# 14TH ANNUAL GENERAL ASSEMBLY

International Association of Maritime Universities

IAMU AGA14

# NEW TECHNOLOGICAL ALTERNATIVES FOR ENHANCING ECONOMIC EFFICIENCY

Constanta Maritime University, 26 - 29 October 2013

14TH ANNUAL GENERAL ASSEMBLY
International Association of Maritime Universities
IAMU AGA14

# NEW TECHNOLOGICAL ALTERNATIVES FOR ENHANCING ECONOMIC EFFICIENCY

**Editors:**
**Lecturer Radu Hanzu Pazara, Ph.D.**
**Lecturer Liviu Constantin Stan, Ph.D.**

**Constanta Maritime University**
**26 - 29 October 2013**

Dear IAMU Members and Colleagues,

It is with great pleasure that I welcome you to the 14th Annual General Assembly of the International Association of Maritime Universities. Constanta Maritime University is deeply honored to host this important event which brings together representatives of all member institutions.

This year's theme - *New technological alternatives for enhancing economic efficiency* – proved to be a purposeful and incumbent issue in the current global industrial context. We, IAMU members, remain faithful to the mission of IAMU and are aware of the need to take joint action in order to reach our goals: create and maintain a global network of members dedicated to building human capacity in the maritime sector, provide opportunities for critical issues and developments in MET to be discussed and resolved in scientific and practical approach, train future generations of highly skilled global seafarers, ensure safety at sea, maritime security and protection of the environment.

The Call for Papers attracted over 60 submissions from the faculty of several IAMU members. The Papers Committee accepted 53 papers that cover a variety of topics, including the use of new training technologies in MET, impact of STCW Manila Amendments on maritime education, new technologies for enhancing maritime transport safety and security, crew resource management in era of technology, new trends in port development.

In organizing the conference, the Local Executive Committee sought to provide you with a valuable opportunity to share ideas with other researchers from maritime institutions around the world. This IAMU conference was meant to become an independent forum for those who dare to think, speak and write. I would like to state my appreciation for all authors who addressed the main challenges that maritime industry and maritime education are currently facing at a global level. Let this meeting point the guidelines for our future actions!

I would also like to express my deepest gratitude for the permanent and valuable support of IAMU Secretary's Office in organizing this AGA. We all proved that by working together, we can reach higher and achieve more.

Prof. Cornel PANAIT, Ph.D.
IAMU Chair,
Vice-Rector of Constanta Maritime University

## SCIENTIFIC COMMITTEE

| | |
|---|---|
| Prof. Cornel PANAIT, Ph.D | Constanta Maritime University/ROMANIA |
| Prof. Doina CARP, Ph.D. | Constanta Maritime University/ROMANIA |
| Prof. Mariana PANAITESCU, Ph.D. | Constanta Maritime University/ROMANIA |
| Assoc. Prof. Emil OANȚĂ, Ph.D. | Constanta Maritime University/ROMANIA |
| Assoc. Prof. Paulică ARSENIE, Ph.D. | Constanta Maritime University/ROMANIA |
| Assoc. Prof. Eugen BÂRSAN, Ph.D. | Constanta Maritime University/ROMANIA |
| Assoc. Prof. Viorel-Fănel PANAITESCU, Ph.D. | Constanta Maritime University/ROMANIA |
| Assoc. Prof. Felicia SURUGIU, Ph.D. | Constanta Maritime University/ROMANIA |
| Lecturer Radu HANZU, Ph.D. | Constanta Maritime University/ROMANIA |
| Lecturer Liviu STAN, Ph.D. | Constanta Maritime University/ROMANIA |
| Lecturer Adrian SABĂU, Ph.D. | Constanta Maritime University/ROMANIA |
| Assistant Daniela MITU, Ph.D. | Constanta Maritime University/ROMANIA |
| Assistant Ana OLTEANU, Ph.D | Constanta Maritime University/ROMANIA |

# CONTENTS

# INTERNATIONALIZATION: INVESTING IN FACULTY

[1]ALIMEN A. ROLANDO, [2]PADOR L. RALPH

[1,2]*John B. Lacson Foundation Maritime University, Philippines*

**ABSTRACT**

In the past years, John B. Lacson Foundation Maritime University -Molo has been prompted by the thrust that the Commission on Higher Education (CHED), Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA), other local and international accrediting bodies, to maintain maritime quality education and sustain its international prestige in terms of research among other areas. One of the strategies that have been started in the past years is to engage faculty in internationalization through international research involvement and/or participation. Although, a frequently cited obstacle to faculty engagement in internationalization plans is lack of funding (Backman, 1984; Bond, 2003; Ellingboe, 1998; Green & Olson, 2003; Steers & Ungsen, 1992; Woolston, 1983), JBLFMU-Molo has devised of a way to invest among its faculty to engage in internationalization through research. This paper provides a directory of the maritime institution in terms of local and international researches. It also implies how faculty is engaged in research through a review of the research outputs of the faculty in the last four academic years 2008-2011.

**Keywords:** *maritime quality education, internationalization, investing, and maritime institution.*

## 1. INTRODUCTION

For so long a time, academic institutions agree to the fact that a lot of thinking is needed to be able to get the best out of the investments they were able to make. Some universities undergo much training to get the best out of their teachers to be able to attract the best clients also in their universities.

Some universities also make sure that they attract the very best faculty members to join their ranks. They get those professors who also belong to the top ranks of their classes and those who have records of dedication and efficiency in teaching and scholarship.

John B. Lacson Foundation Maritime University – Molo, Iloilo City, Philippines, believes in the power of its faculty. This maritime academic institution not only makes it a point to hire professors initially with Masters' degrees in their areas of specialization. More so, it hires professors with doctorate degrees to complete its roster of qualified teachers.

Yet, it has been a challenge for the university to retain its outstanding teachers. Many of them also undeniably weigh better offers from other better institutions or abroad. The University is thus left with what can be the best option to make as regards this phenomenon. One of the strategies that has been done to ensure competitiveness in the academic marketplace and to appeal to top professors, was to invest aggressively in faculty in forms of competitive salary and exposure in international research through active participation.

One educator noted that the caliber of an academic institution rests upon the quality of its faculty, who are the lifeblood of the university. He wrote:

Like students, faculty are attracted to those institutions best equipped to help them reach their professional goals and where they are most likely to be associated with the most exciting colleagues and peers. Endowed professorships, as well as gifts that provide support for faculty to conduct research or implement a program, honor the best minds and make the roster of faculty even stronger.

Investing in faculty is one of the ways the University has thought of in order to reshape many of its current practices. In this context, faculty involvement in international research conferences has been one strategy of restructuring the university's thrust of gaining faculty productivity. Other ways are leaders of professional associations, access to scholarship grants, publications, and an improved communication protocol.

## 2. RESEARCH PROBLEM

The need to involve the faculty members in internationalization through their research involvement has been echoed in the many organizations like the Association of American Colleges as early as 1985. This means that the faculty should be encouraged to make sure that their curricula are designed to advance students' understanding of what is happening around them, both locally and internationally. This goes on to say that the measure of faculty responsibility is embedded in their academic practice. This is translated in both engagement in academics and research.

It is in this line that many institutional leaders have expressed their intentions to develop internationalization plans to include exposure and research involvement among others. Green and Schoenberg (2006) noted that "it would be difficult to find a college or university today that is not making some effort to internationalize" (p. 1). By investing in faculty, such an effort of internationalization is achieved.

With this, the paper wishes to address the following questions:

(1) What is the percentage of the research outputs of JBLFMU-Molo in the last three school years, 2008-2009, 2009-2010, and 2010-2011?

(2) What are the linkages established by JBLFMU-Molo in terms of research?

(3) What are the different collaborations in research invested by JBLFMU-Molo?

## 3. CONCEPTUAL FRAMEWORK

In the faculty's research involvement, research indicates that lack of financial resources prevents the development of incentives for faculty to engage in international activities, in general, and internationalization plans, in particular (Backman, 1984; Bond, 2003; Ellingboe, 1998; Green & Olson, 2003; Steers & Ungsen, 1992; Woolston, 1983). Engberg and Green (2002) noted that "the most frequently cited reason for inaction in higher education is lack of funding" (p. 16).

In the pursuit of academic endeavours as internationalization, scholars and practitioners recommend that in order for an academic institution to realize such plan, the institution needs a sustainable budget. For instance, in JBLFMU-Molo, Iloilo City, Philippines, ample budget is in place for faculty who wants to join local and international research conferences.

Based on experts, internationalization plans, internationalization scholars and practitioners recommend that such plans require dedicated resources, such as budgets for academic exchanges, faculty development workshops, international curricular development grants, and international research grants (Olson et al., 2006; Paige, 2005; Siaya & Hayward, 2003).

This study looked into the research involvement of the faculty as part of the internationalization effort of the JBLFMU-Molo and also to reinforce how investing in faculty through research was done.

Figure 1 shows the schematic diagram of the study.

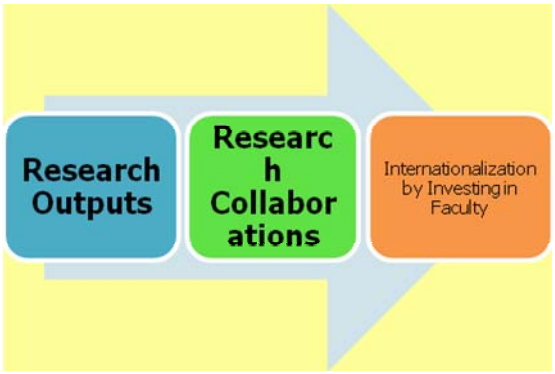



Figure 1
The Schematic Diagram of the Research

## 4. METHOD

In order to address the questions advanced in this study, document analysis was done. Document analysis is the systematic examination of instructional documents such as syllabi, assignments, lecture notes, and course evaluation results in order to identify instructional needs and challenges and describe an instructional activity.

Expert show that the focus of the analysis should be a critical examination, rather than a mere description, of the documents. In this context, document analysis was done to gain insight and examine trends and patterns on the frequency of research outputs. Frequently, it is used to evaluate a course such as evaluating the pattern in the faculty involvement in internationalization through research engagement.

## 5. DATA COLLECTION

Data collection method done in this paper is only document analysis. While document analysis was done, the researchers reviewed internationalization plans and other related documents.

## 6. RESULTS AND DATA ANALYSIS

The constant comparative method served as the primary analytical method used to systematically and continually categorize, compare, synthesize, and interpret the data collected (McMillan & Schumacher, 1997; Merriam, 2002; Strauss & Corbin, 1998).

The constant comparative method is a process in which any newly collected data is compared with previous data that was collected in one or more earlier studies.

This is a continuous ongoing procedure, because theories are formed, enhanced, confirmed, or even discounted as a result of any new data that emerges from the study.

### *6.1 Research Outputs of JBLFMU-Molo in the Last Three School Years, 2008-2009, 2009-2010, and 2010-2011*

The Research Outputs of JBLFMU-Molo in the last three (3) years are the following:
(a) the previous SY 2008-2009 had 37 studies;
(b) SY 2009-2010 had 47 studies, and;
(c) the present SY 2010-2011 has 49 studies.

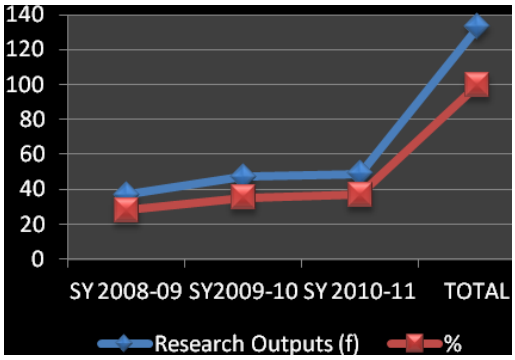



Figure 2
Research Outputs of JBLFMU-Molo in the last three school years

With these research output, JBLFMU-Molo

garnered awards by the research organizations where these papers were presented.

For SY 2008-2009, not any of the faculty members received an award in research. Two (2) awards for SY 2009-2010 were given to the faculty members of JBLFMU-Molo such as:
(1) "Third Place Best Oral Research Presentation" and
(2) "One of the Ten Outstanding Filipino Researchers" given by Philippine Association of Institutions for Research (PAIR) at Boracay Island in December 2009.

For SY 2010-2011, five (5) awards were received by the faculty members of JBLFMU-Molo, Iloilo City, Philippines, in Research. These awards are the following:
(1) Global On-Line Journal Award;
(2) Platinum Award in Oral Research Presentation;
(3) Silver Award in Oral Research Presentation;
(4) National Research Leadership Award 2010;
(5)Third Best Paper Award in Disaster Preparedness.

The awards were given by Philippine Association of Institutions for Research (PAIR) at Cagayan de Oro in August 2010 and Environmental Educators Network in the Philippines (EENP) in February 2011.

*6.2 International Linkages in International Conferences*

As for SY 2008- 2009, ten (10) faculty members presented studies in the International Conferences. For SY 2009-2010, thirteen (13) faculty members presented at International Conferences. For SY 2010-2011, twenty four (24) faculty members presented their studies at International Conferences.

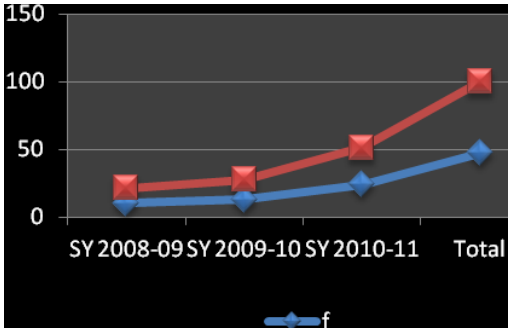



Figure 3
International Linkages of JBLFMU-Molo in the Research Conferences

*6.3 Investing in Faculty: Collaborations in Research by JBLFMU-Molo*

Figure 4 showed the collaborations done by John B. Lacson Foundation Maritime University – Molo, Iloilo City, Philippines, through the different research outputs of the faculty members. Seventeen (49 percent) of the papers were presented at the Philippine Association of Institutions for Research (PAIR); Four (11 percent) of the research papers were presented in the Asian Congress for Media and Communication (ACMC); six (17 percent) of the papers were presented in the Environmental Educators Network in the Philippines (EENP); three (9 percent) at the Association of Teacher Educators at Texas USA; three (9 percent) were presented in the Transportation and Navigation at Poland; and two (5 percent) were in the International Conference in Finland.

Obviously, JBLFMU's collaborations are international and national in nature as shown in the evidences of the research outputs.

Table 1
Collaborations (Local & International) done by JBLFMU-Molo

| Name of Association | Type of Conference | Total | f |
|---|---|---|---|
| ACMC (Asian Congress for Media & Communication) | International Conference at Ateneo de Davao, Davao City | 1 | 3 |
| ACMC (Asian Congress for Media & Communication) | International Conference at Sarabia Manor Hotel, Iloilo City | 3 | 9 |
| Philippine Association of Institutions for Research (PAIR) | International Conference at Vigan, Ilocos Norte | 10 | 29 |
| Philippine Association of Institutions for Research (PAIR) | National Conferences at Cebu & Boracay Island | 7 | 20 |
| Environmental Educators Network in the Philippines (EENP) | International Conference at Ateneo de Davao, Davao City | 2 | 5 |
| Environmental Educators Network in the Philippines (EENP) | International Conference at Silliman University, Dumaguete | 4 | 11 |
| Association of Teacher Educators, International Conference at Texas, USA | Hyatt Hotel, Dallas, Texas, USA | 3 | 9 |
| International Seminar in Transportation & Navigation TRANS-NAV 2009 at Poland | Gdynia Maritime University, Poland | 3 | 9 |
| International Conference at Finland | Finland, Europe | 2 | 5 |
| **TOTAL** | | **35** | **100** |

*6.4 Investing in Faculty: Collaborative Studies*

The Research Department of JBLFMU-Molo, Iloilo City, the Philippines, has also established collaborations with the different colleges and universities here in the Philippines and abroad.

The following are the collaborative completed studies:

(a) For SY 2008-2009, one (1) collaborative study was conducted. This study was "Performance in Physics, Attitudes, and Study Habits among Engineering Students as Influenced by Certain Related Factors" JBLFMU-Molo & University of San Agustin.

(b) For SY 2009-2010, one (1) collaborative study was conducted. This study was titled "Seagrass Diversity in the Western and Eastern Sites of Igang Bay, Guimaras, Philippines" and was conducted by John B. Lacson Foundation Maritime University - Molo & the University of the Philippines.

(c) For SY 2010-2011, three (3) collaborative studies are conducted. The titles of the studies are the following:

(1) Sexting as Socio-Cultural Practice and its Influence among Filipino Youth: A Journey to Explore;

(2) Facebook as Social Capital and Its Role in Transforming Filipino Teenagers: A Reflective Analysis John B. Lacson Foundation Maritime University -Molo, & Occidental Mindoro State University, and;

(3) Status of Fish Catch among Fisher folks at the Municipality of Oton leading to Coastal Zone Management by JBLFMU-Molo, Iloilo City & Marine Institute Memorial University of Newfoundland, Canada.

*6.5 Investing in Faculty: Other Collaborations*

The JBLFMU-Molo, Iloilo City, the Philippines, as maritime university and the Members of the Research Committee are active members of different organizations. These organizations, associations, and societies are the following:

(1) Philippines Society for Educational Research and Evaluation (PSERE);

(2) Philippine Association of Institutions for Research (PAIR);

(3) Asian Congress for Media and Communication (ACMC);

(4) Environmental Education Network of the Philippines, Inc. (EENP);

(5) Western Visayas Association of Physics Instructors (WVAPI);

(6) Philippine Association for Graduate Education (PAGE);

(7) Association of Teacher Educators (ATE) International;

(8) Commission on Higher Education- Regional Research Center (CHED);

(9) Commission on Higher Education- Zonal Regional Center (CHED);

(10) Philippine Association of Maritime Researchers (PAMR);

(11) International Association of Maritime Universities (IAMU);

(12) Philippine Society of Mechanical Engineers (PSME);

(13) Society of St. Vincent de Paul (SSVP) International;

(14) Philippine Society of Physics (PSP);

(15) Provincial Environment of National Resources Office (PENRO);

(16) City Environment National Resources Office (CENRO);

(17) Regional Environment Educators Network (REEN Region 6);

(18) Sea grass Network International (SEAGRASS Net).

To attain that different collaborations / accreditations / certifications of JBLFMU-Molo, Iloilo City, the Philipines, returned good development to the faculty members, students, and staff. Through these organizations and agencies, many activities in research were drawn just to satisfy the level of accreditation and certification.

Thus, ushered internationalization and forming strategic alliances not only in research but also in other functions of the maritime university in Asia.

## 7. CONCLUSIONS OF THE STUDY

Internationalization by investing in faculty showed differential investment as an organizational practice that encouraged faculty to participate in research.

This practice stimulated faculty engagement in internationalization by providing incentives and communication mechanisms to support faculty in integrating international dimensions into their teaching, research, and service.

This study likewise shed light on how the university invested in the faculty by giving them budget or funding in research pursuits and endeavours.

## 8. RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are advanced by the researcher:

The administration of JBLFMU-Molo, Iloilo City, Philippines, should sustain the skills, enthusiasm, and drive of the instructors towards sustaining the research to achieve the global competence in maritime education. This can be done through in-house training and seminars, reviews, colloquia, research presentation in national and international conferences.

Continuous training and exposure of these faculty members and marine engineers in research and related activities here in the country and abroad are meant to prepare them to become competent contributors to the realization of the research goals of the University.

JBLFMU-Molo, Iloilo City, Philippines has to be cognizant of the drive of internationalization through sustaining investments in faculty to attract more to engage in research.

## 9. ACKNOWLEDGMENTS

The authors would like to acknowledge the support given by the administration, faculty members, and students of John B. Lacson Foundation Maritime University - Molo, Iloilo City, Philippines for conducting this present study.

## 10. REFERENCES

[1] BACKMAN, E. L. (Ed.), *Approaches to international education.* New York: Macmillan, (1984).
[2] BEAN, J. P., & KUH, G., *A typology of planning programs, Journal of Higher Education*, 55(1), 35-55, (1984).
[3] BOND S., *Untapped resources: Internationalization of the curriculum and classroom experience*, Canadian Bureau for International Education Research, 7, 1-15, (2003).
[4] CHILDRESS, L. K., *Internationalization Plans for Higher Education Institutions*, Journal of Studies in International Education, 13(1), 289-309, (2009).
[5] CHILDRES, L. K. (in press), *Interdisciplinarity: A Catalyst for Faculty Engagement in Internationalization.* Journal of Global Initiatives, 4(1).
[6] CHILDRESS, L. K., *The Twenty-first Century University: Developing Faculty Engagement in Internationalization*, New York: Peter Lang. Olson, C. L., Green, M. F., & Hill, B. A. (2005), *Building a strategic framework for comprehensive internationalization*, Washington, DC: American Council on Education, (2010).
[7] ELLINGBOE, B. J. *Divisional strategies to internationalize a campus portrait*, in J. A. Mestenhauser & B. A. Ellingboe (Eds.), Reforming the higher education curriculum: Internationalizing the campus (pp. 198-228), Phoenix, AZ: The Oryx Press, (1998).
[8] BOGAt, G., & REDNER, R., *How mentoring affects the professional development of women in psychology*, Professional Psychology: Research and Practice, 16, 851-859, (1985).
[9] BOYLE, R., *First-order principles for college teachers: Ten basic ways to improve the teaching process*, Bolton, MA: Anker Publishing, (1996).
[10] BOYLE, P., & BOICE, B., *Systematic mentoring from new faculty teaching and graduate teaching assistants*, Innovative Higher Education, 22(3), 157-159, (1998).
[11] HARGREAVES, A., & FULLAN, M., *Mentoring in the new millennium*, Theory into Practice, 39(1), 50-56, (2000).
[12] GLASER, Barney G., *The Constant Comparative Method of Qualitative Analysis*, Social Problems 12, no. 4: 436-445, (1965).
[13] GREEN, M. F., & OLSON, C. L. *Internationalizing the campus: A user's guide*, Washington, DC: American Council on Education, (2003).
[14] HAHN, D., *Political Communication: Rhetoric, Government, and Citizens* (Second ed.), State College, PA, USA: Strata, (2003).
[15] KRIPPENDORFF, K., *Content Analysis: An Introduction to Its Methodology*, Newbury Park, CA: Sage, (2004).
[16] JOHNSRUD, L. K., *Enabling the success of junior faculty women through mentoring*, in M. A. Wunsch (Ed.), Mentoring Revisited: Making an Impact on Individuals and Institutions (pp. 53-63), San Francisco: Jossey-Bass, (1994).
[17] KALBFLEISCH, P.J., & DAVIES, A. B., *An interpersonal model for participation in mentoring relationships*, Western Journal of Communication, 57, 399-415, (Fall 1993).
[18] KRAM, K. E., *Mentoring in the workplace*, In D. T. Hall (Ed.), Career Development in Organizations, San Francisco: Jossy-Bass, (1986).
[19] OLSON, C. L., GREEN, M. F., & HILL, B. A., *A handbook for advancing comprehensive internationalization: What institutions can do and what students should learn*, Washington, DC: American Council on Education, (2006).
[20] OTTO, M. L., *Mentoring: An adult developmental perspective*, in M. A. Wunsch (Ed.), Mentoring Revisited: Making an Impact on Individuals and Institutions (pp. 15-26), San Francisco: Jossey-Bass, (1994).
[21] PAIGE, R. M., *Internationalization of higher education: Performance assessment and indicators.* Nagoya Journal of Higher Education, 5, 99-122, (2005).
[22] QUERALT, M., *The role of the mentor in the career development of university faculty*, Paper presented at an annual conference of the National Association of Women Deans, Administrators, and Counsellors, April, Indianapolis, Indiana, ED 216514.35 pp. MF-01; PC-02, (1982).
[23] RICE, R. E., SORCINELLI, M. D., & AUSTIN, A. E., *Heeding new voices. Academic careers for a new generation*, Washington, DC: American Association for Higher Education, (2000).
[24] SIAYA, L., & HAYWARD, F., *Mapping internationalization on U.S. campuses: Final report, Washington, DC: American Council on Education*, (2003).
[25] STEERS, R. M., & UNGSEN, G. R., *In search of the holy grail: Reflections on the internationalization of business education*, In A. M. Rugman & W. T. Stanbury (Eds.), Global Perspective: *Internationalizing management education (pp. 301-316)*, Vancouver, Canada: University of British Columbia, (1992).
[26] STRAUSS, A., & CORBIN, J., *Basics of qualitative research: Techniques and procedures for developing grounded theory (2nd ed.)*, Thousand Oaks, CA: Sage, (1998).
[27] STEMLER, S., *An overview of content analysis, Practical Assessment, Research & Evaluation*, 7(17), 1, (2001).

[28] SORCINELLI, M. D., *Effective approaches to new faculty development, Journal of Counselling & Development*, 72, 474-479, (1994).
[29] WUNSCH, M. A., *New directions for mentoring: An organizational development perspective*, in M. A. Wunsch (Ed.), Mentoring Revisited: Making an Impact on Individuals and Institutions (pp. 9-23), San Francisco: Jossey-Bass, (1994b).
[30] WOOLSTON, V., *Administration: Coordinating and integrating programs and services*, in H. M. Jenkins (Ed.), Educating students from other nations: American colleges and universities in international educational exchange (pp. 184-209), San Francisco: Jossey-Bass, (1983).

# SIMULATOR PROGRAMS (2-D AND 3-D): INFLUENCE ON LEARNING PROCESS OF BSMT AND BSMAR-E STUDENTS AT MARITIME UNIVERSITY PHILIPPINES

[1]ALIMEN A. ROLANDO, [2]PADOR L. RALPH, [3]ORTEGA B. NILO

[1,2,3]*John B. Lacson Foundation Maritime University, Philippines*

## ABSTRACT

This study aims to determine the 2-dimensional and 3-dimensional simulator programs and their influence on the learning process of BS Maritime Transportation and BS Marine Engineering students at Maritime University, Philippines. The participants in this study were the 160 BSMT and BSMar-E students of the Maritime University (JBLFMU-Molo) for school year 2010-2011. Participants in the study were enrolled at the Deck Simulator Program and Engine Room Simulator (ERS), which introduced the 2-D and 3-D simulator programs as part of the different tasks for skills development of maritime students (BSMT and BSMar-E) at Maritime University in the Philippines. The researchers instructed the respondents to write down all their comments, suggestions, observations, and remarks on the perceived influence of using the 3D and 2D simulator programs. After the gathering of the qualitative information, the researchers classified and categorized the write-ups of the respondents into different "categories." The analysis of comparison in relation to learning process brought about by the two (2) simulator programs was processed by the researchers. The "categories" were used towards establishing the concepts/views whether these simulation programs influence the learning process of nautical (BSMT) and marine engineering (BSMar-E) students at Maritime University (JBLFMU-Molo) in the Philippines. The results revealed that the 2-D and 3-D simulator programs are good learning aids which are helpful to marine engineering students. Sustaining the marine engineering students' "competent skill" in performing the different tasks in simulator is needed and should be enhanced.

**Keywords:** *2-D simulator program, 3-D simulator program, learning process, BSMT, BSMar-E.*

## 1. INTRODUCTION

Video tapes, computer simulations, and multimedia software can encourage the students to think like scientists (Brungart & Zollman, 1996). This kind of instructional technology stimulates students to learn and to like their subject (Harwood & Mc Mahon, 1997; Sumanpan, 2008) even though it seemed difficult to understand. These software and technological-instruction activities can facilitate the learning process, more likely to those students who are interested in manipulation and skills. The instructors in higher education institutions should be innovative and creative in dealing with students in order to convey and translate their ideas to achieve effective learning process.

Studies in the field revealed that simulation activity offers education providers a significant educational tool to meet the needs of today's learners by providing them with interactive and practice-based, instructional technologies. Using simulations in teaching and testing has the following potentials that can enhance the total learning process: more effectively utilize faculty in teaching of basic engineering skills, allow learner to revisit his skill in the simulator a number of times in an environment that is safe, non-teaching and conducive to learning, actively engage students in their learning process where they can display higher-order of learning rather than simply mimicking the teacher role model, contribute to the refinement of the body of knowledge related to the use of simulation in maritime education by providing insights in order to formulate best practices related to design and use of simulation technology (Tumala, Trompeta, Evidente, & Montaño, 2008). Furthermore, the authors underscored the use of virtual environment for instructional use in relation with the learners' characteristics. In this study, the authors stressed that learners benefited from the use of simulator as a learning tool irrespective of the type of cognition. In the same vein, the authors have found out the role of the learning program as an indicator of successful learning that now depended on simulation itself. The need to join hands in coming up with programs and program designs that will best cater to the desired learning outcomes of the learners is well stated in this particular study.

The key issue in successful application of simulator classes is ensuring that simulation serves its purpose. The primary aim of any simulator experience is to create a certain level of skills performance among students. In the study entitled "Attitude, Skills Performance, and Implications of using Simulators among Marine Engineering Students of JBLFMU-Molo, Iloilo City, Philippines" conducted by Alimen, Ortega, Jaleco, & Pador (2009), it was emphasized the following: students do not seem to be sold completely to the use of simulator as indicated by "moderately positive attitude" towards simulator use, sustaining the marine engineering students' 'competent skill' in performing the different tasks in simulator is needed and it should likewise be enhanced, the significant correlation between the attitude and skill performance in simulator is reinforced by several studies which support the relationship between learner attitude and their performance. It is also stated that technology has been apparent in this regard as it has reached a threshold where virtual or simulated approaches can meet or exceed the learning outcomes of

expository (teacher-centered) approaches, the implications suggested that simulator should consist, more than anything else, of a set of updated and upgraded computer software to address the observations and comments from the students.

## 2. STATEMENT OF THE PROBLEM

The present study aimed to determine the use of 3D and 2D simulator programs and its influence on the learning process of nautical (BSMT) and marine engineering (BSMar-E) students at the Maritime University (JBLFMU) in the Philippines.

To further understand the study, the following questions were advanced:

(1) How do marine engineering students perceive the 3D and 2D simulator programs in terms of learning at the maritime university?

(2) What are the comments, suggestions, and remarks about the 2D simulator program of nautical and marine engineering students?

(3) What are the common remarks and suggestions of the nautical and marine engineering students related to the 3D simulator program?

(4) Which are the perceived 2D and 3D simulator influences in the learning process of the nautical and marine engineering students?

## 3. THEORETICAL FRAMEWORK

The present study was anchored on the theory advocated by Alimen, Ortega, Jaleco, & Pador (2010) in their study entitled "Attitudes, Skills Performance, and Implications of Using Simulator Programs among Marine Engineering Students of JBLFMU-Molo" by employing descriptive-qualitative mode of data collection. Moreover, in terms of the qualitative study, Yamut (2008) employed a series of descriptions and information to determine the theme, characteristics, opinions, reflections, and views of the subject of the study. In this study, the researchers allowed the respondents to express their ideas, opinions, and views on 2-D and 3-D simulation programs and their influences on the learning process of marine engineering students at the Maritime University in the Philippines.

## 4. CONCEPTUAL FRAMEWORK

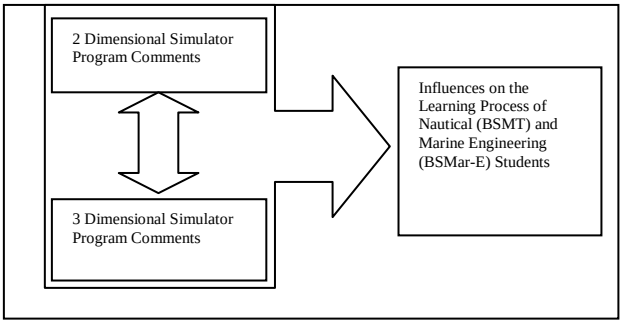



Figure 1 2D and 3D simulator programs and their influences on the learning process of nautical and marine engineering students

## 5. METHOD

This study used the descriptive research design. The respondents of the study were the nautical (BSMT) and marine engineering (BSMar-E) students at Maritime University (JBLFMU) who were using the 3D and 2D simulator programs. The research process involves the description, interpretation, and comparison of the comments, suggestions, and remarks of marine engineering students on simulator programs at the Maritime University.

## 6. PARTICIPANTS

The participants in this study were the 180 nautical (BSMT) and marine engineering (BSMar-E) students of the Maritime University (JBLFMU) for the academic year 2010-2011. Participants in the study were familiar with Deck Simulator and Engine Room Simulator (ERS), which includes the 2D and 3D simulator programs as part of the different tasks for skills development of nautical and marine engineering students at Maritime University (JBLFMU) in the Philippines.

## 7. PROCEDURE

The researchers instructed the respondents to write down all their comments, suggestions, observations, and remarks on the perceived influence of using the 3D and 2D simulator programs. After the gathering the qualitative information, the researchers classified and categorized the write-ups of the respondents into different "categories." The analysis of comparison in relation to the learning process brought about by the two (2) simulator programs was processed by the researchers. The "categories" were used towards establishing the concepts/views whether these simulation programs influence the learning process of nautical (BSMT) and marine engineering (BSMar-E) students at Maritime University (JBLFMU) in the Philippines.

## 8. RESULTS AND DISCUSSION

This section of the study focuses on the results and discussion about 2D and 3D simulator programs and their influences on the learning process of marine engineering students at Maritime University (JBLFMU-Molo) in the Philippines.

Table 1 Perceived Influences of 2D and 3D Simulator programs on the Marine Engineering Students Learning Process at JBLFMU-Molo

| |
|---|
| *2D and 3D programmes are educational and can be used for learning in BS Marine Engineering;<br>*More computers should be available for 2D and 3D so that learning would be more efficient;<br>*2D and 3D simulator programs are good learning aids which are helpful to marine engineering students<br>*The 2D and 3D simulator programs are helpful in terms of improving and adding to students' learning;<br>*They are very useful for the students to familiarize with the different parts of machines and equipment on-board; |

*Extend the number of hours on 2D and 3D simulator programs in order to enhance the knowledge and skills of marine engineering students;
*2D and 3D simulator programs are suitable in the learning process of marine engineering students.
*The 2D simulator program is beneficiary for the students towards shipboard visualization;
*it should be imposed to students as additional learning and must be prioritized among other subjects;
*add more units especially for those students finishing their bachelor degree;
*helpful to students;
*we suggest making it more realistic;
*make students familiarize with the systems on-board;
* it is easier to operate and easy to locate specific systems;
* it helps students to identify if a valve is open or closed;
*it is good but not so very good;
*some parts of the system are not working;
* I want to see that there is a fluid flowing to the pipes;
*The 2D simulator program shows how to operate the machineries on-board;
* It is easy to locate all the valves and machineries when you are operating it;
* the students must be acquainted first with how to use the machineries and they must be aware of the consequences when they failed to follow the correct procedure;
*2D simulator program helps a lot of students from JBLFMU-Molo as a learning material. It stimulates the real situation on-board a ship;
*to improve the 2D simulator program, it is necessary to let the students know how to use and maximize all the programs;
*it is a great help for us to learn because you could

*3D is more practical than 2D so therefore it should be given more attention;
*I prefer 3D to 2D because it is more challenging and it gives critical thinking opportunity to the students;
*The 3D set-up reflects the reality on-board that gives thorough learning to the marine engineering students;
*3D is slightly confusing and sometimes difficult to handle;
*3D seems real but the leaking system should be put into higher resolution to achieve more realistic view;
*3D simulator program is a state-of-the-art learning tool. It is a great opportunity for the students to experience real engine operation through virtual simulation;
*3D is a higher version of simulator program necessary to marine engineering students in terms of skill-development programs at JBLFMU-Molo, Iloilo City.

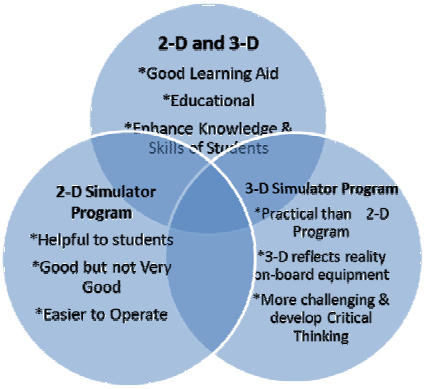



Figure 2 Summary of the views/insights of the nautical (BSMT) and marine engineering (BSMar-E) students towards 3D and 2D simulator programs

## 9. CONCLUSIONS AND RECOMMENDATIONS

The key issue in successful application of state-of-the-art simulator programs is the instruction to ensure that simulation serves its purpose. The primary aim of any simulator experience is to create a certain level of skills performance among students. In summary, this study has the following conclusions:

The 2D and 3D simulator programs are good learning aids which are helpful to marine engineering students. Sustaining the marine engineering students' "competent skill" in performing the different tasks in simulator is needed and should be enhanced.

These simulator programs are very useful to the students to familiarize with the different parts of the machinery and equipment on-board. It is also stated that technology has been apparent in this regard as it has reached a threshold where virtual or simulated approaches can meet or exceed the learning outcomes of expository (teacher-centered) approaches.

The implications found here suggest that the simulator should consist, more than anything else, of a set of updated and upgraded computer software and hardware to address the observations and comments of the students.

