies such as inadequate implementation of safety management procedures, poor risk assessment practices, and insufficient atmospheric testing prior to entry. These systemic failures underscore the need for enhanced procedural compliance and improved training in hazard recognition. This research emphasizes the importance of addressing human factors comprehensively to prevent similar incidents. Recommendations include stricter enforcement of enclosed space entry protocols, improved risk assessment implementation, and fostering a robust safety culture aboard oil tankers. By identifying systemic failures and proposing corrective measures, this study contributes to improving maritime safety standards and reducing enclosed space-related accidents.

Keywords: enclosed space entry, crude oil tanker, human factors, HFACS-MA, maritime safety

TOWARDS SUSTAINABLE PORT OPERATIONS: A CASE STUDY OF THE PORT OF BAR

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Abstract

The transition from traditional to "green ports" has become a vital part of creating a more sustainable shipping network, aiming to improve efficiency while reducing harm to the environment. This shift not only supports environmental responsibility but also enhances the efficiency and long-term viability of port operations. This paper explores the case of the Port of Bar in Montenegro, investigating its potential to evolve into a more environmentally conscious maritime hub. Strategically located and well connected through rail and road networks, with sufficient quay length and water depth, the port is well-positioned to play a stronger role in the Adriatic region. The study reviews current operational practices, identifies existing environmental challenges, and suggests practical steps forward, such as adopting renewable energy sources and cleaner technologies. Using principles from operations research and green logistics, it proposes a step-by-step model. It also considers key policy frameworks and EU directives that support this kind of transformation, especially in the context of climate change and regional collaboration. By focusing on a smaller Mediterranean port like Bar, which often goes unnoticed in global discussions, this research adds valuable perspective to the ongoing conversation about sustainable port development. The findings suggest that while transitioning to a green port model presents logistical and financial challenges, it opens up opportunities for long-term benefits, including improved competitiveness, better regulatory alignment, stronger community relations, and economic gains. These benefits range from reduced energy costs and lower operational expenses to increased productivity driven by modernized infrastructure and optimized processes.

Keywords: green ports, regulatory framework, port operations practices, energy efficiency, sustainable development

SUSTAINABLE MARITIME TRANSPORT – PAST, PRESENT AND FUTURE

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Abstract

The term maritime transport refers to the transport of people and goods by sea. Since the majority of the Earth's population abandoned the nomadic lifestyle that it practiced in history, the need for the transport of people and goods has arisen. Since the beginning of transport and trade, the largest share of goods and people have been transported by sea, both throughout history and today. Only the way in which maritime transport takes place has changed. In its beginnings, the power of man and the wind was used. After that came the development of the steam engine. The industrial revolution led to the use of diesel engines. The use of engines necessarily leads to the use of different types of fuel. At the beginning of the industrial revolution, the sustainability of the use of different types of fuel was not taken into account. However, after some time, the question began to arise whether we have enough fuel that we use for the next generations, for the next 100, 200 or 300 years of constantly increased maritime traffic. The use of different types of drives (that is, fuel) in the distant and recent past, as well as in the present, was analysed. People's attitude towards the Earth and its resources was more responsible in the past than it is today. Therefore, maritime transport also developed according to the principles of sustainable development. Future generations will have to plan, live and work in accordance with the principles of sustainable maritime transport.

Keywords: maritime transport, sustainable development, marine fuel

METHANOL AND AMMONIA AS ALTERNATIVE FUELS FOR ICEBREAKING OPERATIONS IN THE NORTHERN BALTIC SEA

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Abstract

The Arctic and sub-Arctic regions are vital for trade and energy but present environmental and operational challenges. Icebreaking fleets are heavily reliant on fossil fuels and solutions are required to meet EU and IMO climate goals. This study evaluates methanol and ammonia as alternative fuels using the Estonian Winter Navigation System simulation model. Methanol offers near term viability due to engine compatibility, but with higher costs and lower energy density. Ammonia presents a long term option but faces technical and safety barriers. Results highlight the need for technological advances and regulatory support to enable sustainable icebreaking operations under evolving climate and policy conditions.

Keywords: winter navigation, system level simulation, icebreaker fuel consumption, alternative fuel, ammonia, methanol

TRANSFORMATION OF MARITIME LOGISTICS AND SUPPLY CHAINS IN MODERN GEOPOLITICAL CHALLENGES (STRATEGIC ROLE OF GEORGIA)

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Abstract

Contemporary geopolitical and economic shocks have significantly impacted maritime logistics and the structure of global supply chains. The war launched by Russia in Ukraine, the acute economic consequences of the pandemic, security risks associated with navigation in the Red Sea, and frequent distractions to ship traffic in sea channels have led to significant changes in both the geographical location of strategic industrial complexes and the structure of the supply chains that support them. As a result, specific countries and companies are gradually moving to diversified supply chain models. The purpose of the presented article is to analyse the main trends in the transformation of maritime logistics and supply chains and to assess the role and opportunities of Georgia in the new geo-economic context. The study pays special attention to assessing the competitiveness of ports in the Black Sea region, for which cargo turnover and throughput indicators, investment dynamics and infrastructure development trends are used. The paper applies mixed research methods that gives us the possibility of both quantitative data analysis and the assessment of structural and regional trends. The study is based on the three main analytical approaches – statistical data analysis (analysis of cargo turnover and throughput utilization indicator of Georgian ports), empirical data analysis (the infrastructure capabilities of ports and volume of carried out investments are studied) and comparative analysis (comparative analysis of supply chain models and transport corridors). Additionally, document analysis and SWOT analysis are used. The research results demonstrate the context of global transformation, where Georgia possesses a strategic maritime transport and logistics potential of international and regional importance. The results of the article are important both in terms of theoretical understanding of the processes taking place in supply chains and maritime logistics at the global and regional levels, and in terms of implementing effective state policy in this area

