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# DEVELOPMENT OF A HOLISTIC MARITIME ENERGY MANAGEMENT PROGRAMME AT THE POSTGRADUATE LEVEL: THE CASE OF WMU

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## Abstract

Energy efficiency in shipping is regarded as one of the most urgent tasks to which the industry needs to respond. According to the 2014 International Maritime Organization's (IMO) Green-House Gas (GHG) Study, the average respective emissions from shipping accounted for approximately 3.1% of annual global CO<sub>2</sub> during the period of 2007–2012. Mandatory technical and operational energy-efficiency measures adopted via Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL) entered into force on 1 January 2013. It is mandatory to implement the Energy Efficiency Design Index (EEDI) for certain types of new ships, as well as the Ship Energy Efficiency Management Plan (SEEMP) for all ships. In order to support uniform implementation and to promote technology transfer, it is vital to educate and train personnel in maritime energy management (MEM) throughout all IMO member states. Notwithstanding, such educational opportunities tend to be limited to technical and vocational levels, and there was no course to educate maritime energy management professionals at the postgraduate level until the World Maritime University (WMU) launched its Master of Science course in the specific field. From the motivations to energy efficiency to modern technology, safety and security, economics, human element, and operations research, the WMU MSc programme is pioneering to foresee the need of higher education for future maritime leaders. The analysis at hand puts forward an interdisciplinary approach to the course design and development in MEM; it also discusses the role of education to support the UN's sustainable development goals (SDGs).

Keywords: Maritime Energy Management, Education, Postgraduate level, Energy efficiency, Sustainable development.

## 1 INTRODUCTION

Energy efficiency has been one of the core missions of modern shipping in addition to other important elements, such as safety, security, and environmental protection<sup>1</sup>. The International Maritime Organization's (IMO) conducted a study on Green-House Gas (GHG) in 2014, which revealed that the average respective missions from shipping accounted for approximately 3.1% of annual global CO<sub>2</sub> emissions during the period of 2007–2012 [1]. The vast majority of the goods and resources which are found in the global market today are delivered by maritime transport. Therefore, the specific transport sector can make a significant impact on energy efficiency, being clearly able to influence at the global level. This responsibility of the industry under discussion was realised by the adoption of the Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). Through the specific legal toolbox, it is now an obligation to implement the Energy Efficiency Design Index (EEDI) for certain types of new ships, as well as the Ship Energy Efficiency Management Plan (SEEMP) for all ships.

With the existence of numerous complex technical specifications to the regulations under discussion, it is a rather self-explanatory fact that the maritime transport sector needs personnel with a very wide

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<sup>1</sup> Each and every day, ships of different size and capabilities carry huge quantities of cargo and a very large number of passengers cost effectively, cleanly and safely. It is true that several maritime Conventions and Regulations stipulate both the operational environment and the training requirements for mariners/seafarers (with the importance and influence of MARPOL - International Convention for the Prevention of Pollution from Ships, STCW - Standards of Training Certification and Watchkeeping, SOLAS and the respective Codes (International Convention for the Safety of Life at Sea, including the ISPS - International Ship and Port Facility Security Code & ISM – International Safety Management Code), among others being well known within all members of the maritime community and many outsiders. For additional details see: M. Bauldauf, D. Dalaklis, A. Kataria, "Team Training in Safety and Security via Simulation: A Practical Dimension of Maritime Education and Training," *10th International Technology, Education and Development Conference* (International Academy of Technology, Education and Development (IATED), Valencia, Spain, 7 March, 2016.

domain of understanding: from technical and engineering matters to legal and management issues. When the maritime industry is dealing with extreme high demands of human resources in specific areas, such as energy efficiency, how can these people be educated and trained for the right type of the industry's needs? Maritime Education and Training (MET) has a crucial role in this respect in order to foresee such needs and provide proper education and training which would meet the expectation from the future labour market.

