WORLD MARITIME UNIVERSITY

People. Development. Impact.

CAHEMA

Concepts of ammonia/hydrogen engines for marine application

Kick-off meeting

Dr. Aykut I. Ölçer (PI)

Professor, Director of Research

Nippon Foundation Professorial Chair in Marine Technology and Innovation

Head, Maritime Energy Management (MEM) Specialization

Dr. Anastasia Christodoulou

Research Associate

Dr. Momoko Kitada

Associate Professor

Dr. Fabio Ballini

Assistant Professor

Dr. Alessandro Schönborn

Assistant Professor

9 April 2021

ABOUT WMU

- Established by IMO in 1983
- Maritime Postgraduate University
- Focus on Maritime & Oceans Education, Research & Capacity-Building

Mission: To be the World Centre of excellence in postgraduate maritime and oceans education, professional training and research, while building global capacity and promoting sustainable development

WORLD MARITIME UNIVERSITY

GOVERNANCE

IMO Assembly (170 IMO Member States)
President: His Excellency Ronaldo Drago Rodriguez

IMO Council (40 IMO Member States)
Chair: Xiaojie Zhang
WMU Governor

WMU Board of Governors (30 appointees by IMO SG) Chair: Chancellor Kitack Lim
WMU Alumnus MSc 1991 MSA(N)

WMU Executive Board (10 appointees by IMO SG)
Chair: Gerardo Borromeo

World Maritime University
President: Dr Cleopatra Doumbia-Henry

WMU WORLD MARITIME UNIVERSITY

MSC PROGRAMS

Malmö - Maritime Affairs
- Port Management
- Maritime Education & Training
- Shipping Management & Logistics
- Maritime Law & Policy
- Maritime Safety & Environmental Administration
- Maritime Energy Management
- Ocean Sustainability, Governance and Management

Shanghai
- International Transport & Logistics

Dalian
- Maritime Safety & Environmental Management

PHD PROGRAM

Malmö - Maritime Affairs
- Environmental Impacts of Marine Activities
- Maritime and Marine Technology and Innovation
- Maritime Economics and Business
- Maritime Energy Management
- Maritime Law, Policy and Governance
- Maritime Safety
- Maritime Social and Labour Governance
- WMU-Sasakawa Global Ocean Institute