In this regard, the following are recommended:

(1) The findings of this study revealed that 2D and 3D simulator programs effectively enhanced the mastery of desired skills of the marine engineering students at JBLFMU-Molo, Iloilo City. Most of the students preferred the 3D simulator program, therefore, the administration should look into the advantages of the 3D simulator program to maximize the applicability of the program. More studies of this kind must be considered to further validate the results of this investigation.

(2) The lack of computers of the 3D simulator program must be addressed through a careful and periodic assessment of the simulation rooms where these courses will be conducted.

## 10. ACKNOWLEDGEMENTS

The researchers would like to acknowledge the support given by John B. Lacson Foundation Maritime University-Molo, Iloilo City to finish this study and present it in the international conference.

## 11. REFERENCES

[1] ALIMEN, R. A., JALECO, V.R., ORTEGA, N.B. , & PADOR, R.(2009), *Attitude, Skills Performance, and Implications of using Simulators among Marine Engineering Students of JBLFMU-Molo, Iloilo City, Philippines*, JBLFMU Research Review (A Refereed Journal) Volume XIX, Number 2, ISSN 1665-8898.

[2] BRUNGART, J.B., & ZOLLMAN, D. A. (1996). *The Influence of Interactive Videodisk Construction Using Real Time Analysis on Kinematics Graphing Skills of High School Physics Students,* Journal of Research on Science Teaching 32, 855-869.

[3] HARWOOD, W.S. & MCMAHON, M.M, *Effects of Integrated Video on Student Achievement and Attitudes in High School Chemistry*, Journal of Research in Science Teaching, Volume 34, Number 6, pp. 617-631, (1997).

[4] SUMANPAN, V.O. (2008). *Multimedia Instruction and Learning Style: Their Effects on Achievement of High School Chemistry Students*, Liceo Journal Higher Education Research, Volume 5, Number 2, ISSN 2094-1064.

[5] TUMALA, B.B., TROMPETA, G.P., EVIDENTE, L.G., and MONTAÑO, R.C (2008). *Impact of Simulator Training on Cognition among Marine Engineering Students*, JBLFMU Research Review (A Refereed Journal) Volume XVIII, Number 1, ISSN 1665-8898.

# UNDERSTANDING OF ENVIRONMENTAL GOVERNANCE AND IMPLEMENTATION OF POLICIES PERTAINING TO EGAÑA RIVER'S PROTECTION, SIBALOM ANTIQUE, PHILIPPINES

[1]ALIMEN A. ROLANDO, [2]BAYNOSA S. RONALD, [3]NONESCO E. ANTONIO

*[1,2,3]John B. Lacson Foundation Maritime University, Philippines*

**ABSTRACT**

The study explored the participants' understanding of the environmental governance and implementation of policies pertaining to the protection of Egaña River, Sibalom in the Province of Antique, Philippines. The study employed the quantitative-qualitative research design by using data-gathering instrument and scheduled interview. Participants of the study were twenty one (21) residents, barangay officials, municipality officers, and fishermen living near the Egaña River at Sibalom, Province of Antique, Philippines. Statistical tools used were frequency count, percentage, and rank to identify the scope of the understanding of the participants regarding the protection of nature. The study identified the different practices, activities, and programs pertaining to environmental protection and implementation of the policies of the municipality towards the protection of the river. Moreover, the study presented the understanding of the policies regarding the river's protection among the different sectors of the community and stakeholders. To further reinforce the data generated, the researchers conducted an interview among the participants in order to draw their understanding about environmental concerns and policy implementation advocated by the government officials concerned.

**Keywords:** *Environmental governance and implementation, river's protection, community, stakeholders.*

## 1. INTRODUCTION

Environmental studies are conducted to address a broad range of issues related to the relationship of human beings with nature. The concept of understanding the different issues and addressing some of the challenges regarding the environmental problems today need knowledge, expertise, resources, and practices obtained from different fields that need to be brought together in order to develop new modes and concept of thinking among different sectors of the community. The implication of environmental studies could not be disputed because of the prevalent problems on nature. Many people take part in the advocacy towards sustainable development. Conducting and engaging in these activities shall be considered as keys towards the future of mankind. The problem and degradation of Mother Earth perceived to be contributed by continuing problems of pollution, loss of forest, solid waste management, issues reflecting economic productivity and environmental security. The developing status of the prevalent problems on environment is considered a major concern and seems to have adequate attention in dealing with academic performances in the colleges and universities in the Philippines.

The environmental governance and protection in the country is seriously challenged by different stakeholders because of the accountability, efficiency, and responsiveness of the local government units (Huesca, 2012). Promoting environmental governance and policy on river and lake protection shall be understood by the local constituents leading towards promising and encouraging prospects of the country's environmental governance. Students have great role in environmental sustainability and exposing them to video documentary on environmental concern would increase their knowledge about the environmental conservation and protection (Quero, 2012).

The threats posed by climate change today increased the urgency of promoting love for the environment and increasing people's capacity to cope. Hence, vulnerability assessment is essential to the progress of adaptation (Matrandea & Schneider, 2008). This is considered an important tool for the development of climate change policies and programs, particularly adaptation and mitigation strategies, for effective management of the impacts of climate change (Neri, 2012).

## 2. STATEMENT OF THE PROBLEM

The present study was conducted in order to present the understanding of environmental governance and implementation of policies regarding the river's protection among the different sectors of the community and stakeholders at Egaña, Antique. In order to understand the present study the following specific questions were addressed:

(1) What are the different activities, schemes, and initiatives manifested by the respondents leading towards the understanding of environmental protection and implementation of policies on Egaña River's protection?

(2) What are the most and least prevalent activities, schemes, and initiatives manifested by the respondents leading towards the understanding of environmental governance and implementation of policies pertaining to Egaña River protection?

(3) What are the comments, remarks, observations, and suggestions of the respondents towards the protection of the river?

## 3. CONCEPTUAL FRAMEWORK OF THE STUDY

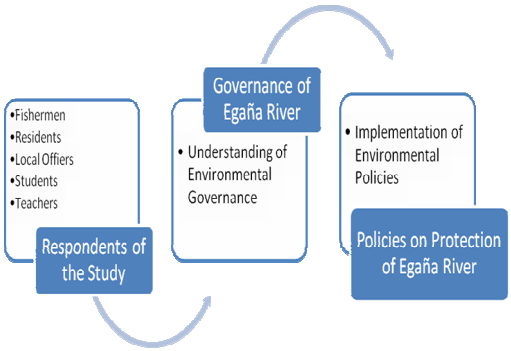



Figure 1 Understanding of environmental governance and implementation of environmental policies on protection of Egaña River situated at Sibalom, Province of Antique

## 4. THEORETICAL FRAMEWORK

The study was anchored on the theory advocated by Tormon (2005) entitled "Assessment of Issues, Concerns and Related Policies and Management Plans in Boracay island, Philippines". This theory states the significant role to intensify information common campaigns, amend ordinances that are practical and focus on basic laws and policies easily understood, delegate responsibilities to the specific sectors, and develop precautionary principle approach through research and development of the place. This theory was used to achieve understanding of environmental governances and implementation of policies focusing on the protection of Egaña River situated at Sibalom, Province of Antique, Philippines.

## 5. METHOD

The design used in this study was quantitative-qualitative employing descriptive method of data gathering procedures. The researchers used fifteen (15) items data-gathering instrument distributed to the fishermen of Egaña, Antique. This instrument was answerable by "yes" and "no." Experts and environmentalists from different fields were invited to review and evaluate the instrument before the final administration to the respondents. Statistical Tools employed in this study were: Frequency count, percentage, and rank for descriptive analysis.

The interview was utilized to gather qualitative data from the respondents. The information, views, and comments of the respondents were categorized to come-up with the holistic views of the respondents towards the preservation and protection of the Egaña River at the Province of Antique.

Permission from the barangay officials of Barangay Egaña at the Province of Antique was properly secured by the researchers prior to the conduct of the study.

Proper courtesy call and consultations were conducted in order to address some protocols and procedures regarding the scope and limitations of the study. Sensitive ideas, information, and knowledge regarding environmental concerns were professionally handled. The confidentiality of the study was strictly followed and exercised by the researchers.

## 6. RESULTS AND DISCUSSION

### *6.1 Results of the Environmental Management of Egaña River at the Province of Antique, Philippines*

The result on Table 1 reflects the procedure of the Municipality on the protection of the Egaña River. The data show that most of the respondents believed that the municipality has no "procedure on protection" of the river. It seemed that the municipality failed to design necessary guidelines and policies towards the protection and preservation of natural resources like Egaña River. The municipality should strictly review and implement the policies on environmental protection, emphasis shall be given to this particular urgent call of nature.

Table 1 Procedures regarding protection of Egaña River?

| | **Frequency** | **Percentage** |
|---|---|---|
| Yes | 5 | 24 |
| No | 16 | 76 |
| Total | 21 | 100 |

The result in Table 2 means that the residents know how to identify the different wastes situated at the river, particularly Egaña River situated at the Province of Antique. Most of the residents (81%) have knowledge on how to identify the wastes at the river while only few (19%) do not know how to identify them. Data are shown below:

Table 2 The residents know how to identify the wastes situated at Egaña River

| | **Frequency** | **Percentage** |
|---|---|---|
| Yes | 17 | 81 |
| No | 4 | 19 |
| Total | 21 | 100 |

Out of 21 residents being interviewed, eighteen (86%) said that they believe that there should be a protection mechanism towards the protection of the river. Only three (3) mentioned that they do not believe that there should be aprotection mechanism on Egaña River at the Province of Antique, Philippines. Data are shown in Table 3.

Table 3 The respondents believe that there should be protection mechanism in order to preserve and protect the Egaña River

| | **Frequency** | **Percentage** |
|---|---|---|
| Yes | 18 | 86 |
| No | 3 | 14 |
| Total | 21 | 100 |

The majority of the residents (86%) shared that they have not seen any posters/markers/bulletin boards pertaining to the advocacy leading towards the river's protection at Baragnay Egaña, Antique. Only few (14%) residents said that they have seen these posters at their place. Data of the study are shown in Table 4 below:

Table 4 Posters/markers/bulletin boards properly labelled regarding the protection of Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 3 | 14 |
| No | 18 | 86 |
| Total | 21 | 100 |

Most of the residents (86%) have knowledge about the penalty imposed upon those who will destroy the river and only few (14%) were not aware of the said penalty.

Table 5 Knowledge that penalty shall be given to those who will destroy the Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 18 | 86 |
| No | 3 | 14 |
| Total | 21 | 100 |

Table 6 Educational campaign regarding the protection of Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 2 | 10 |
| No | 19 | 90 |
| Total | 21 | 100 |

The result in Table 6 reveals that when it comes to the educational campaign towards the protection of Egaña River, nineteen (19) residents said they "have no knowledge" about the issue. This is reflected by the responses and answers of the majority of respondents (19, 90%) and only two (2, 10%) were aware of this educational campaign of the municipality. The result would be a wake-up call for those who are involved towards environmental and ecological concerns to exert more efforts on the activities and initiatives related to these particular global concerns and issues.

On the concern of cleanliness, the majority of the residents agree to maintain the cleanliness of the Egaña River as reflected in Table 7. Out of the 21 respondents of the study, 13 believe that the government officials should maintain and sustain whatever activities, projects, and initiatives pertaining to the cleanliness of the river. The clean river shall generate many benefits like abundant fish and marine organism which make the area/place bio-diversified. Other pollutants and heavy metals could be avoided if cleanliness is in place and properly maintained and monitored.

Table 7 Government officials have to maintain the cleanliness of the Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 13 | 62 |
| No | 8 | 38 |
| Total | 21 | 100 |

At the barangay level, it seemed that the barangay officers have already started and initiated management scheme on how to protect the river. The initiatives are geared towards the participation and cooperation of the different stakeholders especially teachers, students, parents, businessmen, fishermen, and government officers. However, some residents (7, 33%) still shared that they do not see any management scheme towards the protection of the river. This concern should be looked into by the BFAR, PENRO, and BFAMRC. Data are shown in table below.

Table 8 The barangay officers initiate management schemes for different stakeholders in order to protect the Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 14 | 67 |
| No | 7 | 33 |
| Total | 21 | 100 |

Based on the result of the study, it shows that the residents of the place already participate and get involved in any program, projects, and initiatives which concerned the protection of the river. However, these programs and projects on environmental protection could be intensified and sustained by more participation and cooperation of the residents. This participation is considered a very significant factor towards the success of any endeavours towards the protection of the river. Data are shown in Table 9.

Table 9 The locals/residents participate in the protection of the river?

| | Frequency | Percentage |
|---|---|---|
| Yes | 15 | 71 |
| No | 6 | 29 |
| Total | 21 | 100 |

The majority of the respondents believe that reasonable protection of Egaña River gives them sustainable livelihood because the river is considered as the only source of their income. The major occupation of the respondents is fishing, therefore, they depend on the river as their source of income to feed the members of their families. Data are shown in Table 10.

Table 10 The residents agree that reasonable protection of the Egaña River shall provide them sustainable livelihood

| | Frequency | Percentage |
|---|---|---|
| Yes | 20 | 95 |
| No | 1 | 5 |
| Total | 21 | 100 |

Table 11 reveals that the residents have demonstrated some actions to protect and preserve Egaña River situated at Sibalom, Antique, Philippines (17, 81%). Majority of the respondents (18, 86%) agreed that the management and protection of the river should be supported by every individual of the place, they also

believed that different stakeholders should take initiatives in maintaining the cleanliness and biodiversity, and sustaining marine life can be done and monitored through strict implementation of governance and policies on management and protection of the river. Data are shown in Table 12, Table 13, and Table 14.

Table 11 The residents show positive action to protect and preserve Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 17 | 81 |
| No | 4 | 19 |
| Total | 21 | 100 |

Table 12 The residents believe that the management and protection of Egaña River should be supported by everyone

| | Frequency | Percentage |
|---|---|---|
| Yes | 18 | 86 |
| No | 3 | 14 |
| Total | 21 | 100 |

Table 13 The residents believe that the different stakeholders should take initiatives in maintaining the cleanliness and biodiversity of Egaña River

| | Frequency | Percentage |
|---|---|---|
| Yes | 19 | 90 |
| No | 2 | 10 |
| Total | 21 | 100 |

Table 14 The residents agree that supporting governance and policy on management of Egana River can sustain the marine life

| | Frequency | Percentage |
|---|---|---|
| Yes | 20 | 95 |
| No | 1 | 5 |
| Total | 21 | 100 |

Most of the respondents believe that clean and diverse river is an indication of good environment. This concern should be the first priority of the officials of the municipality of Egaña situated at Sibalom, Antique, Philippines towards environmental governance and implementation of policies on the protection of the river. The least prevalent activity is the educational campaign regarding the protection and preservation of the river. The respondents perhaps believe that these activities should be enjoined by everyone especially the teachers, parents, students, tax payers, municipality officers, and government officers (DENR, BFAR, & MFARMC).

Table 15 The residents believe that clean and diverse river is an indication of good environment

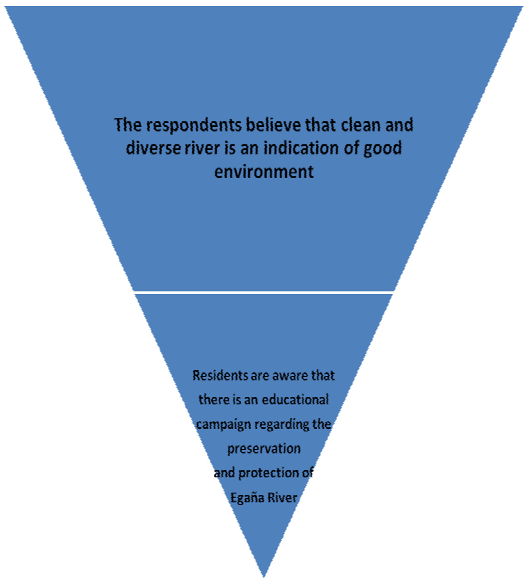
| | **Frequency** | **Percentage** |
|---|---|---|
| Yes | 21 | 100 |
| No | 0 | 0 |
| Total | 21 | 100 |

Table 16 Summary of the activities/advocacies leading towards understanding and implementation of policies regarding the protection of Egaña River at Sibalom, Antique, Philippines

| **Item** | **f** | **P** | **R** |
|---|---|---|---|
| The respondents believe that clean and diverse river is an indication of good environment. | 21 | 100 | 1 |
| Supporting governance and policy on management of Egaña River can sustain the marine life. | 20 | 95 | 2 |
| Reasonable protection of the Egaña River shall provide sustainable livelihood. | 20 | 95 | 3 |
| Believing that the different stakeholders should take initiatives in maintaining the cleanliness biodiversity of Egaña River. | 19 | 90 | 4 |
| Believing that the management and protection of Egaña River should be supported by everyone. | 18 | 86 | 5 |
| There should be protection mechanism in order to preserve and protect the Egaña River. | 18 | 86 | 6 |
| Residents are knowledgeable that penalty shall be given to those who will destroy the Egaña River. | 18 | 86 | 7 |
| Residents should show positive action to protect and preserve Egaña River. | 17 | 81 | 8 |
| Residents know how to identify the wastes situated at the river. | 17 | 81 | 9 |
| The locals/residents participate in the protection of the river. | 15 | 71 | 10 |
| Barangay officers shall initiate the management schemes for different stakeholders in order to protect the Egaña River. | 14 | 67 | 11 |
| The government officials have to maintain the cleanliness of Egaña River | 13 | 62 | 12 |
| The municipality should have procedures regarding protection of the river. | 5 | 24 | 13 |
| Posters/markers/bulletin boards are properly labeled regarding the protection of Egaña River. | 3 | 14 | 14 |
| Residents are aware that there is an educational campaign regarding the preservation and protection of Egaña River. | 2 | 10 | 15 |

The data shown in the summary (Table 16) reveal that the municipality of Sibalom, Antique should give emphasis and attention on the three (3) areas such as the following: (a) educational campaign regarding the preservation and protection of Egaña River, (b) posters/markers/bulletin boards regarding the protection of Egaña River, (c) the municipality should have procedures regarding the protection of the river. Moreover, the members of the council on environmental protection should also notice the following: (a) government officials have to maintain the cleanliness of Egaña River, (b) Barangay officers shall initiate the management schemes for different stakeholders in order to protect the Egaña River, and (c) the locals/residents participate in the protection of the river.

The most prevalent understanding of environmental governance and implementation of policies on the protection of Egaña River situated at Sibalom, Antique, Philippines is "clean and diverse river is an indication of good environment." This is the most prevalent response among the respondents. This is an indication that most of the respondents wanted their river to be properly monitored by authorities concerned. This monitoring leads towards cleanliness of the river in order to achieve the standards of bio-diversity. Many respondents believed that when the river is bio-diversified, abundant stock of fish shall be observed, and other marine organisms are thriving in the river.




*6.2 Comments*

*Comments, suggestions, remarks, and observations regarding the environmental protection and implementation of policies on Egaña River situated at Sibalom, Antique, Philippines*

*No effort from the municipality;
*Prevent the Garbage coming from other barangays;
*Local government should prevent the residents from other barangays of throwing their garbage and plastics to the river especially waste from piggery;
*No concrete programs to preserve and protect the river;
*Amo gid daad ka importante sa amon ang katinlo sang Egaña River (The cleanliness of Egana River is very important to us);
*Put Projects to Egaña River;
*Stop illegal fishing and electrifying the fish;
*Burugan naton para ang officials sang banwa makabulig sa katinlu-an sang Egaña River (help the municipal officials of the town towards the cleanliness of Egaña river);
*Local officials should maintain the cleanliness of the river;
*Help us to protect the river;
*Stop polluting the river;
*It must be cleaned from waste and garbage and stop illegal fishing activities;
*Stop cyanide practice and using electricity in fishing;
*Gusto ko matinlo ang suba para maka kuha kami isda (I want the river to become clean so that I can get fish);
*The local officials are neglecting the river.

## 7. CONCLUSIONS

The majority of the respondents of the study believed that Egaña River should be protected and monitored in order to safeguard its cleanliness. These indicators lead to clean and well-preserved environment.

The residents of Barangay Egaña at the Municipality of Sibalom, Province of Antique, Philippines were aware that education regarding the protection of the river should be enhanced and enforced. Qualitative data through comments and suggestions shared by the respondents of the place are indicators of their environmental understanding and reflection of how the government officers implemented the environmental policies pertaining towards river's protection and preservation.

## 8. RECOMMENDATIONS

Based on the results and conclusions of the study, the following recommendations are advanced:

(1) The ideas and data reflecting the understanding of environmental governance and implementation of policies on the protection of Egaña River shall be the major concern and focal point of discussion among the government officers of the Municipality of Sibalom, Province of Antique, Philippines.

(2) Major concerns pertaining to the protection of Egaña River shall be initiated and participated by the different sectors especially the teachers, students, parents, residents, and government officers of the Sibalom, Province of Antique, Philippines.

(3) Parallel studies shall be conducted to determine other areas of concern and issues towards the environmental understanding and protection of the Egaña River situated at Sibalom, province of Antique, Philippines.

## 9. ACKNOWLEDGMENTS

The authors would like to acknowledge the support given by the administration, faculty members, and students of JBLFMU-Molo, Iloilo City, Philippines for this study.

## 10. REFERENCES

[1] AGARWAL, K.C., *Environmental Biology*, Nidi Publishers Ltd. Bikaner, 2001.
[2] BHANUCHA, Erach, *The Biodiversity of India, Map*, in Publishing Pvt. Ltd, Ahmedabad – 380013, India, Email: mapin@icenet.net, 2003.

[3] BRUNER, R.C., *Hazardous Waste Incineration*, McGraw Hill Inc. 480 pgs., 1989.
[4] CLARK R.S., *Marine Pollution*, Clanderson Press, Oxofrd (TB).
[5] CUNNINGHAM, W.P., COOPER T.H., GORHANI E. & HEPWORTH M.T., *Environmental Encyclopaedia*, Jaico Publishing House, Mumbai, 1196 pgs., 2001.
[6] DE AK, *Environmental Chemistry*, Wiley Eastern Ltd.
[7] GLEICK, H.P., *Water in Crisis, Pacific Institute for Studies in Development, Environment and Security*, Stockholm Environmental Institute, Oxford University Press, 473 pgs., 1993.
[8] HAWKINS, R.E., *Encyclopaedia of Indian Natural History*, Bombay Natural History Society, Bombay (R).
[9] HEYWOOD, V.H., and WATSON R.T., *Global Biodiversity Assessment*, Cambridge University Press 1140 pgs., 1995.
[10] JADHAV, H. and BHOSALE V.M., *Environmental Protection and Laws*, Himalaya Publishing House, Delhi 284 pgs., 1995.
[11] MCKINNEY, M.L. and SCHOCH R.M. *Environmental Science Systems and Solutions*, Web enhanced edition, 639 pgs., 1996.
[12] MHASKAR, A.K., *Matter Hazardous*, Techno-Science Publications (TB).
[13] MILLER, T.G., Jr., *Environmental Science*, Wadsworth Publishing CO. (TB).
[14] ODUM, E.P., *Fundamentals of Ecology*, WB Saunders Co. USA, 574 pgs., 1971.
[15] RAO, M.N. and DATTA A.K., *Waste Water Treatment*, Oxford and IBH Publishing Co., Pvt. Ltd. 345 pgs., 1987.
[16] HUESCA, E. F., *Decentralization and Environmental Governance: Understanding Environmental Policy Implementation in Lakeshore Communities in Mindanao, Southern Philippines*, Conference Abstract ISSN 2244-2863, Published by West Visayas State University, Lapaz, Iloilo City, Philippines, (2012).
[17] QUERO, S., *Understanding Environmental Conservation: A Study on the Effectiveness of Video Documentary in teaching Environmental Conservation among Fourth Year High School Students*, Conference Abstract ISSN 2244-2863, Published by West Visayas State University, Lapaz, Iloilo City, Philippines, (2012).
[18] MASTRANDREA, M. D. & SCHNEIDER, S. *The Rising Tide: Time to Adapt to Climate Change*, Boston Review, Volume 33, Number 67, November-December, (2008).
[19] NERI, D. L., *Global Predictors of People's Vulnerability to Climate Change*, International Journal of Multidisciplinary Research, Volume 3, Jan, 2012, ISSN 22438327, (2012).
[20] TOMON, D., *Assessment of Issues, Concerns and Related policies and Management Plans in Boracay Island, Philippines*, First UP-Visayas Graduate Research Conference held at the Auditorium of UP-Visayas, Iloilo City, Philippines, (2005).

# ENGINE ROOM SIMULATOR (ERS) TRAINING COURSE: PRACTICABILITY AND ESSENTIALITY ONBOARD SHIP

ALIMEN A. ROLANDO

*John B. Lacson Foundation Maritime University, Philippines*

**ABSTRACT**

This study determined the essentiality and practicability of the Engine Room Simulator Training Course onboard ship among special program cadets of JBLFMU-Molo, Iloilo City, Philippines. This employed the qualitative research method where data are gathered through an interview and the subjects were the special program cadets who had taken the ERSTC and had undergone apprenticeship onboard an international vessel. The participants were the ten (10) engine cadets of the special program specifically the Norwegian Ship-owners Association (NSA) Cadets of JBLFMU-Molo, Iloilo City, Philippines taking up marine engineering, which had taken the Engine Room Simulator Training Course (ERSTC) and had undergone apprenticeship onboard international vessel. As whole, the ERS Training Course is essential onboard ship in a manner, that most of the vessels are computer based or UMS. It gives basic idea and knowledge on the operations and functions of the machineries and equipment in a specific system onboard, gives experiences on how to trouble shoot and rectify and make the mastery of operating procedure easy like starting and stopping of the main engine, synchronizing of generators. Furthermore, ERS Training Course is very practicable on the UMS vessels and essential on the manned machinery space when taken as whole. As such, the machineries and equipment, operation and functions are the same onboard even though the positions are less complicated on the simulator that it is fixed and organized. Lastly, it is applicable onboard regardless on the types of vessel, kind of cargo carried, and mode of operations.

**Keywords:** *Engine Room Simulator Training Course, UMS, onboard training, engine officers.*

## 1. BACKGROUND AND THEORETICAL FRAMEWORK OF THE STUDY

At the time that man started discovering things around him, many innocent people were amazed. Starting from the discovery of fire upon the ignition of two stones that creates flame, to the invention of gunpowder by the Chinese people.

After several years of evolution, technology had created a great change in life on land and in water. Men had created highly complicated gadgets, the development of machines, treatments in the field of medicine, and in science and technology.

Now, even on board the ship technology had really affected the life of many seafarers. Just imagine the kind of ships 30-40 years ago. During those times everything was being done manually. For example, when an alarm is heard everybody must go down the engine room to trace the exact place where a deficiency is spotted. But now, even inside one's cabin, one can immediately track the place where the alarm started. Because of the sophistication of technology, most international vessels are under a special operational system, which is widely known as the "UMS" or the Unmanned Machinery Space. This system helps most marine engineers do their work easier. Through this system, they are not obliged to monitor everything in the engine department from time to time. If the crew on duty can already stay inside their cabin while doing their duty at the same time and if the alarm is heard they can immediately determine where the alarm is coming from.

With the continuous development of technology, ships became complicated and highly powered with their machineries and gadgets. And so, in order to be competent in using these machineries one must undergo trainings, seminars and special courses that could comply with the standards of these vessels.

With the rapid development of technology, a new and better training course is introduced which gives the new generation of marine engineers the idea and knowledge with the usage of these technologies. Such course is known as the "Engine Room Simulator Training Course." The ERSTC is an upgrading course offered by a school to the future Engine officers with the functions and usage of the machinery and equipment in the engine room and also enhances the abilities and competency of the engineers.

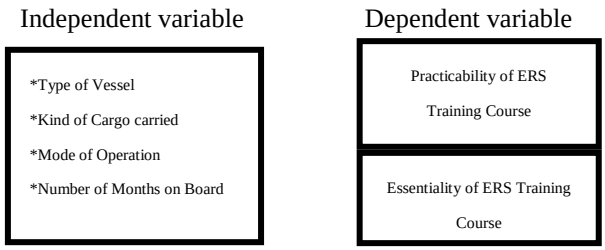



Figure 1 Practicability and essentiality of ERS Training Course

## 2. STATEMENT OF THE PROBLEM

This study determined the essentiality and practicability of the Engine Room Simulator Training Course onboard ship among special program cadets of JBLFMU-Molo Inc. This study also aimed to answer the following questions:

1. Is the Engine Room Simulator Training Course essential to special program cadets of John B. Lacson

Foundation Maritime University (JBLFMU)-Molo Inc. when taken as a whole?

2. Is the Engine Room Simulator Training Course essential to special program cadets of JBLFMU-Molo Inc. when grouped according to a) Type of Vessel; b) Kind of Cargo Carried; c) Mode of Operation?

3. Is the Engine Room Simulator Training Course practicable to special program cadets of JBLFMU-Molo Inc. when taken as a whole?

4. Is the Engine Room Simulator Training Course practicable to special program cadets of JBLFMU-Molo Inc. when grouped according to a) Type of Vessel; b) Kind of Cargo Carried; c) Mode of Operation?

5. How does the Engine Room Simulator training Course help the special program cadets of JBLFMU-Molo?

## 3. SIGNIFICANCE OF THE STUDY

The researchers believed that this study is beneficial to the following:

JBLFMU community and Administrator. This shall be the basis in enhancing and promoting the quality of education and learning among marine engineering students, specially the special program cadets onboard ship.

JBLF Training Center. This will give an insight about the essentiality and practicability of the Engine Room Simulator Training Course onboard a ship in improving the quality of learning and training.

Students. They will be able to appreciate and give more importance to the Engine Room Simulator Training Course on its essentiality and practicability onboard ship. Also this will give an idea about the said course.

For Future Use. This will give information about the Engine Room Simulator Training Course, on its essentiality and practicability onboard ship to the researchers who find interest to pursue the same study.

## 4. RESEARCH DESIGN

This employed the qualitative research method where data are gathered through an interview and the results were compared.

## 5. THE PARTICIPANTS

The participants were the ten (10) engine cadets of the special program specifically the Norwegian Ship-owners Association (NSA) Cadets of JBLFMU-Molo Inc., Iloilo City taking up marine engineering, which have taken the Engine Room Simulator Training Course and have undergone apprenticeship onboard international vessels.

## 6. DATA GATHERING INSTRUMENT AND STATISTICAL TOOLS

The research procedure involved the preparation of the study instrument, choosing the participants, data processing and analysis.

The participants were chosen randomly and the interview technique was employed because the researchers chose the qualitative type of research, using a qualitative-questionnaire made by the researchers and approved by the adviser.

## 7. RESULTS OF THE STUDY

The interviewee number one (1)'s answers on the question asked by the researchers were shown in Table 1. Interviewee number one (1) has already taken the ERSTC (Engine Room simulator Training Course) and boarded an Oil-Chemical tanker vessel for ten (10) months carrying finished products of oil like gasoline, LPG, LNG, etc. The mode of operation of machinery is unmanned machinery space (UMS). For him, the ERSTC is very essential and practicable onboard for the reason that most of the vessels today use UMS. The simulator gives him knowledge and basic ideas of the correct procedures in operating machineries and different systems which are carried onboard. It made him familiarize because the machineries onboard are the same in the simulator but some fittings are not found in his vessel.

The results gathered by the researchers on the interviewee number two (2) were shown in the following sections. Interviewee number two (2) has already taken the ERSTC and boarded a General Cargo Vessel carrying bulk, ore, etc. for almost eleven (11) months. The mode of operation of the machineries is UMS.

The data gathered from the interviewee number three (3) were shown on the following sections. Interviewee number three (3) has already taken the ESRTC and boarded a Tanker vessel for almost ten (10) months carrying LPG, LNG, etc. The mode of operation of machineries is UMS.

Interviewee number four (4) has already taken the ERSTC and boarded a General Cargo Ship for almost ten (10) months carrying all forest products like lumber, wood, etc. The mode of operation of the machineries is manned machinery space.

The results gathered by the researchers from the interviewee number five (5) were shown in the following sections. Interviewee number five (5) has already undergone an ERSTC and boarded a Bulk vessel for almost 11 months carrying ore, bulk, etc. and the mode of operation of machineries is a manned machinery space.

The results gathered by the researchers on interviewee number six (6) were shown in the following sections. Interviewee number six (6) has already taken the ERSTC and boarded a General Cargo Vessel carrying bulk, ore, etc. for 12 months and 2 days. The mode of operation of the machineries is UMS.

The results gathered by the researchers from interviewee number seven (7) were shown in the following sections. Interviewee number seven (7) has already taken the ERSTC and boarded an Oil Chemical Tanker carrying palm oil, gas oil and molasses for almost ten (10) months. The mode of operation of the machineries is UMS.

The results gathered by the researchers on interviewee number nine (9) were shown in the following sections. Interviewee number nine (9) has already taken the ERSTC and boarded a General Cargo Vessel carrying pulp and different kinds of metals for 12 months and 8 days. The mode of operation of the machineries is manned machinery space.

The results gathered by the researchers on interviewee number ten (10) were shown in the following sections. Interviewee number ten (10) has already taken the ERSTC and boarded an Oil Chemical Tanker carrying various oils for almost eleven (11) months. The mode of operation of the machineries is UMS.

## 8. CONCLUSIONS

Based on the interviews, the qualitative results lead the researchers to conclude that:

As whole, the ERS Training Course is essential onboard ship/ in a manner, that most of the vessel is computer based or UMS. Also, it gives basic idea and knowledge on the operations and functions of the machineries and equipment in a specific system onboard. When the system fails, it gives experiences on how to trouble shoot and rectify and make the mastery of operating procedure easy like starting and stopping of the main engine, synchronizing of generators, etc.

The same qualitative findings shared by the respondents during the interview when they were grouped according to type of vessel, kind of cargo carried and mode of operations, the ERS is essential onboard ship.

Furthermore, ERS Training Course is very practicable on the UMS vessel and practicable on the manned machinery space when taken as whole. As such, the machineries and equipment, the operation and functions are the same onboard even though the positions are less complicated on the simulator that it is fixed and organized.

## 9. IMPLICATIONS FOR THEORY AND PRACTICE

The Engine Room Simulator (ERS) Training Course is applicable onboard regardless of the type of vessel, kind of cargo carried and mode of operations.

## 10. RECOMMENDATIONS

Based on the findings of this study, the researchers arrived at the following recommendations:

The administrator and the head of the JBLF Training Center must give importance on the ERS Training Course. They should open the Engine Room Simulator to everybody, so that the students could practice on the operation of the machineries and equipment on board ship in the time they were available or must be added to the curriculum of the Marine Engineering Course.

For the school, they should maintain the computer and the equipment in good condition and additional computer to occupy more students.

To Instructors and Assessors of the ERSTC of JBLF Training Center, they should be strict to the student in assessing and must improve their teaching skills.

In addition, students must take the ERS seriously so that they could learn more about the operations and functions of the different machineries onboard.

## 10. REFERENCES

[1] BARIA, R.O., *Electronics Technology As A Subject: Attitude and Performance Among Marine Engineering Students*, Unpublished Thesis, John B. Lacson Foundation Maritime University-Molo, Iloilo City, 2004.

[2] CARETA, T. and DUNLAP, R., *Transfer of Training Effectiveness in Flight Simulation*, 1998.

[3] DOYLE, E., *Reconstructing a Marine Casualty: The Effectiveness of the Full-Mission Simulator as a Casualty Analysis Tool*, Marine Navigation and Safety of Sea Transport, Taylor and Francis Group, London, U.K., 2009, pp.69-74.

[4] GATTIKER, J., *Using the Gaussian Process Model for Simulation Analysis Code*, Los Alamos technical report LA-UR-05-5215, 2005.

[5] GLIMM, C., HIGDON, G., SCHULTZ, S., *Error Analysis in Simulation of Complex Phenomena*, Los Alamos Science special issue on Science-Based Prediction for Complex Systems, no.29, 2005, pp.6-25.

[6] HU Y. & WAN, B., A *Simulation Study on Diesel Engine Performance Failure*, Proc. ISME Tokyo. Vol. 2, 2000, 797-803.

[7] JALECO, V., *Teaching-Learning Situation in Maritime Schools in Western Visayas*, Unpublished Dissertation, University of San Agustin, Molo, Iloilo City, 2004.

[8] LOBATON, J. A., *Students' Mathematics Performance As Moderated by Their Attitude Towards the Subject*, Unpublished Thesis, John B. Lacson Foundation Maritime University-Molo, Iloilo City, 2003.

[9] MCKELLOP, H.A. & D'LIMA, D., *How have wear testing and joint simulator studies helped to discriminate among materials and designs?*, J. Am Acad Orthop Surg, Vol 16, No suppl_1, July 2008, S111-S119.

[10] OLSEN, N., et al., *The Swarm End-to-End mission simulator study: A demonstration of separating the various contributions to Earth's magnetic field using synthetic data Earth Planets Space*, 58, 2006, 359–370.

[11] PORRAS, E.P., *Teaching Performance Towards Management, Work and Study Conditions, and Communication Climate Among the Faculty of a Maritime Institution*, Unpublished Thesis, John B. Lacson Foundation Maritime University-Molo, Iloilo City, 2004.

[12] ROOF and KAPOS Associates, *Trade-Offs Between Live and Simulated Training*, 1996.

[13] RUPPEL, F. and WYSOR, W., *Guidelines for Simulator-Based System Testing*, 1997.