Keywords: maritime logistics, supply chain, seaports, cargo turnover, competitiveness, transformation

APPLICATION OF IOT TECHNOLOGY FOR REAL-TIME PERFORMANCE MONITORING OF SHIPBOARD PV SYSTEMS

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Abstract

The implementation of Internet of Things (IoT) sensor technology has significantly transformed the monitoring and optimization of photovoltaic (PV) systems on ships. These advanced sensors enable real-time tracking of key parameters such as solar power generation, panel temperature, and overall system efficiency, ensuring optimal energy utilization in maritime environments. Special emphasis was placed on the integration of PV sensors for measuring the intensity of solar radiation, temperature sensors for detecting thermal fluctuations of panels, current and voltage sensors for analyzing output performance, insulation resistance sensors for preventing electrical failures. Advantages of using IoT networks and advanced analytical algorithms, data is processed in real time, enabling predictive diagnostics and early detection of potential failures. Cloud-based platforms facilitate seamless data storage and remote accessibility, enabling ship operators to make informed decisions. This paper explores the application of IoT sensors in real-time monitoring and management of renewable energy sources on ships, thus contributing to maritime sustainability. The conclusions highlight the importance of IoT technology for increasing the energy efficiency of ships, along with guidelines for future innovations in maritime affairs.

Keywords: IoT technology, shipboard, pv systems, real-time

THE ANALYSIS OF THE TRENDS IN THE PORT-CITY INTERFACE

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Abstract

The interface between the port and the city represents a dynamic space in which economic, spatial and social processes intertwine. The port as an infrastructural and logistical system and the city as the center of life and urban functions have developed a complex and often conflicting relationship throughout history. The scientific paper examines the fundamental theoretical assumptions about ports and cities, analysing the interdependent processes of urbanization, globalization and changes in the port industry that directly affect the shaping of urban spaces. The paper continues with a presentation of contemporary trends in the development of port-city relations with a particular focus on the processes of repurposing former industrial and port zones into spaces for public, cultural and tourism purposes. It highlights challenges such as the isolation of ports, environmental problems and lack of coordination between port and city authorities are highlighted, which often make it difficult to establish functional cohesion. Using European examples such as Rotterdam and Genoa, successful models for the transformation of port areas into integral parts of the urban space are presented, while maintaining the economic importance of the ports. Through a comparison with the national context, the city of Rijeka is identified as an area with great potential for the implementation of similar repurposing and integration strategies. In conclusion the paper emphasizes the need for sustainable planning, dialogue between stakeholders, and changing the perception of port spaces as closed and isolated, towards their functional and spatial integration with the urban environment.

Keywords: port, city, interface, urbanization, port industry

A SMART SHIP COLLISION AVOIDANCE FRAMEWORK USING AI

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Abstract

The maritime industry faces significant obstacles to ensure safe navigation. The main aim of this project is to developed an advanced AI based ship recognition system to preclude collision in dangerous situations. The technology is packed in strategic locations close to the ship and offers real time detection of neighbouring vessels. AI algorithms help in analysing data from various sources, such as cameras and other sensors, so that potential collision hazards could easily be detected. Once it is detected, the alert notification passes through the ship's communications systems hence allowing them to make their first decision on time. In this study, the model is implemented is artificial intelligence-based deep learning model You Only Look Once, version 8 (YOLOv8). The model's object detection accuracy is 99.06% for real-time collision avoidance. The main aim of this research is to improve marine safety by elevating situational awareness and providing early warnings to stop collision avoidance at sea. The device uses powerful artificial intelligence and deep learning algorithms to automatically locate neighbouring vessels, even in difficult weather conditions like limited visibility rough at the seas. By combining data from several sensors, the system can precisely estimate the proximity and movement of nearby vessels. The detection system is strategically deployed at critical spots aboard the vessel to provide complete coverage of probable collision areas. The system immediately alerts the bridge duty officers through the ship's bridge or other integrated communication systems.

Keywords: real-time detection, collision risk evaluation, AI, deep learning, digital alerts

SAFETY ASPECTS OF HYDROGEN FUEL IN MARITIME TRANSPORT

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Abstract

The maritime transport sector is undergoing a significant transition toward decarbonisation and reducing GHGs (Greenhouse Gases), leading to significant interest in hydrogen as an alternative fuel. Hydrogen presents a promising environmentally friendly energy carrier. However, its chemical and physical properties introduce specific safety challenges that require careful assessment. This paper employs a SWOT analysis to systematically evaluate the strengths, weaknesses, opportunities, and threats associated with using hydrogen as a fuel in maritime transport. Emphasis is placed on the key safety-related challenges, currently available risk mitigation strategies, and relevant international regulatory frameworks, all framed within a comprehensive SWOT analysis. The results highlight the necessity of early-stage integration of safety measures, specialised crew training, and cross-sector collaboration in developing standardised safety protocols. With effective risk management and proactive measures, hydrogen possesses the potential to become an important component of a safe and sustainable maritime transport future. The findings contribute to identifying priority areas for improving the safe implementation of hydrogen as a fuel.