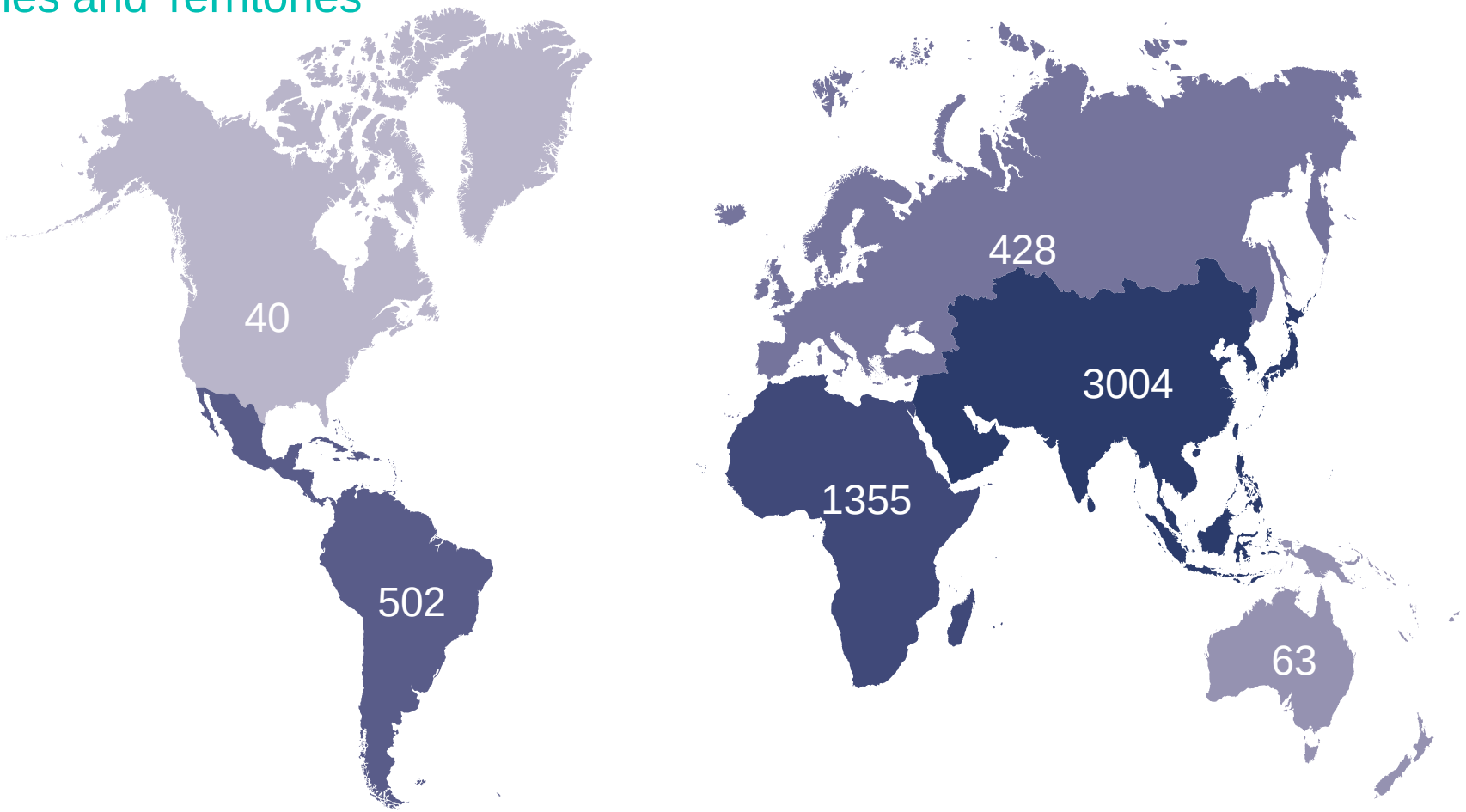
PG DIP PROGRAMS

- Postgraduate Diploma in Executive Maritime Management (in collaboration with DNV GL)
- Postgraduate Diploma in Maritime Energy
- Postgraduate Diploma in Marine Insurance Law and Practice
- Postgraduate Diploma in International Maritime Law (in collaboration with Lloyd´s Maritime Academy)
- LLM in International Law (in collaboration with Lloyd´s Maritime Academy)

GLOBAL IMPACT

5,392 Alumni

170 Countries and Territories



WORLD MARITIME UNIVERSITY

WMU RESEARCH PRIORITY AREAS

Maritime

- RPA1: Maritime Energy Management
- RPA2: Maritime and Marine Technology and Innovation
- RPA3: Maritime Economics and Business
- RPA4: Maritime Social and Labour Governance
- RPA5: Maritime Law, Policy and Governance
- RPA6: Maritime Safety
- RPA7: Environmental Impact of Maritime Activities

Ocean

- RPA8: Navigational Right & Freedoms
- RPA9: Deep Blue: Capacity Building & Areas Beyond National Jurisdiction
- RPA10: Oceans, Climate Action & the UN 2030 Agenda
- RPA11: Blue Limits: Spatial Governance of Ocean Space & the Ocean/Coastal/Terrestrial Interface
- RPA12: Challenges in Ocean Governance

MARITIME RESEARCH PORTFOLIO EXAMPLES

- ITF Transport 2040 Project: An assessment of the technological developments in the global transport sector and their implications on jobs and employment by 2040, with a budget of 1.2mUSD

