

## Maritime Education and Research to Face the XXI-st Century Challenges in Gdynia Maritime University's Experience

### Part II – Gdynia Maritime University of Experience the 21st Century Challenges

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**ABSTRACT:** In the paper, divided into two parts, a problem of advancements in maritime education and research facing the 21st century challenges, based on the case study of the Gdynia Maritime University (GMU) experience is discussed. Part I is devoted to the advances in the maritime education and research towards the challenges in a global meaning. The maritime education challenges are focused on contribution of the University's representatives in full implementation of the STCW 1978 as amended in 2010 convention, and on the flexible adoption of the academic specializations and programmes to the European and National Qualifications Frameworks, as well as to the needs of a global and local labour market. The research advancements in the maritime universities are basically oriented to marine transport problems, and their main focus is concentrated on the implementation of new technologies, effective and reliable technical and organizational solutions, friendly for users and environment.

Part II is dedicated to the Gdynia Maritime University experiencing the 21st century challenges. In this part, firstly the education and research potential of the Gdynia Maritime University, as the one of the world-leading maritime universities, is shortly presented. And next, the GMU's contribution and good practices concerning the participation in modification of the processes of the IMO STCW 78/2010 convention, adoption of programmes into the international and national qualification frameworks' standards and procedures, as well as the development of research addressed to a new technological and organizational solution are described and analyzed.

#### 1 INTRODUCTION

The GMU experience in building of modern base for maritime education results from its [1][2]:

- contribution in the modification processes of the IMO STCW 78/2010 Convention,
- adoption of programs to the National and European Qualifications Framework procedures,
- creation of new specialisations in response to the needs of a global and local labour market,

Development of research on selected purposes addressed to new technological and organizational solutions friendly for users and environment.

#### 2 THE GMU CONTRIBUTION IN THE MODIFICATION OF PROCESSES OF THE IMO STCW 78/2010 CONVENTION

The legislative way and a role of GMU in comprehensive review of the IMO STCW Convention and STCW Code [3] start with the Polish activities on

ECDIS (Electronic-Chart Display and Information Systems). The university has performed standards for ECDIS in 1995, followed by deliverance of IMO Model Course on Operational Use of ECDIS (2000), Interim Guidance on Training in the Use of ECDIS (2001), IAMU Model Course on ECDIS (2004), Performance Standards for ECDIS (2006), an Operational Handbook on ECDIS (2009), the STCW Convention in Manila (2010) and IMO Model Course on Operational Use of ECDIS (2012).

The Polish activities on ETO (Electro-Technical Officers) are also performed by the GMU and refer to the definition and mandatory requirements for certification of Electro-Technical Officer and Senior Electro-Technical Officer (Poland, France, United Kingdom, Bulgaria – 2007), consolidation of the requirements for electro-technical officers at operation and management levels (Poland, France, United Kingdom, Bulgaria and Iran – 2009), decision to include in STCW Convention requirements for electro-technical officers at operation level and electro-technical ratings at support level (2010), the STCW Convention, Manila (2010), IMO Model Course Draft for Electro-Technical Officers (2012).

More comprehensive information concerning Polish activities in IMO on Electro-technical Officers requirements can be found in [4][5]. That paper summarizes the legislative way and a role of the Gdynia Maritime University in a comprehensive review of the IMO STCW convention and STCW code as well as the consequences resulting from it.

### 3 ADOPTION OF THE GMU PROGRAMMES TO THE NATIONAL AND EUROPEAN QUALIFICATION FRAMEWORK PROCEDURES

In Poland and in the GMU's programmes and procedures, the implementation of the National Qualification Framework for higher education and the life-long learning have been designed to be adequate to the European frames levels. It means that levels of the Polish Qualifications Framework correspond with eight tiers specified in European Framework of Qualifications [2][6], defined in Recommendation of European Parliament and European Union Board. Moreover, the correspondence of the National Framework of Qualifications with the European Framework, ensures transparency of the system of higher education in Poland and is a base of compatibility of qualifications (diplomas) obtained in Polish universities with the qualifications gained in other countries.

As an example – a concept of education process at Marine Engineering Faculty of GMU is shown below [1].

The first level studies cover two options: a practical profile with 8 semesters of the study and 240 ECTS points (including 6 month practice at sea) as well as a general profile with 7 semesters of the study and 210 ECTS points (including 4-6 weeks of industrial practice).

The second level studies also covers two options: a practical profile with 4 semesters of the study and 120 ECTS points (including 6 months practice at sea,

dedicated to students graduated after no-marine first level) as well as a general profile with 3 semesters of the study and 90 ECTS points.

A final effect is the expected elimination, or at least reduction of education obtained in Poland, either in the case of continuation of education abroad or international job market activity.