[14] TOWNE, D. M., Learning *and instruction in simulation environments. Englewood Cliffs*, NJ: Educational Technology Publications, 1995.

[15] TUMALA, B., TROMPETA, G., EVIDENTE, L., and MONTAÑO, R., *Impact of Simulator Training on Cognition among Marine Engineering Students*,

JBLFMU Research Review, Volume XVIII. Number 1, 2008, pp. 65-87.
[16] WHITE, S. R., & BODNER, G. M., "Evaluation of computer simulation experiments in a senior-level capstone course", *Chemical Engineering Education*, 33(1), 1999, 34-39.
[17] ZALEWSKI, P., *Fuzzy Fast Time Simulation Model of Ship's Maneuvering*, Marine Navigation and Safety of Sea Transport. Taylor and Francis Group, London, U.K., 2009, pp. 75-78.

# VIEWS TOWARDS SUSTAINABLE ENVIRONMENT ON GLOBAL WARMING MITIGATION: SILVER POMPANO STUDY OF JBLFMU-MOLO

[1]ALIMEN A. ROLANDO, [2]PADOR L. RALPH, [3]ORTIZO D. CICERO, [4]ASPIRACION G. JOHN

[1,2,3,4]*John B. Lacson Foundation Maritime University, Philippines*

**ABSTRACT**

The present study was conducted to determine the views on sustainable environment towards global warming mitigation by employing the Silver Pompano as a mariculture study of JBLFMU-Molo, Iloilo City, Philippines. This study employed descriptive the quantitative-qualitative method of collecting data. Respondents of the study were the faculty members of the university who were engaged in the mariculture project of the university. Results revealed that the mariculture project is an attempt to deal with the environment and global warming mitigation issues, opportunity to engage in the global warming mitigation activity like planting mangroves around the pond, to deal with particular species of fish; sources of global warming mitigation according to the perception of the respondents are the following: news from media, lectures/talks from international and national seminars/conferences, school teachers / instructors / environmentalists, family members, friends, and personal observation; the perceived causes of global warming problems were due to man's act of negligence, weak implementation of environmental-protection policies by the concerned agencies, insufficient knowledge of the constituents involved, and natural occurrences; some of the respondents were not engaged in this activity; respondents have been engaged in environmental initiatives/activities aside from the Silver Pompano Mariculture activity towards global warming mitigation endeavours such as: tree planting program, information and education on global warming, solid waste management information drive, and energy conservation activity; respondents were motivated by the following reasons: belief, desire to help, and concern for the environment; respondents wanted to become "members only" in any of the activities towards sustainable-environmental global warming issues. Silver Pompano Mariculture opens opportunities for learning environmental issues and problems.

**Keywords:** *Sustainable environment, mariculture, Silver Pompano, and global warming mitigation.*

## 1. INTRODUCTION

The Philippine is a biodiversity hotspot and mega diversity area vulnerable to climate change. Climate change is expected to exacerbate the various stresses facing the different ecosystems and large populations of many species of the Philippine archipelago. Marine species could be lost due to the synergistic effects of climate change and habitat fragmentation (Lasco, 2010; Peras, et al. 2008). Moreover, the study of Perez (2010) stressed that the climate change phenomenon is likely to change the world landscape as well as the composition of the lives that presently dwell upon it.

Responses to climate change have been traditionally organized in the attempts of reducing the risks and improving society's resilience, increase climate variability, and long term climate changes (Medrano, 2010; Chou, 2010; Baasco (2009). These things were supported by Medrano (2010), stating that adaptation to climate change is not a technical challenge, but one that involves society in its broadest sense. The major role of the society is very vital to address problems on global warming and climate change because society is composed of learned individuals.

In the study of Tumala (2009), it was stated that advocates of environmental and ecological concerns should organize a crusade intended for global warming mitigation activities that have relationship with nature. These activities should bring change in human behaviour in order to lessen the collective impact of the natural environment. It was mentioned in the study that to protect the environment, there has to be willingness to adopt responsible environmental behavior among the constituents of the community. In the same vein, the study of Tan (2009) strongly cited that environmental education is a tool in creating the needed change. Mitigation is identifying the cause of the changing condition. After identification of the problem, action based on the cause is very important.

Sustainability does not simply mean whether something can last. It addresses how particular initiatives can be developed without compromising the development of others in the surrounding environment, now and in the future. It enables people to adapt to and prosper in the increasing complex environment. Sustainability involves a way of thinking that is integrative, holistic, and ecological (Hargreaves & Fink, 2003).

Another indicator of successful global mitigation management is the collaborative effort. Mirasol and Itaas (2008) suggested that collaborative efforts to achieve good environmental management shall be pursued among academic, non-government organizations (NGOs), and local government units (LGUs). As a maritime university, most of the initiatives and activities on environment geared towards collaboration with different stakeholders, especially LGUs.

In response to the call of resolving constraints in global warming, the maritime university, specifically JBLFMU-Molo embarked in this mari-culture study. This investigation brought opportunities to the faculty members and students to experience the essence of

dealing with global warming mitigation issues and problems. Furthermore, it enabled the faculty members and students to explore and commune with the environment and experience the effect of global warming to the marine-pelagic species of fish known as Silver Pompano.

The Silver Pompano is an Indonesian marine finfish and scientifically known as Trachinotus blochii, Lacepede. It is a pelagic and active species that is easy to domesticate and culture in tropical marine waters. The Silver Pompano belongs to the Carangidae (trevally and jacks) and lives in the coral reef areas of less than 7 meters depth (Juniyanto, Akbar, and Zakimin, 2008). It lives in the open sea and is found in the Atlantic, Indian and Pacific oceans. Juvenile Silver Pompano are commonly found in sandy areas or near sandy-clay estuary water. At the juvenile stage they tend to group together, becoming solitary as adults (Juniyanto, Akbar, and Zakimin, 2008). Sand molluscs and other invertebrates are the main natural food of this fish (Perez, 2010). It was introduced from Taiwan, China because it is the most popular species cultured in Taiwan, but it is also found in Indonesian waters. It takes 3 years for the fish to mature as broodstock (Juniyanto, Akbar, and Zakimin, 2008). As the fish grows fast and fetches a good market price it has a good potential for aquaculture in the Asia-Pacific. This particular species of fish enabled the faculty members to establish mariculture fishpond at Villa Corazon, Nueva Valencia, Guimaras, Philippines. This study of JBLFMU-Molo offered opportunities to the students and faculty members to engage in the sustainable environmental global warming mitigation activities.

## 2. CONCEPTUAL FRAMEWORK

The present study included independent variables consisting of respondent-related factors such as: age, gender, and classification. Moderating variable included the Silver Pompano mariculture study of JBLFMU-Molo. The dependent variable was the views towards sustainable environment on global warming mitigation.

## 3. THEORETICAL FRAMEWORK

The present study was anchored on the study conducted by Pareja, Buenaventura, and Eusebio (2009) titled “Global Warming Mitigation Initiatives through Sustainable Opportunities and Challenges of the One Million Trees and Beyond: Project of De La Salle, Philippines.” This study emphasized that dealing with global warming mitigation initiatives need a learning by doing approach, collaborative activities, involvement of educators, and community partnership. These are the indicators of activities leading towards sustainable environment on global warming mitigation.

Another framework employed in this study was derived from the study titled “Slowing Global Warming: Mitigation Strategy for the Developing World” conducted by Pachauri and Barathan (2010). The framework focused on mitigation strategies. These

strategies suggested the need to recast environmental strategies in order to mitigate climate change, keeping in mind that such obviously reflect different ecological, development and cultural realities, and agenda for problem solving. The advocates stressed that the tools of assessment and techniques of analysis need to be placed in more holistic frameworks in response to global warming and climate change. In the light of the identified frameworks on global warming mitigation, this study was conceived by the researchers to determine the different issues and views on sustainable environment global warming mitigation among the faculty members and students who were involved in the Silver Pompano Mariculture study of JBLMFU.

## 5. STATEMENT OF THE PROBLEM

The present study determined the Silver Pompano as a mariculture study of JBLFMU-Molo and views on sustainable environment towards global warming mitigation. To understand the study, the following questions were advanced:

(1) What are the ideas of the respondents about Siver Pompano study in relation to sustainable-environment global warming mitigation?

(2) What are the environmental problems observed by the respondents in their participation in the Silver Pompano mariculture study of JBLFMU-Molo as an entire group?

(3) What are the sources of environmental global warming information shared by the participants in engaging in the Silver Pompano Mariculture study?

(4) What are the causes of the environmental problems as perceived by the respondents in joining with the mariculture study?

(5) Are the respondents engaged in the ecological, environmental-friendly and sustainable-global warming mitigation initiatives?

(6) What are the groups that influenced the respondents to the practices of environmental-sustainable global warming mitigation initiatives?

(7) What are the sustainable initiatives conducted by the respondents to help mitigate the problems in global warming?

(8) What are the dominant motivating reasons in joining this sustainable environmental global mitigation activities/initiative of maritime university?

(9) What are the types of involvement engaged by the respondents in this sustainable environmental global warming issue?

(10) What are the roles preferred by the respondents in addressing the sustainable-environmental global warming mitigation activities/initiatives?

(11) What are the qualitative views of the respondents about the sustainable environmental global warming mitigation?

## 6. SCOPE AND LIMITATION OF THE STUDY

The scope of the present study was to determine the Silver Pompano as a mariculture study and views on sustainable global warming mitigation among the faculty members and students at JBLFMU. It further ascertained the profile of the respondents who are involved in the

project at Villa Corazon, Nueva Valencia, Guimaras, Philippines.

## 7. MATERIALS AND METHOD

This study employed the descriptive quantitative-qualitative method of collecting data. Quantitative method is explained by (Alimen, 2010) by stating that by mystery and expressiveness of numbers, what is inexpressible can be expressed, indescribable can be described, and what is reasonable to expect can be predicted, or a logical conclusion to a series of events can be inferred. Statistics is a language that can speak where other tongues are mute. Words cannot express the concepts that have been reserved for eloquence and expressiveness of statistics alone.

This study employed the quantitative method by employing appropriate statistical tools to describe and determine views on sustainable environmental global warming mitigation that were used as qualitative information, views, and ideas that warrant the results of this study.

Aside from the quantitative method, the present study also considered the role of qualitative mode of investigation. The researchers also utilized qualitative method because it is endlessly creative and interpretive. The researchers were not just left with the fields and mountains of empirical materials and then easily write up their findings. Qualitative interpretations are constructed because the researchers created a field text consisting of field notes and documents for the field (Plath and Sanjek, 1990 as cited in Alimen, 2010).

## 8. RESPONDENTS OF THE STUDY

Respondents of the study were maritime seafarers/instructors and students who had been involved in the Silver Pompano Mariculture Project of JBLFMU (Table 1). Data are shown in Table 1.

Table 1
Distribution of the Respondents

| Category | Frequency | Percentage |
|---|---|---|
| A. Entire Group | 75 | 100 |
| B. Age | | |
| Above 41 years old | 29 | 39 |
| 21-40 years old | 26 | 34 |
| 20 & below years old | 20 | 27 |
| Total | 75 | 100 |
| C. Gender | | |
| Male | 41 | 55 |
| Female | 34 | 45 |
| Total | 75 | 100 |
| D. Classification of Respondents | | |
| Student | 29 | 39 |
| Faculty | 46 | 61 |
| Total | 75 | 100 |

## 9. DATA-GATHERING ISNTRUMENT

The data-gathering instrument contained ten (10) open-ended items on the "Silver Pompano Mariculture Study and Views towards Sustainable Environment Global Warming Mitigation." This data-gathering instrument consisted of qualitative questions on the activities, practices, beliefs, preferences, ideas, and views on sustainable environment on global warming mitigation. Maritime faculty members were utilized as respondents and were involved in the environmental project. They were interviewed with regards to environmental campaign-activities towards global warming mitigation.

## 10. QUANTITATIVE STATISTICS

The appropriate quantitative statistics used in this study were frequency count, percentage, proportion, and rank. No inferential statistics was employed in the study.

## 11. RESULTS AND DISCUSSION

The ideas of the respondents about the Silver Pompano study in relation to environment and global warming mitigation are stated in the following statements: (1) the Silver Pompano (Trachinotus blochii) mariculture was an attempt to deal with the environment and global warming mitigation issues (39, 50%), (2) it unveiled the principle of ecological-sound marine culture through understanding of natural ecosystem such as natural inflow of energy and resources (f = 15, 20%), (3) opportunity to engage in the global warming mitigation activity like planting mangroves around the pond (f = 11, 15%), (4) it dealt with this particular species of fish that is believed to have promising potential in the midst of climate change and global warming problems (f = 6, 10%), (5) it presents relationship between DO and CO2 (f = 4, 5%).

It is simply shown that the respondents perceived the study as a way to study the environment and other factors related to global warming mitigation. Silver Pompano is a suitable candidate for marine finfish aquaculture in the environment because it can tolerate water quality problems, easily adapt to the environment, and can grow fast.

Waste management is perceived as an environmental problem by the respondents in the Silver Pompano study. According to the respondents, there is a need to look into the system of the generation, collection, storage, transport, separation, processes, treatment, and disposal of solid wastes dump in the sea.

### *11.1 Sources of Global Warming Mitigation as Perceived by the Respondents*

In this particular section of the study, the sources of global warming mitigation according to the perception of the respondents are the following: (1) news from media (f = 20,27%), (2) lectures/talks from international and national seminars/conferences (f = 14,19%), (3) school teachers/instructors/environmentalists (f = 12,16%), (4) family members (f = 11,15%), (5) friends (f = 10,13%), and (6) personal observation (f = 8,10%).

*11.2 Causes of Global Warming*

The respondents identified the perceived causes of global warming problems as the following: (1) man's act of negligence (f = 25,33%), (2) weak implementation of environmental-protection policies by the concerned agencies (f = 21,28%), (3) insufficient knowledge of the constituents involved (f = 15,20%), (4) natural occurrences (f = 14,19%).

*11.3 Response in Dealing with Environmental-Friendly Global Warming Initiatives*

The majority of the respondents (f = 55,73%) in the study were doing environmental-friendly global warming activities and some of the respondents (f = 15, 20%) were not engaged in this activity. Very few of them (f = 5,7%) were not certain if they were really conducting environmental-friendly global initiatives or activities. The result is very favorable with the study of Milan (2010), who mentioned that there is an urgent need in our country to train future leaders who will work to ensure the sustainability of our life support system. The result is a positive indicator that the respondents of the present study are potential environmental leaders and have the characteristics to look at environment problems in the light of their own experiences and moral values, committed to leverage their areas of expertise to realize sustainable development in their profession and private lives, can exercise leadership in fulfilling social responsibilities, are protective and restorators of the environment, and promoters of sustainable activities.

*11.4 Groups that Influenced the Respondents to Practice Environmental-Global Warming Initiatives*

The different groups that influenced the practice of environmental-friendly global warming initiatives according to rank: (1) members of the family (f = 18, 24%), (2) school teachers/instructors (f = 15,20%), (3) mediamen ( f = 12,16%), (4) church members (f = 11, 15%), (5) non-government organizations (f = 10,13%), and (6) local government units (f = 9,12%). The data simply show the significant role of family members in persuading or influencing individuals to engage in environmental-global warming mitigation initiatives. This may be because of the characteristics of the Filipino families as being caring, trusting each other, understanding, and closely-bonded whether in happiness or in sorrows. The second significant group is school teachers/instructors. This is true when dealing with the protection of nature and environment. Teachers are always in the front line in advocating sustainable-ecological environmental warming mitigation activities. The media are the next group because of their capability to disseminate the information and news in their respective stations.

*11.5 Environmental Initiatives Participated by the Respondents*

The respondents of the study revealed that they have been engaged in environmental initiatives/activities aside from the Silver Pomapano Mariculture towards global warming mitigation endeavours. These are the following activities: (1) tree planting program (f = 26, 35%), (2) Information and education on global warming (f = 19,25%), (3) solid waste management information drive (f = 16,21%), (4) energy conservation activity (f = 14,19%).

*11.6 Reasons that Motivate in the Involvement at Sustainable Global Warming Activities*

The results revealed that the respondents were motivated by the following reasons: (1) belief of the importance of environment (f = 30,40%), (2) want to help (f= 24,32%), and (3) concern (f = 21,28%). Most of the respondents cited that they "believe it is important" to get involved in the sustainable-environmental global warming. This simply means that most of the respondents are persuaded by the importance of the issue on global warming. These sustainable-environmental global warming issues are the "truth" of the present time, which if not properly given attention will bring traumatic impacts and effects to all, especially to environment-loving people.

*11.7 Roles of the Respondents in the Global warming issues*

One of the organizers is the second reason (f = 23,31%), and the least is the chief organizers (f = 20, 26%). Respondents thought that to become the chief organizers would mean they could not relax anymore, they would have so many things to do, and this entails responsibility and accountability. Therefore, they shun from becoming members to be the major players. They are satisfied to become one of the organizers or initiators. Although some of them confessed that they have the expertise and capabilities. To become front liners, they need ability, time, and expectation to do the necessary things towards the attainment of global warming mitigation efforts. This role becomes even more pronounced when they ensure accountability towards environmental safety and sustainable-environmental management practices.

*11.8 Types of Involvement Wanted by the Respondents*

The results of the study revealed that most of the respondents wanted to involve in the "planning" (f = 45, 60%) of sustainable-environment global warming, some of the respondents wanted to be involved in "implementation" (f = 20,27%), and only few wanted to be involved in "recruitment" (f = 10,13%).

*11.9 Views of Respondents on Silver Pompano towards Mitigating the Effect of Climate Change*

In engaging with this study, the respondents learned the following views of sustainable environment on global warming mitigation:

It opens opportunities for learning the following: (a) disadvantages in fishing in the open sea during erratic weather conditions, (b) sea encroaching of the coastland

resulting to salt water intrusion, and (c) more dams and water catchments are being constructed to buffer changing rainfall patterns;

The Silver Pompano is suitable to cultivate, adaptive to the tropical marine waters of the Philippines, as the temperature increases due to global warming;

The fish can tolerate temperature up to 31 degree centigrade and increasing salinity from 30-32 ppt, few of the effects of global warming;

Aquaculture might lessen the effects of climate change if programs are created and consumption of aquaculture products is promoted;

Patronize produce from the sea and man-made aquatic ecosystems rather than depending on industries that help escalate the amount of CO2 and other greenhouse gases in the atmosphere;

Promising potential in the aquaculture industry even with the threats of climate change;

Mariculture as economic system is part of the larger natural system, while the ecosystem provides protection of the farm/pond from natural storm surges;

Enables to understand the essential of free-flowing water that would flow through the system to mitigate extreme heat brought by global warming;

Effects of variable factors that would interplay with environment such as sediment, pollution, weather, and metabolic wastes;

## 12. CONCLUSIONS

Based on the findings of the present study, the following conclusions were advanced:

(1) The ideas of the respondents about the Silver Pompano study in relation to environment and global warming mitigation are stated in the following statements: the Silver Pompano mariculture as an attempt to deal with the environment and global warming mitigation issues, unveiled the principle of ecological-sound marine culture through understanding of natural ecosystem such as natural inflow of energy and resources, opportunity to engage in the global warming mitigation activity like planting mangroves around the pond, to deal with particular species of fish that is believed to have promising potential in the midst of climate change and global warming problems, and the relationship between DO and CO2 .

(2) Most of the respondents engaging in the project observed the following environmental problems: global warming/extreme heat, oxygen depletion, air/water pollution, water siltation, and waste management.

(3) Sources of global warming mitigation according to the perception of the respondents are the following: news from media, lectures / talks from international and national seminars / conferences, school teachers / instructors / environmentalists, family members, friends, and personal observation.

(4) The respondents identified the perceived causes of global warming problems as the following: man's act of negligence, weak implementation of environmental-protection policies by the concerned agencies, insufficient knowledge of the constituents involved, and natural occurrences.

(5) The majority of the respondents in the study were doing environment-friendly global warming activities, while some of the respondents were not engaged in this activity. Few of the respondents were not certain if they were really conducting such initiatives or activities.

(6) The different groups that influenced the practice of environment-friendly global warming initiatives according to rank: members of the family, school teachers/instructors, mediamen, church members, non-government organizations, and local government units.

(7) The respondents have been engaged in environmental initiatives/activities aside from the Silver Pomapano Mariculture activity towards global warming mitigation endeavours such as: tree planting program, information and education on global warming, solid waste management information drive, and energy conservation activity.

(8) The respondents were motivated by the following reasons: belief, desire to help, and concern for the environment.

(9) Most of the respondents wanted to become "members only" in any of the activities towards sustainable-environmental global warming issues. Some of the respondents wanted to be "organizers" and few opted to become chief organizers.

(10) The respondents wanted to involve in the "planning" when it comes to sustainable-environment global warming, some of them wanted to be involved in the "implementation," and only few wanted to be involved in the "recruitment" process.

(11) Silver Pompano Mariculture opens opportunities for learning the following: (a) disadvantages in fishing in the open sea during erratic weather conditions, (b) sea encroaching of the coastland resulting to salt water intrusion, and (c) more dams and water catchments are being constructed to buffer changing rainfall patterns.

## 13. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations were presented:

(1) Sustain the Silver Pompano Mariculture study in order to have more faculty members and students understand the effect of global warming and to suggest more activities to mitigate the ill effect of the climate change.

(2) Encourage more individuals to get involved in any activities on global warming so that more resources will be drawn.

(3) Conduct more conferences and seminars on global warming mitigation advocacies.

(4) Education on global warming mitigation of concerned individuals shall be considered by the government and private sectors in their strategic management plan.

(5) Add more activities on global warming mitigation projects so that more people will be involved.

(6) Design more global warming mitigation activities so that more members of the family, school teachers/instructors, mediamen, church members, non-government organizations, and local government units will be involved.

(7) Request more tree planting activities, information and education on global warming, solid waste management information drive, and energy conservation activities in school and communities.
(8) Sustain the respondents' belief, desire to help, and concern for the environment by giving of awards and recognition.
(9) Encourage interested individuals to become also "organizers" and "leaders" when environment global warming activities are needed.
(10) Involve government officials in the "planning" when it comes to sustainable-environment global warming, "implementation," and "recruitment" process.
(11) Use Silver Pompano Mariculture to give more opportunities for learning sustainable-environmental global warming mitigation education.
(12) Parallel studies shall be conducted to study other parameters that lead to more conscientious environmental global warming mitigation concepts.

## 14. ACKNOWLEDGMENTS

The authors would like to acknowledge the support given by the administration, faculty members, and students of JBLFMU-Molo for this study.

## 15. REFERENCES

[1] ALIMEN, R., *Aftermath of Typhoon Frank: Perceiving Environmental Causes and Effects towards Environmental Leadership in Iloilo City*, Published by Research Department, JBLFMU-Molo, Iloilo City, 2010.
[2] BAACO, A. T., *Partnership Between LGU and Private Sector: An Overview of Some Issues Related to Global Warming Initiatives in the City of Puerto Princesa*, Published by EENP International Conference and Scientific Meeting, Silliman University, Philippines, 2009.
[3] DENZIN, N.K., & LINCOLN, Y., *Handbook of Qualitative Research*, Sage Publications, Inc., London, United Kingdom, (2000).
[4] HARGREAVES, A. & FINK, D., *Sustaining Leadership*, Phi Delta Kappan, The Professional Journal for Education, (2003).
[5] HELVER, *Fish Nutrition*, Academic Press, London and New York, (1976).
[6] JUNIYANTO, N. M., AKBAR, S., & ZAKIMIN, *Breeding and Seed Production of Silver Pompano (Trachinotus blochii, Lacepede) at the Mariculture Development Center of Batam, Marine Finfish Aquaculture Network.*
[7] KUNGYANKIJ, P., TIRO, L.B., PUDADERA, B.J., POTESTA, I.O., *Biology and Culture of Sea Bass (Lates calcarifier)*, Aquaculture Extension Manual Number 11, Southeast Asian Fisheries Development Canter, Tigbauan, Iloilo, Philippines, (1986).
[8] LASCO, R. D., *Biodiversity and Climate Change*, International Conference on Biodiversity Journal, CHED, (2010).
[9] LOKE Ming Chou, National University of Singapore, CHED Journal, (2010).
[10] MALAYANG, B., *What Needs to be Core of Climate Change Education?* EENP International Conference on Environmental Education at Ateneo de Davao, Davao City, Philippines, (2010).
[11] MEDRANO, W., *Responses to climate* EENP International Conference on Environmental Education at Ateneo de Davao, Davao City, Philippines, (2010).
[12] MILAN, P., *Who do we consider as environmental leaders*?, Published by EENP International Conference on Environmental Education at Ateneo de Davao, Davao City, Philippines, (2010).
[13] MIRASOL, J. and ITAAS, E.C., *Integration of Environmental Management to Local Policy Makers Priority Agenda: The Bukidnon State University Experience*, JPAIR, The Official Research Journal of the Philippine Association of Institutions for Research, Volume 1, Number 1, (2008).
[14] MOKOGINTA, I., *Formulasi Pakan Buatan untuk Ikan Laut*, Pertemuan Teknologi Lintas UPT, Direktorat Jenderal Perikanan, (1997).
[15] PAREJA, M.C., BUENAVENTURA, J. C., EUSEBIO, B. C., *Learning by Doing Approach. Global Warming Mitigation Initiatives through Sustainable Approaches: Gains and Challenges of the One Million Tress and Beyond*, Project of La Salle Philippines, Lasallian Institute for the Environment (LIFE) De La Salle, Philippines, Presented during the Second International EENP Confrence at Silliman University, Philippines, (2009).
[16] PERAS, R. J. , PULHIN, J. M., LASCO, R. D., CRUZ, R. V. & PULHIN, F. B., *Climate variability and extremes in the Pantabangan-Carranglan Watershed, Philippines*: *Assessment of Impacts and Adaptation Practices*, Journal of Environment Science and Management, Volume 11, Number 2, ISSN 0119-1144, (2008).
[17] PEREZ, A.G., *The climate change phenomenon*, EENP International Conference on Environmental Education at Ateneo de Davao, Davao City, Philippines, (2010).
[18] PIPER, R.G., IVAN, B.M., LEO, E.O., JOSEPH, P.M., LAURICE, G.F., JHON, R. L., *Fish Hatchery Management*, United States Department of the Interior, Fish and Wildlife Service, Washington, D.C., (1982).
[19] TAN, A., *Some Insights from the Oil Spill Affected Communities in Guimaras, Philippines*, Published by EENP International Conference and Scientific Meeting, Silliman University, Philippines, (2009).
[20] TATAM, S., HANFI, A., & SHOGO, K., *Budidaya Bawal Binatang di Keramba Jaring Apung. Balal Besar Riset Perikanan Budidaya Laut Gondol*, Department Kelautan dan Perikanan dengan, Japan International Cooperation Agency, Bali, (2003).
[21] TIM BALAI, *Budidaya Laut Batam Pembenihan Bawal Bintang (Trachinotus blochil (Lecepede)*, Balai Budidaya Laut Batam Direktorat Jenderal Departemen Pertanian, Batam, (1999).
[22] TUMALA, B., *Finding Environmental Belief in a Maritime Milieu*, JBLFMU Research Review, (A Refereed Journal), Volume XIX, Number 2, 2009.
[23] WATANABE, T., ARAKAWA, T., KITAJIMA, C., & FUJITA, S., *Effect of Nutrition Quality of Broodstock Diets on Reproduction of Red Sea Bream*, Bull of the Japanese Soc. Of Sci. Fish 50, (1984).

# EFFECTIVENESS OF PROJECT BASED LEARNING ON TRANSFORMING THE GAINS TO WORKLIFE: A FOLLOW UP STUDY THROUGH MARINE ENGINEERING DEPARTMENT GRADUATES

[1]ASYALI ENDER, [2]ERGINERK EMRAH

*[1,2]Dokuz Eylul University, Maritime Faculty, Turkey*

**ABSTRACT**

As students learn better and easier by actively participating in the learning process, student-centered learning and teaching environment in engineering programs have become more and more common in higher education. At DEU Maritime Faculty Marine Engineering Department Project Based Learning (PBL) has been applied to senior class students. There has been an ongoing debate about the effectiveness of active learning methods and the number of researches related to the transfer of the skills and knowledge gained by these methods to real life is limited in the literature. A follow up study has been conducted through project team members two years after their graduation. The impacts and effectiveness of Project Based Learning on (1) the programme outcomes of marine engineering department (2)the knowledge, skills and abilities required for ship engineers as listed at "The Occupational Information Network" and (3)the knowledge areas specified in "Project Management Body of Knowledge" guide have been examined. The results revealed that there has been positive impact of PBL on the graduates during their work life.

**Keywords:** *Project Based Learning, SolarSplash, Green Energy, Marine Engineering*

## 1. INTRODUCTION

The recent trends in the world of professional work as well as the academic world demand that the under graduate, when having completed higher education, have been equipped with general intellectual abilities and perspectives, higher order cognitive abilities and general personal competencies to be activated at interpersonal relations, getting involved in teamwork, problem-solving, decision-making, effective communication and leadership[1].As students learn better and easier by actively participating in the learning process, student-centered learning and teaching environment in engineering programs have become more and more common in higher education. Team project-based learning has been introduced and is increasingly used as a teaching and learning method in higher education to promote knowledge building through social interaction [2].

As the dynamics of working environment change, education and training methodologies that prepare students for real life have to change and adapt themselves. Feller explained the differences between the old and new paradigm of teaching (See Table1). In the new paradigm students are involved in construction of the knowledge, the aim of the instructor is to develop students' competencies and talents rather than to classify and sort students and cooperative learning is applied instead of competitive learning, instead of transferring knowledge from faculty to student, knowledge is jointly constructed.

Table 1Theold and new paradigm of teaching

| | Old paradigm | New paradigm |
|---|---|---|
| Knowledge | Transferred from faculty to students | Jointly constructed by students and faculty |
| Students | Passive vessels to be filled by faculty's knowledge | Active constructor, discoverer transformer of own knowledge |
| Faculty purpose | Classify and sort students | Develop student's competencies and talents |
| Relationships | Impersonal relationship among students and between faculty and students | Personal transaction among students and between faculty and students |
| Context | Competitive /individualistic | Cooperative learning in classroom and cooperative teams among faculty |
| Assumption | Any expert can teach | Teaching is complex and requires considerable training |

Source: (Fellers, 1996) [3]

## 2. ACTIVE LEARNING IN DEUMF

Maritime transportation is a complex and dynamic socio-technical system formed by technology, environment, people and organizational structures.

In this multi-dimensional, multi-disciplinary and dynamic environment, the aim of maritime education and training is not only to give trainees basic technical knowledge to perform pre-designed routine and standardized objectives, but also to improve their critical

thinking, decision-making and problem-solving skills, social intelligence and moral motivation[4].Maritime education has to focus more on team-spirits, group success, asense of collaboration, becoming involved with and helping one another[1].

Student-centered active learning methods have been used at DEU Maritime Faculty since 2002, including miscellaneous methods ranging from problem-based learning to task-based learning.The education strategy of Maritime Faculty is to empower students and to provide the students with certain proper knowledge, supported by desired skills and profound attitudes that they will need in their future professional careers and also give them the ability to respond quickly to changes in technology, operations, practices and procedures on board and ashore. DEUMF accepts active learning as a valuable and reliable method to achieve these aims and to comply with the requirements of STCW/78 and 2010 Manila amendments.

Project Based Learning (PBL) isa systematic teaching method that engages students in learning essential knowledge and life-enhancing skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products and tasks [5]. Shortly we can definePBL as a model that organizes learning around projects. PBL not only enhanceslong-term retention of knowledge but improves non-technical skills of students.

Projects are complex tasks, based on challenging questions or problems, that involve students in design, problem-solving, decision making or investigative activities; give students the opportunity to work relativel yautonomously over extended periods of time; and culminate in realistic products or presentations[6]. PBL can cover a spectrum ranging from brief projects based on a single subject to year-long and multidisciplinary projects. The projects are specifically designed to cover situations that are typically encountered in the world of shipping industry and to raise students' awareness of the application of managerial principles to industrial and commercial problems. The overall aim is to simulate situations that require solutions by small project teams [7].

The graduates of the Marine Engineering Department are employed as officers on board merchant vessels, in charge of supervising and coordinating the activities engaged in operating and maintaining engines, boilers, deck machinery and electrical and refrigeration equipment. Different forms of active learning have been applied and experienced at DEUMF Marine Engineering Department to improve the quality of higher education. The first-year students are exposed to 11 modules through Problem Based Learning methodology, three of which cover department specific subjects and the others are on the basic engineering programs studied in collaboration with DEU Faculty of Engineering. The second and third-year curricula are mainly designed around modules based on marine engineering subsystem. The forth-year curriculum is designed on Task-Based Learning approach and covers such eight blocks as Technical Ship Management, Engine Room Simulator at management level, Main and Auxiliary Machinery Operations and Maintenance, Refrigeration and HVAC Systems, Technical and Operational Ship Management, Engine Room Simulator Advanced Skills, Safety at Sea and Emergency Operations, and Hydraulic and Pneumatic Control System.

## 3. EFFECTIVENESS OF PBL

There has been an ongoing debate about the effectiveness of active learning methods. There are many ways of making judgments about the effectiveness of active learning and especially within the content of this study Project-Based Learning. This study is based on the survey method and participant self-report to evaluate PBL effectiveness. A follow-up study has been conducted on project team members who have been working on board of merchant for two years as officer. The impacts and effectiveness of Project Based Learning on (1) the programme out comes of Marine Engineering Department, (2)the knowledge, skills and abilities required for ship engineers and listed in "The Occupational Information Network" and (3)the knowledge areas specified in "Project Management Body of Knowledge Guide" have been examined. The instruments used in collecting data are open–ended as well as Likert type survey questionnaire. The details of these measurement tools are mentioned below.

The main objective of the Bologna Process is to ensure more comparable, compatible and coherent systems of higher education in Europe. The Ministers responsible for higher education in the forty-six countries of the Bologna Process convened in Leuven/Louvain-la-Neuve in 2009 and determined higher education priorities for the decade to come. These priorities and main working areas for the next decade were social dimension, lifelong learning, employability, student-centred learning and the teaching mission of education, international openness, mobility, education, research and innovation, as well as data collection, funding of the Higher education and multidimensional transparency tools[8].

Within the Bologna Process DEUMF Marine Engineering Department defined 20 programme outcomes by a participative process (See Table 2). Programme outcomes can be defined as "what the student is expected to know, understand and be able to do immediately after graduation".

The O*NET program is a source of occupational information. Central to the project is the O*NET database, containing information on hundreds of standardized and occupation-specific descriptors. The database, which is available to the public at no cost, is continually updated by surveying a broad range of workers from each occupation [9].The Content Model which is the conceptual foundation of O*NET provides a framework that identifies the most important types of information about work and integrates them into a theoretically and empirically sound system.

Table2.Marine engineering program outcomes

| |
|---|
| PO1:An ability to apply knowledge of mathematics, science and engineering to marine engineering problems |

| |
|---|
| PO2:An ability to identify, formulate and solve engineering problems in marine engineering and related fields |
| PO3:An ability to design a system, component or process to meet desired needs |
| PO4:The broad education necessary to understand the impact of marine engineering solutions, especially related to the maritime safety, health, maritime security and marine environmental issues in a global and social context |
| PO5:An ability to analyze and interpret marine engineering related data, as well as to design and conduct experimental work if necessary |
| PO6:An ability to use the techniques, skills and modern engineering and computing tools necessary for marine engineering practice |
| PO7:An ability to function on same and multi-disciplinary teams |
| PO8:An ability to function independently |
| PO9:A recognition of the need for, and an ability to engage in life-long learning |
| PO10:An ability to communicate effectively orally and in writing in Maritime English/Turkish |
| PO11:An understanding of professional and ethical responsibility |
| PO12: Knowledge of contemporary issues |
| PO13: Knowledge and awareness of quality issues |
| PO14:The broad education necessary to perform marine engineering at operational/management level |
| PO15:The broad education necessary to perform electrical, electronics and control engineering at operational/management levels |
| PO16:The broad education necessary to perform maintenance and repair at operational/management levels |
| PO17:The broad education necessary to perform controlling the operation of the ship and the care for person at operational/management levels |
| PO18:An ability of leadership and managerial skills |
| PO19:Commitment to Turkish Maritime traditions |
| PO20: Knowledge of national and international legislation |

The Content Model was developed using research on job and organizational analysis. It embodies a view that reflects the character of occupations (via job-oriented descriptors) and people (via worker-oriented descriptors). The Content Model also allows occupational information to be applied across jobs, sectors or industries (cross-occupational descriptors) and within occupations (occupational-specific descriptors). These descriptors are organized into six major domains, which enable the user to focus on areas of information that specify the key attributes and characteristics of workers and occupations. These domains are: Worker Characteristics, Worker Requirements, Experience Requirements, Occupation-Specific Information, Workforce Characteristics and Occupational Requirements [9].Within the content of this study, Knowledge, Abilities, Skills required for a Ship Engineer were used during the survey. According to the definition as mentioned at O*NET, Ship Engineers supervise and coordinate activities of crew engaged in operating and maintaining engines, boilers, deck machinery and electrical, sanitary and refrigeration equipment aboard ship.Project management has become an important area of study among engineering students. A Guide to the Project Management Body of Knowledge (PMBOK Guide) defines the term project as a "temporary endeavor undertaken to create a unique product, service or result" and defines "project management" as the "application of knowledge, skills, tools and techniques to project activities to meet project requirements".PMBOK Guideis a recognized standard for the project management profession and a formal document that describes established norms, methods, processes, and practices for managing most projects, most of the time across many types of industries[10]. International Project Management Association (IPMA) states: "Project Management (PM) is the planning, organising, monitoring and controlling of all aspects of a project and the management and leadership of all involved to achieve the project objectives safely and within agreed criteria for time, cost, scope and performance/quality[11].