With the aim to keep the supply and demand of the personnel in the maritime energy management field balanced, the analysis at hand discusses the case of the World Maritime University (WMU) which recently launched a MSc programme on maritime energy management. Industry-driven motivations are not necessarily the main driving factors in this case, as the WMU's attempts to go beyond the scope of vocational education and training. The specific case highlights an interdisciplinary character in teaching and research activities within the emerging field of maritime energy management (MEM). In the current analysis, the role of education and its association with the maritime industry will be extensively discussed in line with supporting capacity building activities to achieve the UN's sustainable development goals (SDGs).

## **2 QUESTIONING THE ROLE OF TERTIARY EDUCATION**

Education is generally regarded as an investment for development both at individual and country levels. OECD countries spend 5.2% of their GDP in average on educational institutions from primary to tertiary education. This figure includes both public and private expenditure. In addition, approximately one-third of the total expenditure goes to tertiary education; this indicates that the cost per student is the highest, due to the higher cost of tertiary-level faculty and their research and development [2].

After compulsory education, it is up to individuals (or family) to decide whether a person will continue to learn at post-secondary education and even at higher education, including universities. Tertiary education costs a lot in many countries and has become a heavy burden to families who do not have well-paid, sustainable jobs. It is expected that a high investment cost to higher education should be paid off by accessing to a better job opportunity. In OECD countries, employment rates are better among the higher-educated and only 4.9% for the tertiary-educated are unemployed; at the same time, 12.4% of adults with below upper secondary education are facing troubles [3]. The fact that not all university graduates were employed after the graduation accelerates sensitivity among tertiary educational institutions about the climate of labour market and industrial needs to specific qualifications. Some highly educated graduates have been struggling to find a job which meets their academic degrees. This problem is not new and exists almost everywhere around the world.

One may observe the general trend of vocational education and training which traditionally focuses on technical vocational skills rather than theoretical knowledge; more emphasis is given on higher level of knowledge-based education. It is a transformation for many vocational training institutions to be more attractive in the labour market and increase the employability of their students, which directly affect their reputations and financial sustainability. In this context, it is more evident that within a university mission is not only to educate people, but to produce high-level research and simultaneously be as much interdisciplinary (not specialised in a single dimension) as possible. Research helps to update the knowledge to transfer towards existing students and fulfils the role of universities as a leading knowledge creator. An interdisciplinary nature of universities also benefits prosperous, talented young people to be exposed to various perspectives and values in different scholarships. However, it is not always straightforward to keep a university research-oriented and interdisciplinary because of its tradition, organisational culture, and management and leadership [4]. The current analysis discusses the case of WMU, especially its new MSc programme on maritime energy management, and how the programme was designed and developed in the scope of capacity building for sustainable development.

## **3 EDUCATION AS A MISSION: THE CASE OF WMU**

WMU in Malmö, Sweden is a postgraduate-level university established in 1983, by the International Maritime Organization (IMO), a specialized agency of the United Nations (UN). The aim of founding WMU is to further enhance the objectives and goals of IMO and to serve to the IMO member states around the world through education, research, and capacity building to ensure safe, secure, and efficient shipping on clean oceans. Education is therefore an important mission of WMU to build

capacity and more than 4,000 maritime professionals from 166 countries, mainly developing countries, graduated from WMU (Fig.1) [5]. Many of those graduates are now assigned to decision-making, influential positions in their organisations, and the WMU's alumni network is a true asset for them to work internationally and solve political and diplomatic problems at work.