### 4 CREATION OF NEW SPECIALISATIONS

This process is caused by the changes and modifications of IMO documents from one side, and in response to the needs of a global and local labour market from another. One of the most important factors stipulating the considered process is to find a good answer to a question: how to attract young people to maritime universities, or wider – to maritime economy career? Experience of the GMU, confirmed with a really satisfying results of the recruitment procedures, confirmed that it is based, among others, on creation of several new specializations in the last years [1]. For instance, at the Faculty of Navigation there were introduced Marine Transport and Logistics Systems, Offshore Technologies and Arctic Navigation. At the Faculty of Marine Engineering – the Marine Power Plant and Offshore Construction Operation, Repair Engineering Management and Operation of Industrial installations. At the Faculty of Marine Electrical Engineering there were Ship Electro-Automation and Data Communication Systems and Networks. And finally, at the Faculty of Entrepreneurship and Commodity Science there were Commodity Science and Quality Management, Modern Tools of Management, Human Resources Management, IT in Transport and Trade as well as Nutrition Services and Diagnostics.

These actions, undertaken by the GMU authorities, are resulting with a very good reputation of the university, confirmed by a growing number of candidates and a very positive opinion of the shipowners and employers.

### 5 DEVELOPMENT OF RESEARCH IN SELECTED AREAS

The main focus of the recently conducted and quickly developed research is concentrated on implementation of new advanced technologies [7], as well as on effective and reliable technical and organizational solutions. The most important projects are dedicated to and implemented in the numerous areas, but their key points are related to the highest values for the world marine community today, it means safety, quality and environmental friendliness [8]. The priorities of the scientific areas are resulting from the "hot topics" in the international cooperation (e.g. 7<sup>th</sup> European Framework Programme) as well as the expectations and challenges formulated by the industry. They cover, among other things, such directions as: Information and Communication Technologies, Energy, Environment, Transport and also Food, Agriculture and Fisheries, Biotechnology.

Short overview of the most important and representative areas of the research carried out at the four GMU faculties is shown below [1].

The Navigation Faculty lead the multi-dimensional scientific and research activities concerning the generally conceived concept of safety in navigation with the use of terrestrial, celestial and radio-navigation. In case of the Marine Engineering Faculty, the research works are connected with combustion of heavy fuels in ship engines with regard to environmental protection issues, operation and diagnostics of power systems, including electrical power plant. Improvement of the processes of generation, distribution and consumption of electrical energy based on new methods of control and electronic power converters application; automation of the processes of ship movement control are the focus for the Marine Electrical Engineering Faculty. The Entrepreneurship and Quality Science Faculty conduct the research on techniques of analysis, assessment and optimization of software reliability; applications of the information technology in supporting decision making processes, the use of new instrumental methods to evaluate quality of food products and the method of eco-balance to evaluate the environmental impact.

One of the measures of the highest level of carried our research at the university is the doctoral entitlement. In the case of the GMU, the national authorization for granting the scientific degree of Ph.D. (Doctor of Philosophy) is obtained respectively:

- Faculty of Navigation in the scientific domain of Transport,
- Faculty of Marine Engineering in the scientific domain of Machine Construction and Operation,
- Faculty of Electrical Engineering in the scientific domains of Electrical Engineering and Electronic Engineering,
- And finally Faculty of Entrepreneurship and Commodity Science in the scientific domain of Commodity Sciences.

Additionally, a Faculty of Electrical Engineering and Faculty of Entrepreneurship and Commodity Science have the highest national entitlement for granting the scientific degree of D.Sc. (Doctor of Science) in Electrical Engineering and Commodity Sciences, respectively.

### 5.1 Example of scientific research on the Faculty of Navigation

The main goal of the research under consideration is the development of e-Navigation concept [9][10][11]. The research method covers and is related to the user needs definition, architecture definition, gap analysis, implementation and review lessons learned.

The core objectives of e-Navigation concept using the electronic data capture, communication processing and presentation are illustrated in Fig. 3.

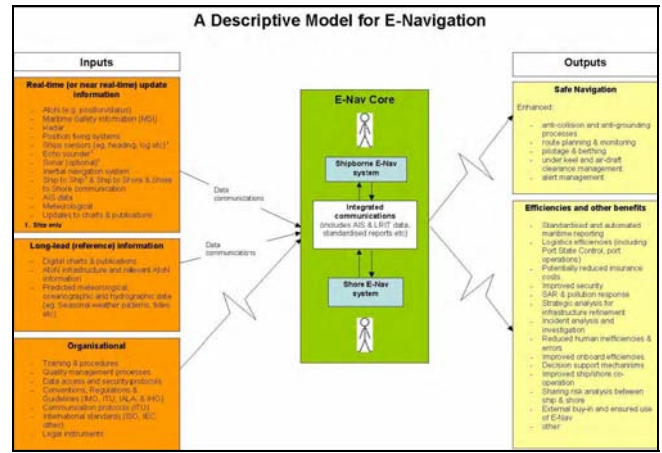


Figure 3. A Descriptive Model of E-Navigation

A comprehensive description of the development of e-Navigation concept, including human element, the basic assumptions, solutions and created possibilities of application can be found in the publications [9][10][11].