PMBOK Guide identifies nine Knowledge Areas that project managers should focus on while managing projects during the project life. These nine know ledgeareas are described below according to PMBOK Guide[10]. Zwikael [12]revealed that the knowledge areas with the greatest impact on project success were time, risk, scope and human resources.

1) Project Integration Management includes the processes and activities needed to identify, define, combine, unify and coordinate the various processes and project management activities within the Project Management Process Groups. In the project management context, integration includes characteristics of unification, consolidation, articulation and integrative actions that are crucial to project completion, successfully managing stakeholder expectations and meeting requirements. Project Integration Management entails making choices about resource allocation, making trade-offs among competing objectives and alternatives and managing the interdependencies among the project management Knowledge Areas.

2) Project Scope Management includes the processes required to ensure that the project includes all the work required and only the work required to complete the project successfully. Managing the project scope is primarily concerned with defining and controlling what is and is not included in the Project.

3) Project Time Management includes the processes required to manage timely completion of the Project.

4) Project Cost Management includes the processes involved in estimating, budgeting and controlling costs so that the project can be completed within the approved budget.

5) Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives and responsibilities

so that the project will satisfy the needs for which it was undertaken.

6) Project Human Resource Management includes the processes that organize, manage and lead the Project team.

7) Project Communications Management includes the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval and ultimate disposition of project information.

8) Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning and monitoring and control on a project. The objectives of Project Risk Management are to increase the probability and impact of positive events and decrease the probability and impact of negative events in the project.

9) Project Procurement Management includes the processes necessary to purchase or acquire products, services or results needed from outside the project team.

## 4. SOLAR SPLASH PROJECT

In 2009, Green Energy Projects Office (GEPO) was established at DEUMF to promote student projects related to solar, wind and hydrogen energy. The first project within this office was to design and build a solar boat and to join the Solar Splash races which have been organized for 18 years in USA. Solar Splash races began in Milwaukee, Wisconsin, in 1994, hosted by Marquette University. In 2000 it was moved to New Orleans to drum up interest from more southern teams and then to Buffalo, New York, from 2001-2005. Solar Splash was held in Fayetteville, Arkansas on Lake Fayetteville from 2006-2010. The event has been hosted by the University of Northern Iowa in Cedar Fall, Iowa, from 2011[13]. Solar Splash is the World Championship of intercollegiate Solar/Electric boating. Its official name is "an international intercollegiate solar/electric boat regatta" and it takes place forover five days. Technical Inspections are done on the first day and the remainder of the time is occupied by five on-the-water competitive events. Points are earned in 7 categories starting with Technical reports that are submitted before teams arrive at the competition. On-site competitions include Visual Displays and Workmanship. On-the-water events begin with a Sprint and a Maneuverability qualifier. This is followed by an event called the Solar Slalom, which is a combination of speed and maneuverability. The final days are spent in the Sprint and Endurance events [14].

Table 3Thespecifications of DEU solar boat

| | Endurance | Sprint |
|---|---|---|
| Length | 5,25 m | 5,25 m |
| Length (include shaft) | 5,95 m | 5,95 m |
| Beam | 1,17 m | 1,17 m |
| Depth | 0,52 m | 0,52 m |
| Draft | 0,15 m | 0,16 m |
| Weight | 222,7 kg | 230,kg |
| Motor Power | 2.2 kW | 7 kW |
| Motor RPM | 650 | 1000 |
| Propeller RPM | 720 | 3071 |
| App. Solar Array Output | 450 Watt | - |
| Batteries | 2 x 42 Ah Lead Acid Battery | 3 x 44 Ah Lead Acid Battery |
| Maximum Current Draw | 70 A | 245 A |
| Maximum Speed | 6 knots | 18 knots |

According to the technical specifications mentioned in the rules prepared by the Solar Splash organization, DokuzEylul University Solar Boat Team built their composite boat by using aramid fiber and epoxy resin with the specs given in Table 3. During the building stage of the solar boat approximately more than 20 students from different classes from DEUMF got involved in the project. 9 students and 3 advisor academics attended the events held in IOWA in 2011. It took 3 years to finish building the boat including the design stage. An interdisciplinary group of advisors consisting of a naval architect and a marine engineer, a mechanical engineer and an electronics engineer also supported the project. Technical and financial support has been gained by the students from various regional industries. Some of these companies sponsored the project.

A team of 9 students consisting of 7 senior students, 1 sophomore and 1 freshman students participated in this contest and got the 7th rank, Rookie Team, with highest overall score and outstanding drive train design awards.

## 5. AIM OF THE STUDY

There has been an ongoing debate about the effectiveness of active learning methods and the number of researches related to the transfer of the skills and knowledge gained by these methods to real life is limited in the literature. This study is aimed at making a contribution to that area.

A follow-up study has been conducted through project team members who had been working on board of merchant vessels two years after their graduation. There were 11 students in this class and 7 of them were reached within this study. Return rate was 63%. Participants self-report through a survey tool to evaluate PBL effectiveness approach is used to assess the effectiveness of Project-Based Learning.

A questionnaire was used to collect the data. Statements concerning the objectives of the study were developed in order to determine the attitudes of graduates towards PBL and its impact on their work life. The questionnaire has four parts. The first part which has twenty statements is to determine the impact of PBL on the programme outcomes of marine engineering department. The second part which has thirty statements, is related to the knowledge, skills and abilities required for ship engineers as listed in “The Occupational Information Network” and the third part has nine statements related to the knowledge areas specified in “Project Management Body of Knowledge”. 5-point Likert Scale with anchors at 1 (I strongly do not agree) and 5 (I strongly agree) was used in the questionnaire. At the fourth part, an open ended question was used where the respondents were allowed to write their thoughts in their own words about the contribution of being a solar

splash team member and PBL to their social and professional life.

## 6. FINDINGS

Some parts from students' essays for the open ended question related to the contribution of being a solar splash team member and PBL to their social and professional life are extracted below.

*As I understand the importance of teamwork during the Project I easily adapted myself as a team member on board...* (Member of a mechanic team)

*Before entering the work life this project team improved my self confidence and improved my technical capacity and improved my ability to look at events from different perspectives…* (Team Member)

*That project improved my skill to have responsibility and to achieve my responsibilities as well as possible. In my professional life this Project improves my skill to understand and realize the problem earlier and to take the precautions in time. Planning is an important skill for success on board and this project improved my planning skills. When there is any problem on plans we had skill to make corrective actions...(*Chief of Technical Team**).**

*Within the scope of an engineering Project, while trying diverse and various means of dealing with the problems we have encountered, we indeed have gained precious experiences in terms of coping with both the expected and unpredictable problems, particularly managing the problem solving processes effectively. Despite various errors and failures suffered, our efforts made on the project have granted us with invaluable experiences regarding error and crisis management. Such experiences have enabled us to keep the project in operation; having utilized the written and/or live data collected through various researches and reflected it to the project. Besides, the team work and cooperation we have established has provided us with some exceptional experiences, which would otherwise be difficult through many other methods. Furthermore, certain social and interrelational gains we have been granted through such experiences have improved our team work competencies and abilities to be a part of the team acting in compliance with certain disciplinary norms to reach the targets set. Thanks to such competencies we have received in dealing with the technical problems and crises encountered in our professional life, we are better able to conduct/manage rational and solution focused efforts. Predicting the likely problems we are able to make proactive proposals. Such a competency is, of course, a very critical differentiation in favor of a marine engineer. The main source of this competency is the gains we have enjoyed during the project process…*(Team Leader)

*Solar Project has provided me with the competency to manage many things in a short time in terms of my professional life and taught me that in social life the team work is the most efficient means of getting the best possible success and also that team work is indispensable in this distinguished profession of marine sciences…* (Member of Mechanic Team)

*.I gained ability to work in multidisciplinary teams and follow new technologies...* (Member of Hull Team)

The impact of Solar Splash Project on the learning outcomes of marine engineering department is mentioned below with the ones having highest overall mean scores.

An ability to design a system, component or process to meet desired needs (μ=4.2857), an ability to analyze and interpret marine engineering related data, as well as to design and conduct experimental work if necessary (μ=4.1429), an ability to function on same and multi-disciplinary teams (μ=4.1429), an ability to function independently (μ=4.4286), a recognition of the need for, and an ability to engage in life-long learning (μ=4.4286), an understanding of professional and ethical responsibility (μ=4.2857), a knowledge of contemporary issues (μ=4.0000), the broad education necessary to perform maintenance and repair at operational/management levels (μ=4.000), the broad education necessary to perform controlling the operation of the ship and the care for person at operational/management levels (μ=4.1429) an ability of leadership and managerial skills (μ=4.1429).Considering O*NET, knowledge, skill and abilities required for ship engineers are mentioned below with the ones having highest overall mean scores. Considering knowledge: design (μ= 4.5714),administration and management (μ=4.3333), mechanical (μ=4.2857). (See Table 4)

Table 4 Impact of PBL on knowledge

| Knowledge | N | Mean |
|---|---|---|
| Mechanical | 7 | 4.2857 |
| Public Safety and Security | 7 | 3.5714 |
| Engineering and Technology | 7 | 4.1429 |
| Transportation | 7 | 3.2857 |
| Mathematics | 7 | 3.0000 |
| Law and Government | 7 | 3.5714 |
| Education and Training | 7 | 4.0000 |
| Design | 7 | 4.5714 |
| Administration and Management | 7 | 4.3333 |
| Computers and Electronics | 7 | 4.0000 |

Considering skills: monitoring(μ=4.7143), operation monitoring(μ=4.5714), troubleshooting (μ=4.5714),repairing (μ= 4.5714),active listening (n: 4.4286), equipment maintenance(μ=4.2857), operation and control (μ=4.2857),speaking (μ=4.4286) have highest mean values. (See Table 5)

Table 5 Impact of PBL on skills

| Skills | N | Mean |
|---|---|---|
| Critical Thinking | 7 | 3.8571 |
| Active Listening | 7 | 4.4286 |
| Equipment Maintenance | 7 | 4.2857 |

| | | |
|---|---|---|
| Troubleshooting | 7 | 4.5714 |
| Monitoring | 7 | 4.7143 |
| Operation Monitoring | 7 | 4.5714 |
| Operation and Control | 7 | 4.2857 |
| Quality Control Analysis | 7 | 4.0000 |
| Repairing | 7 | 4.5714 |
| Speaking | 7 | 4.4286 |

Considering abilities: deductive reasoning (μ=4.571), oral comprehension (μ=4.2857), Speech Clarity (μ=4.2857),written Comprehension μ=4.4286) have highest mean values(See Table 6).

Impact of Solar Splash Project on Project management knowledge areas are found as follows, with highest mean scores: project time management(μ=4.5714), project human resource management(μ=4.4286), project communications management(μ=4.4286). (See Table 7)

Table 6 Impact of PBL on abilities

| Abilities | N | Mean |
|---|---|---|
| Problem Sensitivity | 7 | 4.1429 |
| Oral Comprehension | 7 | 4.2857 |
| Oral Expression | 7 | 4.1429 |
| Control Precision | 7 | 3.8571 |
| Near Vision | 7 | 4.0000 |
| Speech Clarity | 7 | 4.2857 |
| Arm-Hand Steadiness | 7 | 3.7143 |
| Speech Recognition | 7 | 4.1429 |
| Written Comprehension | 7 | 4.4286 |
| Deductive Reasoning | 7 | 4.571 |

Table7 Impact of PBL on PM knowledge areas

| PM knowledge areas | N | Mean |
|---|---|---|
| Project Integration Management | 7 | 4.1429 |
| Project Scope Management: | 7 | 3.8571 |
| Project Time Management | 7 | 4.5714 |
| Project Cost Management | 7 | 4.2857 |
| Project Quality Management | 7 | 3.4286 |
| Project Human Resource Management | 7 | 4.4286 |
| Project Communications Management | 7 | 4.4286 |
| Project Risk Management | 7 | 4.1429 |
| Project Procurement Management | 7 | 4.2857 |

## 7. CONCLUSIONS

The results of the follow up study that was conducted through solar splash project team members two years after their graduation revealed that PBL has improved graduates'self confidence and technical capacity, lifelong learning, administration and management knowledge, deductive reasoning abilities and trouble shooting skills and ability to function on same and multi-disciplinary teams. It is concluded that PBL approach has positive impact on the graduates during their professional careers.

## 8. REFERENCES


[1] KALKAN, M., CERIT, A.G., DEVECI, D.A., ZORBA, Y., ASYALI,E.,*A Pioneering Endeavour towards Effective Higher Maritime Education: Problem-Based Learning at Dokuz Eylul University Maritime Faculty*, International Higher Education Congress, New Trends and Issues, 27-29, 5, Istanbul,2011.

[2] VON KOTZE, A., COOPER, L., *Exploring the Transformative Potential of Project-Based Learning in University Adult Education*, Studies in the Education of Adults, 32(2), 212, 2000.

[3] FELLERS, J.W., *People Skills: Using The Cooperative Learning Model To Teach Students "People Skills"*, Institute For Operations Research And The Management Sciences, Interfaces, 26, 5 September, 42-49, 1996.

[4] ASYALI, E.,*PBL Applications in MET*, Proceedings Problem Based Learning in Maritime Training and Education Workshop, 21-33, Izmir, Turkey,1-3 June, 2003.

[5] http://pbl-online.org/About/whatisPBL.htm 3/4/2013.

[6]http://www.ri.net/middletown/mef/linksresources/documents/researchreviewPBL_070226.pdf (2/3/2013).

[7] CERIT, A.G., DEVECI, D.A., ERDOĞAN, B., GÜNDÜZALP, C.G., PINAR, R., ŞALK, M.,*DenizİşletmeciliğiveMühendislikÖğrencilerininProjeyeDayalıÖğrenimeİlişkin*Değerlendirmeleri, III,AktifEğitimKurultayıBildirilerKitabı, İzmir, 2006.

[8] Leuven/Louvain-la-Neuve Communiqué, The Bologna Process 2020-*The European Higher Education Area in the new decade Communiqué of the Conference of European Ministers Responsible for Higher Education*, Leuven and Louvain-la-Neuve, 28-29 April 2009.

[9] http://www.onetcenter.org/about.html 2/3/2013.

[10] PROJECT MANAGEMENT INSTITUTE (PMI), *Guide to the Project Management Body of Knowledge*,4th Edition,2008.

[11] INGASON, H.T., JÓNASSON, H.I., *Contemporary Knowledge and Skill Requirements in Project Management*, Project Management Journal, Vol. 40, No. 2, 59–69,2009.

[12] ZWIKAEL, O., *The Relative Importance of the PMBOK Guide's Nine Knowledge Areas During Project Planning*, Project Management Journal, Vol. 40, No. 4, 94–103,2009.

[13] http://www.solarsplash.com/index.php,02/04/2013.

[14] GULMEZ,Y., *Alternative Energy Resources at Shipping, Solar Splash and DEU Solar Boat*, Diploma Project, 34, DEU Maritime Faculty Marine Engineering Department, 2011

# ECONOMIC CRISIS IMPACT ON THE MARITIME CADETS TRAINING

[1]BARSAN EUGEN, [2]GROSAN VOICU NICOLAE

[1,2]*Constanta Maritime University, Romania*

**ABSTRACT**

In the last 10 years, The Constanta Maritime University (CMU) had to surpass great difficulties in order to ensure places for the compulsory 12/6 month sea training period for its students. Year after year, one of the most difficult tasks for the rector and the deans was to find and convince Romanian and mainly foreign owners to accept our cadets on their ships.

In the last two years, things had changed dramatically regarding the ship owners' policy to recruit young cadets. Our paper will underline the economic crisis impact upon the training of maritime cadets and the medium term effects on the qualified man power demand for the world merchant fleet. We also intend to make some comments regarding the tendencies of demand/supply for merchant officers in Europe and the changes that seams that are made in the on-board training programs.

**Keywords:** *On board training, practical training, economic crisis, maritime education, STCW.*

## 1. INTRODUCTION

Considering the specificity of maritime transports, technological and computerized development in shipping and the fact that the carriage of cargo represents an economical activity, the correct and efficient management of human resources, of the personnel working in the maritime field, represents one of the main ways towards a successful fulfilment of the targeted objectives.

Having qualified personnel on board ships becoming larger and larger, faster and better equipped with last generation devices, becomes a necessity, dictated by the reality on board ships, by electronic and computerized equipments, by the development of the administrative system and high standards requirements concerning maritime safety, security and environment protection.

Cadets, future maritime officers, deck or engineers, are not just simple mariners on the world's oceans and seas, but also important resources for operations developed on land or on board offshore ships.

Professional performance and competence standards are established through international conventions, especially STCW 78/95 Convention with 2010 amendments, convention which clearly states conditions concerning education and training of the maritime personnel.

Cadets' activity on board a ship represents the practical part of the educational process, developed in maritime education institution, institutions with a partly common curriculum, according to international requirements and provisions. Shipping companies, according to QMS policy, have well defined directory lines concerning cadets' activity on board, as well as the programme and educational content which should be studied during the embarked training period.

It may seem surprising that up to 1990 no study was elaborated concerning the determination of the number of people involved in the maritime transport activity worldwide. The necessity of such a study became more obvious as the work force internalization developed and the first trial on this regard was made by BIMCO and ISF in 1990 by publishing a study which was reviewed in 1995 and 2000 and the results of this revision are extremely interesting [1].

Reports issued by specialists in the field [2] reached the conclusion that there is deficit of officers and a surplus of ratings and estimations were made regarding the future evolution of offer and demand considering certain hypothesis.

An empiric analysis leads to the conclusion that the number of members of a crew was not reduced by more than one third and that efforts in training new cadets were not increased by more than one third, and this is why most probably the difference between offer and demand is going to increase.

Besides the number of seafarers, it is important to analyse the quality of their training too.

The international maritime market passes through a period dominated by substantial modifications, due to the worldwide economical crisis [3].

This global situation determined maritime universities to rethink most of their curricula in order to train mostly capable graduates for the officer position on specialized ships with a high degree of technology.

If 20-30 years ago the high degree in technology could only be talked about on board special purpose ships, such as oceanographic research vessels, today specialized vessels, such as container ships, oil tankers, passenger ships, offshore vessels knew an unprecedented development.

Having in mind the continuous evolution of computerized equipments, shortly all maritime ships will have the same hi-tech endowments, no matter the type and/or the size of the ship [4]. For these ships crewing and training requests, both theoretical and practical are considerably superior compared with those from 10-15 years ago.

## 2. THE ECONOMIC CRISIS & THE CREW MANNING POLICY

At the end of 2008 the entire world economy entered a decreasing phase which couldn't be solved up till now in a favourable manner.

The economic system, on all levels, either macroeconomic or microeconomic was troubled, economic exchanges among the states of the world reached a nonplus, hundreds even thousands of factories closed their doors and million people became unemployed [5].

Of course, the crisis did not avoid the maritime domain. Ship owners had to reduce expenses, given that the freight market had substantially decreased and implicitly the operators' or ship owners' incomes were considerably reduced. One of the most usual forms of reducing expenses was represented by letting go the personnel and/or hiring cheaper labour [6].

Many ships have been put out of operation and part of the navigating personnel was left out of work.

In such situation, having cadets on board ships became for the majority of ship owners an unjustified expense which was eliminated since the first period of the economical crisis.

Most states attend the on board training programme according to recommendations of the International Shipping Federation, recommendations made according to STCW Code requirements.

The enforcement of the International Convention concerning work over seas – 2006, requirements and obligations stated by ILO, and the last provisions of the STCW Manila 2010 Convention, shall determine ship owners, in spite of the economical crisis, to take a series of positive decisions and to improve their policy concerning navigating personnel, a policy which also concerns cadets [7].

Providing conditions for practical training stages of cadets on board ships is a very difficult task, especially if there is a financial pressure on the ship owner brought about by the economical crisis.

In spite of all these, all crewing companies require previous professional experience before recruitment, on different types of ships. The situation seems totally inappropriate as long as a future „junior officer" did not succeed to go on enough voyages, therefore he did not have the physical possibility to acquire such an experience [8]. Times when cadets were taken in a large number by ship owners are long passed and nowadays very few young people manage to get over with the compulsory training on board period of 12 months.

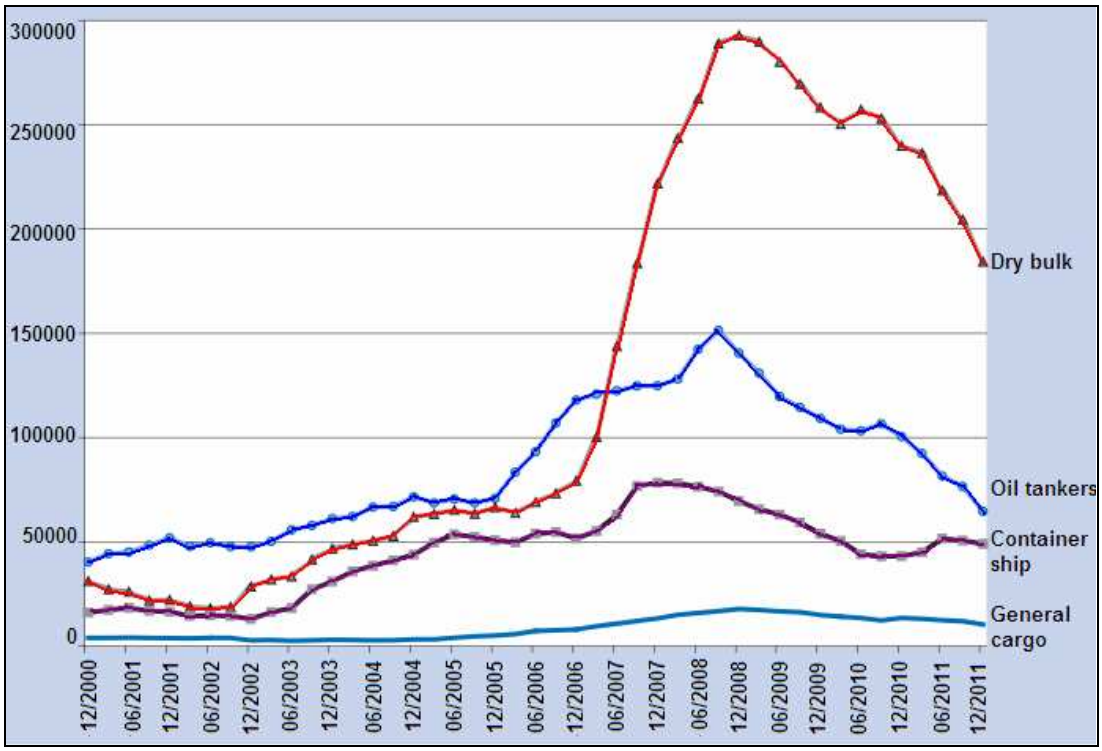



Figure 1 World tonnage on order, 2000–2011 (Thousands of dwt)

It was believed that 2011 was going to be the final year of the world economical crisis based on some small economical increases in some industrial sectors, this fact leading to an increase of the optimism degree among ship owners. Unfortunately there were simple speculation based on minimal information and the following years, 2012 and 2013, remained at the same stagnation level of transportation demand [9].

The number of ships taken out of operation in different ports of the world, left under the care of a minimum safety crew, has reached 30%. Some ship owners had to surrender, especially those who weren't strong enough, considering the "preservation" of ships as the best solution. The graph from figure 1 clearly demonstrates the impact of the global economic crisis upon all types of maritime transport capacities [10].

Other ship owners, whose fleet was large enough in number of ships, have "preserved" only part of the ships considered to be non-performing, continuing to exploit

the other ships trying this way to cover expenses generated also by ships out of operation.

Part of the ship builders were surprised to find out that finished ships and ready to be delivered could not be paid for by those who ordered them and against their will they became owners, entering the shipping market at a not very promising time.

States having ships under their national flag provide on a certain level cadets' access on board ships for training but their number is way beyond expectations.

At "European Manning & Training Conference" in 2012 from Sopot, Poland, besides problems related to shipping and maritime industry, there were discussions concerning the crewing activity on a European level [11,12]. More representatives of different participating states brought up the lack of qualified personnel for specialized ships and the lack of offers for cadets. Moreover attention has been drawn over the fact that this lack of interest for future officers, not having the opportunity to train as cadets on maritime ships, will create a huge void in the future concerning „junior officers".

Continuation of the economical crisis period will certainly generate a surplus of theoretically well trained personnel (graduates of maritime education institutions) with no work experience [13].

For now, it may be considered that the influence of the economical crisis annulled the deficit of certified personnel at the world fleet level. But, in reality, an aging of the navigating personnel phenomenon will appear, a stagnation in promotions, which will determine an important number of officers (no matter their specialization) to give up this profession and to look up for work on shore [14]. At the time when maritime traffic will start reinvigorating and settling (on the level of 2005-2006) there will be proof that the deficit of certified personnel will be even higher than it was at the beginning of the economical crisis [15].

At "European Manning & Training Conference" in 2013, which took place in May, at Dubrovnik, besides different themes approached, there were some of the previous topics of the Sopot conference related to finding some solutions for awakening the ship owners' interest in taking cadets on board. Unfortunately possible identified solutions are only punctual and can only be applied by a restricted number of ship owners.

Sure thing: the economical crisis has strongly affected and influenced cadets' access on board ships, no matter if they belonged to the European or Asian area [16].

## 3. CMU AND THE ONBOARD TRAINING EXPERIENCE

Constantza Maritime University (CMU) always struggled to obtain as many as possible on board training places for its cadets. During the last twenty years we experienced different stages regarding the cooperation and collaboration between our university and the shipping companies.

In the first place was the 90' period when there were no STCW constrains regarding cadets on board training. At that time CMU had his own training ship and was performing 3-5 training voyages per year for the students after their 3rd year of study.

STCW 95 amendments stipulating the 12 month compulsory on board training period for deck cadets and 6 month for engineer cadets entered in force in 1997.

Due to the dissolution of the Romanian merchant fleet and the emerging crew manning companies on the Romanian seafarers labour market, the Romanian Naval Authority (RNA) accepted until the year 2000 that the most part of the on board training for our cadets to be done on board CMU training ship.

After the year 2000 the RNA requirements became in accordance with the STCW 95 provisions so the 12/6 month on board training stages for all CMU graduates

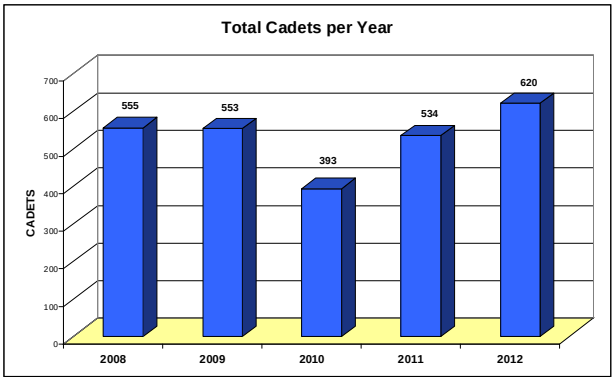



Figure 2 CMU – total number of cadets/year

became compulsory. Consequently 2000 – 2005 was a very harsh period for our students because there were very few shipping companies available for taking on board our cadets.

In the following graphs we would like to show the CMU experience regarding the on board training process dynamics between years 2008 and 2012.

Starting from 2005 the shipping companies came to our university asking for cadets and officers. At first we were surprised by such a change in attitude. After a while it became clear that the new approach of the owners was dictated by the already existing lack of officers and the prognosis confirming shortage of well trained officers for the merchant fleet during the next 10 years. In accordance with the figures mentioned in the BIMCO report, the actual shortage is around 27,000 officers and in our opinion will increase with another 15-18% by 2015.

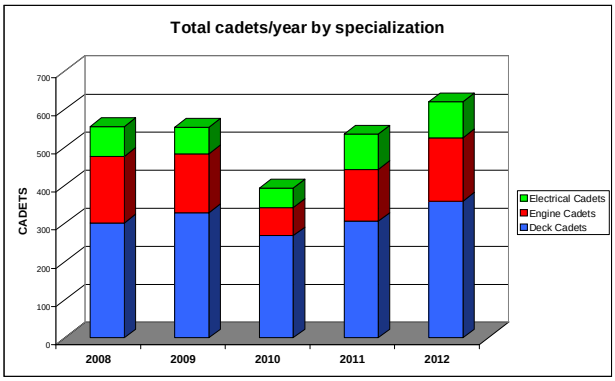



Figure 3 CMU – total number of cadets/year by specialization

As a direct consequence, many owners changed their strategies regarding the recruiting of personnel and established new policies in order to develop or extend to the STCW 2010 amendments we estimate that the request for electro-technical cadets will increase in the next years because this category of officers has for the

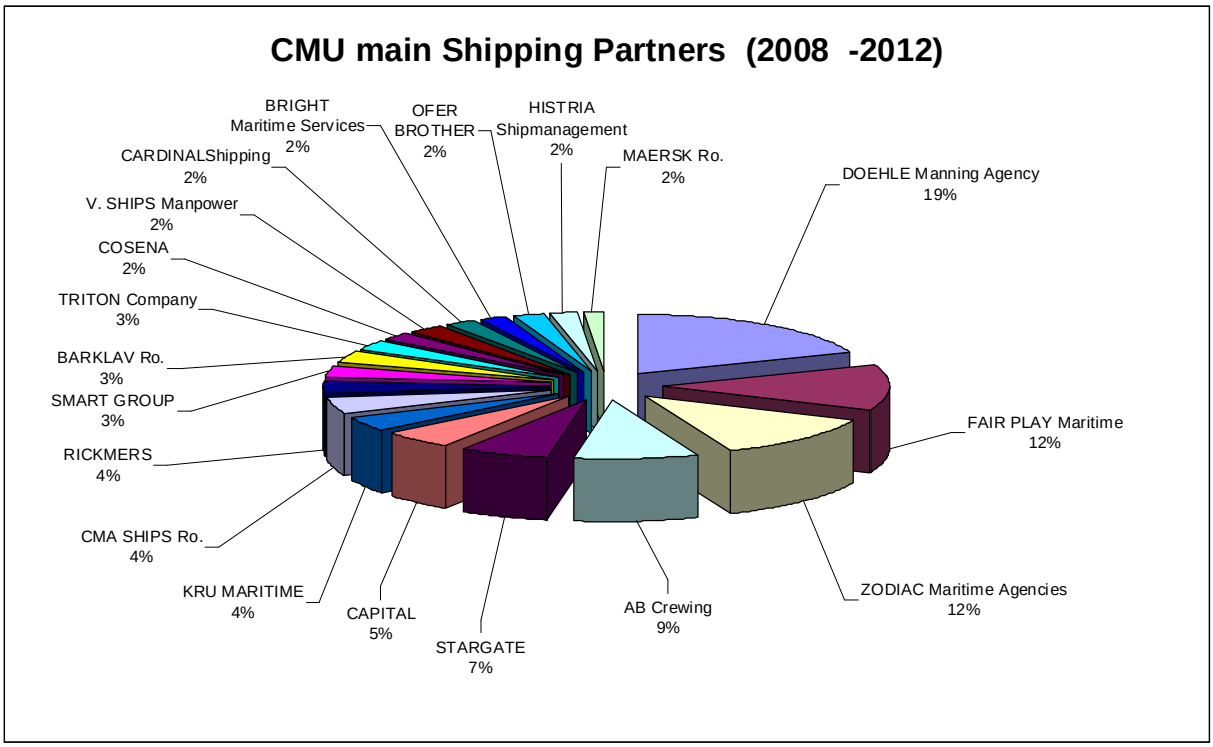



Figure 4 CMU – main shipping partners

their cadets' training programs. We had shipping companies that offered scholarships for 15% of our students, from both faculties (navigation and electro-mechanics), including scholarships for the students in the junior years of studies.

In figure 2 we have a compressive image of the total number of CMU students that had annually

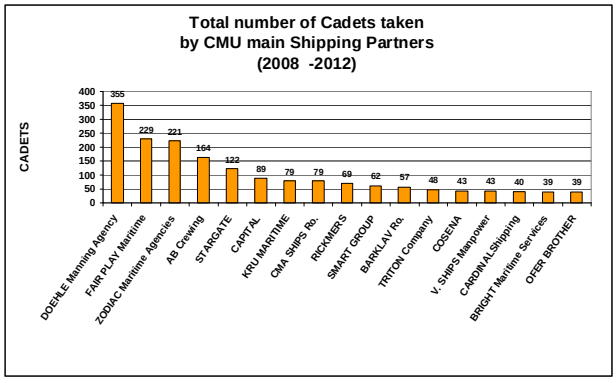



Figure 5 Total number of cadets by shipping companies

undertaken the on board training. Excepting the year 2010, the average number of students that are going on board merchant vessels are around 565 per year. In 2010 this number dropped at 393 cadets, meaning a reduction of the average number with almost 31%. Figure 3 shows the distribution of our cadets making annually training stages in accordance with their specialization. The average annual proportion is: 57.2% deck cadets, 30.0% engineer cadets and 14.7% electro-technical cadets. Due first time an recognized international legal training status. From the two graphs we can conclude that in year 2010 the global economic crisis had a maximum financial and psychological impact over the ship owners.

At that time CMU signed more than 20 institutional contracts [17] with ship-owners or crewing companies for providing them a large enough number of cadets. Graph from figure 4 depicts the importance of the Constantza Maritime University main shipping partners (ship owners or crewing companies). The percent figures represent the number of cadets taken by each company from the total number of students that had on board training stages between 2008 and 2012. Actually the same figures are presented also in figure 5. Here we can better see the top of the seventeen most "helpful" shipping companies for CMU. In this five years period

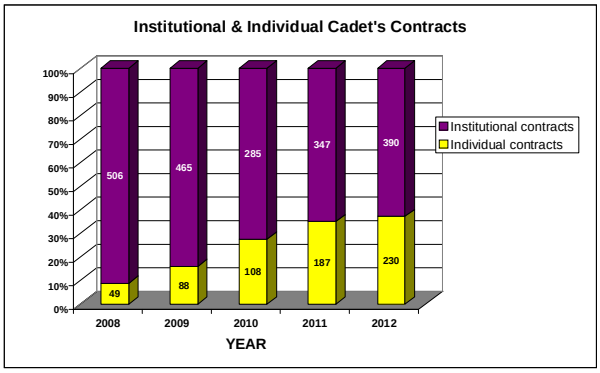



Figure 6 Cadets with institutional and non-institutional training contracts

"Doehle Manning Agency" was the most valuable partner taking a total of 355 students (19.3%) from the total number of students (2665) that done on board practical training. On 2nd and 3rd place we have "Fair Play Maritime" and "Zodiac Maritime Agencies" with almost the same number of students taken on board (around 225 students). Next we have "AB Crewing" that is the representative in Romania **of** Nippon Yusen Kaisha **(**NYK Line) and "Stargate Crewing Agency" who is working with various German shipowners. These two crewing agencies took an average of 240 cadets in 5 years. The next twelve shipping companies (presented in our graphs) took an average number of 10 students/year. This rate is not very impressive but in total their contribution was very important because they manage to maintain the same offer over the years.

Another 15-20 crewing agencies tried all their best to secure more cadets for other international ship-owners, many times making better job offers than the companies that had signed contracts with our university. Figure 6 shows the report between the number of cadets that manage to make the on board training stages having institutional contracts and the cadets that had to find by their own places on board maritime ships (individual contracts).

If you look closely at this graph (figure 6) you can see that the number of individual contracts increased steadily year after year. This trend could appear to be illogical in a period of economic crisis. The reality between this tendency is that when the main CMU shipping partners decrease their ability to offer positions for CMU cadets, our students take the effort to find opportunities to go on board ships on their own hands. Consequently their applied for cadets' positions to all the available crewing companies and smaller ship owners in a desperate effort to make at least a few months on board training.

Now is time to see how the economic crisis influenced the cadet recruitment policy of the main shipping partners of CMU. For this matter we think that the graphic presented in figure 7 is very eloquent.