*Fig.1: WMU Chancellor and IMO Secretary-General, Mr. Kitack Lim (WMU alumnus 1991), and WMU President, Dr. Cleopatra Doumbia-Henry, with the Class of 2016.*

WMU offers several core areas of subject streams in line with its mission of being the world centre of excellence in postgraduate maritime and oceans education, professional training and research, while building global capacity and promoting sustainable development. Those core areas are divided into seven different specialisation courses under the common degree of MSc in Maritime Affairs. They are:

- Maritime Education & Training (MET);
- Maritime Energy Management (MEM);
- Maritime Law & Policy (MLP);
- Maritime Safety & Environmental Administration (MSEA);
- Ocean Sustainability, Governance and Management (OSGM);
- Port Management (PM); and
- Shipping Management & Logistics (SML)

Among those, both the “Maritime Energy Management (MEM)” and the “Ocean Sustainability, Governance and Management (OSGM)” are newly introduced in 2016. While the OSGM specialisation was transformed from the previous similar course, the MEM specialisation was completely new at WMU. In addition, such courses focusing on maritime energy management at a postgraduate level are non-existent around the world. In this respect, WMU foresaw the need in managing energy efficiency in global maritime industries.

The WMU's mission also includes providing an international focus and forum for networking and collaboration on critical issues and developments in maritime transportation worldwide. For this purpose, in January 2017, WMU hosts the International Conference on Maritime Energy Management (MARENER 2017), covering a range of themes, from regulatory framework to energy efficient ship design and operation, energy management in ports and shipyards, economics, social and human dimensions, theoretical aspects, alternative fuels and marine renewable energy, and offshore and ocean energy. These themes speak by themselves an interdisciplinary nature of the MEM specialisation programme at WMU.

#### **4 DESIGNING AN INTERDISCIPLINARY ACADEMIC PROGRAMME**

In specialised universities, such as WMU, it is not always easy to design an interdisciplinary academic programme. In the case of WMU which has been serving as the world's leading maritime university, its

unique history of being established by the UN's specialised agency, IMO, brands WMU as a prestigious institution, especially among the developing countries. Various stakeholders, including the mother organisation (i.e., IMO), donors, governing boards, and students and their families can also affect how WMU is presented. In addition, the organisational culture and traditions are known as an influential factor in managing academic activities in schools as well as impacting on students' performance [6].

When the Maritime Energy Management (MEM) specialisation was proposed at WMU in 2013, there was an increasing interest in developing a new direction of the university in order to effectively contribute to the UN's goals, namely the Millennium Development Goals (MDGs) and the forthcoming Sustainable Development Goals (SDGs). While MDGs failed to address the impact of energy in developing and sustaining human activities, it was a sensible decision that SDGs include the Goal 7: "Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All" [7], which has raised the concern of how the maritime transport industry can contribute by implementing energy efficiency (see Fig.2). In fact, the theories and practices in maritime energy management are much advanced in developed countries, especially Europe. By offering a postgraduate degree in maritime energy management to the WMU students who mainly come from developing countries, which need technical assistance in order to build capacity in their countries. Hence, the establishment of the MEM specialisation at WMU meets its mandate and missions as a UN organisation.



Fig.2: UN's Sustainable Development Goal 7

Source: Division for Sustainable Development, UN-DESA, <https://sustainabledevelopment.un.org/sdg7>

Within the framework of UN's SDGs, the MEM specialisation must have accommodated interdisciplinary characters. Energy management as well as maritime transport systems can be extremely technical and of an "engineering" character. However, it requires policy makers, decision makers, safety and security specialists, economists, and even sociologists to support energy efficiency technology in the sector for effective implementation. Both internal and external contributors to the MEM specialisation include a wide range of experts and professionals from different disciplines mentioned above.

The total length of the WMU's MSc programme in Malmo campus is 14 months. It starts with general maritime subjects, including laws and regulations, economics, leadership and management with all the other. Regardless of their enrolled specialisations, approximately 130 of all the students start those general subjects together. After the first term, students are divided by specialisation and the curriculum focusing on maritime energy management starts from here for seven and a half months. During this period, students study seven modules: [EGY 101] Energy and Maritime Industry; [EGY 102] Energy-Efficient Ship Design and Operation; [EGY 103] Energy Management in Maritime Onshore Facilities; [EGY 104] Alternative Fuels and Marine Renewable Energy; [EGY 105] Human Element and Economics of Energy Management; [EGY 106] Maritime Energy Management and Operational Research; and [EGY 107] Applied Energy Research. These modules cover an interdisciplinary scope of different subjects; in other words, based on essential knowledge of

technology and engineering science, the course will make the students prepare for leading and managing changes in maritime energy.