### 5.2 Example of scientific research on Faculty of Marine Engineering

The main aim of the presented research is the diagnosis of marine diesel and turbine engines [12][13]. The research method is based on the modern methods of non-invasive assessment of technical condition of marine engines such as the measurement and analysis of indicator graphs, measurement and vibration analysis, measurement of acoustic emission, measurement and analysis of exhaust gases emission, thermovision, video endoscopy and surface analysis.

Below a short characteristic of the indicator graphs application is presented. The laboratory stand and example of the recorded measurement results are illustrated in Fig. 4 and Fig. 5, respectively.



Figure 4. Laboratory stand for the measurement and analysis of indicator graphs

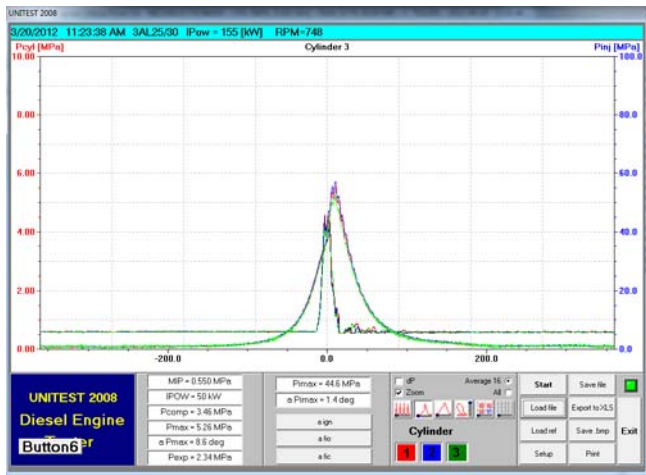


Figure 5. Exemplary characteristic of a pressure in the combustion chamber and a pressure after the fuel injection pump

Presented indicator graphs concern the measured characteristic pressures, which are applied in diagnostics of the marine diesel engines, including fuel injection processes.

More information connected with the analysis of indicator graphs, its theoretical basis, practical importance and applications can be found in publications [12][13].

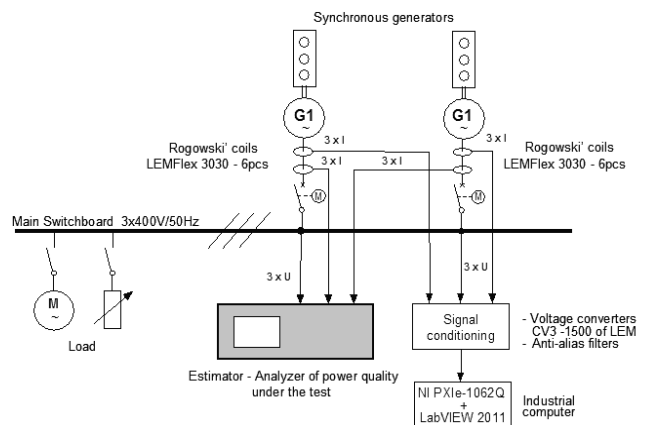
### 5.3 Example of scientific research on Faculty of Electrical Engineering

The main goal of the presented research is the assessment of power quality of electrical power system onboard of ships [14]. The research method consists of a measurement and analysis of power quality indices characterizing the ship electrical network in the light of the classification societies' rules and requirements.

In Fig. 6a) an exemplary configuration of ship electrical power station with measurement devices is illustrated. A system is equipped with controlled load giving a possibility to evaluate the load distribution parameters basing on the real signals in ship electrical power stations.