Due to page dimensions constrains we selected only the first eight shipping/crewing companies that over the years sent on board the largest number of our students (50.4% from the total number of cadets embarked). In

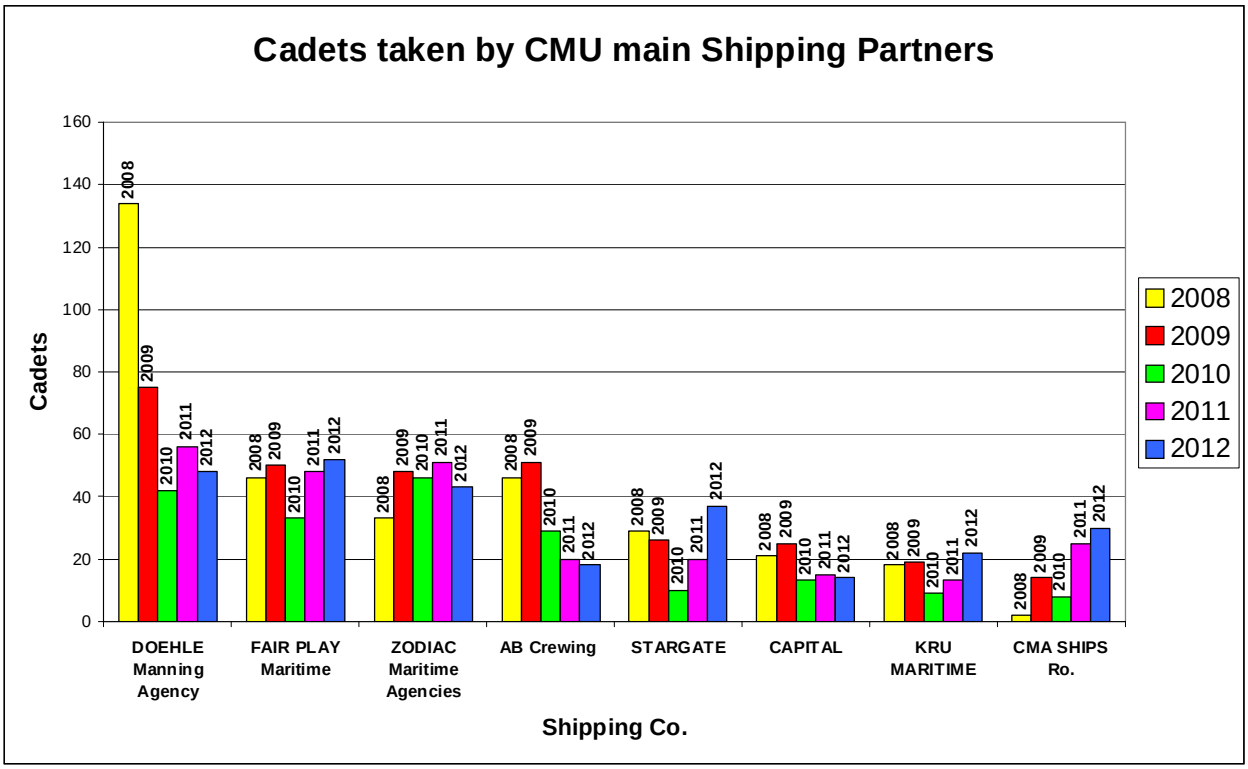



Figure 7 Cadets taken each year by CMU main Shipping Partners

figure 7 we can see the number of cadets enrolled by these eight companies each year from 2008 to 2012. Surprisingly there is not a common behavior for all the companies over this period, with only one exception. The exception is the year 2010 when all our main shipping partners significantly reduced the number of cadets employed. Compared with the previous year (2009) and expressed in %, this reduction was as follows:

- Doehle Manning Agency - 44%,
- Fairplay Maritime - 34%,
- Zodiac Maritime Agencies - 4,2%,
- AB Crewing (NYK) - 43,1%,
- Stargate Crewing Agency - 61,5%,
- Capital Shipping & Trading - 48.0%,
- KRU Maritime - 52,6%,
- CMA Ships Romania - 42,9%

As we can see, with the exception of Zodiac Maritime (drop only 4.2%) the rest of seven companies had reduced the number of Romanian employed cadets

with an average of 40% compared with previous year 2009.

What happened after 2010 is also very interesting. In seven from eight cases, shipping companies started to increase the number of cadets embarked. The only partner that steadily decreased year after year the number of cadets taken from Romania was Nippon Yusen Kaisha **(**NYK Line) represented by AB Crewing. More than that, in four cases (Fairplay, Stargate, KRU, CMA) the number of cadets employed in 2011 and 2012 were greater than in 2008 or 2009. Of course that the figures that we presented in this paper reflect only the interaction between Constantza Maritime University and the above mentioned shipping/crewing companies. We can not say if the trends presented in figure 7 replicate their general policy of these companies regarding cadets' enrolment or it is only the case with Romanian students. For example, we know for sure that NYK deliberately reduced the number of cadets recruited from EU countries but increased the recruitment of Indian and Philippine cadets.

Another event that is encouraging us to hope that in the next years the recruitment policy of cadets will regain the normal process is that in 2013, for the first time, Maersk Line took a large number of cadets (over 50) from our University and seams to became no. 1 shipping partner from this point of view.

At the end of the paper we would like to talk about a project that helped our students during their on board training period. It is an EU founded project type ERASMUS that is supporting students' mobility for practical training purposes. We need some time to explain to the Romanian ERASMUS head-office staff the particularities of the practical training that was done by the students of Constantza Maritime University and

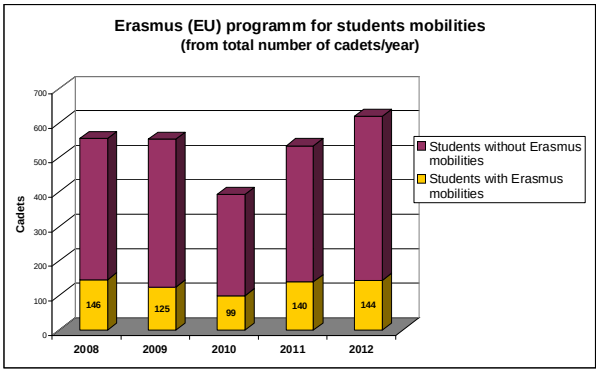



Figure 8 Cadets beneficiary of the Erasmus Mobility Program

that some of the ERASMUS project general rules could not apply for the on board training. It was necessary to change some financial procedures and reporting forms and also the monitoring process had to be reorganized. Finally we manage to make the program work and in a few words, each student that was starting his cadet training stage is receiving around 300 euro/month for a period of three months.

At he beginning of the project (year 2008, 2009), from the students point of view, all these money were practically extra pocket money because all the expenses were covered by the owners and also the cadets were receiving some wages during their on board embankments.

Starting with 2010 when owners drastically reduced the expenses for cadets training, CMU used this founds to encourage owners to still embark students on their ships. Instead of giving the same amount of money to the students we transfer the money to the shipowners for

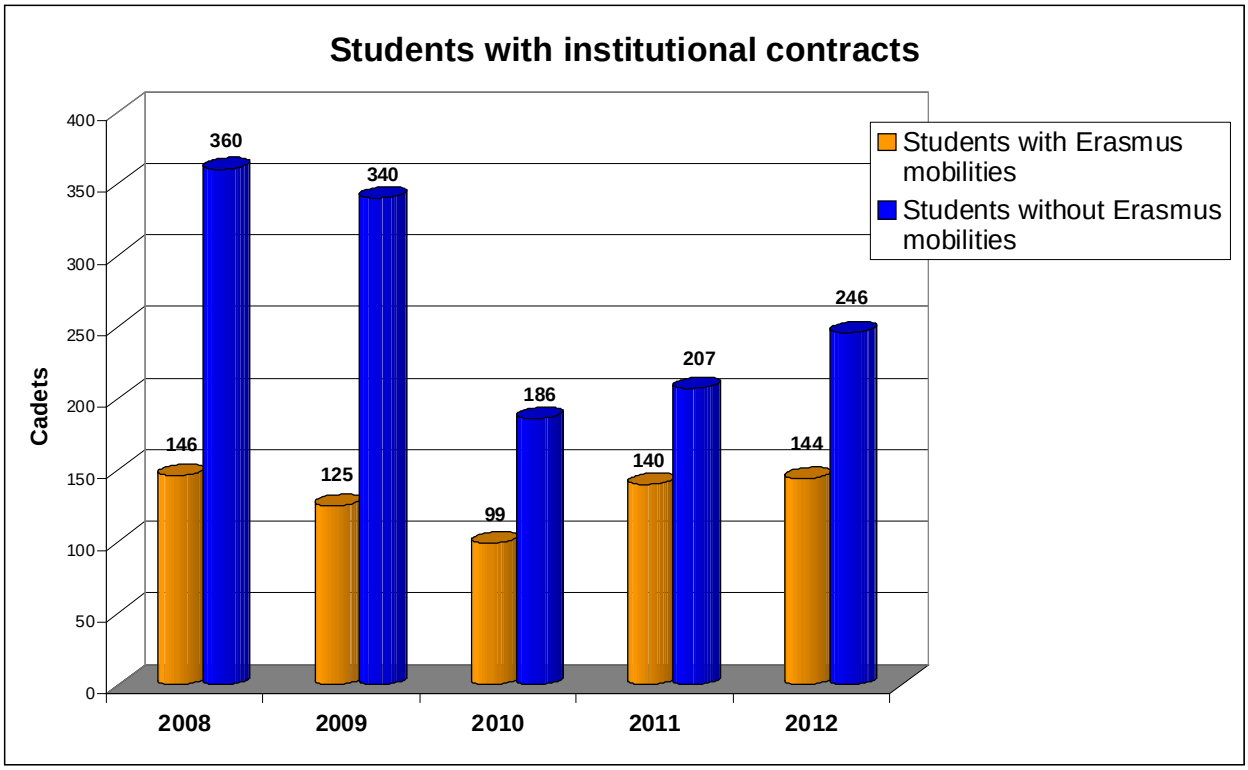



Figure 9 Erasmus Mobility Program for students with institutional contracts

covering part of the air travel costs involving the transfer of the student to/from the ship. This was the only opportunity found to us use the ERASMUS money and to comply also with the financial rules imposed by this EU program. In figure 8 we presented the proportion of cadets that were beneficiary of the ERASMUS mobility project compared with the total number of cadets embarked/year.

The students enrolled in the Erasmus project have to be only students recruited by the shipping companies that have contracts signed with CMU (institutional contracts). In the graph from figure 9 we can see the number of students that had institutional contracts divided between the students with and without ERASMUS financial support for training. As you can see after 2010 the number of ERASMUS students increased helping students and encouraging owners to continue their on board training stages for our students.

## 4. CONCLUSIONS

Now we can say that the 2005-2008 period was the boom period regarding the possibilities offered to our students to go on board maritime ships and to perform their compulsory training stages.

In the last two years, due the world economic crisis things had changed dramatically regarding the ship-owners' policy to recruit young cadets. As we already show in chapter 2, one of the first reducing costs measure undertaken by owners was to drop out the cadets from their ships.

For Constantza Maritime University the year 2010 worst the worst year as number of students that manages to go on board ships for fulfilling the compulsory training stage. If you consider the year 2008 as a reference year (555 embarked cadets) the drop in year 2010 was of almost 30% (29.2%).

After 2010 it seams that the perspective for cadets had improved and year after year the number of students that found positions on board merchant ships as cadets increased. Because our main shipping partners did not retake the on board training policy as before 2010 we can not be very optimistic for the near future, but it can be a moment of owners re-orientation towards new fresh maritime officers markets. Maybe some of the major owners will try to increase the number of Chinese or Myanmar officers on board their ships. Meanwhile other owners that already experienced such officers will give a better chance to the eastern EU officers as Romanian and Bulgarians.

The level of training of the maritime graduates will be in all cases the main factor that will incline the balance toward a maritime training world area or another.

Using EU projects found for supporting students' mobility for training is a great advantage mainly for the students and especially in this very difficult economical period.

Once again we have to underline that for the Romanian maritime student the milestone is not to obtain the required standard of education but to accumulate de 12 months of onboard training.

## 5. REFERENCES

[1] BIMCO, Manpower 2010 update- *The worldwide demand for and supply of seafarers*, 2010

[2] COLLET I., *Economic ebb and flow in maritime sectors*, ,European Commission, Feb 2013

[3] ECONOMIC COMMISSION for Latin America and the Caribbean (ECLAC), *The crisis and its future impact on the global economy*, 2008-2009

[4] BARSAN E., MUNTEAN C., *Compulsory Simulator Training Stages for Deck Officers*, 12th General Assambly of International Association of Maritime Universities – Gdynia, Poland, June 2011, published in Green Sheeps, Eco Shipping, Clean Seas, Pub. GMU, Gdynia, Poland, 2011

[5] ASYALI E., ZORBA Y., CERIT A. G., SAG O. K., *The Impact of global economic crisis on human resources strategies in maritime industry*, Dokuz Eylul University, School of Maritime Business and Management, Izmir, Turkey, 2010.

[6] POCUCA Z., ZANNE M., *The Impact of global economic crisis on the dry bulk shipping industry*, University of Ljubljana, Faculty of Maritime Studies and Transportation, 2009

[7] ĆOROVIĆ B., PEJAKOVIĆ-KOVAČEVIĆ S., ŠEKULARAC – IVOŠEVIĆ S., *Analysis of Recent Supply and Demand of Educated Seafarers in Montenegro and Worldwide*, Transactions on Maritime Science, Vol.01. No.02, October 2012

[8] DEMIREL E., ZIARATI R., *Combining Vocational and Academic Requirements in the Maritime Education and Training*, Piri Reis University Campus Tuzla/Istanbul, 2012

[9] LEWARN B., - *A review of some solutions to the shortage of maritime skills- Maritime Transport Policy Centre*, Australian Maritime College, 2009

[10]OXFORD ECONOMICS. *An independent review of the economic requirement for trained seafarers in the UK- Final report of DfT and Review Panel*, December 2011

[11] 15th EUROPEAN MANNING AND TRAINING CONFERENCE, 10-11 May 2012, Sopot, Poland

[12] ANNUAL EUROCREW MEETING, 20 May 2012, Gdynia, Poland

[13] UNITED NATIONS CONFERENCE on Trade and Development (UNCTAD), *Report by UNCTAD Secretariat*, Geneva, 2012

[14] JAPAN INTERNATINAL TRANSPORT INSTITUTE & THE NIPPON FOUNDATION, *A Study on the "Future Global Supply and Demand for Seafarers and Possible Measures to Facilitate Stakeholders to Secure a Quantity of Quality Seafarers"*, May 2010.

[15] SULPICE G., *Study on EU seafarers employment, Final report,* Commission Directorate - General for

mobility and transport, Directorate C – Maritime transport, MOVE/C1/2010/148/SI2.588190, May 2011

[16] WAGTMANN M.A., PAWLIK T., *Meeting the Future Need for Teaching Strategic, Shore-Based International Maritime Human Resource Management*, 11th General Assambly of International Association of Maritime Universities – Busan, Korea, October 2010, published Technical Cooperation in MET, ISBN 978-89-5532-285-0, Pub. KMU, Busan, Korea, 2010.

[17] POPESCU C., VARSAMI A., HANZU-PAZARA R., *Cooperation between Constanta Maritime University and the Local Maritime industry* - A Solution for the Compulsory Training on Board, 11th General Assambly of International Association of Maritime Universities – Busan, Korea, October 2010, published Technical Cooperation in MET, ISBN 978-89-5532-285-0, Pub. KMU, Busan, Korea, 2010.

# MACRO-TRENDS IN HIGHER EDUCATION CURRICULUM REFORM AND THE IMPLICATIONS FOR MET

BENTON GRAHAM

*California Maritime Academy, USA*

**ABSTRACT**

There are two divergent schools of thought on the appropriate future direction of higher education. One side sees a return to skills-based, vocationally-oriented, hands-on training as necessary to compete in the globalized economy: training workers through specific programs of occupational relevance in this view is key to an economically-healthy society. The other side warns that an education tailored too closely to specific technologies and industries will quickly become obsolete due to the rapidly-evolving character of occupations themselves, and therefore institutions of higher learning must instead focus on critical and creative thinking as well as problem-solving skills. Maritime education and training, as it has always oscillated between these bifurcated poles, provides a unique lens through which to explore the ramifications of these educational trends.

**Keywords**: *vocational education, liberal education, maritime education and training.*

## 1.INTRODUCTION

In arguments about the future direction of higher education in America and across the world, there is a growing philosophical divide between proponents of are-emergent, "skills-based instructional model" and those in favor of a model of liberal education with a more generalized curriculum. On one hand, and in the words of Emery Hyslop-Margison, "Responding to various political, economic, and social forces, current debates on the future of schooling are increasingly framed within the discourse of occupational relevance, globalization, and international market competition. Reflecting a historical pattern consistent with various market economy crises, governments and corporations from industrialized countries around the world are heralding vocational education reform as a major determinant of economic success within the new global economy"[1].From this perspective, narrowly-focused curricula that produce "job-ready" graduates are key to national economic health. On the other hand, according to David Kearns, former CEO of Xerox Corporation, "the only education that prepares us for change is a liberal education. In periods of change, narrow specialization condemns us to inflexibility – precisely what we do not need. We need flexible intellectual tools to be problem solvers, to be able to continue learning over time" [2].I argue that this debate has serious implications for maritime education and training and especially so if the twin poles of this term ("education" *and* "training") are viewed either as discrete entities or as synthesized components. In an age of rapid technological change, the skills generated by a more attenuated educational structure may facilitate the transition into the shipping industry much quicker, but these skills may also be rendered obsolete sooner than later.

On average, an educated American citizen will change jobs every 4.4 years[3].According to the Bureau of Labor Statistics, an American will hold more than eleven different jobs in his or her lifetime [4]. On average, it takes more than four years to obtain a 3rd Mate's license and diploma at the California Maritime Academy. (45% of students graduate in four years; and additional 12% graduate within six years) [5]. For young mariners, often a career at sea is shorter than the time taken to acquire the license for that career: different estimates approximate active sea duty as little as five to seven years after graduation [6].

This paper interrogates the ramifications for maritime education and training given the aforementioned presuppositions, and will address the following questions: What prepares students best for their occupational life: an in-depth skills-based training or an education more attuned to those "flexible intellectual tools" such as critical thinking, life-long learning, and information literacy? Given the deep need for highly technical workers, to what extent should we privilege the "skills-based" dimension of MET? Conversely, given the plethora of new career trajectories, to what extent should we privilege more malleable knowledge regimes? Can the two sides of this equation be combined for the best of both worlds, or would this effort merely dilute the power of each? How do the struggles over curricular reform actually embed this philosophical rift? In terms of educational focus, what might MET learn from the larger world, and what may the larger world learn from us?

## 2. PROFESSIONAL EDUCATION, VOCATIONAL EDUCATION, MARITIME EDUCATION

It must be noted at the outset that there are some semantic inconsistencies and ambiguities regarding the terms "professional education," "technical education," and "vocational education" and these ambiguities are exacerbated by different uses in different national

educational systems. In general, vocational education prepares people for specific trades or careers, and this often includes professional fields such as engineering. Vocational education, in some views, tends toward the instruction of procedural knowledge as opposed to the instruction of declarative knowledge which tends toward theory and abstract conceptualizations.

Increasingly, American institutions of higher education are turning toward European models and developing more technical/vocational areas of study in order to produce highly-skilled workers. An analysis of 225 U.S. colleges from 1987 to 2008 found an increase in the percentage of graduates whose majors were vocational (as opposed to liberal arts) from 10.6 percent to 27.1 percent. Data for 2011 finds that vocational majors have continued to increase up to 29.1 percent [7]. This is driven, in part, by a national anxiety regarding the diminishing power of the American workforce in the global arena, and there is significant federal and state pressure to put students into the work force immediately by directing them into career-related majors as opposed to "impractical" areas of study.

Curriculum reform often gets cast in patriotic terms: "American strength in production and manufacturing depends on a return to skill based education" [8], claims Leo Smith. The U.S. Secretary of Education has claimed that "the challenge producing the best-educated, most competitive workforce in the world is not just a question of national pride, it is an economic imperative," and this is reinforced by President Obama's declaration that "education is an economic issue. Folks need a college degree. They need workforce training. They need a higher education to make sure our graduates are ready for a career" [9]. Derived in part by the financial crises of 2008, educational reform in the United States is often framed through economic discourse. Again, to cite from President Obama – this time his 2013 State of the Union address, American education models lag behind its European counterparts: "Right now, countries like Germany focus on graduating their high school students with the equivalent of a technical degree from one of our community colleges, so that they're ready for a job. … We need to give every American student opportunities like this.. tomorrow, my Administration will release a new "College Scorecard" that parents and students can use to compare schools based on a simple criteria: where you can get the most bang for your educational buck….To grow our middle class, our citizens must have access to the education and training that today's jobs require" [10]. Clearly, the mechanism for curricular change towards skill-based instruction is driven by a perceived need for economic stability.

This re-orientation is not driven solely by governmental anxieties about an ill-trained and ill-equipped workforce – it is also predicated upon student concerns for employment after graduation. At least 40 percent of American students drop out of four-year universities before graduation, and the rate is higher at two-year institutions. According to Professor of Economics Alex Tabarrok, "young people now need to have a strategy – the economic calculus has changed. There is now a widening distribution of earnings by major, and as a result, we as a county need to look more closely at emulating those programs in European countries that turn out highly skilled workers." [11].Sentiments like this have led to legislature like the "Student Right to Know Before You Go Act" which requires colleges to provide more information on what students will pay for a college education and what they can expect in return, from monthly student loan payments to postgraduate salaries [12]. The Higher Education Research Institute has found that "more students entering college in the fall of 2012 believe that the current economic situation significantly affected their college choice," and "incoming students persist in putting a premium on job-related reasons to go to college [13].

There is, however, a counter argument that acknowledges that using salaries as a proxy to evaluate colleges or majors is reductive, commodifying a broader educational experience that can't be so easily measured. It can also tilt the scales against majors in the liberal arts, which are less lucrative at first than some vocational or professional occupations but pay off over the long run [14].

Of course, Cal Maritime is not immune to these trends and the admissions department and career services carefully track graduates earnings in order to promote the academy to prospective students. Average starting salaries after graduation are published prominently on the website, broken down by major. Moreover, strong job placement rates for the institution also figure conspicuously in admissions literature [15]. Moreover, the mission of the institution appears to be in line with these emergent trends in higher education. Maritime training is nothing if not "skills-based" and Cal Maritime proudly trumps its hand-on, experiential education.

The pressures for colleges and universities to turn to technical, vocational, skill-based majors and to publicly reveal the earnings of graduates are not without a counterargument, however. While salary after graduation may be a valid data point, there are other factors to consider. "If you focus primarily on salaries you're really diminishing the real value of education," Tracy Fitzsimmons, board of directors of NAICU."A really great college education prepares students to enter into the work force, but it also prepares them to think deeply about the world around them." [16]. Framed another way, "The question is will the critical thinking skills responsible citizenship demands be inspired and nurtured by vocational courses of study ? [17].

## 3. LIBERAL EDUCATION, GENERAL EDUCATION, MARITIME EDUCATION

"Liberal Education" is often invoked as an antinomy to professional, technical, vocational, or skill-based training, although there is a broad array of associations with the term. According to the American Association of Colleges and Universities, some mistakenly assume that it is politically aligned with the

left, while others link the term solely to the arts and humanities rather than the sciences. In fact, most definitions of the term refer to "a philosophy of education that empowers individuals with broad knowledge and transferable skills [18]. While a liberal arts education remains a classic model, because of the aforementioned reasons – the need to generate a career-ready population and the perceived lack of use-value – interest in a liberal arts education is diminishing.

Yet, many still argue for the importance of the broadly-educated student for several reasons. First, it is far more important for students to develop transferable skills and capacities than to be trained for a single occupation that may become obsolete or be so radically changed by technology that one is ill-equipped to adapt to the changes. Narrow technical skills have a much shorter shelf life than broader skills and capacities. Second, interviews with industry advisors often reveal a need for problem-solving skills and verbal and written communication skills – attributes which are not always foreground in more technical areas of education. In the words of Professor Delbanco of Columbia University, "The university should be a place for reflection. … We don't want to have a population that has technical competence but is not able to think critically about the issues that face us as a society" [19]. This is echoed in the work of Harvard Professor Tony Wagner: "the capacity to innovate – the ability to solve problems creatively or bring new possibilities to life – and skills like critical thinking, communication and collaboration are far more important than academic knowledge….Young people who are intrinsically motivated—curious, persistent, and willing to take risks – will learn new knowledge and skills continuously. They will be able to find new opportunities or create their own – a disposition that will be increasingly important as many traditional careers disappear" [20].

Additionally, there may be some long-term issues with skills-based training over the life span of the career. Hanushek, Woessmann and Zhang, in their study on various educational models in the US and Europe, find that most research focuses almost entirely on the school-to-work transition. When looking at the "life-cycle work experience" (or to make this specific to our concerns, ship to shore and beyond), they find there is a trade-off between short-term and long-term costs for the individuals and the entire society. After first acknowledging what has already been mentioned – that the skills generated by vocational education may facilitate the transition into the labor market more quickly, they found that individuals with general education "experience improved employment probability" and are more likely to receive "career-related training relative to those with vocational education, giving them the opportunity to continue updating their skills to be employed in a changing economy" [21]. Conversely, while vocational/technical education at the secondary level may help students get jobs, they may suffer from lower lifetime earnings by having skills and knowledge that are less transferable across firms and industries. They're also less likely to engage in lifelong learning, which obviously entrenches this tendency. "This reduces the return on investing in vocational education for both the individual and society" [22].

As a member of the California State University, The California Maritime Academy is held to certain standards and practices of curricular diversity put into place to insure well-roundedness. In addition to numerous units in the humanities and the social sciences, students are required to take a minimum of three semester units in study designed to equip learners for lifelong understanding and development of themselves as integrated physiological, social, and psychological beings. This requirement is meant to support the aforementioned notion that fostering a sense of perpetual learning is not only intrinsically valuable, but has an economic value as well. In order to assess this outcome, surveys were sent to graduation seniors as well as alumni. Initial feedback from the 2013 assessment shows that over 85% of CMA graduates have sought out additional formal learning opportunities and 74% learn independently for their pown personal or professional development.

## 4. SYNTHESIS OF EDUCATIONAL MODELS

There is an attempt within many institutions, including Cal Maritime, to bring together the best of both worlds –specific maritime technical training and a curriculum designed to promote life-long learning, foster creativity and sharpen critical thinking. This resonates with the work of Stanford professor Ann Colby, who notes that there is a false dichotomy between choosing between skills-based training and the rich, deep learning we associate with the liberal arts [23].The strongest academic programs, according to many scholars in the field, are those which combine elements of the liberal arts education with professional training. Such practices could be deployed through more innovative curriculum reform which looks to interdisciplinary studies as a model (cf: Benton, "The Interdisciplinary Curricular Model: Adaptations for a Fluid Future." IAMU AGA 10 Proceedings.) Alternatively, embedding internships into programs often allow students to see how the practical is connected to the rest of academic learning.

Captain Ergun Deminerel and Prof. Reza Siarati explicitly link these twin poles in their aptly-named essay "Combining Vocational and Academic Requirements in the Maritime Education and Training". Their focus is the European educational system, but the issue is similar to that facing the American system – how one might "partnership" between the operating methods and requirements of vocational training (and in their case, specifically maritime training) with the rigor of theoretic academic practices [24].The best programs combine major elements of a liberal arts education and professional training. This would seem to be obvious, but there are problems.

First, for Cal Maritime and many other MET

programs, there exist credit unit thresholds which cannot be exceeded. The target total unit load in the California State University system is 120, and there is pressure to reduce the units in any program which exceeds this standard. The degree-granting program in Marine Transportation is at 159 units; the Marine Engineering program is at 161 units. STCW certification in multiple competencies requires a certain amount of course hours, and thus any attempt to supplement required major elements with additional courses is nearly impossible without exceeding the credit unit limit. Consider the re-distribution of units in the marine transportation major from 1997 to 2009 as seen in Table 1.

Table 1.Comparison between the degree content in Marine Transportation - 1997 and 2009:

| Unit Category | Units 1997 | Units 2009 | % Change |
|---|---|---|---|
| General Education | 45 | 50 | 10% increase |
| Maritime Technical | 69.5 | 70 | No change |
| Maritime Management | 21 | 11 | 48% decrease |
| Sea Training | 12 | 24 | 100% increase |
| Other | 3.5 | 3.5 | No change |

Doubling the number of units for sea time was necessary to justify the educational workload during that component. What is unfortunately lost is a number of courses in maritime management, but this was sacrificed in part to ensure compliance with general education requirements, and the STCW competencies within the maritime technical category could not be compromised.

One issue with the discrete categorization of units in this manner, however – to bifurcate the technical from the managerial to the general– is to invite a divide, both formally and philosophically, between the educational components. Nonetheless, such a grouping serves to identify the total curriculum and to propose recommendations for changes. To push too far into the liberal arts may erode the skill set necessary for successful job placement. There is also a fear of diminishing the hands-on experience and applied technology that many of our institutions value as educational practices. Conversely, an additional trend with potentially harmful effects is the movement to migrate many liberal arts courses and much of general education into distance education platforms. The emergence of MOOC (Massive Online Open Courses) threatens to marginalize these courses further.

Thus, the conundrum: we want our students to be globally aware critical and creative thinkers, as well as strong communicators with an understanding of the motivating forces of history and culture so that they can adapt to a rapidly evolving workplace and succeed through a series of careers. We also want them to be technologically proficient and competent in their specific fields of study. We want to do both, within a certain time frame and within specific budgets, and to move too far in one direction may dilute the power and value of the other.

One way through this impasse may be to re-conceptualize the dilemma not as two separate entities that must struggle for space and power in a limited curricular field, but to foster a holistic, interdisciplinary approach to skills-based training and intellectual theorization. To take one example: a cornerstone of Cal Maritime's mission is Leadership Development. It is acknowledged that the world is dynamic, fast-paced, and complex in both scope and scale. "The ability to efficiently and effectively process and prioritize information and make quick, informed decisions has never been more precious. America's leading maritime enterprises recognize the need for intelligent, responsible, conscientious, team-oriented graduates who can think critically and creatively while responding to stressful situations" [25]. Viewed in this way, leadership development becomes one of those aspirant qualities we want to instill in our students via leadership courses, ethics courses, literature courses, and survey of history. To foster leadership skills in cadets is to almost inevitably work in the terrain of lifelong learning that has traditionally been the domain of general education and the liberal arts. A sense of self-esteem, if well fostered, can lead to confidence which in turn allows for flexibility in changing occupational arenas. However, leadership is also adopted and measured in those skills-based courses as well. Bridge Team Management implicitly and explicitly foregrounds leadership development over several areas, including Sea Training, Introduction to Bridge Simulation and Watch standing Simulation – a capstone course. By literally and figuratively "bridging" intellectual flexibility and drill-driven skill acquisition, the divergent paths of these educational philosophies may merge.

## 5. CONCLUSIONS

Our interconnected, globalized world and our national economies have a deep need for highly technical workers, but the skills-based training necessary to produce these workers may actually be detrimental given the highly malleable and rapidly changing environment into which they are placed. This dilemma is being played out on national and international forums of education, with different systems and models vying for validity. The International Association of Maritime Universities, with its particular focus on maritime education and training, is in a unique position to weigh in on this matter. If we see our mission as one which trains the seafarer and educates the whole citizen, we may have a model that other institutions and educational structures may choose to adopt.

## 6. REFERENCES

[1] HYSLOP-MARGISON, E.J., *An Assessment of the Historical Arguments in Vocational Education Reform*, Journal of Career and Technical Education, Vol. 17, Number 1, 2000.

http://scholar.lib.vt.edu/ejournals/JCTE/v17n1/hyslop.html#spring.
[2] KEARNS, D., qtd in Debra Humphreys, *Making the Case for Liberal Education: Responding to Challenges*, Association of American Colleges and Universities, 2006.
http://www.aacu.org/leap/documents/LEAP_MakingtheCase_Final.pdf.
[3] BUREAU OF LABOR STATISTICS
http://www.bls.gov/news.release/tenure.nr0.htm.
[4] DOBRIN, C., *How Many Jobs Do Americans Hold in a Lifetime?*, 2011.
http://www.mindflash.com/blog/2011/05/how-many-jobs-do-americans-hold-in-a-lifetime/.
[5] GRADUATION RATE IMPROVEMENT INITIATIVE, *Consortium for Student Retention Data Exchange*, California Maritime Academy
http://www.asd.calstate.edu/csmde/index/html
[6]http://www.searchbydegree.com/merchant-mariners-sailor-career.html.
[7] FERRAL, V.E., *Are Vocational Education, Liberal Arts on a Collision Course*?, Pacific Standard, May, 2013,www.psmag.com.
[8] SMITH, L., *An Argument for Vocational Education*, Smyrna Vinings Patch, January 2012.
http://smyrna.patch.com/blog_posts/an-argument-for-vocational-education.
[9] OBAMA, B., qtd in Ferral, *Are Vocational Education, Liberal Arts on a Collision Course*? Pacific Standard, May, 2013,www.psmag.com.
[10] OBAMA, B., *State of the Union Address2013*
http://www.nytimes.com/2013/02/13/us/politics/obamas-2013-state-of-the-union-address.html?pagewanted=all.
[11] TABARROK, A., qtd in Tugend, Alina, *Vocation or Exploration? Pondering the Purpose of College*, The New York Times, May 4, 2012.
http://www.nytimes.com/2012/05/05/your-money/career-or-deep-learning-pondering-the-purpose-of-college.html?pagewanted=all&_r=0.
[12] NELSON, L.A., *Transparency Consensus*, February, 2013.
http://www.insidehighered.com/news/2013/02/12/cantor-support-bill-graduates-salaries-rare-example-policy-bipartisanship.
[13] THE AMERICAN FRESHMAN: NATIONAL NORMS FALL 2012. HERI Research Brief, January 2013. http://heri.ucla.edu/tfsPublications.php.
[14] NELSON, L.A., *Transparency Consensus*, February, 2013.
http://www.insidehighered.com/news/2013/02/12/cantor-support-bill-graduates-salaries-rare-example-policy-bipartisanship.
[15] THE CALIFORNIA MARITIME ACADEMY
https://www.csum.edu/web/admissions/why-choose-cal-maritime. See, for example: "Cal Maritime alumni predominate in the maritime industry around the Pacific Rim. Those who influence hiring and promotion have direct knowledge of the quality and relevancy of the education we provide. Several of the same companies and agencies that hire Cal Maritime graduates have many other connections to the Academy. We have many industry advisory groups telling us what knowledge, skills and traits they would like to see as part of a changing economy and workforce. 93% of the graduating class of 2011 (all majors) were employed in their field by August 1, 2011. The remaining 8% did not respond to our survey. Average starting salaries in each major were as follows: Marine Transportation $69,000, Marine Engineering Technology, $71,000, Facilities Engineering Technology $73,000, Mechanical Engineering (licensed) $63,000, Mechanical Engineering (non-licensed) $57,000, Business Administration-International Business and Logistics $44,000, Global Studies and Maritime Affairs, $40,000."
[16] NELSON, L.A., *Transparency Consensus*, February, 2013.
http://www.insidehighered.com/news/2013/02/12/cantor-support-bill-graduates-salaries-rare-example-policy-bipartisanship.
[17] NELSON, L.A., *Transparency Consensus*, February, 2013.
http://www.insidehighered.com/news/2013/02/12/cantor-support-bill-graduates-salaries-rare-example-policy-bipartisanship.
[18] HUMPHREYS, D., *Making the Case for Liberal Education: Responding to Challenges*, Association of American Colleges and
Universities,
2006.http://www.aacu.org/leap/documents/LEAP_MakingtheCase_Final.pdf.
[19] TUGEND, A., *Vocation or Exploration? Pondering the Purpose of College*, The New York Times, May 4, 2012.
http://www.nytimes.com/2012/05/05/your-money/career-or-deep-learning-pondering-the-purpose-of-college.html?pagewanted=all&_r=0.
[20] WAGNER, T., qtd in Thomas Friedman, *Need a Job? Invent It*, The New York Times, March 30, 2013.
http://www.nytimes.com/2013/03/31/opinion/sunday/friedman-need-a-job-invent-it.html.
[21] HANUSHEK, E.A, WOESSMANN, L.,ZHANG, L., *General Education, Vocational Education, and Labor-Market Outcomes Over The Life-Cycle*, The National Bureau of Economic Research ,October, 2011.
http://www.nber.org/papers/w17504.
[22] HANUSHEK, E.A, WOESSMANN, L., ZHANG, L., *General Education, Vocational Education and Labor-Market Outcomes Over The Life-Cycle*, The National Bureau of Economic Research, October, 2011.
http://www.nber.org/papers/w17504.
[23] COLBY, A., qtd in Tugend, Alina, *Vocation or Exploration? Pondering the Purpose of College*, The New York Times, May 4, 2012.
http://www.nytimes.com/2012/05/05/your-money/career-or-deep-learning-pondering-the-purpose-of-college.html?pagewanted=all&_r=0.

[24] DEMIREL, E., ZIARATI, R., *Combining Vocational and Academic Requirements in the Maritime Education and Training*, Marifuture, March, 2013. http://www.marifuture.org/Publications/Papers/Combining_vocational_and_academic_requirements_in_the_Maritime_Education_and_Training. pdf.

[25] THE CALIFORNIA MARITIME ACADEMY, *Educational Effectiveness Report*, March, 2011. https://www.csum.edu/c/document_library/get_file?uuid=a84bab22-a5b6-4827-ae8d- f1807d70b9af&groupId=63267.

# CHALLENGES AND POTENTIAL OF TECHNOLOGY INTEGRATION IN MODERN SHIP MANAGEMENT PRACTICES

BHARDWAJ SURESH

*AMET University, Chennai, India*

**ABSTRACT**

This paper is based on the research project that explores the challenges and potential of technology integration in current ship management practices. While technology advancements were designed to be contributing to minimising task complexity, issues such as fatigue, increased administrative burden and technology assisted accidents still plague the industry. In spite of the clearly recognisable benefits of using modern technology in the management of ships, in practice its application appears lacking by a considerable margin. The main driver of the study was to appreciate the cause of this disparity.