Keywords: hydrogen, maritime transport, safety, alternative fuels, risk assessment

HYDROGEN AS A MARITIME TRANSPORT FUEL – LEGAL FRAMEWORK

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Abstract

International regulations form the legal backbone of global maritime operations and serve as a foundation for national regulatory frameworks. Hydrogen, as a promising alternative fuel, could significantly advance the decarbonisation of maritime transport. However, its large-scale application requires not only technological innovations but also a robust and adaptable legal framework. Integrating hydrogen as a fuel into maritime operations poses challenges at both national and international levels, particularly regarding the harmonization of legislation in the areas of maritime safety, environmental protection, and operational procedures. This article explores existing global legal frameworks regarding the integration of hydrogen as a marine fuel. It analyses relevant legal instruments, including the IMO IGF Code, SOLAS, MARPOL, and the way EU legal framework aligns its maritime decarbonization targets with those established by the IMO through its Green Deal Initiatives. Furthermore, it identifies regulatory gaps, particularly in hydrogen safety, certification, crew training, bunkering, and storage. The article contributes to the growing body of research on the legal aspects of using hydrogen as a fuel in maritime transport, linking technical challenges with legal preparedness. This is especially important and useful for legislators and all stakeholders in maritime transport, as it will assist in further researching a legal foundation for implementing hydrogen in the maritime transport sector.

Keywords: hydrogen, maritime transport, legal framework, decarbonisation

SAILING INTO THE GAP: EXPLORING BRANDING IN INDUSTRIAL CLUSTERS AND THE MISSING MARITIME LINK

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Abstract

Branding in industrial clusters has emerged as a crucial strategic activity to enhance collective identity, visibility, and competitiveness, particularly within business-to-business (B2B) contexts. While existing research covers branding practices to some extend across industrial ecosystems, the application and development of branding strategies within maritime clusters remain underexplored. Current study conducts a systematic literature review focusing on peer-reviewed research to map existing knowledge on branding in industrial clusters and to identify the extent to which maritime clusters have been included in this discourse. It aims to unfold under researched areas and proposes for future research on maritime cluster branding. Findings reveal that while industrial cluster branding is a well-established research field, branding within maritime clusters has received limited scholarly attention. By mapping the evolution of industrial cluster branding research and revealing the maritime cluster branding gap, this study offers a conceptual foundation for future investigations. It highlights the need for a deeper understanding of collective brand identity formation, stakeholder coordination, and promotional strategies in maritime industry clusters operating within B2B environments.

Keywords: Industrial Cluster, Branding, Maritime Cluster, B2B branding

DECARBONIZATION OF ESTONIAN FERRY LINES – CHALLENGES AND OPPORTUNITIES

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Abstract

Decarbonization in the shipping industry plays a central role in global research and innovation activities. Ways to achieve zero-emission shipping include energy efficiency improvements, operational changes, the use of non-fossil fuels, retrofit and redesign of ships. Although the environmental regulations of the European Commission and the International Maritime Organization (IMO) apply only to ships above 5000 GT, the local industry representatives and authorities in many European counties also target greenhouse gas (GHG) emissions reduction from a wider shipping sector, including smaller ships and island ferries. To achieve the GHG emissions reductions, low-carbon fuels such as biodiesel, hydrogen, and its derivatives have been proposed for ferries along with direct electrification. From the design and operation viewpoint, these alternatives involve higher investment risk, including (a) capital-intensive infrastructure requirements, (b) powertrain implementation and onboard storage sizing, and (c) fuel availability and price volatility. This study focuses on an Estonian ferry line, which serves as the primary means of transportation for connecting the mainland. Consequently, it plays a critical role in facilitating the mobility of cargo and passengers to and from the islands. We analyse possible future energy system development paths to evaluate potential alternative fuels, based on existing ferries and local port infrastructure. Subsequently, we develop and apply an energy-transport optimization model to analyse alternative fuel investments from a techno-economic-environmental viewpoint. Finally, we present a preliminary comparative analysis of GHG emissions reductions and operating costs from the perspective of energy consumption, supporting the industry's decision makers in evaluating the future competitiveness of the shipping lines.

Keywords: decarbonization, shipping, alternative fuels, electrification

ENHANCING JUNIOR DECK OFFICERS PERFORMANCE THROUGH SIMULATOR TRAINING

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Abstract

This paper analyses common errors by junior deck officers in maritime simulator training, emphasizing strategies to enhance navigational safety through improved situational awareness, communication, and teamwork. Research of recorded simulator sessions revealed prevalent mistakes, including misjudging minimum safety distances, misinterpreting navigational signals, lapses in situational awareness, poor communication and lack of effective teamwork. Key variables influencing errors include distraction levels and scenario difficulty. Actions such as targeted training programs, dynamic scenario designs, and coordination exercises, were tested to reduce error rates. Results indicate that structured feedback, collaborative training, and adaptive scenarios significantly improve situational awareness, communication, and decision-making. The study highlights the importance of addressing human factors and experience gaps in maritime training, providing scalable strategies for real-world application. These findings promote safer maritime operations by training young deck officers with new skills to enhance situational awareness and teamwork, reducing navigational incidents.