- EU Horizon 2020 Projects

	Title of EU-H2020 Project	WMU Budget	Start date
1	CyberMAR (Cyber preparedness actions for a holistic approach and awareness raising in the Maritime logistics supply chain)	464,967 EUR (3 years)	1 September 2019
2	SAFEMODE (Strengthening synergies between Aviation and maritime in the area of human Factors towards achieving more Efficient and resilient MODE of transportation)	252,000 EUR (3 years)	1 June 2019
3	CHEK (deCarbonising sHipping by Enabling Key technology symbiosis on real vessel concept designs)	357,000 EUR (3 years)	1 June 2021

- EU Regional (Interreg): GoLNG: Developing LNG in the Baltic Sea Region; Hybrid (Freight) Sailing; Sustainable Approaches and Innovative Liaisons (Resubmission), SAIL, is the research project aiming at exploring and promoting merchant wind assisted sailing in a Triple Helix (science, economy, public) approach.

- IMO REDUCTION OF GHG EMISSIONS FROM SHIPS: Comprehensive impact assessment of the short-term measure – Responsible for Task 1 – Literature Review – Input to MEPC 76 (2021).

- “EU Emission Trading System - impacts of including maritime transport”. Funded by the Swedish Transport Administration (Trafikverket)

- International Association of Maritime Universities (IAMU) “Data fusion and machine learning for ship fuel efficiency analysis: a small but essential step towards green shipping through data analysis". IAMU and the Nippon Foundation: The work on skills for the future Global Maritime Professional (GMP) resulting in a Global Maritime Professional Body of Knowledge (GMP BoK)

MTCC SEMINAR AT WMU OCT’ 19

Title at IMO Website:
EU/IMO global project drives energy efficiency in the maritime sector

WORLD MARITIME UNIVERSITY

EXPERT WORKSHOP ON ENERGY AND SHIPPING – FEB'20

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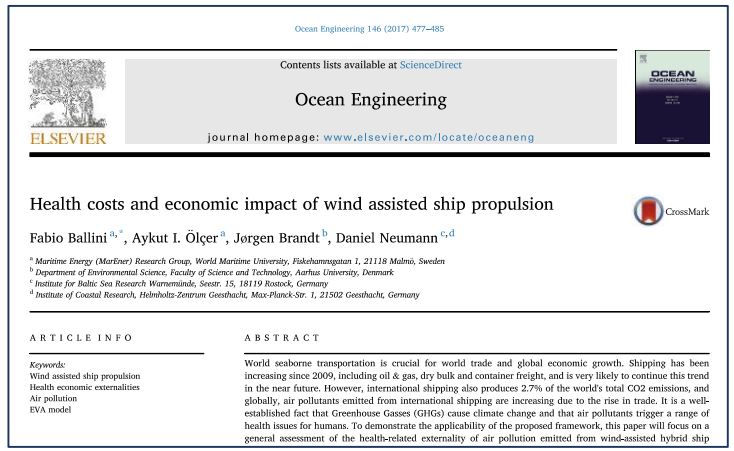
MEM PUBLICATIONS



Ocean Engineering 146 (2017) 477–485

Contents lists available at ScienceDirect

Ocean Engineering

journal homepage: www.elsevier.com/locate/oceaneng

Health costs and economic impact of wind assisted ship propulsion

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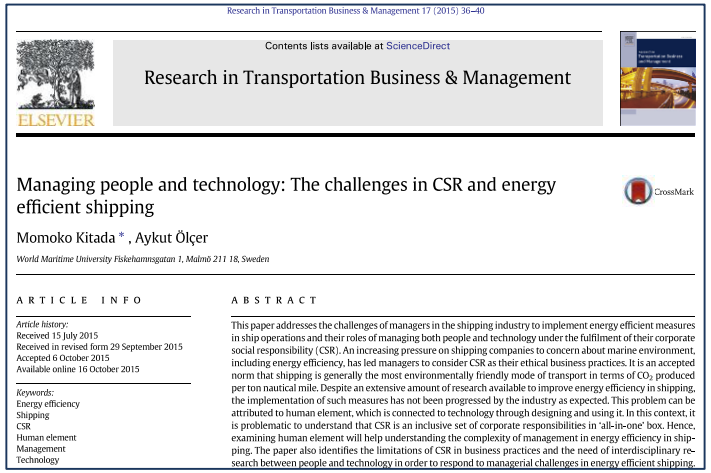
ARTICLE INFO

