Maritime Energy Management: The Journey Towards A Zero/Low Carbon and Energy Efficient Maritime Future

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Prospects for Energy and Maritime Transport in the Nordic Region
26 February 2020
The Least (or Zero) Emission Ship?

(Source: WMU Maritime Energy Management Specialization EGY102 Lecture Notes)
Sustainable Shipping for a Sustainable Planet

Source: (WMU Maritime Energy Management Specialization EGY102 Lecture Notes)

IMO
World Maritime Theme for 2020
Air Pollution - Motivation and Drivers

- Environmental impact of Air Pollutants and GHGs (climate change, ..) and other externalities

- More stringent environmental regulations (MARPOL Annex VI Chapter 4), Kyoto to Paris Agreement and the latest IMO GHG Strategy

- Volatile fuel oil price

- World population, energy demand and prices

- Energy resources scarcity and Energy security

- UN2030 Agenda (SDGs 7 & 13 in particular)

Future Ship Propulsion Technology

- From Human to Diesel Engines
- Fuel cells, batteries?
- Nuclear (or Thorium?)
- Alternative fuels and Renewables
- (Solar, Wind, LNG, biofuel, Methanol, ..)
- Hybrid (right mix?)

(Ref: Shipping innovation by Niko Wijnoelst, Tor Wergeland, Figure 407, page 378)
The PG Pathway in MEM Stream

**PhD in MARITIME ENERGY**

**MSc in Maritime Energy Management**

- **Foundation Studies (Term 1)**
- **Subjects in Term 2**
  - Subject 1: Energy for Sustainable Maritime Industry
  - Subject 2: Energy-Efficient Ship Design and Operation
  - Subject 3: Energy Management in Maritime Onshore Facilities
  - Subject 4: Alternative Fuel/Technologies and Marine Renewable Energy
  - Subject 5: Maritime Energy Management and Operational Research
  - Field Studies and Seminar

- **Dissertation**

**PG Diploma in Maritime Energy**

**Professional Development Courses**

**Priority Area:** Maritime Energy Management

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The Holistic View of MEM

- Regulatory framework
- Energy efficiency
- Renewable / Cleaner energy
- Technology and innovation
- Human element
- Economics of energy management

As the International Maritime Organization’s centre of excellence for postgraduate maritime education, WMU’s mission is 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.
Maritime Research Priority Areas (RPAs)

**WMU’s 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.

- Maritime Energy Management
- Maritime and Marine Technology and Innovation
- Maritime Economics and Business
- Maritime Social and Labour Governance
- Maritime Law, Policy and Governance
- Maritime Safety
- Environmental Impact of Maritime Activities
Maritime Energy Management (RPA1)

Key topic areas:

- Maritime energy policy and governance
- Economics and social dimensions of energy management
- Energy management over the life-cycle of ships and in maritime onshore facilities (ports, shipyards)
- Renewable energy including ocean energy applicable to the maritime industry
- Marine technology and innovation related to energy
- The circular economy from a waste reduction and renewable energy perspective
Recent Areas of Interest

- Ocean energy
- Renewable energy and alternative fuels and technologies
- Real-time decision support systems for energy efficient ship operations
- Climate change impact on port infrastructure and its adaptation
- Lean, energy efficient and green ports and shipyards
- Life cycle cost/environment impact models of green solutions for ships, ports and shipyards
- Decision making for trade-off situations of cleaner seaborne transportation

Current 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**
  - EU Regional (Interreg): LNG Value Chain for Clean Shipping, Green Ports and Blue Growth in Baltic Sea Region (Go LNG)
  - IMO: A research project intended to assess the impact of the human element on international shipping, with a budget of £500,000
  - International Association of Maritime Universities (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)

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<table>
<thead>
<tr>
<th>Title of EU-H2020 Project</th>
<th>WMU Budget</th>
<th>Start date</th>
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<tbody>
<tr>
<td>1 CyberMAR (Cyber preparedness actions for a holistic approach and awareness raising in the Maritime logistics supply chain)</td>
<td>464,967 EUR (3 years)</td>
<td>1 September 2019</td>
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<tr>
<td>2 SAFEMODE (Strengthening synergies between Aviation and maritime in the area of human Factors towards achieving more Efficient and resilient MODE of transportation)</td>
<td>252,000 EUR (3 years)</td>
<td>1 June 2019</td>
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Managing people and technology: The challenges in CSR and energy efficient shipping

Momoiku Kikado, Aykut Oğuz

Abstract

The paper addresses the issues of managing people and technology in CSR and energy efficient shipping. It discusses the challenges faced by companies in managing the complex relationships between employees, technology, and sustainability. The authors highlight the importance of aligning company goals with employee values and providing training on energy efficiency. They argue that effective leadership is crucial in creating a culture that supports sustainable practices.

Keywords: CSR, Technology, Sustainability

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

Yusur A.A. Fang, Aykut Oğuz

Abstract

This paper presents an approach for developing a ship performance model in varying operating conditions using artificial neural networks (ANN) and regression techniques. The model is based on historical data of ship performance and environmental conditions. The authors demonstrate the effectiveness of the model in predicting ship performance under different operating conditions.