Keywords: situational awareness, communication, teamwork, human factors, navigational safety

IMPACT OF PREVIOUS VESSEL TYPE EXPERIENCE ON NAVIGATIONAL BEHAVIOUR

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Abstract

This study investigates whether the type of vessel where seafarers gained their primary experience is associated with their decision-making and procedural behaviour during navigation. Using structured interviews and a full-mission bridge simulator, the research examined how officers from different vessel backgrounds perform in key areas such as avoidance manoeuvres, bridge familiarization, checklist use, CPA compliance, passage plan briefings, and lookout procedures. Participants were grouped based on their previous experience: LNG, Oil-Chemical, Container, and Others. While most results showed no statistically significant differences between the groups, several trends have been noticed. LNG-experienced officers rated passage plan briefings and checklist use higher, and performed better in CPA compliance. The Oil-Chemical group showed lower CPA compliance despite moderate confidence in their responses. Lookout practices varied greatly, with cadets reportedly acting as lookouts in the 'Others' group, contrary to STCW regulations. The findings suggest that while training may be standardized, onboard culture and operational routines related to vessel type may influence seafarer behaviour. The study highlights the importance of experience context in shaping operational readiness and suggests areas for further investigation, especially in relation to company procedures and bridge team structure.

Keywords: navigational behaviour, vessel type, bridge procedures

MARITIME FINANCE ADAPTATION (MAR FIN ADAPT): A BLENDED FINANCE APPROACH TO MARITIME CLIMATE RESILIENCE AND SUSTAINABILITY

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Abstract

The maritime sector is facing rising sea levels, extreme weather events, and ecosystem deterioration, but these threats hardly offer any support through target resilience finance. Mar Fin Adapt is an innovative data-based strategic finance framework to quantify public, private, and philanthropic revenue flows against systemic funding gaps. Applying environmental and financial datasets with a coastal vulnerability index, climate exposure metrics, and investment flow analyses will facilitate correlations between statistically significant outcomes and risk reduction and nature-based adaptation investment. Pilot application with the framework across five coastal regions resulted in a score improvement of 25 and 30 percent, or an efficiency of over 60 percent of disbursement toward high-resilience-score projects. Blended finance mechanisms achieved an average risk offset of 40 percent to enhance private sector participation. The model further enabled intersectoral collaboration and shaped three policy recommendation drafts. Such results confirm that data-aligned and adaptive investment pathways could statistically improve resilience outcomes by simultaneously increasing access to affordable funding for vulnerable maritime communities.

Keywords: resilient coastal infrastructure, maritime climate, vulnerable coastal communities, mar fin adapt, flexible mixed-funding model

BATTERY RETROFIT IN A DP2 OFFSHORE VESSEL: A CASE STUDY ON EMISSIONS REDUCTION AND EU MRV COMPLIANCE

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Abstract

Modern energy generation in Europe, both from fossil fuel extraction and wind energy, thrives in the North Sea. To meet the demands of these industries, the offshore sector deploys a significant number of vessels performing various roles, including transportation of personnel and goods, waste collection, and serving as evacuation systems in emergencies. The high utilization of offshore vessels in Northern Europe necessitates careful monitoring, as their emissions contribute negatively to both global warming and environmental impact of shipping activities on port cities. However, the safety requirements of these vessels, all equipped with Dynamic Positioning (DP) systems, make shipowners hesitant to retrofit with new technologies. This work presents a case study of an Offshore Platform Supply Vessel (OPSV) equipped with DP2 and delivered in 2009, which has been retrofitted to include an energy storage container with lithium-ion batteries which allowed the ship to operate in hybrid modes. The retrofit does not compromise the vessel's DP or manoeuvring capabilities, and it can serve both hotel and propulsion systems. Additionally, the system can be used in port and be recharged via an onshore power supply. To assess the efficiency of the vessel before and after the retrofit, fuel consumption and emissions were compared and contrasted in three operational modes: port, DP manoeuvring and navigation. The implementation of the battery-based energy storage system has proven highly beneficial, reducing CO_2 emissions by an average of 14%, with significant reductions measured during the DP manoeuvring operations, where CO_2 emissions decreased by up to 17% relatively to original configuration (before retrofitting). Moreover, the system ensures compliance with updated European legislative framework, as the revised EU Monitoring, Reporting, and Verification (MRV) Regulation encompass offshore ships of 400 GT and above from January 1, 2025. With the current retrofit, the OPSV has also reduced the compliance costs in the coming years, in particular the need to purchase EU Emissions Trading System (ETS) allowances. From an economic standpoint, the payback period for the retrofit is achieved by the fourth year, leaving another six years of operational life according to the extended lifecycle. Therefore, despite the high initial costs associated with battery technologies and infrastructure development, the long-term economic benefits, coupled with regulatory incentives, make electrification of an OPSV a compelling proposition for the maritime industry.