Keywords:
Wind assisted ship propulsion
Health economic externalities
Air pollution
EVA model

ABSTRACT

World seaborne transportation is crucial for world trade and global economic growth. Shipping has been increasing since 2009, including oil & gas, dry bulk and container freight, and is very likely to continue this trend in the near future. However, international shipping also produces 2.7% of the world's total CO2 emissions, and globally, air pollutants emitted from international shipping are increasing due to the rise in trade. It is a well-established fact that Greenhouse Gasses (GHGs) cause climate change and that air pollutants trigger a range of health issues for humans. To demonstrate the applicability of the proposed framework, this paper will focus on a general assessment of the health-related externality of air pollution emitted from wind-assisted hybrid ship



Research in Transportation Business & Management 17 (2015) 36–40

Contents lists available at ScienceDirect

Research in Transportation Business & Management

Managing people and technology: The challenges in CSR and energy efficient shipping

Momoko Kitada *, Aykut Ölçer

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ARTICLE INFO

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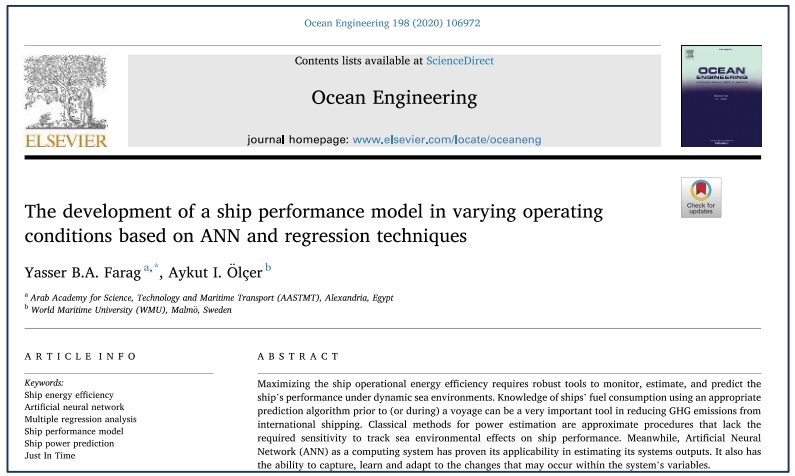
Keywords:
Energy efficiency
Shipping
CSR
Human element
Management
Technology

ABSTRACT

This paper addresses the challenges of managers in the shipping industry to implement energy efficient measures in ship operations and their roles of managing both people and technology under the fulfilment of their corporate social responsibility (CSR). An increasing pressure on shipping companies to concern about marine environment, including energy efficiency, has led managers to consider CSR as their ethical business practices. It is an accepted norm that shipping is generally the most environmentally friendly mode of transport in terms of CO_2 produced per ton nautical mile. Despite an extensive amount of research available to improve energy efficiency in shipping, the implementation of such measures has not been progressed by the industry as expected. This problem can be attributed to human element, which is connected to technology through designing and using it. In this context, it is problematic to understand that CSR is an inclusive set of corporate responsibilities in 'all-in-one' box. Hence, examining human element will help understanding the complexity of management in energy efficiency in shipping. The paper also identifies the limitations of CSR in business practices and the need of interdisciplinary research between people and technology in order to respond to managerial challenges in energy efficient shipping.