Keywords: Ship Performance, Artificial Neural Networks, Regression Techniques
## MSc in Maritime Energy Management

### EGY 111 Energy and Maritime Industry - Principles and Regulatory Framework 4 EC
To apply systems thinking; to define concepts related to energy and provide an appraisal of available energy; to discuss the predominance of fossil fuels; to examine the problems associated with air emissions; to explain local pollution and global climate impacts; to understand the international regulatory and institutional framework for air emissions; to compare energy security for private and public entities; to examine energy management in the shipping context.

### EGY 102 Energy-Efficient Ship Design and Operation 8 EC
To understand MARPOL Annex VII including EEDI, SEMP, MVR, DCS and technology transfer; to examine technological innovation related to energy management in the maritime industry; to explain the basic process of onboard power generation and describe principal energy consumers; to identify energy-saving measures in both ship design and operation; to discuss ship design and energy efficiency through ship resistance reduction means and propulsion efficiency improvement technologies; to discuss ship operation and energy efficiency through operational measures both at ship and fuel levels along with the integration of port<button>ship; to analyze the impact of technical and operational measures on fuel consumption of ships; to discuss machinery technologies including hull and propeller maintenance along with relevant ISO standards.

### EGY 108 Energy Management in Maritime Onshore Facilities 8 EC
To discuss energy management in terms of its vision, planning and strategy in the context of port/shipyards; to provide an overview of the ISO 50001 energy management system certification process and ISO 14001 environmental management systems; to explain energy auditing through real applications from port/shipyards; to discuss the socio-economic benefits associated with abatement technologies adopted in response to international, European and regional port emissions regulations; to analyze the externalities in port/shipyards; to apply the Circular Economy and industrial symbiosis approach within port/shipyards; to analyze the impact of climate change on port infrastructure and to discuss its adaptation.

### EGY 112 Alternative Fuels/Technologies and Marine Renewable Energy 8 EC
To describe emission limits and technological options globally and within Emission Control Areas (ECAs); to examine emission abatement technologies and alternative fuels including LNG, LPG, biofuels, hydrogen and methane; to discuss alternative future technologies including fuel cells and batteries; to demonstrate a systematic understanding of the application of life-cycle analysis on fuel cell concept; to discuss renewable energy for electricity generation and marine renewable energy including offshore wind and ocean energy (wave, ocean and tidal currents and tidal range, OTEC and saltwater gradient) along with their environmental and social impacts including underwater noise; to examine solar and wind power applications onboard ships as well as in maritime onshore facilities.

### EGY 106 Human Element and Economics of Energy Management 4 EC
To discuss the social and human aspects of modern technology applications in maritime energy and the related IMO and EU Instruments; to analyze further to maritime energy management and discuss the role(s) of stakeholders and potential solutions; to discuss and analyze energy management systems including the cost, financing and economic evaluations; to analyze the demand and supply of energy, electricity markets, and climate change policy; to examine the evaluation of sustainable investment in ports and shipyards.

### EGY 106 Maritime Energy Management and Operational Research 4 EC
To describe operational research (OR) techniques relevant to maritime energy management (MEM), in particular simulation, optimization and decision making; to discuss the interaction between MEM and operational research through mathematical modeling; to apply relevant OR techniques through OR software such as multi-criteria decision making, Monte Carlo simulation, extremity modeling and search optimization in ship design and operation; to analyze and evaluate strategic investments and decisions through risk analysis; to apply OR applications within the MEM context.

### EGY 113 Leadership in the Fourth Industrial Revolution 4 EC
To examine technological innovation related to energy management in the maritime industry; to understand the impact of the Fourth Industrial Revolution within the MEM context including autonomous ships, internet of things, cyber-physical systems, maritime digitalization, big data and artificial intelligence; to understand science policy-visibility interface with the principle of science-based decision-making for future maritime energy leaders; to analyze the country needs and develop a practical tool for action for their country or region to achieve the UN’s sustainable development goals.

### FST 101 Field Studies 4 EC
To provide a range of field study opportunities to demonstrate the application of the theory taught in the specialization subjects. Guided to travel to major time destinations that offer valuable insights into organizational practices and networking opportunities with professionals around the world.

### WMU 424 Service on Maritime Transport Policy and Maritime Communications 2 EC
To give students an opportunity to exchange ideas with each other and with maritime experts through presentations, debates and discussions. The seminar covers overview of maritime transport policy as well as contemporary issues in information and communication technology.
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PG Diploma in Maritime Energy (via DL)

Module 1  Maritime Energy and Sustainable Development
Module 2  Ships and Energy Efficiency
Module 3  Future Propulsion Technologies
Module 4  Energy Conservation in Ports and Shipyards
Module 5  Best Practices and Life-Cycle Perspectives
Title at IMO Website:
EU/IMO global project drives energy efficiency in the maritime sector
The Way Forward?

- The Paradigm Shift?
- Mindset Change?
- Right Combination of thematic pillars
- Right combination of EE measures
- Collaboration amongst all stakeholders
- ....