In Fig. 6b) a front panel and exemplary recorded results with the use of elaborated Estimator-Analyzer of power quality. More information about this power quality Estimator-Analyzer, its software, including methods and algorithms for measurements under consideration as well as hardware and research results, are presented in publications [15][16].

a)



b)

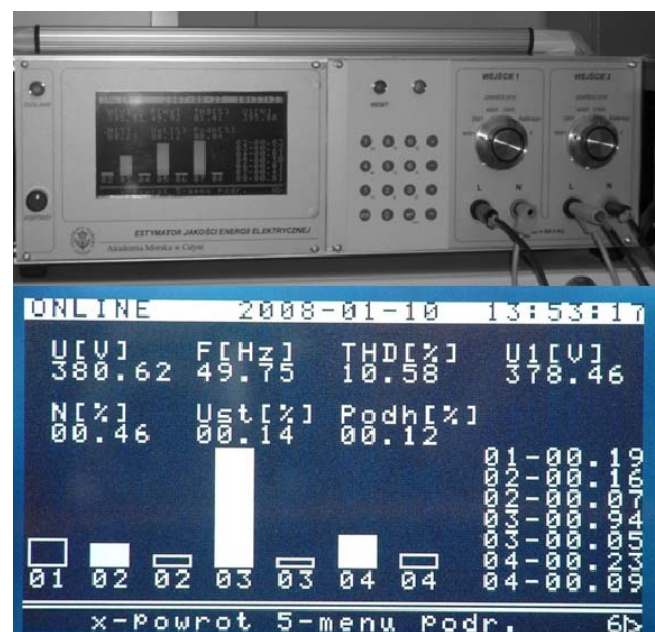


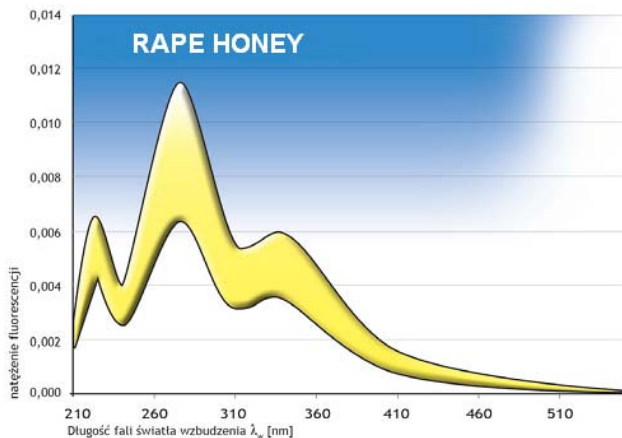
Figure 6. Laboratory stand for experimental verification of power quality parameters in the electrical power systems onboard of ships.

### 5.4 Example of scientific research on Faculty of Entrepreneurship and Commodity Sciences

In the field of commodity science and quality the research activities concern shaping, evaluating and protecting of raw materials quality and food products in planning, producing storing and trade turnover. The examples of research tasks are chemical food pollution, ecological conditions of food quality, application of ecobalance method and products of evaluation of environmental liabilities.

The main goal of the presented research is the application of new instrumental methods of evaluation of products' quality [17][18]. The research method is based on the application of fluorescence method for identification of brand and overheated honeys.

a)



b)

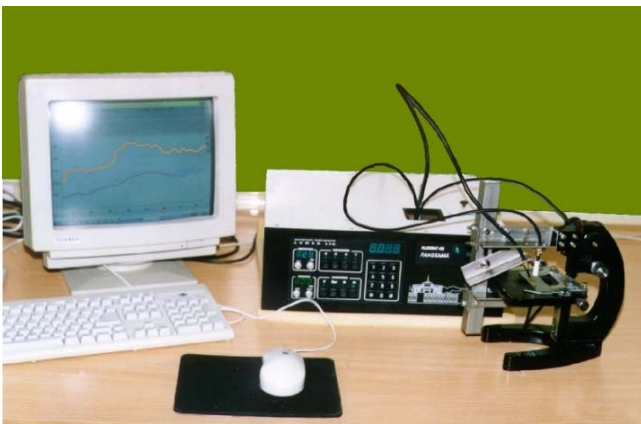


Figure 7. Application of fluorescence method of identification of selected products properties a) laboratory stand b) exemplary recorded measurement result

Some additional data and description of the fluorescence method for identification of selected products are included in the publications [17][18].

## 6 FINAL REMARKS

Gdynia Maritime University Experience to XXI-st Century Challenges is based on firstly, in maritime education domain – on active contribution of the University's representatives in full implementation of the STCW 1978 as amended in 2010 convention, and on the flexible adoption of the academic specialisations and programmes to the European and National Qualification Frameworks, as well as to the needs of a global and local labour market. Secondly, in the maritime domain - they are basically oriented to marine transport problems, and their main focus is concentrated on the implementation of new technologies, effective and reliable technical and organisational solutions, friendly for users and environment.

Summing up the two parts of the presented paper, its main goal is the analysis of and the consequences resulting from the 21<sup>st</sup> century challenges that the maritime universities face, as well as the multi-aspects discussion of some ways and solutions based on the

Gdynia Maritime University's experience, how to overcome these challenges. *The presented approach deals with two domains, maritime education and marine transport-based research, respectively.*

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