Ocean Engineering 198 (2020) 106972

Contents lists available at ScienceDirect

Ocean Engineering

journal homepage: www.elsevier.com/locate/oceaneng

The development of a ship performance model in varying operating conditions based on ANN and regression techniques

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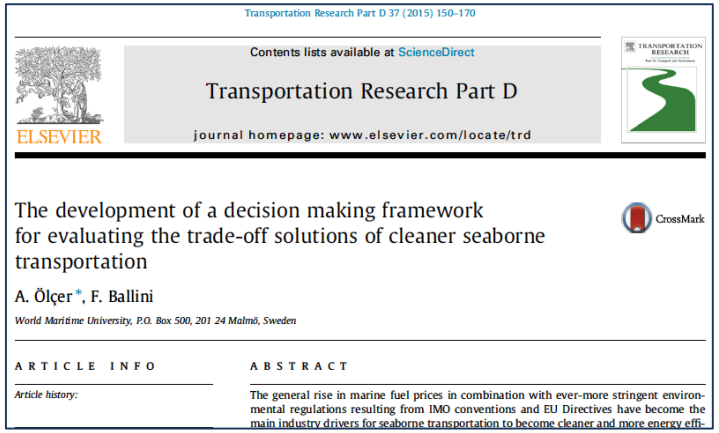
ARTICLE INFO

Keywords:
Ship energy efficiency
Artificial neural network
Multiple regression analysis
Ship performance model
Ship power prediction
Just In Time

ABSTRACT

Maximizing the ship operational energy efficiency requires robust tools to monitor, estimate, and predict the ship's performance under dynamic sea environments. Knowledge of ships' fuel consumption using an appropriate prediction algorithm prior to (or during) a voyage can be a very important tool in reducing GHG emissions from international shipping. Classical methods for power estimation are approximate procedures that lack the required sensitivity to track sea environmental effects on ship performance. Meanwhile, Artificial Neural Network (ANN) as a computing system has proven its applicability in estimating its systems outputs. It also has the ability to capture, learn and adapt to the changes that may occur within the system's variables.



Transportation Research Part D 37 (2015) 150–170

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

The development of a decision making framework for evaluating the trade-off solutions of cleaner seaborne transportation

A. Ölçer *, F. Ballini

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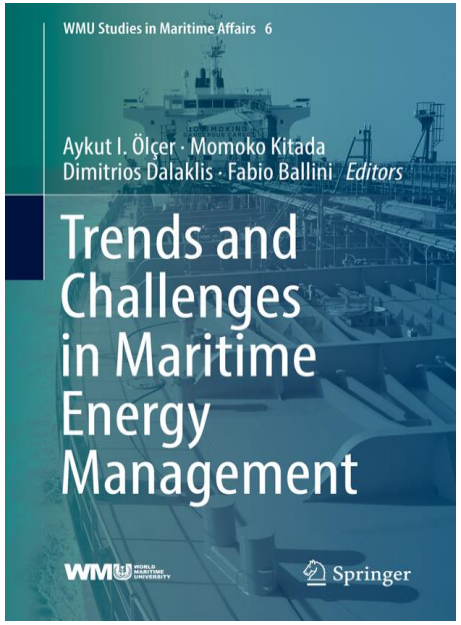
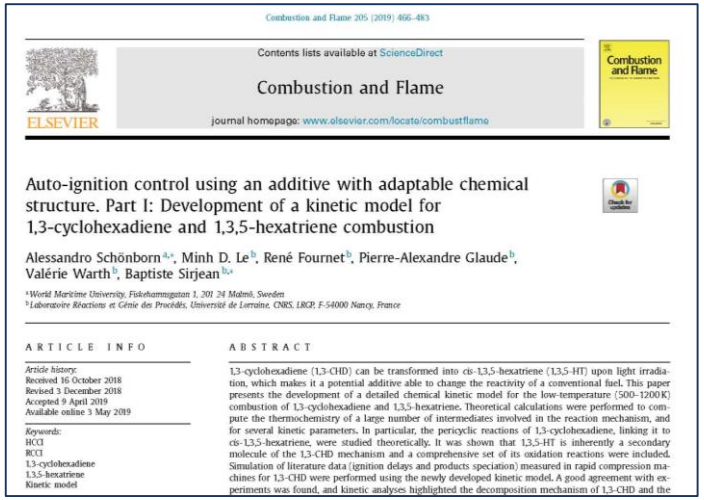
ARTICLE INFO