Keywords: ship green house gas emissions, offshore platform support vessel, hybrid diesel-electric propulsion, fuel consumption reduction, ship decarbonization retrofitting

CLOUD SERVICES AND MARITIME CYBERSECURITY IN THE BALTIC SEA REGION

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Abstract

The maritime sector in the Baltic Sea region is undergoing rapid digital transformation, with growing adoption of cloud-based technologies in fleet management, logistics, and port operations. While these innovations offer improved efficiency and coordination, they also expose critical systems to evolving cybersecurity risks. This paper explores the intersection of maritime digitalization and cybersecurity in the Baltic context, with a particular focus on the adoption of cloud services. Drawing on a qualitative, interpretative approach (referencing legal frameworks, illustrative case studies, stakeholder concerns, and regional policy documents), the study identifies key vulnerabilities, including reliance on third-party cloud providers, fragmented regulatory implementation, and gaps in cross-border coordination. Given the Baltic Sea's strategic significance in European and global trade, the analysis highlights the need for harmonized cybersecurity frameworks, structured threat intelligence sharing, and investment in maritime-specific training and secure digital infrastructure. By framing current challenges in light of legal, operational, and geopolitical dynamics, the paper contributes to a broader understanding of how regional cooperation can enhance maritime cybersecurity resilience in an increasingly contested digital environment.

Keywords: maritime cybersecurity, cloud computing, baltic sea region, digital resilience, critical infrastructure protection

MACROSCOPIC MODELLING APPROACHES FOR EVALUATING THE EFFECTS OF HIGHWAY INFRASTRUCTURE DEVELOPMENT ON THE SPATIAL CONFIGURATION OF MARITIME PORT HINTERLANDS

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Abstract

The hinterland of a maritime port is a fundamental factor in determining its economic performance, regional influence, and long-term development potential. Ports with extensive hinterlands can attract and handle larger cargo volumes, thereby strengthening their position within global and regional supply chains. However, the size, shape, and structure of a port's hinterland are not fixed—they evolve in response to changes in land-based transport networks. Among these, the road infrastructure is particularly impactful, as it directly affects travel times, accessibility, and connectivity to inland economic centers. Travel speeds on road networks are influenced by roadway classification, traffic congestion, and infrastructure quality. This paper examines the effects of highway infrastructure development on the spatial configuration of the hinterland of Constanta Port, Romania's largest maritime gateway, with a specific focus on grain cargo flows. Using a macroscopic modelling framework, the study simulates the accessibility landscape before and after the implementation of recent highway projects. The analysis incorporates road speed profiles, freight flow characteristics, and network topology to identify shifts in the port's functional hinterland. A set of quantitative indicators, supported by graphical representations, illustrates the extent to which new highways alter cargo distribution patterns and enhance regional connectivity. The results underline the strategic importance of coordinated infrastructure planning in maximizing the efficiency and competitiveness of maritime ports. The methodology and findings presented in this study can serve as a valuable tool for policymakers and infrastructure planners in evaluating the broader territorial impacts of highway investments.

Keywords: maritime ports, hinterland, land network, macroscopic model

ADJUSTING THE MASTER OF MARITIME MANAGEMENT PROGRAMMES TO THE UP-COMING ERA OF AUTONOMOUS VESSELS IN FINLAND

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Abstract

For the past two decades, the Master's Programmes in Maritime management and administration in Finland have been aimed at persons who wish to continue in maritime management and expert positions in the ship-ping company's land organisation. The persons are required to have a bachelor's degree and minimum of 2-3 years of work experience on board. The IMO has been preparing the MASS code (Maritime Autonomous Sur-face Ships) for years, which will be completed and enter into force after 2026. Autonomy will increase gradual-ly. The IMO defines the levels of autonomy of vessels (I–IV). Fully autonomous vessels with no crew at all will also gradually be introduced (levels III to IV). This change has been taken into account in the design of the mas-ter's degrees which begin in September 2026. The shore organisations of shipping companies are preparing for a situation in which the vessels operate at different levels of automation. Some of the duties previously assigned to the ship's officers will be transferred to the land organisation. At first, the tasks will be carried out by the previous commanders, now only land. Later, the division of tasks will become even more differentiated as automation increases. For example, decision-making that requires legal expertise can be centralised in the future as transport documents become electronic. The tasks of the ground personnel will require more techno-logical and software expertise. This will be reflected in both the content of the training and the methodological choices of the training. Problem based learning (PBL), which was previously used as a rule, will be comple-mented by more training that requires the use of the Challenge Based Learning (CBL) method. This article presents both the changes and methodology of the reformed Master of Maritime Management education, as well as the changes in the content and methodology of the Autonomous Shipping Operations Master program.

Keywords: curriculum development, autonomous vessels, MASS, problem based learning (PBL), chal-lenge based learning (CBL)

FROM CLASSROOMS TO GLOBAL CONNECTIONS: THE IMPACT OF EXTRA-CURRICULAR ACTIVITIES ON GMP COMPETENCY BUILDING

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Abstract

In response to the growing complexity and globalization of the maritime industry, the International Association of Maritime Universities (IAMU) introduced the Global Maritime Professional Body of Knowledge (GMP BoK), which outlines a comprehensive framework of knowledge, skills, and attitudes (KSAs) required for future maritime professionals. This study explores the integration of extracurricular activities as a structured pedagogical strategy for developing soft skills aligned with the Tier A affective learning outcomes of GMP BoK. The research was conducted at Kherson State Maritime Academy and the Maritime Professional College in Ukraine in partnership with international academic institutions. Over the period 2019 – 2025, 553 cadets participated in a series of international and interdisciplinary extracurricular initiatives, including COIL projects, webinars, team-based quests, and poster sessions. A mixed-methods approach was used, incorporating psychometric testing, surveys, self-assessments, and observation. The findings demonstrate that participation in extracurricular activities significantly enhanced cadets' leadership, teamwork, interpersonal communication, ethical responsibility, proactivity, and decision-making. The study offers a structured mapping of all eleven GMP BoK soft skill areas and proposes a new model for evaluating the transition from awareness to action through cadets' reflective and proactive engagement. The research highlights the strategic role of affective learning in maritime education and advocates for the institutional integration of extracurricular programming as a catalyst for developing globally competent and safety-oriented maritime professionals.