In addition, the unique selling point of the WMU's MEM specialisation programme is field studies in which students visit various professional sites, relating to their specialised topics. For example, the MEM field studies in the academic year of 2016-2017 include Italy, Finland, Turkey and United Kingdom where students can visit port, shipyard, shipping company, maritime administration, coast guard, maritime university, UN organisations (e.g., IMO and Food and Agriculture Organization (FAO)) as well as traveling by sea and experiencing first-hand the energy efficient operation of a ship. Needless to say, these on-site experiences help to transform the students' theoretical knowledge to more practical and applicable one. Throughout the field studies, students will see, hear, smell, touch, and possibly taste different flavour and perspectives of stakeholders and their relationships in a big picture. The host countries and organisations to the MEM field studies benefit the students' visit as well, because the students will remember the services and know-how that they have learned during the visits, and when the graduates are posted in decision-making positions of their countries in the future, there may be a return for possible investment and business cooperation. Such a long-term relationship between WMU and the industry stakeholders is being leveraged for maximum results in capacity building in the field of maritime affairs, including maritime energy management.

The MEM specialisation is therefore a comprehensive package for students and other stakeholders to ensure the support to the realisation of SDG 7. This has been done not only by teaching but also by research. The Maritime Energy Management Research Group (MarEner) serves as a leading team to conduct research and consultancy in the area of maritime energy management, for example, the EU Marco Polo project<sup>2</sup>, the GoLNG project<sup>3</sup>, the International Association of Maritime Universities (IAMU) research project<sup>4</sup>, and so on. These research experiences feed back into the existing MEM specialisation curriculum in the form of [EGY 107] Applied Energy Research.

## 5 APPLIED ENERGY RESEARCH FOR CAPACITY BUILDING

The module called [EGY 107] Applied Energy Research offers a unique experience of practical research design and practice for the MEM specialisation students in their early research career. The MEM specialisation believes that research is the main tool for capacity building and knowledge creation, especially in the students' local contexts. The majority of literature and reports relating to energy efficiency in the maritime sector has been published in so-called developed countries, however it is equally important to understand how the other countries, especially developing countries, deal with the same problem of maritime energy management by proper scientific methods. This view is supported by the UN's SDG 7.a, stating that 'by 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy and energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology [8].'

Unlike other modules which progress one by one, the total of four weeks in the module of Applied Energy Research come in between the other modules to enhance the students' learning curve.

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<sup>2</sup> On The Mos Way Network (OTMW-N) is European Commission (EC) co-funded project under the Marco Polo II Call 2013. It is a Common Learning Action coordinated by the University of Strathclyde (UoS) from UK. The project team includes also the City of Glasgow College (CGC) from UK; the University of Genoa (UniGE), and La Spezia Port Authority (LSPA) from Italy; Ocean Finance (OF) and Environmental Protection Engineering S.A. (EPE) from Greece and the WMU located in Sweden. The original duration of the project was 18 months from 1 May 2014 to 31 October 2015. <http://www.onthemosway.eu/onthemoswaynetwork/>

<sup>3</sup> Within the Baltic Sea Region, the Interreg project "GoLNG", will provide a strategy for a smoother and more efficient use of LNG as a fuel for transport; the aim is to enable blue transport corridors in the region. This will be done by investigating transport flows and LNG infrastructure developments; researching and putting forward ways to improve the wider transport chain by incorporating all available transport modalities as well as enlarging the number of entities/industries that can benefit from the use of LNG will also take place. The strategy under discussion will further provide LNG stakeholders with a knowledge base on policies and regulation as well as on technological standards, and describe well-functioning solutions and business models already present in the transport sector of the region. See also [www.golng.eu](http://www.golng.eu), accessed January 2017.