The study first reviewed a wide body of literature on issues involving the use of technology which included academic literature with empirical evidences and theoretical explanations of implementation of technology at work. With the help of the extant knowledge this research embarked on providing an explanation to the gap that existed in the application of technology in the shipping industry. By taking a case study approach the thesis looked into the induction and integration of technology in the management and operation of ships that primarily interfaced closely between the ship and its management unit on shore. Three companies with mutually diverse management setup were studied. The fourth case comprised of purposefully selected senior members of ships' staff.

The analysis of the data revealed that the manifestation of the gap in technology implementation is caused by deeper influences at work in the shipping industry. The un-optimised technology integration results in the seafarer, who is the keystone to the technology application, becoming a victim of the circumstances. The technology that was intended to ease operations and burdens ends up in controlling him, even leaving him under-resourced and causing fatigue. This was not an unintended outcome but the result of weak regulatory practices, short-term capital outlook and weakened labour practices in the shipping industry all caused by wider social and economic developments affecting not just this industry but businesses globally. The impact of such influences was however more acute in this industry resulting in such extreme consequence.

By bringing to light the limited application of some fundamental principles of human-systems integration, this study has attempted to expand the boundaries of research on the subject and contributed to the holistic understanding of the various underlying factors that influence technology integration in ship management processes.

**Keywords:** *human-machine interface, optimisation, technology integration*

## 1. INTRODUCTION

Along with the concerns for human safety and environmentally safe operations, the key dimensions of service quality of shipping industry include operations and management efficiency which are characterised by the outcomes of service performance and enabled by technology applications for process efficiency. However, in the maritime field there is very little evidence of any proper research on technology integration and management systems and the factors that make them or prevent them from working optimally [25], [5], [42]. Sharma [36], in his study of the understanding of a service management framework in the ship management industry, finds that it primarily runs on heuristics and thumb rules.

While technology advancements were designed to contribute to minimising task complexity and to mitigating human errors, issues of fatigue, increased administrative burden, technology assisted accidents etc. still plagued the industry. Shipping as the principal service providing industry within transportation, produces this service with the ship as its core constituent unit that operates geographically remotely and in a high risk environment. Yet, technology including information communication technology infrastructure is now seen to be increasingly rendering the ship manager capable of holistically managing ship operations effectively [24], [31], [25].

How is the technology being inducted and integrated into the modern shipping practices? What has been the impact of it so far? Is there scope and potential for optimisation? These were the drivers of the study. The effects of technological change and information technology are now changing the processes involved in ship operation and management, and are seen to be so dramatic that it can be compared to the effect brought about by change from sail to steam that changed the management structures, the technical aspects and the staff development needs of processes [11].

The principal aim of this study was to deepen understandings of challenges and potential of technology integration in modern ship management practices and explore opportunities for process optimisation in alignment with contemporary management theory and practice, and fill in the void in academic study conducted in this field. In order to achieve the objective effectively, the thesis delves into relevant literature, follows a

qualitative methodology and presents and discusses extensive findings from empirical research before drawing conclusions.

With the objective to delimit the research project in the architecture of ship management system, the function of 'technical management' that has greatest influence on the ship management practice is scoped.

## 2. THE ECONOMICS OF TECHNOLOGICAL CHANGE

Maritime transport serves world trade. The driving force that guides the efforts of any transport system is the quest to win more business by providing cheaper transport and a better service [41]. Thus it is not hard to see that the choice of economic logic for value creation in shipping has always been lowering of costs.

Technological change poses some of the most important concerns for shipping management in the current time. Shipping industry that was largely controlled by cargo shippers and shipping companies, existed in closely controlled regimes and was carefully supervised by charterers. This elicited close interest in investments and operation performance. Now shipping has evolved into an aggressively competitive market driven regime. Charterers are often replaced by traders who take short term view and prefer to hire ships they need from the spot market rather than charter long term [40]. This is also the case with ship owners who are more of asset players and may sell their vessels and buy new ones or move them in and out of third party management, depending on fluctuating market situations, making it difficult to plan investment in technology [37].

Ship owners may also come from a conservative background which views technology with suspicion from the investment return optimisation perspective. However, as the technology keeps changing frequently, this inflicts a 'wait and watch' approach in ship-owners' decision making, rendering the task more difficult. With the slicing of the maritime value chain and the activities such as crewing, technical and commercial operations being performed by separate entities, it has influenced the incentive structure in the industry in many ways. The industry grapples with issues of split-incentives now well recognised as barrier to the diffusion of new and efficient technology. The ship owner faces the dilemma between minimization of operation costs with crewing costs to his account as against his capital costs of new or retrofit of equipment to existing tonnage where charterers or commercial operators draw the benefit.

Frankel [14] points out that technology change decisions are usually made on the basis of economic and performance advantage, but the choice, timing, scale of introduction, and utilization of old as well as new technology is becoming more difficult now as new technologies become increasingly available long before the expiration of the economic life of existing technologies.

The problem of technological change is also different whether one is an early or late adopter of existing technologies, in as much for large and financially powerful versus small and growing transport companies considering a new technology. Their perception of value and risk is quite different, which in turn affects their technology change decisions.

However, the development and deployment of technology is intimately bound with the notions of progress and a natural societal advance from a lower state to ever higher ones, a necessity characterised by integration or change from less coherent to more coherent forms [22]. The evolution of technology integration and automation architecture in ship operations and management has been through three main areas: (a) advances in instrumentation and control, (b) evolution of information systems and (c) advances in maritime communications. Being a safety-critical industry, the deployment of technology focused more on its capability to enhance safety; and since safety management is an integral part of overall ship management, this area then *inter alia* got partially addressed with technology interface, but lacked in holistic approach. Knudsen [23] empirically finds that efforts to reduce accidents in seafaring have led to proliferation of procedures such as workplace assessments and checklists which not only increase avoidable work load but also are perceived by many seafarers as counteracting the use of common sense, experience, and professional knowledge epitomised in the concept of seamanship.

This points out to the lack of any scientific approach in the practice of technology integration in ship operations and management.

## 3. THEORY OF TECHNOLOGY INTEGRATION

Most rational decisions are based on some form of theory. It provides a conceptual framework and gives a perspective for the practical study of the subject. Thus, theory and practice are inseparable. Together they lead to a better understanding of factors influencing patterns of behaviour in work organisations and application of the process of management [7].

The theoretical models that examine the interaction between technology and organisation have evolved over a period of time. Nevertheless, technology has always been the central variable in organisational theory, guiding research and practice [30].

Arvanitis and Loukis [4] point out that, while technology plays a key role in an organisation, existing literature in operations management still holds an organisation-centric or a process-centric view when studying business entities. Despite the significant impacts of technology, the three way technology-organisation-process interaction has largely been neglected in literature [48], [17]. Technology, organisation structures and business processes are closely integrated and in any technology-intensive environment, organisation structures and business processes need to be developed or modified in simultaneity with technology development application [9].

Figure 1 below shows the trinity view model that easily lends to simultaneity and dynamics where technology, organisation and processes co-exist and

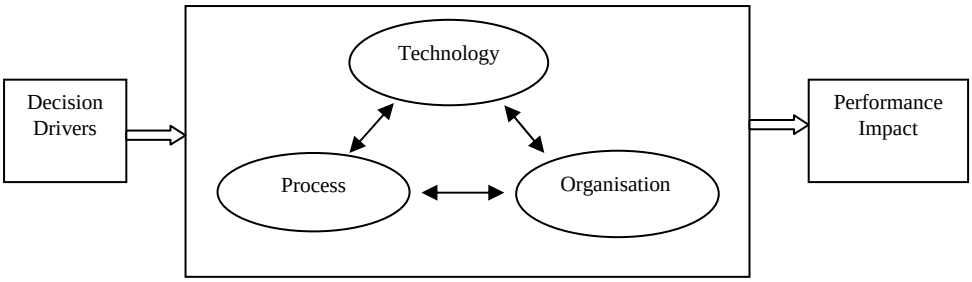



Figure 1 Technology Centric Framework with simultaneous technology-process-organisation view.

these dimensions are systematically integrated into an entity [46], [9].

The study of interaction between technology and organisation highlights some key issues [32], [49], [33]:

Technologies are products of their time and organisational context. While they have flexibility in interpretation, design and use, they are a function of hardware, organisation context and human factors that can be summarised in the following maxims:

a) The temporal and spatial distance between construction of technology and its application affects its flexibility. The greater the distance, the lesser the flexibility.

b) The workplace culture and interacting human element also plays a key role in the deployment and application of technology.

c) There is a simultaneous mutual impact among technology, organisation and process.

d) Technology today is a driving force that stimulates changes within organisations.

## 4. RESEARCH METHODOLOGY

A qualitative, exploratory research approach with case study as strategy was considered appropriate. The focus was on examining how the shore based managers and ship board staff who are at the two vital ends of the technical management process perceive and cope with the changing nature of work and skills as a result of the technology integration into the management and operation practices. A qualitative enquiry with such methods of research relies upon opinions, perceptions, interpretations and experience of the participants, which was planned to be sought. A case study is an appropriate research strategy of empirical enquiry to investigate a contemporary phenomenon within its real-life and natural context as demanded by the enquiry at hand that corroborates the intent of in-depth understanding without involving explicit control or manipulation of variables. Case studies typically combine data collection techniques such as interviews, observation, questionnaires, and document analysis which were all used as research tools [47].

Four case studies were selected, three of which were company settings undertaking technical management of ships in a mutually varied structure of constitution. (Case A) was an *in situ* examination and interaction with the management of a large third party management company that has in its basket the management of ships belonging to various ownership companies. The second case study (Case B) is a similar examination and interaction, but with the management of a single ownership company that manages and operates its own ships and does not use the services of and divest managerial control to third party ship managers. The third case study (Case C) has a profile completely different from that of case A or B. Case C is a state owned company, and while fulfilling obligations for the various government departments, the company was noted to have maintained a strong presence in the international shipping business with fleet profile of modern, young and diversified vessel types to serve different and specialized trades. The company was a profitable commercial venture of the state. Since the company has had a track record of profitability since its inception about five decades ago, it enjoyed enhanced autonomy and delegation of powers towards capital expenditure.

The fourth case study (Case D) consisted of interviews with senior sailing staff that have had long sailing experience including sailing on-board fairly modern ships that were equipped with modern technology to enable giving meaningful insight and inputs to the subject of research in context. While this would generally be the type of ships operated by the above types of business enterprises in case A, B or C, it was ensured that the sailing staffs were not in the current employment of these companies. The on-board staffs who are at the core of operations in a shipping company would give vital input from their perspectives which may not be available from the staff ashore in the previous three cases.

Multiple case designs allow cross-case analysis and comparison, and the investigation of a particular phenomenon in diverse settings.

Furthermore, an ‘Explorative Integrative’ form of case study approach was adopted in this project. ‘Explorative integration’ embraces both theory-driven research and an explanatory bottom up approach. It is an inherently cyclic design of several phases, explanatory, explorative, interpretative and understanding. As an analytical endeavour, it aims at generating facts in the field in order to create an integrative view of the case, depicted in figure 2 below [26]:

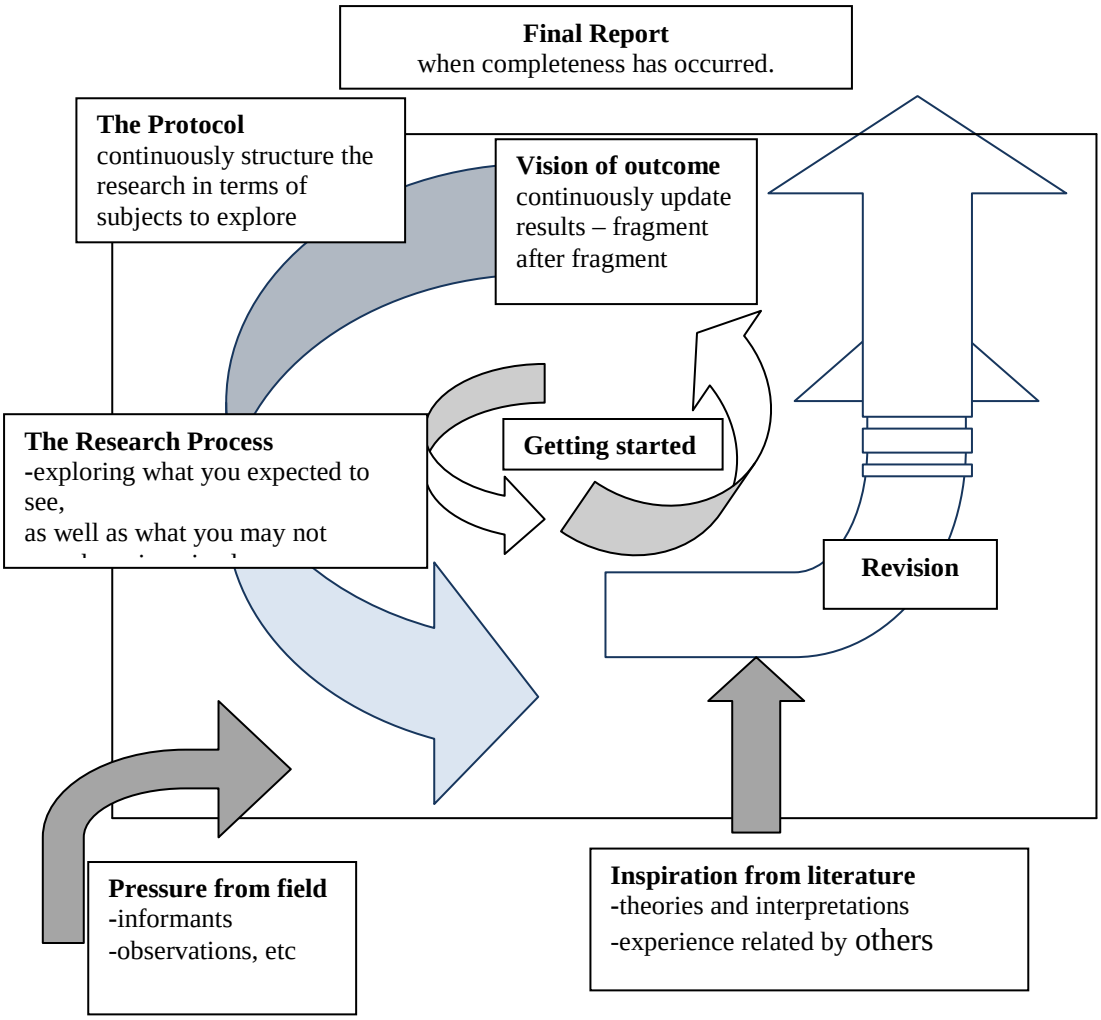



Figure 2 'Explorative Integration' as process

This research was based on the 'post positivistic' paradigm by Guba [15]. The paradigm, which is the basic set of beliefs that guides actions in connection with a disciplined inquiry, is characterised by the responses to ontological, epistemological and methodological questions. These are the starting points that determine what inquiry is and how it is practiced. In post-positivist research, truth is constructed through dialogue on issues raised during interviews, participants' reactions and researcher's own interpretations of these interwoven ideas [34]. Post positivism's empirical quest for knowledge emphasizes replicability across heterogeneous populations, settings, times, perspectives and deductive, critical refutation. Scientific generalisations gain warrant only through such replication and criticism.

## 5. THE TECHNOLOGY INTEGRATION GAP

This research has shown that the seafarers who are at the cutting edge of delivering on ship's performance for the shipping industry are not in the least averse to technology integration as is suggested by some. There is no vacuum towards this initiative from the shipboard standpoint. For example during the fieldwork of this study the enthusiasm towards handling of latest technology that in particular rendered reduced their administrative burden or made operations easy for them was amply discernible. So also their vehement assertion of existence of large potential for optimised operations through enabling technology that could also enhance their own safety further affirms the notion.

However the evolving structure of the industry under the influence of forces of globalisation in which it exists, are seen to create failures and barriers in its holistic and well founded implementation. The main challenges thrown up due to this scenario were seen to be as below:

The main drivers for technology uptake were seen to be more as a reactionary stance of compliance to the requirements of regulations and customer directives rather than a proactive initiative as a value preposition guiding organisation towards satisfied constituents and sustainable value creation.

The economic logic of low cost operation underpins every technology change decision and the cost-benefit analysis remains myopic to short term financial returns on investment. The ship manager, in keeping to business objectives fails to undertake any initiative on technology implementation and is driven by the regulatory demands. As a result such implementation takes the shape of mere incremental advancement without considering its design, operational constraint or impact. The regulatory drive in turn originates from the business initiatives taken by the private entrepreneurial organisations promoting such technology without any in-

depth understanding of usage circumstances. This technology push is largely proposed keeping in mind the need for greater safety in industry operations. Thus the need for enhancing safety in the industry is made to take the centre stage, which being a safety critical industry cannot ignore. The concept and the scope of technology integration are largely drawn from similar form of technology already in use in other industries. The literature review showed evidences of far greater degree of technology interventions in industries such as aviation, medical sciences and process industries, but as compared to shipping industry the interventions in such industries were based on much more robust fundamental research application [32].

Some of the features of the shipping industry which are not directly connected to the implementation process of shipboard technology nonetheless have a profound impact on the final outcome. The industry's fragmented structure fails to encourage any such holistic and concerted approach to technology integration. It is seen that in the globalised shipping environment there are myriad of actors in a common enterprise. This gives rise to split-incentives phenomenon. The ship owner, particularly if he himself is a mere asset player finds him not reaping the full benefits, with the ultimate beneficiaries of technology change being many other actors in the business. The fragmentation and lack of genuine interest in the value of technology implementation is then reflected in the way in which it is implemented and operated in practice. Not much attention is paid to whether such implementation benefits the operators or not but what was evident from the study that such implementation was seen as a cost and the management were keen to see its immediate benefits were realised. The reduction in crew size is thus considered as a natural and inevitable corollary as it is equated with the cost that needed to be recovered due to implementation of 'expensive' technology on ships. Arguably in some cases implementation of technology in this way is seen as a good return on investment and the implementation of technology itself is a ploy to reduce expenses on manpower.

Technology excuse thus gets pushed to reduce on-board crew numbers below the optimum. This gets coupled with lack of learning opportunity and experience in an automated environment which then proves risky in situations of abnormality or emergency. Also many a times the seafarer who is not an electronics expert is ill-equipped to handle automation faults. Thus reduced and inexperienced crewing only adds a layer of complexity adding to seafarers' stress and fatigue. Skilling issues prevail within the industry which is left grappling with the up-skilling/deskilling dilemma in light of poor technology integration. It is seen that while technology intervention incentivises crew reduction and allows for a cheaper deskilled workforce, in reality poorly integrated technology integration demands placing up-skilled and not down-skilled shipboard workforce. In practice abnormality and emergency, even occasional technology failure demands highly skilled crew to be able to adequately respond to out of the normal operational needs.

What was also evident from the study was the technology aided panopticism of the shore based management which proves detrimental to independent and trustworthy work environment on-board ships, thus exacerbating the traditional ship-shore divide. The study showed that the application of technology was interpreted to the advantage of the management to the extent that it was felt that in practice the usage of technology is skewed to work largely for the managers. It was used for improved flow of instruction from the managers to the ships and for monitoring work output of seafarers. The work environment of the ship in itself is considered challenging enough, and on top the poor considerations of socio-technical systems in the technology integration process involving ship-shore interface only exacerbated such divisive feeling. The dominating and controlling stance of the shore management engendered a sense of apathy and reluctance among the seafarers. The critique of panopticism in organisational theory draws attention to the inevitable interrelationship between power and resistance, and also to that between capital and control, which may not work when applied in much concentrated form [8].The seafarers thus felt undervalued and mistrusted and tended to perceive shore management as cunning even immoral that tried to fix liability on them. This again was largely a consequence of poor consideration of social factors in technology integration process that eroded mutual trust and respect. The underlying reason for why seafarers were not considered as a key player in the introduction of technology arguably relates back to the fact that technology adoption was a reflection of mere regulatory compliance and an act that only had to satisfy immediate economic rationality.

The design of technology remained alienated from the operation function. It is acknowledged that the design stage itself is the most crucial stage to address the functional requirements direct from the user perspective and all the principles of human factors engineering can if at all, find its most worthwhile application at this very stage. However, as evidenced from the findings, this aspect did not find visibility in the shipping domain, where design was seen as technology-led rather than design-for-use [3]. It led to non-standardisation and poor integration of equipment into work system but without integrating human characteristics into its definition, design or development. Even the quality of assessment, type approval and certification of such interconnected systems by the approving authorities like classification societies was found to be inadequate and wanting. With operability hardly being considered at the design stage, it resulted into stress and fatigue for the operator even encouraging mistakes which no amount of training or management intervention can mitigate.

This research has further established that many a times over-reliance on technology crept into operation functions leading to reduced situational awareness, suspension of traditional seafaring skills and consequential enhancement of risk of accident. Although no direct evidence of technology initiated accident was

noted in this study it is not hard to determine how the operator could be getting absorbed into technology overlooking its vulnerability and the need to treat it with healthy scepticism. It could be argued that such technology spawns a sense of over-confidence about the situational awareness inducing the seafarer to forego his core-competency skills, which in some scenarios could prove counter-productive.

Furthermore, this study shows that the investment in appropriate training of crew in handling integrated technology finds no ownership in the growing disintegration between the owner, flag, operators, managers thus blurring the link between owners and those responsible for the crew. The short-term contracts afforded minimal obligations towards the seafarer and the economic logic in a split-incentive scenario afforded evading bearing of costs towards any such training [18], [2].

Another discernible outcome of such blinkered application of technology led to information clutter in the management and operation of ships. In the management function of ship-shore interface, the ease of communication afforded shore management to exercise excessive control by demanding documentary evidence from the seafarers resulting in the production of a plethora of paperwork. It is no surprise that the ship's staffs question the veracity of such exercise that adds to the administrative burden and diverts them from the main objective of running the ship safely. Many seafarers also perceived such top-down implementation practice as countering the use of their professional skills and experiences embraced in proven good practice of seamanship [23]. The study showed that in the operation of ships the un-optimised overload of information through poorly integrated operating systems puts greater demand on cognitive resources over-saturating the operator. The premise that automation reduces the workload thus remained an illusion.

Such forced implementation not only increased avoidable work load but was also perceived by many seafarers as countering the use of common sense, experience, and professional knowledge epitomised in the concept of seamanship. The strong community of practice established over a long period of time in a relatively secluded working environment made it harder to penetrate into and bring about any change with ease. It requires deft handling and as discussed, through a paradigm of an inclusive new practice with technology integration rather than such imposition.

In summation, the seafarers' attitude to technology integration is unequivocal. However, the economic short-sightedness of the split-incentivised industry operation totally ignores the seafarers. Bhattacharya's [6] seminal findings reveal that ineffective regulatory infrastructure, weak employment practices, the absence of trade union support and lack of organisational trust in the shipping context manifests deeper sociological issues and organisational weaknesses in the shipping industry. Such concerns were the underpinning concerns in this study too. The seafarers' antipathy to un-optimised technology integration in the wake of his experience of enhanced control, mistrust and disrespect towards his seamanship, even his genuine concerns for safety were construed as rejections by the maritime business operating from ashore.

## 6. TECHNOLOGY INTEGRATION GAP RATIONALISED

The above interpretation of the research is further analysed below. This section reviews and explains the gap in technology integration in light of prevailing theories and framework of globalisation, neo-liberal capitalism, principal-agent theory, regulation of technology, socio-technical theory and community of practice. While these generalise across industry sectors however in the shipping industry due to its unique nature and structure, are found to be highly accentuated. This creates the paradox of immense potential of technology integration failing to be taken up and manifesting as the gap.

It is seen that the globalised shipping industry environment affords no real incentive to the ship-owner directly for technology uptake beyond remaining compliant for business to run. The highly fragmented structure of the industry that is seen to give rise to split-incentive problem is akin to the principal-agent problem that is accompanied by a rich stream of theory and empirical research. Principal-agent theory premises that where parties have partly differing long-term goals, for example that they aim for profit maximisation in their respective companies, then market failure occurs [21]. There is then economising on bounded rationality while simultaneously safeguarding the terms of contract against the hazards of opportunism [44].

The ship-owner only minimally complies with the technology that gets pushed through regulation imposed for safety, security and environment reasons, conforming to the reactive compliance culture that dominates the industry. This in turn is exacerbated when the globalisation affords the ship owner to *choose* his regulator in terms of the flag of the state he wishes the ship to fly. Guttal [16] among many others has argued that globalisation is a form of capitalist expansion that entails the integration of local and national economies into a global, unregulated market. Although economic in its structure, globalisation is equally a political phenomenon, shaped by negotiations and interactions between institutions of transnational capital, nation states, and international institutions. Its main driving forces are institutions of global capitalism, but it also needs the firm hand of states to create enabling environments for it to take root. Globalisation is always accompanied by liberal democracy, which facilitates the establishment of neo-liberal state and policies that permit globalisation to flourish. Contrary to the development theories, be they 'conservative, modernisation, or dependency theory' that conceived development as 'national development', present notions underlying neo-liberal economic development as are being pushed through globalisation, re-conceives development as global competitiveness within the global market place [29]. The neo-liberal freedom as a concept gets tied down to free markets where people are free so long as they submit to the dictates of deregulated free markets. Significantly, the race to the bottom hypothesis argues

that states in their competition to attract mobile capital must converge to the lowest common denominator.

The extra-ordinary element for shipping industry is the fact that the law of the seas is grounded in the notions of freedom of the seas with underlying principle of navigation of the oceans freely, ship's national state having exclusive dominion over that ship and no other nation can exercise dominion over that ship. The Flag of Convenience (FOC) phenomenon and later mimicked by the international registries that is encouraged in such environment shows the veracity of de-regulation of the marine industry. This conforms to the notion of globalisation theory put forth earlier and explains the minimalistic attitude adopted by the industry regulators. The fact that an international regulation is enacted upon a nation by nation basis who remain keen to make their states attractive choice as regulators, the sovereign privilege creates an unregulated environment where capital is free to act as it pleases [1].

In the global context, the policy making is seen to get politicised with self-serving agenda of the constituent members of policy making bodies belaying the notions of any common good for the industry. The issue, particularly in safety-critical industry like shipping becomes that the dividing line between *social* regulation on health, safety, environment and *economic* regulation of technology gets blurred when technology is passed off as enhancing safety. The regulation of technology follows the leading theory of interests lobbying to shield business profits. The theory that it is the subgroups of the industry that drive technology in the garb of social regulation on safety, health and environment, do so to serve own parochial advantage by raising rival firms' cost, endures [43].

Munck [27] had contended that globalisation combines several strands, such as the consensus among global economic policy makers who favour market-based development strategies over state-managed ones, the control of G7 states over global market rules, and the control of financial power in the hands of transnational corporations and banks to facilitate its implementation. Seen in this light, even the monopoly rights such as patents and copyright those are strengthened to encourage innovation arguably become counter-productive. They not only become barriers to shared common ideas of standardised operation that plague the shipping industry as seen in this study, but also with powerful state actors pushing the policy making in favour of their own technology suppliers wards off any competition. Stiglitz [39] has argued that the developed world has carefully crafted laws which give innovators the exclusive right to their innovations and the profits that flow from them. In cases like pharmaceutical industries the costs go beyond money when access is denied to affordable lifesaving drugs and highly profiteering companies researching on lifestyle drugs than lifesaving drugs simply because the poor cannot afford to pay for the drugs. R&D intensity defined as the ratio of R&D expenditure to GDP is an important determinant of innovation. This is in excess of 4% in OECD countries with USA alone accounting for 41% in the OECD area gross domestic expenditure in 2009 [12], [28].

The discussion thus in part explains the lack of control from the flag states in the case of regulating technology implementation in the shipping industry. As flag states remain competitive in acquiring business of ship registration – especially those which are not so scrupulous and renowned for being under-resourced– a flag-state based control for the implementation of shipboard technology is unlikely to be effective. But what is equally striking is that the maritime states where such technology is being developed also fail to control the adoption and implementation practices of such technology. They refrain from interfering because by giving the freedom they are better able to promote home-grown technology manufacturers corroborating the arguments presented above.

Another causal factor for the technology gap is identified as lack of fundamental research into the technology integration in shipping environment and paucity of appreciation of the fact that technology has always been the central variable in organisational theory guiding research and practice so evident in other safety-critical industries. Being an extreme case of a globalised industry, the ship and the seafarer lie in the centre of a complex constellation of multiple interests. The contractual employment of the seafarer, his non-existent relationship with owner, mixed nationality crewing, and dysfunctional communication with managers find no support for him. What comes out glaringly is that the seafarer, who manages technology for optimum performance of the sole productive unit – the ship, and on whose performance the profiteering of the myriad of actors in the industry hinge, finds himself at the bottom of priority.

The explanation once again lies in the outcome of economic globalisation that underpins the state–capital–labour relationship. The increasing dependence of national economies on global economic flow of investments sees financial capital play off one territorial jurisdiction against another to gain optimum return including labour that is cheaper, more flexible and more easily subjected to hard work. As nations compete amongst themselves the content of their labour laws are watered down to the detriment of their workers including those that protect their rights [35]. Even ILO [19] has conceded that while there is improvement in global production systems, globalisation has impacted work and worker relations, compromising the observance of core labour standards. Growing amount of literature on social dimensions of globalisation shows that many are wary of the so-called benefits of globalisation [20], [35], [19]. Labour fortunes are undermined by an ideological discourse that upholds profit as sign of efficiency that will generate the required levels of productivity to sustain economic growth for national development. To succumb to labour demands or interests would render an economy inefficient and directed towards failure, thus making out labour 'standing in the way' of national progress if it insists that its interests should be considered. In this way, while globalisation is about

removing state restrictions on capital, it seeks also to control labour by making believe that social protection and job security are uneconomic and inimical to economic growth [20]. Stiglitz [38] asserts that such economic policies that purport to separate efficiency issues from equity treats labour as commodity and runs counter to the interest of workers. 'Labour market flexibility' and 'capital market flexibility' appears as symmetric policies but they have very asymmetric consequences – and both serve to enhance the welfare of capital at the expense of workers. Lack of consultation with seafarers in the use of shipboard technology, discarding the user perspective in the development of such products and requiring seafarers to merely adapt and comply once the technology is implemented as this study reveals, can all be explained by the wider developments discussed above. It corresponds to the statements made earlier [6] of the shipping industry where widespread *laissez-faire* approach has resulted in significant restructuring of its labour market to the detriment of the seafarer.

There is thus no concerted effort or interest or ownership towards long term and organised development. Any development is then left to be driven by reactionary situations of accidents and incidents which in the maritime industry have severe limitations in getting to the root of the causal factors to drive meaningful change. Worse still, there is failure to see the seafarer coping with abnormalities and evolving practices then get built on this 'new normal' that even start defining *rule-making* practices. In complex systems, there are 'latent pathogens' normally tolerated in the system but 'awakened' by a specific situation and then create a causal link leading to an accident. The seafaring culture of 'making everything work,' as highlighted in this thesis and seen to be accepted by the organisation is a potent ground for harbouring such latent pathogens. As Wynne [45] has argued, contextual normalisation of working technologies takes place according to local rationalities but this fragments the overall social nature of technology while evolving its informal practical rules. A general perception remains that just before the accident everything was perfectly normal. Thus a holistic application of sociology of scientific knowledge in better understanding of technology remains stunted. Technologies get evaluated by their external effects or risks alone but not by the relationships that may be intrinsic to them. As science becomes an increasingly economic resource in industrial competition, the rush to exploit scientific knowledge as commercial technologies allows less time and social access in pilot phases. Thus wider systems problem arise often more acutely during commercial lifetime of technologies.

Related is the causal factor of limited end-user participation in the design and development of technology integrated functions. This effectively means that the knowledge and experience of seafarer is scarcely entered into the information networks which inform the design process. There also is lack of appreciation that end-users contribute important workplace knowledge on processes, tasks, equipment and potential risks. Ethnography with participatory user analysis of contextual enquiry does not find a place in the design considerations, which is a critical factor in the success of any interactive systems function. The most important objective is to achieve usability which is defined by Fiset [13] as, "...the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a special context of use..."

Limited application of human factors engineering is then evidenced in the design and operations of technology integrated practice. The focus remains technology, engineering and equipment rather than cognitive and social ability of operation in an integrated environment with due regard to human characteristics, limitations and the ergonomics. This thesis has investigated that the socio-technical theory as a systems approach focuses on the interdependencies between and among people, technology and organisational environment that provided the holistic construct. Clearly then, the socio-technical theory remains as valid today as it was in the 1950s. We continue to live in a world greatly affected by technology; so much so that we take for granted the choices made for us by the technical system designers. Today as in the past, the socio-technical paradigm calls on us to question the design assumptions underlying technical systems to ask, "Is this the best way to design and utilise technology for people and society?" So also, when attempting optimisation, to question "Whether we have assessed the degree of joint optimisation of social and technical systems in light of the demanding external environment?" Both the technical and the social systems must produce positive outcomes. This method contrasts with the traditional that first designs the technical component and then fits it to people, as is seen to be widely practiced in the shipping industry. The traditional method as seen often leads to mediocre performance at high social costs [10]. The cause lies in the organisational context of rewards and sanctions in case of high technology systems. The shore based management finds appeals of speed, power and manoeuvrability in current sophisticated design winning over concerns of ease of operation or maintenance. The costs in excessive fatigue and workload are borne by the seafarers who make the systems work on daily basis as their feedback on poor design is judged as self-serving [32].

This section has analysed the technology potential gap in terms of theoretical framework generally applicable in other sectors. Exacerbated in the shipping industry environment due to its unique structure and disposition, the un-optimised technology integration results in the seafarer who is the driver of technology, become a victim of the circumstances. The technology that was intended to ease the seafarer's operations and burdens ends up in controlling him, even leaving him under-resourced with fewer crews and causing fatigue. Influences of strong community of practices then manifest his frustrations as resistance and hindrances to technology integration from the ship standpoint. There is a large gap in what seems technically rational in concept and intent and what actually gets implemented in the shipping industry.

## 7. OVERALL REFLECTIONS

It needs to be appreciated that the challenges and potential of technology integration into management practices ultimately translate into human performances. Human performances and human-system integration will never be effective unless it is seen by all stake-holders as an integral part of the entire systems engineering process, from initial exploration and concept evaluation through operational use, even reengineering; and be responsive to users' needs.

By bringing to light the limited application of some fundamental principles of human-systems integration and discussing the broad underlying optimisation potential of ship operations and ship management, this study has attempted to expand the boundaries of research on the subject in the maritime industry, in a way that both contributes to academic knowledge and has significance for those in the industry. It thus achieves the objectives that the study set out for itself.

Credibility of a study involves the level of truth value that it achieves by investigating the level of engagement which allows an analyst to build trust and learn about the setting under investigation. Adequate engagement was achieved in the settings of the three companies and the ships staffs' interviews. Respondent validation was achieved in all analyses.

Due to the rigour applied in the application of appropriate methodology it can be claimed that the findings while emerging from the study of three specific companies do relate to the wider context in the maritime sector.

This study thus contributes to the better and holistic understanding of the impacts of technology integration in ship management processes and its productivity, thus providing a better picture of this take up in the shipping industry.

## 8. REFERENCES


[1] ALDERTON, T. and WINCHESTER, N., Globalisation and de-regulation in the maritime industry, *Marine Policy, 26*, 35-43, 2002

[2] ALDERTON, T., BLOOR, M., KAHVECI, E., LANE, T., SAMPSON, H., THOMAS, M., WINCHESTER, N., WU, B. and ZHAO, M., *The global seafarer: living and working conditions in a globalised industry*, International Labour Office, Geneva, 2004.