Keywords: global maritime professional, body of knowledge, soft skills, affective learning, extracurricular activities

ANALYSIS OF THE CMMS DATABASE

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Abstract

Maintenance is a process that requires good organization of resources, spare parts and personnel. In order to better organize maintenance in companies in the maritime sector, planned maintenance was introduced. The system has been continuously developed and has evolved over time into a Computerized Maintenance Management System (CMMS), the most important organizational form of planned maintenance in the maritime sector. To support this role, commercial CMMS programs have been developed and sold on the market. This paper analyzes an example where a company does not have a sufficiently developed system for planned maintenance and examines what solutions could be implemented using the available tools. Using an Excel file available to the company as part of the Microsoft Office package and using their own resources to create a computer database, a proposal was made for the creation of their own unique CMMS. This analysis shows a small sample of the company's system, which contains several thousand pieces of information. A cross-sectional analysis shows that the system is fully functional and can meet the company's requirements. The price that would have to be paid is the time that would be spent on data entry and configuring the program. Comparing this approach with competing commercial CMMS programs, the result is clear and complete. The proposed in-house system is cheaper, meets the company's needs and is tailored to its requirements, but does not have all the features that commercial CMMS programs offer and requires constant employee involvement in its development and improvement.

Keywords: maintenance, buoys, CMMS, data analysis

INTEGRATION MODEL OF AUTONOMOUS UNDERWATER VEHICLES AND UNMANNED AERIAL VEHICLES FOR COMBATING ILLEGAL, UNREPORTED AND UNREGULATED FISHING

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Abstract

Illegal, unreported and unregulated (IUU) fishing can pose a serious threat to biodiversity, maritime ecosystem and fish fonds that otherwise can be exploited in a more adequate and economical manners. Advanced fishing management techniques, enhanced algorithms, and newly developed technologies, more specifically the upswing of unmanned aerial vehicles (UAV) and autonomous underwater vehicles (AUV), can help provide new solutions to combat the illegal activities at sea. This paper aims to explore the current findings regarding usage of UAVs and AUVs for abundance assessments and direct and indirect prevention of illegal, unreported, and unregulated (IUU) fishing by applying thorough analysis, compilation, systematic comparison and evaluation of methods and technologies indispensable for creating a modern fishery management system supported by AUVs and UAVs. As the contribution, the paper proposes an integrated model for deterrence of maritime misconduct by combining UAV and AUV systems, as well as using them for localizing high-risk areas according to depletion of fish stock. In that way distributing resources in the appropriate areas for maximizing the efficiency of law enforcement efforts by various agencies operating underwater and aerial maritime drone systems. In addition, possible challenges and drawbacks of the system that will have to be addressed are also examined and explained. Limitations of the study include the fact that the model has not been implemented in practice, which opens the gates to further research and possible continuation and expansion of proposed integrated UAV and AUV IUU fishing prevention model.

Keywords: IUU fishing, sustainable fishing, AUV, UAV

ANALYSIS OF NAVTEX SIGNAL RECEPTION IN THE NORTHERN ADRIATIC AREA

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Abstract

The Navigational Telex (NAVTEX) as one of the Maritime Safety Information (MSI) dissemination systems contributes to the safety of maritime navigation. The research analyzes anomalies in the reception of NAVTEX signals from the Coast Radio Station (CRS) Split Radio at a fixed location in the area of the Northern Adriatic. Despite the distance of only 155 nautical miles (NM), measurements with NAVTEX and RTL-SDR receivers showed very low RF signal levels at 490 kHz and 518 kHz during daytime broadcasts from CRS Split Radio, which made message decoding impossible. Night time reception, however, enabled successful decoding of NAVTEX messages transmitted from CRS Split Radio. Additionally, transmitters located over 200 NM away showed stronger RF signal levels, indicating a complex interaction of propagation conditions and local topography. The applied methodology included synchronized measurements using the built-in tools of the NAVTEX receiver's Control Panel and spectral analysis in the SDR# software. The results confirm the phenomenon of diurnal dependence of Medium Frequency (MF) radio waves on the Earth's ionosphere. During the day, the D-layer of the ionosphere absorbs most of the energy of MF sky waves, limiting the range to the ground wave propagation. At night, with the disappearance of the D-layer, MF sky wave reflections from the E- and F- ionospheric layers become dominant, enabling transmissions to several hundred NM. These findings have direct implications for navigation safety, as the Northern Adriatic is a zone of increased maritime traffic where the lack of MSI increases the navigational risks.