<sup>4</sup> IAMU 2014 Research Project titled "Improving Energy Efficiency of Ships through Optimisation of Ship Operations" was conducted by the Istanbul Technical University (ITU) and WMU. The purpose of this project is to create a mechanism and develop a Decision Support System (DSS), which is to monitor the energy consumption on a real-time basis and to optimise it through a real-time decision support system that will help improve the energy efficiency of ship operations within SEEMP. For more information, see O.Arslan, E. B. Besikci, "Improving Energy Efficiency of Ships through Optimisation of Ship Operations," IAMU 2014 Research Project, No. 20140301, Tokyo: IAMU, 2015. Retrieved from <http://iamu-edu.org/wp-content/uploads/2014/06/20140301-ITUMF.pdf>

Experts, mostly external professionals, in different maritime energy topic areas give lectures and engage with the students each week. While the students write a weekly report, they also form groups of 3 or 4 students which collaboratively develop a research design over time and make a group presentation, and eventually write a joint research article. The MEM teachers act as tutors and coaches to support the process of learning. Finally, the students will peer-review the other group's research article and exercise how to make a critical analysis and provide effective feedback to peers.

From a pedagogical viewpoint, the tasks and assignments which students undertake will enhance active learning by 'reading, writing, discussing and being engaged in solving problems [9].' Multiple roles that students play during the module are also stimulating their interest and involvement. For example, they act as reporters (to write a weekly report); co-authors (to write a joint research article); presenters (to make a presentation at an in-house seminar); and scientific reviewers (to write a critical peer-review to the others' work).

In addition, in order to support the pedagogical process designed in the module of Applied Energy Research, the MEM teachers provide generalised feedback in the early stage of students' activities and make them diagnostic about their research problems. The research show that generalised feedback in the early stage of learning a new concept can be effective [10]. The role of teachers here is to guide the students to approach the problem scientifically and build confidence in their arguments. In the later stage of writing up a research article, teachers help facilitate the students' learning in a seminar as well as in more personalised coaching, depending on the strengths and weaknesses of each student.

Building a research capacity will never be a quick process. The WMU's MEM specialisation, however, attempts to provide the first set of training to the students so that in a long term, it is believed to start building a research capacity and even global research network in the area of maritime energy management. WMU's effort to establish a global research network is also made in the form of hosting the MARENER 2017 conference, mentioned earlier in the section 3.

## 6 CONCLUSION

Today, sea-going vessels are the most important means of transport; associated statistics indicate that about 90% of the total volume of global trade is borne exclusively, or at least partially, by sea [11]. It is crucial to emphasise the fact that operations taking place within the wider maritime transport domain are very demanding endeavours and quite often associated with rather high risks; the level of safety at sea is clearly depending heavily upon the professionalism and competence levels of seafarers. The key to maintaining a safe shipping industry and preserving the marine environment lies in all seafarers across the world possessing high standards of competence and therefore fulfilling effectively their duties on-board their vessels.

Maritime Education and Training (MET) activities hold a pivotal role in the preparation of seafarers in order to safely and effectively respond to the operational requirements at sea. The development of a holistic post-graduate level programme on maritime energy management at WMU is in line with its clear mission to support the IMO member states to prepare for the realisation of SDG 7 and other associated goals, such as SDG 4 (equality in education); SDG 9 (industry, innovation, and infrastructure); SDG 13 (climate action); SDG 14 (sustainable use of oceans and marine resources); and SDG 17 (global partnership). The range of relevant UN goals can be even more expanded in the future when the MarEner research group grows and build more capacity in teaching and research networks. There is a huge potential in the area of maritime energy management, having attracted 17 students who successfully enrolled from all around the world in the academic year of 2016-2017.

Education is a long-term investment in many countries. Emerging needs from the industry and labour market should be captured in a timely manner and educational sectors can be more proactive than reactive to respond to the future of young people. In this respect, the WMU's MEM specialisation and its research group, MarEner, are the first step to start making a change and building capacity in the area of maritime energy management, without leaving anyone behind.

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