[3] ALLEN, P. Perceptions of technology at sea amongst British seafaring officers, *Ergonomics, 52 (10):* 1206-1214. Doi: 10.1080/00140130902971924, 2009

[4] ARVANITIS, S. and LOUKIS, E.N., Information and communication technologies, human capital, workplace organisation and labour productivity: a comparative study based on firm-level data for Greece and Switzerland, *Information Economics and Policy, 21 (1)*, 43-61, 2009

[5] BARNETT, M., DAVID, G. and PEKCAN, C., *Non-technical skills: the vital ingredient in world maritime technology?* Paper of IMarEST, downloadable from the Nautical Institute's website at: http://www.he-alert.org/documents/published/he00515.pdf, 2006

[6] BHATTACHARYA, S. Sociological factors influencing the practice of incident reporting: the case of the shipping industry, *Employee Relations, 34 (1)*, 4-21, Doi: 10.1108/01425451211183237, 2012

[7] BILLBSBERRY, J., *There is nothing so practical as a good theory: How can theory help managers become more effective*, The Effective Manager: perspectives and illustrations, Sage publications, 1996

[8] BOYNE, R., Post-panopticism, *Economy and Society, 29(2)*, 285-307, 2000

[9] CHENG, L.C., GIBSON, M.L., CARRILO, E.E. and FITCH, G., A technology-centric framework for investigating business operations, *Industrial Management & Data Systems, 111 ( 4)*, 509-530, Doi : 0.1108/02635571111133524, 2011

[10] CHERNS, A., Principles of socio-technical designs revisited, *Human Relations, 40*, 153-162, 1986

[11] COLLINS, P. AND HOGG, J. M., The Ultimate Distributed Workforce: the use of ICT for seafarers, *AI& Society, 18*, 209-241, Doi: 10.1007/s00 146-003-0287-5, 2004

[12] DUMONT, M., STOJANOVSKA, N. and CUYVERS, L. World inequality, globalisation, technology and labour market institutions, *International Journal of Manpower, 32 (3)*, 257-272, Doi: 10.1108/01437721111136750, 2011

[13] FISET, J. Y., *Human – Machine Interface Design for Process Control Applications*, Research Triangle Park, NC 27709, USA, ISBN 978-1-934394-35-9, 2009

[14] FRANKEL, E. G., The economics of technological change in shipping, *Maritime Policy and Management, 18-1*, 43-53, Doi: 10.1080/03088839100000005, 1991

[15] GUBA, E. G., *The Paradigm Dialog*, New Delhi: Sage. ISBN 0-8039-3823-3, 1990

[16]GUTTAL, S., Globalisation, *Development in practice, 17 (4-5)*, 523-531, Doi: 10.1080/09614520701469492, 2007

[17] HELPER, S. and SAKO, M., Management innovation in supply chain: appreciating chandler in the twenty-first century, *Industrial and Corporate Chang, 19 (2)*, 399-429, 2010

[18] ILO, *Impact on seafarer's living and working conditions of changes in the structure of the shipping industry*, ILO, Geneva, 2001

[19] ILO, *A fair globalisation: The role of the ILO*, Report of the Director-General on the World Commission on the social dimension of globalisation, Geneva, 2004

[20] JENKINS, R., Globalisation, production, employment and poverty: debates and evidence, *Journal of International Development, 16*, 1-12, 2004

[21] JOHNSON, H. *Towards understanding energy efficiency in shipping*, PhD thesis, Department of Shipping and Maritime Technology, Chalmers University of Technology, Gothenburg, Sweden, 2013

[22] KING, J., Technology and the course of Shipping, *Ocean and Coastal Management, 44*,567-577, 2001

[23] KNUDSEN, F., Paperwork at the service of safety? Workers' reluctance against written procedures exemplified by the concept of 'seamanship', *Safety Science, (47)*, 295-303, Doi: 10.1016/j.ssci.2008.04.004, 2009

[24] LORANGE, P., Strategic re-thinking in shipping companies, *Maritime Policy and Management, 28 (1),* 23-32, 2001
[25] LYRIDIS, D.V., FYRVIK, T., KAPETANIS, G.N., VENTIKOS, N., ANAXAGOROU, P., UTHAUG, E. and PSARAFTIS, H.N., Optimizing shipping company operations using business process modelling, *Maritime Policy and Management, 32*(4), 403-420, Doi: 0.1080/03088830500300636, 2005
[26] MAALOE, E., Explorative Integration – the expansive cyclic, multi-theoretical approach to case research, course notes, The School of Business at Aarhus University, Aarhus, Denmark, 2010
[27] MUNCK, R., *Globalisation and labour: the new 'Great Transformation',* Zed Books, London, 2002
[28] OECD, *OECD Science, Technology and Industry Scoreboard,* OECD, Paris, 2011
[29] ONDER, N. Integrating with the global market: The State and the crisis of political representation, *International Journal of Political Economy, 28 (2),* 44-84, 1998
[30] ORLIKOWSKI, W.J., The duality of technology: rethinking the concept of technology in organisations, *Organisation Science, 3 (3),* 398-427, 1992
[31] PANAYIDES, P.M., Competitive strategies and organisational performance in ship Management, *Maritime Policy and Management, 30(2),* 123-140, Doi: 10.1080/0308883032000084850, 2003
[32] PERROW, C., The organisational context of human factors engineering, *Administrative Science Quarterly, 28 (4),* 521-541, 1983
[33] POWELL, W.W., Review essay: explaining technological change, *American Journal of Sociology, 93 (1),* 185-197, 1987
[34] RYAN, A.B., *Post-Positivist Approaches to Research,* In: Researching and Writing your thesis: a guide for postgraduate students, MACE: Maynooth Adult and Community Education, pp. 12-26, http://adulteducation.nuim.ie/documents/Thesis.pdf., 2006
[35] SERVAIS, J.M., Globalisation and decent work policy: reflections upon a new legal approach, *International Labour Review, 143 (1-2),* 185-207, 2004
[36] SHARMA, K. K., Integrative approach to services management: A study of global ship management, paper presented at the *10th International Research Seminar in Service Management* in La Londe, France, Available from:http://www.cerog.org/lalondeCB/SM/2008_lalonde_seminar/Papers/S2-3-2_SHARMA_Integrative_approach_to_sces_management.pdf., 2008
[37] SHEA, I.P., *The organisational culture of a ship: A description and some possible effects it has on accidents and lessons for seafaring leadership,* Ph.D. thesis, University of Tasmania, Australia, 2005
[38] STIGLITZ, J., Employment, social justice, and societal well-being, *International Labour Review, 141 (1-2),* 9-29, Doi: 10.1111/j.1564-913x.2002.tb00229.x, 2002
[39] STIGLITZ, J., Innovation: a better way than patents, *New Scientist, 191,* 20, 2006
[40] STOPFORD, M., Defining the future of shipping markets, *Presentation at the ITIC Forum 2000: Innovative Thinking is Crucial,* London, UK, 2000.
[41] STOPFORD, M., *Maritime Economics,* (3rd edn.), Oxon, UK, Routledge, 2009
[42] THAI, V.V., Service quality in maritime transport: conceptual model and empirical evidence, *Asia Pacific Journal of Marketing and Logistics, 20, (4),* 493-518, Doi: 10.1108/13555850810909777, 2008
[43] WIENER, J.B., The regulation of technology and the technology of regulation, *Technology in Society, 26,* 483-500, Doi: 10.1016/j.techsoc.2004.01.033, 2004
[44] WILLIAMSON, O. Transaction-cost economics: the governance of contractual relations, *Journal of law and economics 22 (2),* 233-261, 1979
[45] WYNNE, B., Unruly technology: Practical Rules, Impractical Discourses and Public Understanding, *Social Studies of Science, 18 (1),* 147-167, 1998
[46] YANG, K.H., LEE, S.M. and LEE, S.G., Adoption of information and communication technology: impact of technology types, organisation resources and management style, *Industrial Management and Data Systems, 107 (9),* 1257-1275, Doi: 10.1108/02635570710833956, 2007
[47] YIN, R.K., *Case Study Research: Design and Methods,* New Delhi, India, Sage publications, ISBN-13: 978-1412960991, 2009
[48] ZAMMUTO, R.F., GRIFFITH, T.L., MAJCHRZAK, A., DOUGHERTY, D.J. and FARAJ, S., Information Technology and the changing fabric of organisation, *Organisation Science, 18 (5),* 749-762, Doi: 10.1287/orsc.1070.0307, 2007
[49] ZUBOFF, S., *In the age of Smart Machines,* Basic Books, USA, 1998

# THE EFFECT OF SHIPBOARD MARINE SIMULATION ON STUDENT SUCCESS IN RADAR COURSES

BROWNE D. STEVEN

*California Maritime Academy, USA*

**ABSTRACT**

Historically, a large percentage of maritime cadets, as many as 25% in some years, have failed the Radar/ARPA class (DL-325) at California Maritime Academy (CMA). This high failure rate has resulted in delayed progress towards graduation and the requirement for additional instructor and classroom resources necessary to teach the same students twice. In May and June of 2012, aboard CMA's training ship, *Golden Bear*, first-year cadets participated in 30 hours of intensive radar training utilizing the ship's new Navigation Laboratory (NavLab). The NavLab contains a part-task integrated bridge electronic systems trainer (IBEST). The NavLab provides the capacity to train up to 20 students simultaneously on simulated radar and automatic radar plotting aids (ARPA) units. In the Fall semester of 2012, every student passed the Radar/ARPA course. This positive result could be attributed to the radar training the cadets received utilizing the simulation system onboard the *Golden Bear* and illustrates the benefits of incorporating simulation technology into Maritime Education and Training (MET) programs.

**Keywords:** *Radar Training, ARPA Training, Shipboard Marine Simulation, Maritime Education and Training.*

## 1. INTRODUCTION

In order to be licensed as Third Mate upon Oceans in the United States, a prospective mariner must complete a Radar-Observer course and an Automatic Radar-Plotting Aids (ARPA) course that have been approved by the United States Coast Guard [1]. This requirement parallels that of the Standards of Training, Certification and Watch keeping (STCW) Code for Officer in Charge of a Navigation Watch (OICNW) [2]. To meet these requirements, Marine Transportation cadets at the California Maritime Academy (CMA) in Vallejo, California, USA, take a combined Radar/ARPA course (DL 325) during their 3rd Class (sophomore) year [3]. Before the Fall semester of 2012, this course was the first exposure to those topics for most students. Historically, cadets have failed this class at a very high rate. In some years, more than 25% of registered students failed to complete the course requirements. As a result, failing cadets have to repeat the course the following semester or the next year, delaying their progress towards graduation. This high failure rate also results in increased requirements for instructor and facility resources to serve repeating students.

During the summer (May and June) of 2012, 3rd class Marine Transportation cadets participated in five days of radar and ARPA training using simulation equipment aboard CMA's training ship, *Golden Bear*. This was the first time this training was offered at the Academy and the first exposure that this group of cadets had to the subjects. During the following academic term (September to December), approximately half of the cadets (n=44) enrolled in the Radar/ARPA course conducted at the CMA campus in Vallejo, California. This paper will examine the effect of the radar and ARPA training conducted on the *Golden Bear* on student success rate in the subsequent course taught on campus.

## 2. SHIPBOARD SIMULATION ON TRAINING SHIP *GOLDEN BEAR*

As a course prerequisite to Radar/ARPA (DL 325), Marine Transportation (deck) cadets must complete Sea Training (CRU 100), a 2-month training voyage onboard CMA's training ship, *Golden Bear* (TSGB) [3]. Typically, cadets take CRU 100 during the summer prior to their 3rd class year at the Academy. In recent years, student enrollments at the California Maritime Academy have rapidly increased; this increase strained the resources of the *Golden Bear* and limited training opportunities. In 2005, for example, 38 cadets enrolled in CRU 100. They were placed in training groups of 12 or 13 students that rotated through three duty assignments: bridge watchkeeping, on-deck maintenance and practical seamanship training. Over the course of the 2-month voyage, each cadet stood approximately 19 4-hour watches on the bridge. Since 2005, the number of cadets enrolled in CRU 100 steadily increased, reaching 78 in 2012, an increase of 105.3% in 7 years. (The number of enrolled students is projected to increase to 85 in the summer of 2013.) Due to the increased enrollment, the number of training groups was increased from three to five to include classroom-based training and simulation training, and the average number of bridge watches per cadet dropped from 19 in 2005 to 9 in 2012. (See Figure 1).

In order to increase both the quantity and quality of training offered to the increasing number of cadets on the training ship, California Maritime Academy constructed a multi-million dollar Navigation Laboratory (NavLab) onboard the *Golden Bear* [4]. The NavLab on the ship contains a full-mission bridge simulator and a part-task integrated bridge electronic systems trainer (IBEST), (See Figure 2). The full-mission bridge (FMB) simulator, in the forward compartment of the NavLab

consists of an Integrated Navigation System and three display monitors (See Figures 3 and 4).

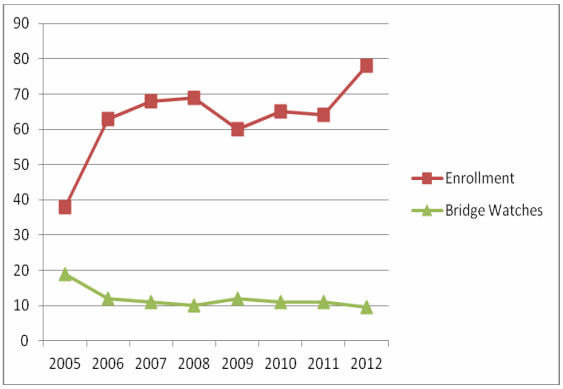



Figure 1 Enrollment and Bridge Watches (2005-2012)

The IBEST, in the after compartment of the NavLab, consists of 10 simulation stations that can be used to train up to 20 students on radar, automatic radar plotting aids (ARPA), electronic display and information systems (ECDIS), ship handling and navigation (See Figures 5 and 6). The primary purpose of the NavLab is to provide 1st class (senior) cadets opportunities to gain additional watch keeping experience in the FMB while on the training voyage. It also is used to introduce 3rd class cadets, enrolled in CRU 100, to the use of radar, ARPA and ECDIS equipment in the IBEST.

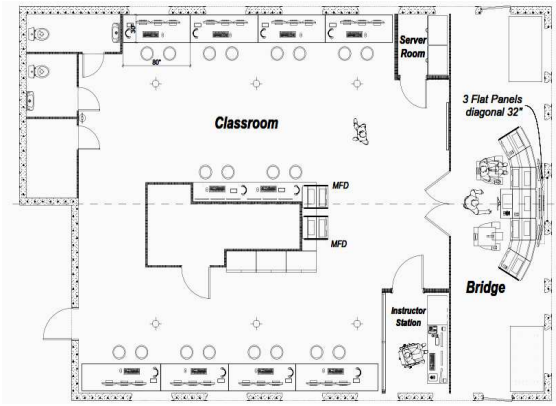



Figure 2 NavLab Layout

Figure 3 Full Mission Bridge (FMB)

Figure 4 Cadets training on the FMB

Figure 5 IBEST Student Station

Figure 6 Cadets using the IBEST

The NavLab was completed in 2011 and fully utilized for training during the *Golden Bear*'s training voyage of May and June, 2012. During the voyage, the 78 cadets enrolled in CRU 100 received five days (approximately 30 hours) of radar and ARPA training in the IBEST. During that period, 2½ training days (approximately 15 hours) were utilized for the teaching and learning of radar plotting techniques for collision avoidance. The remaining 2½ days (again, approximately 15 hours) were used for training in radar navigation and the use of ARPA in collision avoidance.

This was the cadets' first formal exposure to these topics in their curriculum. In the Fall semester of 2012, 44 of the students that had received the shipboard training enrolled in the Radar/ARPA course (DL 325) on the CMA campus.

## 3. STUDENT FAILURE RATE IN RADAR/ARPA COURSE (DL 325), 2003 to 2011

The Radar/ARPA course (DL 325) at CMA consists of a lecture portion and a lab portion. Each week, for 14 weeks, enrolled cadets attend two 1-hour lectures and two 2-hour labs, a total of 84 instructional hours each semester. Radar and ARPA theory is taught during the lecture periods, while the lab periods are utilized for hands-on training and assessment of radar plotting techniques for collision avoidance, radar navigation skills and the use of ARPA. The lecture is conducted in a lecture hall and each section of the course typically is limited to 24 students due the room capacity. The lab is conducted in the Radar/ECDIS Lab in the Simulation Center on campus which is fitted with 8 radar/ARPA simulation stations and each section is limited to 16 students. Students are scheduled to take the course either in the Fall or Spring semester of their 3rd class years at the Academy, depending on the first letter of their last names.

The Radar/ARPA course is graded on a Credit/No Credit basis. In order to receive credit, a cadet must achieve passing scores on: a radar plotting test in week 5 (90% or better to pass), a radar skills assessment in week 7 (100% to pass), a written exam on radar theory in week 9 (70% or better), a written exam on ARPA theory in week 14 (70% or better), and an ARPA skills assessment in week 14 (100%). If a student fails to achieve a passing score on any of the assessments, a grade of No Credit is issued and the student is dropped from the course at the time of the failure.

### *3. Historical Success Rate*

From the Fall of 2003 to the Fall of 2011, cadets failed DL 325 at a high rate. (Although the course is offered in both the Fall and Spring semesters, only the data from the Fall semester is examined in this paper. This is deemed to be appropriate because course data for the Spring of 2013 is not yet available.) The failure rate has varied from a low of 6.1% to a high of 25.5%. During the time period, the overall failure rate was 16.4%. (See Table 1)

Table 1. DL 325 failure rate by year

| Semester | Year | Enrolled | Credit | No Credit | % No Credit |
|---|---|---|---|---|---|
| Fall | 2003 | 46 | 38 | 8 | 17.4% |
| Fall | 2004 | 44 | 33 | 11 | 25.0% |
| Fall | 2005 | 32 | 28 | 4 | 12.5% |
| Fall | 2006 | 43 | 37 | 6 | 14.0% |
| Fall | 2007 | 36 | 30 | 6 | 16.7% |
| Fall | 2008 | 51 | 38 | 13 | 25.5% |
| Fall | 2009 | 49 | 46 | 3 | 6.1% |
| Fall | 2010 | 53 | 43 | 10 | 18.9% |
| Fall | 2011 | 54 | 48 | 6 | 11.1% |
| Total: | | 408 | 341 | 67 | 16.4% |

Seven instructors taught DL 325 sections in the years 2003 to 2011. Instructors were assigned to teach DL 325 based on the needs of the Academy and the availability of the instructor. Some instructors taught DL 325 as many as 5 semesters in the time period (e.g. Instructor #1), while other instructors taught the course once (e.g. Instructor #6.) Table 2 shows the student failure rate by instructor (with names removed.) Over the course of the decade, two instructors, #1 and #3, failed 20% or more of the students enrolled in their classes. The causes of the variance of the failure rate by instructor were not explored.

Table 2. DL 325 failure rate by instructor

| Instructor | Enrolled | Credit | No Credit | % NC |
|---|---|---|---|---|
| #1 | 113 | 89 | 24 | 21.2% |
| #2 | 94 | 83 | 11 | 11.7% |
| #3 | 90 | 72 | 18 | 20.0% |
| #4 | 41 | 36 | 5 | 12.2% |
| #5 | 39 | 33 | 6 | 15.4% |
| #6 | 17 | 16 | 1 | 5.9% |
| #7 | 14 | 12 | 2 | 14.3% |
| Total: | 408 | 341 | 67 | 16.4% |

### *3.2 Repercussion of High Failure Rate*

Radar/ARPA (DL 325) is a prerequisite course for 10 other courses in the Marine Transportation curriculum [3]. Accordingly, students that fail DL 325 are stalled in their progress towards graduation and must retake DL 325. Retaking the course in a subsequent semester increases the academic burden on the student due to the additional course load that semester.

The high failure rate has an impact on the Academy as well. Each semester a significant portion of the students enrolled in DL 325 are attempting the course for the 2nd or 3rd time. Because of the small number of students allowed per lecture (24) and lab (16), the Academy often must add additional sections of the course to serve the repeating students. The addition of course sections requires classroom space and instructors. In the past 10 years, 7 additional course sections have been added to the schedule to serve repeating students, necessitating the hiring of the equivalent of one full-time instructor.

## 4. STUDENT SUCCESS RATE, FALL 2012

### *4.1 Results*

As discussed earlier, 78 3rd class cadets participating on the training voyage of the *Golden Bear* in the summer of 2012 received radar and ARPA training in the new NavLab facility. This was the first year cadets received such training on the ship. In September of 2012, 44 of those cadets enrolled in Radar/ARPA (DL 325). Instructor #1 was assigned to teach 27 of the cadets, while Instructor #3 taught the remaining 17 students. As indicated by Table 2, these are the instructors with the highest failure rate in the past 10 years. At the conclusion of the course taught in the Fall of 2012, every student passed the course. This was the

only time in the 10 years examined by this study that the failure rate was 0%.

Upon the completion of DL 325, Instructors #1 and #3 were interviewed by the author. They reported that the course was conducted using the same academic standards as in previous years. In their opinions, every cadet passed the course because they were better prepared due to the training received aboard the *Golden Bear*.

*4.2 Student Survey*

At the end of the course, students were asked to complete a brief survey regarding the training conducted aboard the ship and the Radar/ARPA course conducted on campus. The survey consisted of six questions:

1. The Radar/ARPA training I received on cruise (CRU 100) was beneficial.
2. The Radar/ARPA training on cruise helped my performance in the Radar/ARPA class on campus.
3. I recommend that the Radar/ARPA training on cruise continue to be offered on CRU 100.
4. I recommend that the Radar/ARPA training on cruise remain the current length (5 days).
5. I recommend that the Radar/ARPA training on cruise be shortened (less than 5 days).
6. I recommend that the Radar/ARPA training on cruise be lengthened (more than 5 days).

The survey utilized a Likert-type scale in which 5 meant "strongly agree", 4 meant "agree", 3 meant "neutral", 2 meant "disagree" and 1 meant "strongly disagree". Forty (40) surveys were completed and returned.

On question 1, the mean was 4.78 and the median was 5. Thirty-nine cadets either strongly agreed (n=33) or agreed (n=6) while only one disagreed with the statement. Similar results were returned for question 3, which returned a mean of 4.93 and a median of 5, with every student either strongly agreeing (n=37) or agreeing (n=3). These results clearly indicate that the students highly valued the training they received and suggest that it be continued to be offered in the future.

Question 2 returned similar results: an average of 4.6 and a mean of 5, with 26 participants indicating that they strongly agree, 12 agreeing and 2 neutral. From these results, it is apparent that the cadets view the training conducted on the *Golden Bear* as contributing to their success in the course.

Survey questions 4, 5 and 6 returned mixed results. 27 out of 40 respondents (67.5%) agreed or strongly agreed that the training should continue to be 5 days in length but 21 participants (52.5%) also agreed that the training should be lengthened. These are contradictory results, but it is plain that most students agree that the training should be 5 days or longer in length. This is supported by the responses to question 5, in which 35 students (87.5%) disagreed or strongly disagreed that the training should be shortened.

*4.3 Limitations*

The student success rate in the Radar/ARPA course in the Fall of 2012 was unprecedented. For the first time in the 10 years examined in this study, every student passed the course. The students in the course attribute their success to the training received aboard the *Golden Bear*. The course instructors agree. Due to the unavailability of other data, however, it would be inappropriate for the author of this study to claim that the training was the causative factor in the students' success. Other data, if available, might reveal other causes. For example, although the grade point average (GPA) and math proficiency scores were obtained for the current students, that data was not accessible for those that took the course in previous years. Perhaps that data would reveal that the cohort of cadets in the Fall of 2012 are smarter or academically better prepared than their predecessors. If so, that would certainly have contributed to their success in the course.

## 5. CONCLUSIONS

The Navigation Labratory onboard the *Golden Bear* was created to solve a specific problem: the reduction in the quality and quantity of OICNW training offered to California Maritime Academy cadets due to rapidly expanding enrollments. It contributed to that goal by allowing CMA faculty to provide an additional training rotation in a world-class ship-based simulation center. This has reduced the number of cadets on the navigation bridge at any one time, ensuring that each cadet on the bridge is not merely an observer but a true watch stander. In addition, it has also provided cadets the opportunity to stand several quality watches in a simulated bridge environment.

The faculty and cadets at CMA also view the NavLab as having contributed to student success in academic courses through early exposure to radar and ARPA concepts. This sucess has the potential to improve graduation rates and time to program completion, and to save the Academy money by removing the necessity of teaching the same students twice.

Although the construction and equiping of the NavLab was very expensive, California Maritime Academy considers it money well spent. In the summer of 2013, the *Golden Bear* will sail again and the cadets onboard will again receive radar and ARPA training, but this year the training will be lengthed to 10 days.

## 6. REFERENCES

[1] United States Code of Federal Regulations, 46 CFR Part 11, www.ecfr.gov.

[2] International Maritime Organization, *Standards of Training, Certification and Watchkeeping, Table A/II-1*, 2011.

[3] California Maritime Academy, *Undergraduate Catalog 2012-2013*, Vallejo, CA, USA.

[4] LEYDA, P., BROWNE, S., COLEMAN, D., *Combining Advanced Marine Simulation with Real Mode Capacity to Enhance OICNW Shipboard Training*, Proceedings of MARSIM 2012, International Marine Simulator Forum, 2012.

# MARKET POWER, MERGERS AND CONCENTRATION OF LOGISTICS CHAINS: A REVISIT OF THE IMPACT OF ECONOMIC RECESSION ON MARITIME TRANSPORT

CHEN QI

*Massachusetts Maritime Academy, USA*

**ABSTRACT**

In recent years, many maritime companies have been actively engaged in vertical and horizontal integrations to survive the economic recession and gain an edge on their competition. As a result, the merged companies hold greater market shares, gain control over logistic chains and become more cost effective and potentially profitable. The paper examines the unique features of vertical and horizontal integrations of upstream and downstream maritime companies, and looks into the consequences of the more concentrated maritime industry affecting cost efficiency, market shares, profitability, further reorganization and scale changes in industry structures. The findings indicate that with vertical and horizontal integrations of shipping and port companies, the maritime industry tends to be more concentrated, more cost effective and ascertain of rents. However, the excess supply, derived from the decreased demand for vessel shipping and overcapacity in TEU throughput, continues to hinder the recovery and expansion of maritime companies and their motivations to seek higher profit margins.

**Keywords:** *horizontal integration, vertical integration, industry concentration, market power, maritime transport.*

## 1. INTRODUCTION

Globalization and borderless operations in manufacturing and services industries are creating greater demand for international transport and logistics. Maritime shipping is one of the key components in this business pattern with up to 80% of global trading freights being moved by maritime mode. Therefore, the worldwide economic downturn since 2008 caused by an unprecedented financial crisis has made a monumental impact on the maritime industry. Shipping and port companies have experienced harsher competition and lower profitability primarily due to the decreased demand for international trade and transportation. To survive the economic recession and gain an edge on their competition, many maritime companies in recent years have become increasingly engaged in vertical and horizontal integration. Big players, like shipping and terminal operating companies, would acquire smaller, but strategically selected organizations. Hinterland transport companies and other maritime services such as storage and the transport of goods would become instrumental assets. As a result, the merging companies hold greater shares within the logistics chains and operate more efficiently. This will change not only the market structure of maritime industry by becoming more consolidated, but also the nature of competition. Maritime companies are selected not for their individual profits, but on the basis of whether they are part of successful logistics chains.

By examining the vertical and horizontal integrations in the new wave of mergers and acquisitions that date back to the mid-1990s, it reveals the rationality behind such strategic business manoeuvre of the maritime companies. The consequences of a more concentrated maritime industry are the effects on cost efficiency, market shares, profitability, further reorganization, and scale changes. Some companies successfully gain control over the logistics chains from production site to final destination through the acquisition of hinterlands, storage space and docks. Findings indicate that with the vertical and horizontal integrations of shipping and port companies, scale and scope effects could bring merged companies higher business rent, cost efficiency, optimization of input sources, and an advantageous position against their rivals. A few colossal companies like Maersk hold such a large amount of market shares that it raises the concern over the risk for the monopolistic or oligopolistic power in the maritime industry. However, the excess supply, derived from the decreased demand for vessel shipping and overcapacity in TEU throughput, continues to hinder the recovery and expansion of maritime companies and their motivations to seek higher profit margins.

The paper is structured as follows: Section 2 explains the features of horizontal and vertical integration in the maritime industry and reasons for the mergers and acquisitions. Section 3 presents consequences of the strategic move of maritime companies and identifies challenges in front of maritime companies under the current economic and financial situations, and Section 4 concludes.

## 2. HORIZONTAL AND VERTICAL INTEGRATIONS AND REASONS FOR MERGERS AND ACQUISITIONS

Every merger and acquisition is designed to make the players a higher profit and the companies engaged such action would achieve economy of scale, increased management efficiencies, full utilization of the financial market, and be able to exploit synergies between rival operations and markets. Maritime mergers and acquisitions can be further categorized into two groups: horizontal integration, the mergers between shipping companies, or vertical integration, the mergers between a shipping and terminal operation company (TOC). Horizontal integrations emphasize the motivation for a

scale and scope of economy, while vertical integration intends to gain control over logistics chains.

*2.1 Analysis of recent merger cases*

Since the second half of 1990s, there has been a noticeably increased trend of both horizontal and vertical integrations in the maritime industry. An unprecedented 30 merger cases indicate the new wave of business practices in regards to shipping and port companies. Table 1 lists the most important cases of mergers and acquisitions (M and A) for that period:

Table 1. Important M and A Cases 1995-2006

| Year | Maritime M and A |
|---|---|
| 1999 | Hanjin acquiring DSR-Senator |
| 1999 | Maersk acquiring Safmarine |
| 1999 | Maersk acquiring Sea-Land |
| 2005 | Hapag Lloyd acquiring Canada Pacific Ships |
| 2006 | Maersk acquiring MSC |

Source: Containerization International, See D. and V. 2009

Let's take A.P. Moller – Maersk Group for a case study and see how the company's engagements in a series of mergers and acquisitions between mid-1990s and mid-2000s have placed Maersk in the position of being the largest container ship operator and supply vessel operator in the world.

In January 1999, A.P. Moller – Maersk Group acquired Safmarine Container Lines, a South African shipping company, for $240 million. At the time of acquisition, Safmarine operated approximately 50 liner vessels and a fleet of about 80,000 containers. It covered a total of ten trades and fully complemented Maersk Line's existing network. Since the acquisition, Maersk Line and Safmarine Container Lines have coordinated their respective liner network to offer customers optimal geographic coverage.

On 10 December 1999, Maersk acquired the international container business of Sea-Land Service Inc. for $800 million. Maersk Line changed its name to Maersk Sealand. The acquisition comprised of 70 vessels, almost 200,000 containers, as well as terminals, offices, and agencies around the world. It was a prime example of horizontal as well as vertical integration. After the merger, Maersk - Sealand had 250 container vessels, more than 550,000 TEU in shipping capacity, and became the largest container shipping company in the world.

Between 1990 and 1996, Maersk Line cooperated with P&O Nedlloyd regarding the use of vessels in several services, calling at ports in Europe, Asia, the Middle East, and the USA. On 11 August 2005, the A.P. Moller - Maersk Group took over all activities in Royal P&O Nedlloyd N.V. At the time of acquisition, Royal P&O Nedlloyd N.V. had 13,000 employees in 146 countries, and operated a total of 156 container vessels with regular calls at 219 ports in 99 countries. As part of the integration with Royal P&O Nedlloyd N.V., Maersk Sealand changed its name to Maersk Line in February 2006.

With the completion of the series of mergers and acquisitions, Maersk's market share in container shipping rose from 10% to almost 15%, and the company was put in a far more advantageous position against its competitors.

While there have been cases of large horizontal integrations leading to a more concentrated maritime industry, vertical integrations have also showed an unprecedented popularity in recent years. Vertical integration is now utilized as a measure by upstream shipping companies to gain control over downstream port companies to subsequently control logistic chains. For instance, in 1998, Maersk acquired Terminal Rotterdam from the APM Terminals, a terminal operating company, and in 2003, Cosco acquired terminal Singapore from PSA. It is reported that eight of the top fifteen terminal operating companies are subsidiaries of shipping companies.

*2.2 Rationality behind mergers and acquisitions*

The rapid globalization process and worldwide economic growth in the last quarter of 20th century has resulted in a rapid increase of international trade. Since up to 80% of international trade utilizes maritime transportation, maritime industry boomed in 1990s which was particularly prevalent in container shipping companies. To seek higher profits, maritime companies were driven to engagement in fleet expansions. However, due to the fact that there had always been excess throughput in liner shipping and the so called "seller's market" for the shipbuilding industry, developing organically was perceived not as quite promising. That is to say, to expand the business by purchasing additional vessels was more or less impeded. To tackle the high operation costs due to rising fuel oil, and labour prices, and to take advantage of the slight relaxation of government antitrust policies, maritime companies pursued the cooperation instead of competition. Mergers and acquisitions were the resolutions sought after to fully realize the potential of cooperation among maritime firms. The trend was accelerated further when Maersk instigated a series of mergers and acquisitions in the late 1990s and early 2000s. By then, Maersk had gained substantial market power and prominent industry shares as its profits surged in comparison to other maritime companies.

The biggest advantage for cooperated companies was the ability to conduct strategic adjustments and fleet reorganization. Through mergers and acquisitions, all related companies could obtain more corporate information, identify new developments in the market trend and strategies of their rivals, lower cost of operation, and expand the allocation of available sources thus optimizing competitiveness and productivity. Mergers and acquisitions would also ensure the possibility to raise the capital necessary for business expansion. On one hand, joint ventures could have relatively easier time raising money from capital market because of their combined capacity. However, on the other hand, they could stem the internal capital flow by letting the company with sufficient funds lend to the

other which would greatly decrease the cost of borrowing money from capital market.

In each form of company integrations, horizontal and vertical, it is intended to increase the profitability of the company with scale economy, diversified business operations, and increased market shares and cost efficiency. Yet horizontal mergers focus more on the scale and scope effects and get an easier access to financial market for money-raising.

For horizontally integrated companies, they have the advantage of controlling fixed costs and reducing the overlap of business operations, making it possible for further specialization and joint efforts in marketing and R&D investments. The impact of scale economy and more diversified business strategies will increase productivity of variable inputs and mitigate the risk of adverse competition from rivals.

Table 2 shows that in the terminal operating business, merging groups have been more successful in increasing market share and obtaining positive financial results. The top company in 2007, HPH, had a market share of 14% with a worldwide throughput of more than 66 million TEU. The top four companies together represent 41% of the worldwide market.

Table 2. Top 4 international terminal operators

| | Turnover In mil. dollars | Throughput In mil. TEU | Throughput shares |
|---|---|---|---|
| HPH | 4,864 | 66.3 | 14% |
| PSA | 3,009 | 58.9 | 12% |
| DP World | 2,731 | 43.3 | 9% |
| APM | 2,519 | 37.4 | 6% |

Source: Containerisation International, See D. and V. 2009

The vertical mergers intend to diversify the business operation with wider span over the upstream and downstream sectors in the maritime industry, and gain control over the logistics chains, which range from production, hinterland transport, storage, vessel loading and unloading, maritime shipping, and ports. The pressing question is how the vertical chain can be organized more efficiently. It was clearly demonstrated that the maritime and port industry has successfully established vertical cooperation. In 2001, Ningbo Port Authority and Hutchison Port Holdings (HPH) were formed into a partnership to jointly operate and develop Ningbo Beilun Port Phase II, with HPH holding 49% shares and NPA 51% of their new joint venture. This is an expert example of a successful vertical integration.

## 3. CHALLENGES FOR MARITIME INDUSTRY

As a result of the numerous mergers and acquisitions over the course of last two decades, market structure of maritime industry has changed immensely. It began as the least concentrated transport industry in comparison to airline and motor carrier industries in 1980s, to distinctly concentrated by the 2000s. The top 20 liner companies held approximately 48% of market shares for container shipping in 80s, while that percentage soared to 75% in 1995 and 82% in 2000. At the same time, the 20 companies occupy only 4% of the total number of the liner companies. That is to say, by 2000, 4% of the liner shipping companies held up to 82% of the market shares. Maersk alone took almost 15% of the market shares in the container shipping market.

The rapidly increasing concentration in the industry has raised considerable concerns over the potential abuse of monopolistic or oligopolistic power in the maritime market. The colossal companies would be motivated to lower the output, increase price, reap super rents, and threaten smaller rivalries with either price or quantity competitions. These would impose higher prices for the demanders of maritime services−the output producers and goods consumers. With the recent economic decline, any increase in additional cost, regardless of how marginal, would be particularly fatal for the producers, who had already experienced more or less rent loss in the recent economic downturns.

However, there are two factors in the maritime industry which might help mitigate the abuse of monopoly power: overcapacity of the industry and organic growth of the merged companies.

For quite some time, overcapacity has been a bottleneck issue for maritime companies. In addition, the economic downturn since 2008 and stagnation of international trade force many shipping companies constantly face the problem of declining demand. The gap between insufficient demand and excess supply in maritime transport resulted in some companies being driven out of market because of rent loss while others taking low profit margins just to survive. Therefore, big companies could be restricted from exercising their monopolistic power, even if they do hold large market shares in the industry. In fact, some companies like Maersk suffer from quite a profit loss in 2009, when the recession just struck the world economy and caused a spirally decreased demand for maritime services.

The organic growth of maritime companies refers to a situation where companies seek to expand their business with additional newly-built transport vessels. In February 2011, CEO of Maersk Eivind Kolding announced that the company would focus on organic growth instead of further mergers and acquisitions for the foreseeable future. To carry out this strategy, the company would place an order for ten of the largest container vessels in the world with 18,000 TEU in throughput from Daewoo Shipbuilding and Marine Engineering (DSME) of South Korea. The advanced container vessels would be built with the latest technological innovations, including the ship design and the energy recycling system. It was estimated that new vessels would reduce carbon emission by 20%, increase energy-saving by 35%, and lower the operating cost by 26%.

Though overcapacity in maritime industry could curb the growing monopolies, it will certainly cause an unintended negative impact on the performance of shipping and port companies. It was estimated that for bulk freight, the throughput of shipping companies grew by 9%, 16.47% and 14.88% in the years 2009, 2010 and 2011 respectively. However, during the same period, the

demand for bulk freight only increased by 4.8%. The excess supply of bulk freight by shipping companies was still as large as 6.1%. Based on the Baltic Dry Index (BDI), the index reading was at 920 in 2012, dropping 40.6% from the year before. Since January 2013, the BDI has been lingering around 900, which indicates not only that the world economy and international trade are still in an unstable position, but also that maritime companies still face difficulty surviving and expanding.