Keywords: NAVTEX, software-defined radio, MF propagation, navigation safety

TRAFFIC CONTROL EFFICIENCY IN THE CITY OF RIJEKA

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Abstract

The goal of this article is to apply positive results of various traffic control and management systems to the urban transport in the city of Rijeka. These results will lead to less congestion and better traffic flow as well as less pollutant emissions and lower primary energy consumption. Traffic congestion is a great and unavoidable problem in medium and large sized cities. Therefore, traffic control efficiency must respond quickly to traffic disruptions and apply the most appropriate measures to solve problems in the traffic network. The methodological approach of the research consists of the development of a prototype solution for traffic simulation. The aim of the simulations is to show how the use of intelligent traffic solutions can manage traffic in urban centers. The application of the simulation is to test innovative scenarios to demonstrate the effectiveness of traffic management in urban areas. The improvement of traffic control efficiency will have a positive impact on the development of urban transport and the increase of traffic safety in the city of Rijeka. The following hypothesis has been set in the article. By applying intelligent traffic solutions and simulation tools it is possible to integrate large amounts of processed data through the integrated platform, thus achieving the validation of innovative scenarios, which can increase the effectiveness of traffic control efficiency. The scientific contribution is the determination of traffic control efficiency system that will develop the traffic management system in the city of Rijeka thus increasing the quality of transport and traffic safety.

Keywords: traffic simulations, urban traffic management, traffic control efficiency, intelligent transport systems

SITUATIONAL AWARENESS AMONG SEAFARERS IN CONDITIONS OF INFORMATION OVERLOAD ON THE NAVIGATIONAL BRIDGE

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Abstract

In modern maritime navigation, the sensor systems, electronic charts, navigation systems, integrated systems, and automated alerts have significantly increased the volume and complexity of information presented to bridge officers. While these technologies aim to enhance operational awareness, they can also lead to cognitive overload, contributing to reduced situational awareness (SA) and increased risk of human error. This research explores the theoretical relationship between information overload and SA among seafarers operating conventional vessels. The study aims to construct a theoretical framework grounded in human factors and cognitive psychology. Key parameters such as perception of situation, attention narrowing, and decision fatigue are investigated in the context of bridge operations. Bayesian Belief Networks (BBNs) are designed to represent the probabilistic dependencies between workload, information density, cognitive state, and decision-making. This model will serve future simulation-based validation, such as reaction time and alarm response accuracy. This paper will provide information for training and workload management.

Keywords: situational awareness, human error, bridge operations

ADVANCING FIREFIGHTING TRAINING BY CFD AND VR IN MET

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Abstract

The evacuation procedures and firefighting training on ships can be significantly enhanced by using Computational Fluid Dynamics (CFD) to simulate fire dynamics on board. However, while CFD provides detailed and accurate modelling, it lacks the ability to effectively visualize these dynamics within a fully navigable 3D environment. This is where Virtual Reality (VR) becomes a powerful complement, offering an immersive and interactive experience for users [1]. This paper presents a CFD simulation of fire spread within a two-storey ship engine room and its integration into a VR environment. A fire scenario originating from the ship's main engine was developed, and the resulting CFD data was transferred into the VR model of the engine room using a custom-built interface [2]. This interface ensures that the complex CFD outputs are accurately mapped into the virtual space. With the use of VR head-mounted displays, users can be fully immersed in a realistic engine room under fire. This enables advanced firefighting training and provides valuable insights for optimizing engine room design to enhance crew safety. The CFD-VR fire application has been tested by experienced seafarers, who reported that the fire behaviour rendered through CFD-based data in VR is significantly more realistic than fire simulations created solely with conventional VR game engines.

Keywords: firefighting, evacuation, maritime education and training, virtual reality, computational fluid dynamics

ZERO-EMISSION SHIPPING MISSION: THE POTENTIAL USE OF NUCLEAR POWER

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Abstract

The shipping industry is responsible for around 3% of global greenhouse gas emissions and currently faces increasing pressure to reduce emissions in line with international climate targets. Among the various low-carbon technologies under consideration, nuclear energy emerges as a compelling alternative for achieving zero-emission shipping. This paper explores the nuclear energy potential to revolutionize the shipping sector by providing a high-density, zero-emission energy source based on recent advances in small modular reactors (SMRs) and improved reactor designs that offer a safer, commercially viable pathway for civilian maritime use that enable long voyages without frequent refuelling. From an environmental perspective, nuclear-powered ships could drastically reduce dependence on fossil fuels and eliminate carbon dioxide, sulphur oxides, and nitrogen oxide emissions, making a significant step toward the International Maritime Organization's (IMO) goal of zero emissions by 2050. In addition, nuclear propulsion enables constant speeds and efficient operation regardless of the volatility of fuel prices or bunker logistics. Despite these advantages, some challenges remain, including high initial capital costs, stringent regulatory frameworks, waste disposal, proliferation risks, and social acceptance. The developed international regulatory standards and port infrastructure for nuclear ships are essential for broad acceptance and introduction in use. With adequate investment in research, robust governance, and global cooperation, atomic energy can serve as a cornerstone for the transition to zero-emission shipping. Ultimately, nuclear propulsion represents a high-risk but potentially high-reward pathway that, alongside other decarbonisation strategies, should be a part of the global effort to achieve sustainable, zero-emission shipping.