Article history:

ABSTRACT

The general rise in marine fuel prices in combination with ever-more stringent environmental regulations resulting from IMO conventions and EU Directives have become the main industry drivers for seaborne transportation to become cleaner and more energy effi-





Combustion and Flame 205 (2019) 466–483

Contents lists available at ScienceDirect

Combustion and Flame

journal homepage: www.elsevier.com/locate/combustflame

Auto-ignition control using an additive with adaptable chemical structure. Part I: Development of a kinetic model for 1,3-cyclohexadiene and 1,3,5-hexatriene combustion

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ARTICLE INFO

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RCCI
1,3-cyclohexadiene
1,3,5-hexatriene
Kinetic model

ABSTRACT

1,3-cyclohexadiene (1,3-CHD) can be transformed into cis-1,3,5-hexatriene (1,3,5-HT) upon light irradiation, which makes it a potential additive able to change the reactivity of a conventional fuel. This paper presents the development of a detailed chemical kinetic model for the low-temperature (500–1200 K) combustion of 1,3-cyclohexadiene and 1,3,5-hexatriene. Theoretical calculations were performed to compute the thermochemistry of a large number of intermediates involved in the reaction mechanism, and for several kinetic parameters. In particular, the pericyclic reactions of 1,3-cyclohexadiene, linking it to cis-1,3,5-hexatriene, were studied theoretically. It was shown that 1,3,5-HT is inherently a secondary molecule of the 1,3-CHD mechanism and a comprehensive set of its oxidation reactions were included. Simulation of literature data (ignition delays and products speciation) measured in rapid compression machines for 1,3-CHD were performed using the newly developed kinetic model. A good agreement with experiments was found, and kinetic analyses highlighted the decomposition mechanism of 1,3-CHD and the

WORLD MARITIME UNIVERSITY

CAHEMA

WP4: Regulatory, economic, and environmental analyses

Analyse the potential impact of ammonia and hydrogen as potential maritime fuels from a holistic perspective.

- Life-Cycle Assessment (LCA) for ‘green’ and ‘blue’ ammonia as a shipping fuel, addressing its impact on greenhouse gas emissions.
- Estimate potential emission levels of air pollutants and greenhouse gases (N_2O, H_2, NH_3 and life-cycle CO_2) from the use of NH_3 and H_2 as potential shipping fuels. Scenarios based on reasonable assumptions on what is technically achievable.
- Estimate the economic cost of the various technologies and the potential socio-economic costs in terms of negative externalities of ammonia and hydrogen engines.
- Cost-benefit analysis to compare the life-cycle greenhouse gas impact and negative externalities with the economic costs of the required technologies.
- Different regulation limit scenarios for the emission of currently unregulated species such as NH_3, N_2O and H_2 will thereby be evaluated, in terms of their costs and benefits. This allows making recommendations for a regulatory framework for emissions of N_2O, H_2, NH_3 and life-cycle CO_2., to ensure that the use of ammonia will be beneficial to the environment and society.
- WMU will host the project website, making the latest news and findings available to the public. To achieve high impact of the project findings, it is aimed to presented these results to the IMO Marine Environmental Protection Committee (MEPC) in the form of an information paper.

WEBSITE

CAHEMA

AIM | OBJECTIVES & OUTPUTS | THE ACTORS

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People. Development. Impact.

THANK YOU

SUSTAINABLE DEVELOPMENT GOALS

IMO INTERNATIONAL MARITIME ORGANIZATION