Keywords: zero-emission, shipping, nuclear power, propulsion

STRUCTURAL CAUSALITY HIERARCHY ANALYSIS: A NOVEL DATA-DRIVEN INTEGRATED FRAMEWORK FOR ASSESSING MARITIME OCCUPATIONAL ACCIDENTS

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Abstract

Given that maritime occupational accidents are characterized by low-frequency yet high-hazard events, there is an urgent need to accurately identify and systematically analyse their risk-influencing factors (RIFs) to enhance maritime safety prevention and control capabilities. This study proposes a novel analytical framework for maritime occupational accidents by integrating Association Rule Mining (ARM), the Weighted Impact Nonlinear Assessment System (WINGS), and Adversarial Interpretive Structural Modelling (AISM). The framework is designed for the systematic identification of RIFs and a multidimensional analysis of their complex interactions. First, a comprehensive dataset of RIFs was constructed using cases from the European maritime accident database. Next, the ARM technique was applied to uncover association rules among these RIFs. Subsequently, the WINGS model was employed to quantitatively assess the nonlinear causal relationships and impact strength of RIFs from the perspective of dynamic information transfer. Finally, the AISM method was utilized to construct a hierarchical structure of RIFs, revealing the underlying pathways of risk transmission. The results of this study effectively illuminate the interaction patterns among RIFs in maritime occupational accidents, identify dynamic risk evolution pathways triggered by specific factor combinations, and validate the applicability and effectiveness of the integrated analytical framework in risk identification and accident mechanism analysis. This research provides both theoretical support and practical guidance for shipping enterprises in building dynamic, targeted, and differentiated safety management systems.

Keywords: maritime safety, maritime occupational accidents, machine learning, association rule mining, wings

EVACUATION TIME PREDICTION BASED ON THE INTEGRATION OF PATHFINDER MODELLING AND MACHINE LEARNING METHODS

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Abstract

Efficient decision-making for passenger emergency evacuation was of utmost importance in dealing with emergencies on passenger ships. The uncertainty and complexity of the evacuation process for passenger ships at sea posed significant challenges to evacuation management. In order to predict the evacuation time of passenger ships quickly and accurately, this study established a simulation model for the evacuation of passenger ship personnel to obtain experimental data. In addition, a feature extraction algorithm was proposed to optimize the prediction model of passenger ship evacuation time. Firstly, a comprehensive simulation model for the emergency evacuation of passenger vessel personnel was established. This model was developed based on the four defined objectives and five key influencing factors identified through passenger ship evacuation scenario analysis. Subsequently, the Association Rule Fusion (ARF) method was employed to aggregate highly correlated influential factors into consolidated interaction features. Following feature fusion, a forward selection approach was applied to evaluate and rank these consolidated interaction features. Ultimately, the dataset was sequentially put into the hyperparameter-optimized machine learning model according to the established feature importance ranking to predict evacuation time. Notably, the experimental results demonstrated that the hyperparameter-optimized XGBoost model emerged as the most stable and robust predictive model, exhibiting superior accuracy and enhanced generalization capability compared to alternative approaches (RF, LightGBM, ANN). This study provided an effective tool for predicting evacuation time and formulating efficient personnel evacuation plans.

Keywords: maritime safety, passenger ship, emergency evacuation, pathfinder, machine learning

THE DECARBONIZATION OF SEAPORTS: AN OVERVIEW OF SELECTED MEASURES

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Abstract

Ports are considered critical infrastructure as they play an important role in international trade and overall economic growth. There are around 4,000 ports worldwide, of which around 1,200 are located in Europe alone. Ports around the world face the same challenge of providing competitive services while ensuring that the negative impact on the environment is minimized, with the environmental problem being particularly acute in peri-urban ports. While the majority of maritime transport emissions are generated during shipping, ships' auxiliary engines run during port calls to keep the ship's systems running. Ships in port usually contribute more than half of all port-related emissions. The remaining emissions come from the port itself. The aim is to reduce port emissions by 90% by 2050. Ports are already working hard to reduce their environmental footprint and gain the support of local communities. They are applying a combination of soft and hard measures, such as reduced charges for greener ships or a truck arrival booking system and other digitalization approaches, as well as offering alternative fuels for ships and shore power (cold ironing), purchasing sustainable cargo handling and other terminal equipment, using renewable energy sources, developing electrical micro grids, etc. These measures represent a major financial, infrastructural and operational challenge, at least initially. This paper presents measures (examples of best practices) that ports have implemented to achieve cleaner operations with an indication of the cost of implementation.

Keywords: seaport, decarbonization, electrification, renewable sources, cost

OPTIMISM – ONLINE PROGRAMME FOR TRAINING ON INTERNATIONAL MANAGEMENT OF ISM CODE

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The International Maritime Organization (IMO)'s Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention, known as the International Safety Management (ISM) Code, became mandatory in 1998. The development of the ISM Code was prompted by several high-profile maritime accidents in the 1980s, most notably the capsizing of the Herald of Free Enterprise, a roll-on/roll-off passenger ferry, at Zeebrugge in March 1987. This tragic incident resulted in the loss of 193 lives out of the 539 passengers and crew on board and highlighted serious shortcomings in safety management and operational oversight. Twenty-five years later – after five amendments and several key provisions introduced under SOLAS Chapter IX relating to the ISM Code – the OPTIMISM project (Online Programme for Training on International Management of the ISM Code) was launched. This initiative is led by five European organisations with support from the European Commission. The primary aim of the OPTIMISM project is to evaluate the effectiveness of the ISM Code and its associated measures in improving safety and operational standards across the shipping industry, and to recommend enhancements where needed. Running from September 2023 to August 2026,

the project will deliver two major outcomes: (1) a comprehensive report on the current state of ISM Code implementation in the maritime sector, along with evidence-based recommendations for improvements; and (2) a fully developed, competence-based online training programme. This course will focus on the principles and practical application of the ISM Code and will include a novel assessment system featuring self-evaluation tools, written assignments, and an oral examination component.

Keywords: ISM code, maritime safety, marine environment, learning from accidents, audits and inspections