The growth of maritime industries is always closely associated with the current international trade and economy situation. The economic and financial crisis in 2008 brought a worldwide recession marked with declining demand for production, low corporate rent, and high unemployment, which in turn, negatively induced low freight rates and declining demand for services within the maritime industry. Though in the past couple of years, there have been positive signs of global recovery in the economy and international trade, recovery tended to be slow or even stagnant. Newly emerging economies, including the Chinese economy, had a reduced demand for output production, and a rising cost of transport due to higher prices for fuel, oil, and labour. It is reported that from January to November of 2012, the average price for "180 fuel oil" was $677.49 per ton, which was the highest average price in the past 10 years. All these factors will further decrease the industry rent.

## 4. CONCLUSIONS

To seek higher rent, fleet expansion, or even simply to survive the economic and financial crisis, some maritime companies have been actively pursuing reorganization and partnership. Since the mid-1990s, a commonly adopted form of cooperation in maritime trade was mergers and acquisitions, including horizontal and vertical integrations. As a result, the maritime industry tends to be more concentrated as a few large companies hold the majority of market shares and gain control over the logistic chains. The scale and scope effects due to the concentration bring merged companies higher business rent, cost efficiency, optimization of input sources, and an advantageous position against their rivals. It is expected that with economic recovery, international trade will eventually pick up the corresponding momentum and the maritime industry will have a higher demand for vessel services and higher profitability. However, at this point, there is no strong indication of huge increases of profit margins in maritime transport because the excess supply, derived from the declined demand for vessel shipping and overcapacity in TEU throughput, continues to hinder the recovery and expansion for maritime companies.

## 5. REFERENCES

[1] CHOI, N.Y.H., YOSHIDA, S., *Evaluation of M&A Effects in Japanese Shipping Companies: Case Study of NYK & Showa Line and OSK & Navix Line*, The Asian Journal of Shipping and Logistics, Vol. 29, No. 1, pp23-42, April 2013.

[2] DEVOORDE, E.V., VANESLANDER, T., *Market Power and Vertical and Horizontal Integration in the Maritime Shipping and Port Industry*, International Transport Forum, Discussion Paper, No. 2009-2, Jan. 2009.

[3] FUSILLO, M., *Structural Factors Underlying Mergers and Acquisitions in Liner Shipping*, Maritime Economics and Logistics, Vol. 11, 2, 209-226.

[4] MENG, S.S., *A Not So Optimistic Estimation of the Maritime Industry for 2013*, Journalist Report, www.China.com.cn, April 24th, 2013.

[5] QI, S.J., LIU, J., *Analysis of Acquisitions of International Maritime Companies*, Centre of Documents in China, http://www.studa.net/Traffic /100604/14074891-2.html, Oct. 2004.

[6] SAMITAS, A., KENOURGIOS, D., *Impact of Mergers and Acquisitions on Stock Returns of Tramp Shipping Firms*, International Journal of Financial Services Management, Vol.2, No. 4, pp.327-343, 2007.

[7] TIROLE, J., *The Theory of Industrial Organization*, MIT Press, 1990.

[8] WARD, H., *Maritime Mergers and Acquisitions*, Maritime Professional, November 2012.

# SITUATIONAL-BASED TRAINING FOR NAVAL ENGINEERS CASE STUDY: ENGINE ROOM SIMULATOR TRAINING

[1]CHITAC VERGIL, [2]RISTEA MARIAN, [3]POPA ADRIAN

[1,2,3] *"Mircea cel Batran" Naval Academy, Romania*

**ABSTRACT**

The educational process for naval electromechanics officers assumes that they will be prepared to handle unconventional and potential dangerous situations. This requirement can be fulfilled by simulation – a very valuable instrument, which can be used to develop useful skills, both for daily routine and for potentially hazardous situations.

The simulators give to the instructor many advantages, when we are talking about this kind of training; there is the possibility to develop scenarios starting from routine tasks that can develop in potentially dangerous situations.

In the scenario developing process, there are some strict limitations, imposed by the trainee's level of competence, mostly regarding cognitive and behavioral abilities, such as problem solving, decision making and assuming leader position (Millican, 1996). This fact is determining the necessity to adopt measurable elements during the design phase, both for the scenario itself and for the assessment module (referring to the specific activities that the trainee should perform during the exercise). The main goal of the exercise should not be the completion.

**Keywords:** *Engine Room Simulator, assessment, scenario.*

## 1. INTRODUCTION

The seafarers training standards are stated on SCTW provisions (Standards of Training, Certification and Watch-keeping for Seafarers). In this regard, the on-board personnel should accomplish those tasks and responsibilities related to navigation, goods handling and stowage, ship command and operational conduct, carrying safety the automation, communication, mechanical, electrical and electronic systems, solving the maintenance and repairing issues and facing the safety standards for persons, ship and goods as well (Mejia, 2011). The right execution of these tasks is achieved on-board of every kind of trade vessel, in respect for all responsibility levels as managerial, operational and execution one.

In accordance with STCW provisions, the levels of skills and competences that will follow to be accomplished by the seafarers for the right tasks execution on-board, in correlation with international safety standards, are related to those standards of competency or knowledge that includes also the minimum requirements of understanding and application capacities (McLaughlin, 2011).

The managerial level is related to responsibility level of the tasks accomplishment associated to the quality of service overtaking as master, chief, chief engineering, or electrical engineering on-board to maritime vessels, including the full assurance of all duties in area of professional responsibility. Therefore, to operational level concept is attached the responsibility level defined by the on-board particular tasks fulfilment in order to carry out the watch keeping service on the bridge or below to naval machine as officer, mechanical or electric rated officer, as communication specialist and so on. By execution level/auxiliary function is understood the level of responsibility associated with tasks or service obligations fulfilment stated on board to maritime vessels, under the managerial supervision of a person appointed on operational or managerial level.

Simulation training has become a mandatory activity for many professions, especially when this requires real situation expertise. Seafarers training activities benefits more and more of the simulation learning procedures, both on ship manoeuvring and engineering training or in cargo handling activities. Actually, most of the processes onboard vessels or onshore related activities are simulated during the training process, in order to develop the necessary abilities, especially in crisis situations.

The highest reality level is achieved by complex simulation systems, which are capable to work in joint mode. One of these systems is installed in the „Mircea cel Batran" Naval Academy's simulator complex.

The Integrated Ship handling Simulator consists of five subsystems that are able to work simultaneously or independently, and they are:

- Ship Maneuvering Simulator (NTPRO 5000);
- GMDSS Simulator (TGS 4100);
- Electronic Chart Display Information System (ECDIS 3000);
- Navi Harbour VTMS module;
- Engine Room Simulator (ERS 5000 and TechSim);

The main aspect that makes the simulator complex unique in Romania is the possibility to work in joint mode for three types of own ship models:

- 5000tdw Ro-Ro vessel, with a four stroke, supercharged S.E.M.T. Pielstick 16 PC2.2 V-400 main engine, 5966kW installed power;
- 65000 tdw Large Crude Oil Carrier, with a low speed, two stroke MAN B&W 6S60MC main engine, 12240 kW installed power;
- ANZAC frigate, equipped by a combined Diesel or Gas propulsion system, with two medium speed, four stroke MTU 12 V 1163 TB83 engines 3365kW each and a General Electric 7LM2500-PF-MLG1O gas turbine with an installed power of 22500 kW.

The ship manoeuvring simulator facilitates training and certification activities for watch keeping officers, masters and pilots from navy, commercial or fishing vessels. It has an own ship models database with dead eights starting from 500tdw, developed according to the IMO STCW 78/95 course models 7.01 and 7.03.

The database consists of various types of vessels (2 general cargo vessels, 5 port container vessels, 2 ore carrier vessels, 3 tankers, one LPG transport vessel, 3 passenger vessels, 2 tugs and 5 navy vessels). In this way, the most types of vessels onboard which „Mircea cel Batran" Naval Academy's graduates will execute their duties are covered.

The Engine Room Simulator was developed in order to comply with the training requirements for both Electromechanics and Naval Electromechanics cadets, for officers manning the engineering watch, second engineering officers and chief engineers, at operational and managerial level.

The facilities offered by this module can be used in order to:

- perform the initial training for the engineering crew (both for Navy and Merchant Marine);
- implement standard watch keeping procedures in normal conditions;

-achieve advanced training (Engine Room Team Management and Crisis Management);

The Engine Room Simulator complies with the IMO 2.07, 2.08, 7.02 and 7.04 course models.

After considering both the facilities and limitations of the simulator complex, one of the most important elements is represented by the instructor, who will have to act as an interface between the simulated technical processes and the trainees' actions during the exercises.

## 2. THE TRAINING PARTICULARITIES IN MARITIME TRANSPORT

The maritime transport is one of the major components of international trade. Nowadays, in professional studies is underpinned that more than 80% from international trade transactions are undertaken based on this mean of transport, that continues to remain the cheapest transport alternative, being in the same time an requisite factor for goods and services demand discharge (UNCTAD, 2011; Ching Tsung Hung, Fei Ching Chuang, 2012.).

The varied outcome of goods sorts, as rows, industrial products, food products or consumer goods have conducted toward ship technical diversification within international river and maritime fleet, together with port infrastructure and professional training needs for seafarers (Vervoort, 2012; Lindmark, 2012; Lewarn, 2009; Bin Wu, 2005). In these conditions the modern maritime transport has become a higher complexity activity in economic area that claims for specific skills, abilities, knowledge and functional-actionable competences (Nicolae, 2013).

The complexity of maritime transport is coming also from the particular features of the oceans and seas, determining efficient and rigorous measures and standards implementing that should provide the seafarers, goods and ship safety, including here the diminishing of pollution against the environment (EU, 2007). But anyway, in this picture the seafarer, no matter his hierarchical position, as master, chief mechanic on operational level or simple sailor, becomes the essential element of functional relation ,,good-ship-environment-transporter" (Nicolae, 2013).

## 3. SIMULATION TRAINING APPROACHES

The naval simulators are developed according to the international standards, as stated by STCW. The implementation level of these standards is assessed by the classification societies, which most of the times have their own standards for each simulator class. In the presented situation the simulator is recognized by DNV as a „Class A, full mission simulator", based on DNV Standards for Certification No. 2.14.

Many simulated modules from the Engine Room Simulator are generic ones but, on the other hand, most of the functional parameters are describing a real machine (e.g. the main engine). This is the main reason that allows us to customize the simulation scenarios for a certain vessel (not only for a general vessel category).

The general level of a common scenario is appropriate for the knowledge and abilities required for managerial level; in order to perform in proper conditions the training for lower levels of competence, the activities will be treated separately in the first stages of training of the complex and interdependent processes.

By using this approach, the most unexperienced trainee will be able to successfully complete its task during the simulation. The most appropriate example is that during several training meetings, unexperienced trainees will carry activities for the engineering department onboard, but each one at his level. Together they will be able to solve a complex problem with a superior level of difficulty. This approach brings their experience closer to the reality onboard and facilitates gaining new competences.

Considering the necessary stages for a proper simulation scenario, in order to be able to define a correct evaluation system and to proper assess the training goals, the passing score is minimum 70% of the maximum possible, for each module (propulsion system, electrical power plant and auxiliaries). To demonstrate the achieved goal, there will be two assessment types: intermediary (for development) and final assessment with the same goals.

The most important aspect when defining the assessment criteria is to identify precise and measurable outcomes for the training activity.

The algorithm used for the assessment activity is presented in figure 1.

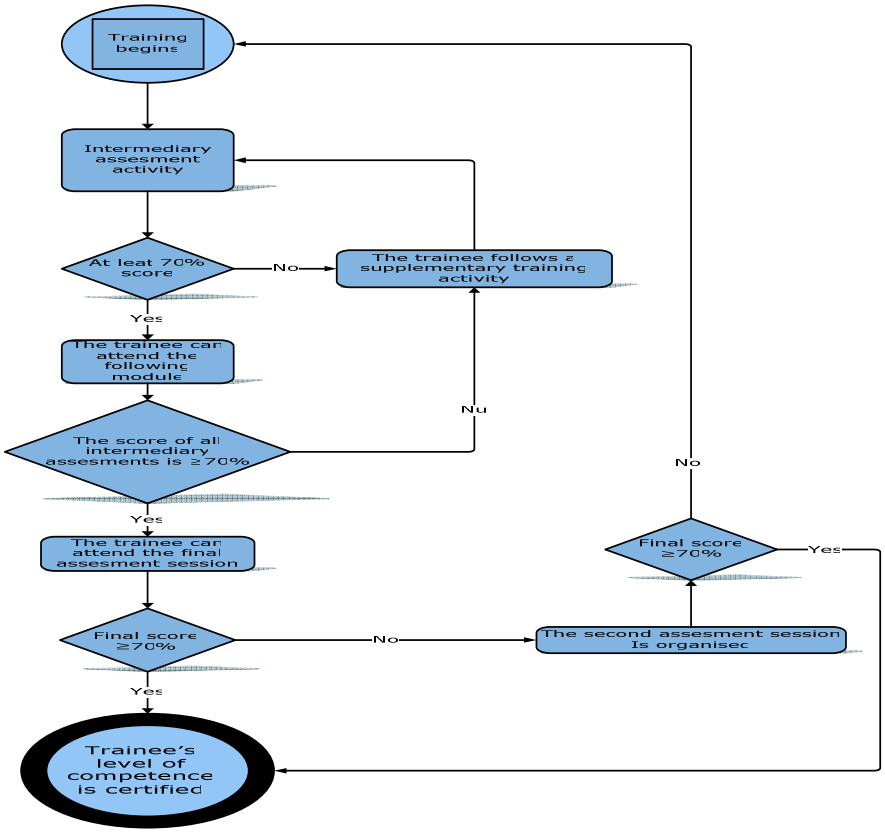



Figure 1. The assessment activity flowchart

In the Engine Room Simulator of „Mircea cel Batran" Naval Academy nine courses were carried from the vocational curricula, according to the STCW A-III/2 section and IMO 2.07 course model. The training is named as „Engine Room Team Management" and its main goal is to create coordinating abilities regarding the engine room watch keeping activities. The course was attended by 108 trainees, with an average of 12 students per session.

At the end of the course, each student completed a satisfaction assessment questionnaire, developed in order to identify the weaknesses for the course curricula. The questionnaire was structured in several sections as: Goals, Structure, The pedagogical strategy,
Infrastructure and Instructor's level of competence. The results are presented in Table 1.

Table 1.Average results of the satisfaction assessment questionnaire

| Questionnaire section | Averaged result |
|---|---|
| 1. Course goal | 4,32 |
| 2. Course structure | 3,89 |
| 3. Teaching method | 3,95 |
| 4. Syllabus | 4,24 |
| 5. Infrastructure | 4,10 |
| 6. Instructor's level of competence | 4,03 |

The level values were determined on a 1 to 5 scale, and the satisfactory level was considered to be higher than 3. Although the results determined a high satisfaction level, we can class each criterion. The course objective has the highest score, while the course structure registered the lowest one.

Based on these results, it was determined that the course structure should be updated, accordingly to the course model specifications, especially regarding the scenarios, the content and scenario difficulty. The remark is that the scenario difficulty level is too high for inexperienced trainees.

The syllabus of the training session involves the development of intermediary stages, like introduction to the simulation environment, simple exercises, on every separate system onboard, being still aware on the differences between the simulated environment and the real system and the mathematical model limits.

During the training activities several corrective assessments can be taken, by observing each trainee during practical activities, in order to determine the mistakes most probably to occur especially in the first stages. In every debriefing moment, discussions on trainee's reactions will be carried in order to determine the errors in their actions and the way to repair.

When developing an educational strategy, the assessment elements have high importance and they have to be validated before.

The lifecycle model of an educational strategy points at this aspect as being crucial for applying the educational technologies (Stoner, 1996).

The assessment criteria validation process was carried with 30 trainees, during the „Engine Room Watch keeping" course from the academic curricula,

which is complementary to the „Engine Room Team Management Course".

The success rate was high, approximately 90%. In the same time several mistakes were determined, which prove to be general for all students (e.g. when switching the fuel feeding system of the main engine from MDO to HFO, they don't check for the HFO temperature and the risk is to stop the main engine).

The assessment procedure development is important in identifying the most likely to occur errors during the exercise. These errors are classified on trainee generated errors and simulation environment generated errors. In this way, the assessing procedure will provide a better image on the competences gained after attending the training.

## 3. CONCLUSIONS

It is obvious that the development stages for a simulated activity can be easily converted into performance standards, which enables the quantification process regarding the trainee's actions during the exercises.

In order to create a better understanding, there is the intention to monitor and identify the most common errors and trainees reactions (positive or negative), in order to develop a comprehensive database with performance standards.

In addition, an information exchange between the institutions with similar capabilities can create a valuable instrument, which will allow the development of a „complete picture" regarding the reality level of the simulation environment and also regarding the quality of the gained competences and abilities.

## 4. REFERENCES

[1] *Course model IMO 2.07 – 2002*, Engine Room Simulator.

[2] MILLICAN, J., BARNETT, M.L., *New challenges for training and assessment*, Paper 7, I Mar E Conference, Vol. 108, p. 46, 1996.

[3] *DNV Standard for Certification No 2.14*, January 2011.

[4] STONER, G., "Conceptual framework", Chapter 3, *Implementing Learning Technology: Learning Technology Dissemination Initiative*, p.6, 1996.

[5] www.transas.com.

[6] www.anmb.ro.

[7] MCLAUGHLIN, H.L., 2011. Seafarers and seafaring. The Blackwell Companion to Maritime, books.google.com.

[8] MEJIA, M.Q., 2011. The STCW Conference in Manila. WMU Journal of Maritime Affairs, 2010. October 2010, Volume 9, Issue 2, pp 231-234.

[9] NICOLAE FLORIN, POPA CĂTĂLIN, MARIAN RISTEA, BEIZADEA HARALAMBIE, *The e-Learning Particularities for Maritime Training and Education. Study Case on Training Simulator for Integrated Ship Management, Quality and efficiency in e-learning*, Proceedings of the 9th International Scientific Conference "e-Learning and Software for Education" Bucharest, April 25 - 26, 2013, Volume 2, Publisher: Carol I National Defence Academy publishing house (ISSN: 2066 - 026X print 2066 - 8821 online).

[10]. CHING TSUNG HUNG, FEI CHING CHUANG, 2012. *The Influence of Global Economic Crisis towards the Financial Performance of the Shipping Industry. Materials Science and Engineering.* Applied Mechanics and Materials (Volume 145), pages 480 - 484.

[11] UNCTAD, 2011. Review of Maritime Transport 2011. Report by the UNCTAD Secretariat, New York, Geneve, 2012.

[12] LEWARN, B., 2009. A review of some solutions to the shortage of maritime skills. Maritime Transport Policy Centre, Australian Maritime College, January, 2009.

[13] VERVOORT, M., 2012. *Maritime Leadership Competence and its Further Implementation and assessment into the Nautical Education Program*. 4th International Conference on Education and New Learning Technologies. ISBN: 978-84-695-3491-5.

[14] BIN WU, WINCHESTER, N., 2005. *Crew study of seafarers: a methodological approach to the global labour market for seafarers*. Marine Policy Volume 29, Issue 4, July 2005, pp.323 -330.

# THE CHALLENGES TO MET QUALITY AS A RESULT OF THE STCW MANILA AMENDMENTS

COX QUENTIN

*Warsash Maritime Centre, Southampton Solent University, Ukraine*

**ABSTRACT**

One of the most striking changes to the STCW convention and its associated code as a result of the 2010 Manila amendments was the mandating of leadership and teamwork training. Perhaps this is a reflection of the complexion of the industry which was traditionally manned and managed under Western-centric values, since the demographic of the industry workforce was largely from the Western hemisphere. This is no longer the case. One might ask why this non-technical training is now a mandatory requirement when it was not in the past. Is there an implication that the cultures and values embedded in STCW are changing from Western to Eastern now the demographic of seafarers is changing? This paper endeavours to discuss what has promoted the call for such changes and the challenges for MET to address them.

**Key words**: *MET, culture, quality*

## 1. INTRODUCTION

One of the most striking changes to the STCW convention and its associated code as a result of the 2010 Manila amendments was the introduction of leadership and teamwork training. More specifically, terms used within the code include effective communication, decisions reflecting consideration of team experiences, assertiveness, leadership, motivation, situational awareness and evaluation of outcome effectiveness. It was a major change since most training mandated prior to this related only to technical training and qualifications. Personal qualities such as social responsibility, crisis management and human behaviour were previously hinted at by certain specialised training for certain positions on merchant vessels. Bridge Team Management courses had been common in the industry but by no means mandatory. Yet, these are arguably the only courses that implied a requirement to demonstrate non-technical skills. The Manila amendments mark a major step forward in mandating further non-technical skills training. Perhaps there has been a reason why this has taken so long. After all, the provision, application and assessment of technical training are much easier by comparison. Either a candidate is competent to operate a piece of machinery or they are not. Of course, the training and competence assessment is not limited to turning the thing on and off, but additionally involves engaging with the output of information from the equipment and applying that data or information. An obvious comparison would be ECDIS equipment training, which coincidentally is also featured in the STCW Manila amendments. The navigator has to apply the information displayed with regard to the navigation of their vessel. There are many options open to the navigator in terms of how the information is applied to the situation and that is down to the judgement of the navigator. That judgement call leads into another matter entirely and not within the scope of this paper.

So perhaps the reason that amendments of this nature have taken so long to appear is that training and assessment of such non-technical skills as the new convention mentions, are not so straightforward. How can you train someone to be a good leader or team player? These are instinctive qualities which are nurtured over a longer time than a mere apprenticeship. These are personal traits which are developed from a very early age and it is very difficult for a training or educational regime to change these characteristics, once they start a maritime career. The instincts of the candidates will likely have been entrenched long before hand, largely formed by the cultural background of each individual, so trying to change them will be a formidable task. Yet, it would seem that this is exactly what the Manila amendments are mandating.

A casual glance at any shipping incident investigation report will provide compelling evidence as to why this ambitious task is not an ill-informed aspiration. Rightly, in my humble opinion, it has become clear that many shipping accidents have not occurred purely because of technical issues but have involved several non-technical elements. A perfect example of this is the USCG investigation into the explosion and sinking of the chemical tanker Bow Mariner in February 2004. Whilst there were most certainly breaches of technical tank cleaning and ventilating operations, the back drop to the incident was an outrageously slack on-board management system and an absolute failure to take into account cultural factors of the staff involved in the operation, as previously cited by Cox (2008). For example one of many recommendations to come out of the report suggested that owners ‘review their internal policies and procedures concerning *workforce interaction* and *co-operation*, including but not limited to delegation of appropriate duties to qualified officers’. (USCG 2005)

Wisely, these very considerations have also been taken into account in many subsequent investigation reports. It

has become abundantly clear that addressing human factors, the so called non-technical factors, as well as the technical ones, will yield a much greater understanding of the sequence of events and contributory factors to the cause of shipping incidents.

The ultimate objective of any investigation will be for lessons to be learned in order to prevent similar future occurrences. However, the industry doesn't have to wait for severe incidents to occur in the future in order to put these lessons into effect. The industry legislation has not waited so long for management procedures to be mandated, since we can look at the implementation of the ISM Code in the 1990s as an example. However, good management and an understanding of human factors do not just lead to the prevention of accidents but can lead to a more productive workforce, who is happier in their work and being part of a team. These more abstract human factors are being addressed by the training espoused by the 2010 Manila amendments to STCW.

## 2. COMPARISON WITH OTHER INDUSTRY

This apparent brain wave to address human factors in the name of incident reduction has not come as an entirely spontaneous initiative. There are many parallels in other high risk industries and it has been an awareness of the development of this kind of training in alternative industries which has led to its introduction in the maritime industry. As cited earlier, we can perhaps examine existing mandatory non-technical training in the shipping industry and analyse what has evolved out of them. Social responsibility, crisis management and human behaviours certainly led the way in terms of mandatory human factor training. Perhaps an earlier example, though largely optional, is that of Bridge Team Management (BMT) training. Current practitioners of resource management training, of which more later, tend to look at BTM training as being too equipment oriented, though there was certainly a strong element of team work, as the title suggests.

Yet, resource management training, as it is generally cited currently, has taken off in several other industries so therefore it has been a not unnatural or unpredictable migration into maritime training and education. Helmreich et al (1999) describes Resource Management as "The utilisation of all human, informational and equipment resources toward the goal of safe and efficient operations".

So which are the industries already choosing to initiate resource management training? They include aviation (O'Conner et al 2008), the military (Cohen et al 1998), medical (including surgery and anaesthetics) (Sutton 2009), the offshore oil and gas industries (Flin 1997), the nuclear industry (Flin 2008) and rail transport (Tsang et al 1999). To be more precise about exactly what is covered in resource management training, let us examine what relevant literature evidences. The resource management training that has been carried out hitherto has included such sub-topics as leadership and teamwork (Spain 2006); decision making (Barnett 2006); assertiveness (Flin 2008); motivation and prioritisation (Guerlain 2007); situational awareness (Kearns 2011); task and workload management (France 2008); culture perception (Al-Lamky 2005); and attitudes and behaviour recognition (Salas 2001).

A 2006 paper by Salas et al., assessed the widespread application of CRM, particularly in the United States. They identified that CRM training had become mandatory in the US military in 1990 but not until 1998 had it become so in commercial aviation. Whatever had caused scepticism of the value of CRM training, it is clear that its credibility had grown significantly during that period. It is also clear that the idea of this kind of training is not especially new. If it has enjoyed mandatory status for over 30 years in the US military then one can argue that its benefits might be worth investigating for application into other industries. The preceding paragraphs of this paper have indicated that's exactly what has taken place. A more current assessment reveals resource management training in the shipping industry grew in popularity even before it became mandatory. In the shipping industry, resource management training has been delivered as Bridge Resource Management (BRM), Engine Room Resource Management (ERM) and for combined disciplines, in the form of Crew Resource Management training (CRM). Many maritime institutions have run such courses voluntarily for years, including Warsash Maritime Academy and South Tyneside College in the UK, Maritime Professional Training in Florida, US and Wavelink in Singapore. In November 2012 the Swedish Club Academy listed over 80 CRM training providers in 35 different countries.

At this stage it is perhaps worth asking why so many institutions across so many countries and in so many industries have found CRM training to be so useful and what has led to its mandating in several of these industries. As suggested earlier, the ultimate aim is to reduce accident statistics by reducing the risk of accidents. By establishing an environment conducive to awareness of safe practice for both the individual and fellow team members, a more productive culture is arguably likely to prevail. So, if managed carefully, the culture and environment promoted by CRM training may very well yield a more productive as well as a safer working platform. Cynics may point out that safety and commercial success are mutually exclusive and one can only be achieved at the expense of another. Yet, the more commercially successful operators in any of the industries mentioned were amongst the first to embrace the benefits of CRM training. It is inappropriate for me, as a MET practitioner, to reveal which commercial employers have chosen to train their staff in CRM techniques in the past, yet there is a close correlation between those employers and their commercial success. If one thinks of the nature of dry and liquid cargo trade, charterers usually have a significant input into the

commercial conduct of a ship owner, by means of charter party clauses and requirements. If these include favouring ship owners whose staff has received specialist non-mandatory training, then it follows that those ship owners are likely to enjoy a more lucrative trade.

What evidence is there that other industries have benefitted from CRM training? A few examples of research in a variety of industries tell us.

"Given that more than 50% of naval aviation mishaps have been attributed to CRM failures (Wiegmann & Shappell, 1999), a robust, scientifically-driven, CRM training program is an important mechanism for addressing the human component of aviation mishaps in the U.S. Navy".

Halbesleben, J. R., Cox, K. R., & Hall, L. (2011), "Transfer of crew resource management training: A qualitative study of communication and decision making in two intensive care units", *Leadership in Health Services*, 24(1), 19-28.

*Design/methodology/approach* – Employees in two intensive care units at a US academic medical centre, one with high training penetration (67 percent trained) and one with low penetration (27 percent), were observed and interviewed about CRM principles and teamwork.

*Findings* – The paper found differences between the units in communication and decision making; it argues that these processes are mediating processes necessary for the effective transfer of CRM training to improvement of safety outcomes.

This is typical of several examples of CR training in industries other than shipping. Another reflects on CRM training in the aviation industry. O'Connor et al (2008) declare that "The findings from the meta-analysis are encouraging for the effectiveness of CRM training".

Burke et al., in their 2004 paper, stated: "Over the past 20 years the military and aviation communities have made a large investment in understanding teams and their requisite training requirements. There are many lessons that can be learned from these communities to accelerate the impact of team training within the medical community".

Sneddon et al., in their 2012 paper, state: "Drilling for oil and gas on offshore installations is a hazardous occupation, and requires personnel to maintain high levels of work situation awareness (WSA)".

They conclude that "Situational Awareness (SA), fatigue and stress management should be key components of CRM for drill crews".

Tsang et al (2009) apply similar research in their own part of the world. "In aviation, Crew Resource

Management (CRM) was developed to address safety issues derived from accident and incident investigations. As CRM has proven its effectiveness by improving teamwork, communication and staff responses to operational hazards, there have been many attempts to expand this concept into other high-risk sectors such as medical, nuclear, or military. Although some work was also conducted to modify CRM for the railway industry, no such experiences yet existed in China or Hong Kong".

## 3. CULTURAL ISSUES

So there can be little doubt as to the credibility of CRM training. It is not such a surprise therefore, that CRM is taking an increasingly significant role in the maritime industry. No doubt research will continue to establish which elements of the training are most effective and which are most difficult to implement. These points have not been ignored by current research, part of which has focussed on cultural awareness. This topic is a major feature of CRM training, as cited, so it is worth examining further. The point should not be lost that since shipping is a global industry, then all manner of cultures will be involved in its practice. Neither would it be amiss to suggest that the balance of power, if that is an appropriate phrase, has changed. Maybe power is not the correct analogy but the stakeholders involved have changed, with oriental cultures playing a much greater role in the industry than in the past. This fact has not been overlooked by researchers. Seva et al (2007) state clearly that "However, the large power gap in the Filipino culture seems to hinder open communication with superiors".

With regard to national cultural issues, the paper by Seva et al (2007) asserts, with reference to Jing, Lu, Yong, & Wang (2002), that culture significantly affects the behaviour of pilots in the cockpit. Seva goes on to explain that national culture will have the strongest influence toward attitude and behaviour, compared to professional and organisational cultures, since the individuals will have been influenced by their national culture for a longer time.

Wrigley (2012) is even more explicit in his observation that "The problem is the lack of data regarding ethnicity, and the impact on effective communication in the cockpit", with respect to the application of CRM in the aviation industry. If the shipping industry has followed other high risk industries in mandating CRM training, then it is more than likely it will follow the same industries in having difficulty in implementing the training. Therefore, it is of the utmost importance that observers from the shipping industry follow fellow high risk industry developments and note

the outcomes of their associated research.

Much competency-based training as prescribed by STCW legislation appears to be based on western-centric values (Emad and Wroth, 2008, Huanxin, 2010). Yet,

statistically, an increasing proportion of seafarers are being taken from the Asian sub-continent and further to the east, according to International Shipping Federation figures (ISF 2009). It is not only the supply of seafarers that have increased from oriental cultures, such as from the Philippines, China but now increasingly from Vietnam and Indonesia (Helmsman 2013). Ship ownership and management is no longer the exclusive domain of the Western hemisphere and China's interest and indeed assets on an international stage are considerable, stretching to involvement in the management of the Panama Canal. National cultural divides are consistently cited as a factor of CRM training (Wrigley 2012, Strauch 2010, Sava et al 2007). Hofstede's D*imensions of Culture* is repeatedly quoted despite some scepticism of its value (McSweeny 2002). Even Trompenaars and Hampden-Turners 1993 alternative, *Seven Dimensions of Culture*, refers to universalism / particularism and individualism / collectivism, which are not remote from Hofstede's original dimensions. So with this apparent shift of focus from west to east, perhaps cultures, whose values are more entrenched in harmony and co-operation, rather than competition and productivity, are prevailing when it comes to the natural evolution of international maritime legislation.

## 4. CONCLUSIONS

Casualties within the shipping industry continue to occur and it would perhaps be naïve to think an absolute blemish free industry could evolve. That does not, however, mean that any slack in the pursuit of an accident free industry should be permitted. Practitioners, observers, managers and even academics still have a duty to the industry to at very least minimise such loss of life or equipment. The continuing occurrence of incidents within the maritime domain demonstrates beyond all doubt that the risks inherent within this industry are similar to those in other high risk industries. It behoves us to learn all we possibly can from observers of those industries and apply the lessons learned to our own. It is perhaps this approach which has yielded the mandating of human factor focussed legislation in the STCW code and convention. Leaving the matter alone at that will not suffice. We should continue to monitor these industries as well as our own and put into effect findings of academic research as vigorously as if they were from our own industry. The embracing of CRM training is only the start of the pursuit. Efficient and effective implementation will be required to benefit from the amendments and this will not be understood unless the implementation of the training is monitored.

## 5. REFERENCES

[1] AL-LAMKY, A., MOIDEEN KUTTY, M., *Motivational Issues and Safety Regulations in Arabia: A Case Study in a Multinational Oil Compan*, Journal of the International Academy for Case Studies; 2005, 11, 6, ABI/INFORM Global, pg. 51.

[2] BARNETT, M., GATFIELD, D., PEKCAN, C., *Non-Technical Skills. The vital ingredient in World Maritime Technology*, Proceedings of the International Conference on World Maritime Technology, London: Institute of Marine Engineering, Science and Technology, 2006.

[3] BURKE, C.S., SALAS, E., WILSON-DONNELLY, K., PRIEST, H., *How to turn a team of experts into an expert medical team: guidance from the aviation and military communities*, Quality and Safety in Health Care, 13 (suppl. 1), i96-i104.

[4] COHEN, M., THOMPSON, B., *Training teams to take initiative: critical thinking in novel situations*, Advances in human performance and cognitive engineering research, Vol. 1, pages 251-292, 2001.

[5] COX, Q., *The Application of Human factors in Maritime Education and Training*, 16th International Maritime Lecturers Association Conference, Izmir, Turkey, October 2008.

[6] EMAD, G., ROTH, W.M., *Contradictions in the practices of training for and assessment of competency: A case study from the maritime domain*, Education and Training, 50(3), 260-272, 2008.

[7] FLIN, R., O'CONNER, P., CRICHTON, M., *Safety at the Sharp End: a guide to non-technical skills*, Farnham: Ashgate, 2008.

[8] FRANCE, D.J., LEMING-LEE, E.S., JACKSON, T., FEISTRITZER, N.R., HIGGINS, M.S., *An observational analysis of surgical team compliance with perioperative safety practices after crew resource management training*, The American Journal of Surgery, 195 (2008), 546–553, Doi:10.1016/j.amjsurg.2007.04.012.

[9] GUERLAIN, S., TURRENTINE, F.E., BAUER, D.T., FORREST CALLAND, J., ADAMS, R., *Crew Resource management for*

*Surgeons; feasibility and impact*, Cogn Tech Work, 2008, 10:255–264, Doi: 10.1007/s10111-007-0091-y.

[10] INTERNATIONAL SHIPPING FEDERATION, *Shipping and World Trade. Numbers and nationality of world's seafarers*, 2010.

[11]http://www.marisec.org/shippingfacts/worldtrade/world-seafarers.php [Accessed 31st March 2013].

[12] HALBESLEBEN, J.R., COX, K.R., HALL, L., *Transfer of crew resource management training: A qualitative study of communication and decision making in two intensive care units*, Leadership in Health Services, 24(1), 19-28, 2011.

[13] HELMREICH, R., KLINECT, J., WILHELM, J., *Models of threat, error and CRM in flight operations*, Proceedings of the 10th International Symposium on Aviation Psychology, Columbus: Ohio State University, pp. 677–682, 1999.

[14] HELMSMAN, *Local seafarers opt for work overseas*, Fadli, The Jakarta Post, Batam Archipelago, Thu, March 07, 2013,

[15]http://www.thejakartapost.com/news/2013/03/07/local-seafarers-opt-work-overseas.html [Accessed 31st March 2013].

[16] HUANXIN, W., *The feasibility of Instructional Assistant System in maritime universities under the semi-military management*, Proceedings of the 18th Conference of International Maritime Lecturers' Association, Shanghai, China, 20-23 October, 2010.

[17]HOFSTED, G., *Culture's Consequences: International differences in work-related value*, Beverly Hills, Cal and London Sage, 1980.

[18] JING, H.S., LU, P.J., YONG, K., WANG, H.C., *The dragon in the cockpit: the faces of Chinese authoritarianism*, Human Factors and Aerospace Safety, 2(3), 257-275, 2002.

[19] KEARNS, S., *Online Single-Pilot Resource Management: Assessing the Feasibility of Computer-Based Safety Training*, The International Journal of Aviation Psychology, 21:2, 175-190, 2011.

[20] McSWEENEY, B., *Hofstede's model of national cultural differences and their consequences: A triumph of faith - a failure of analysis*, Human Relations, Jan 2002, 55, 1, ABI/INFORM Global, pg. 89, 2002.

[21] O'CONNOR, P., HAHN, R., SALAS, E., *The US Navy's Crew Resource Management Program: The past, present, and recommendations for the future*, Human Performance Enhancements in High-Risk Environments: Insights Developments and Future Directions from Military Research, 90-105, 2010.

[22] O'CONNOR, P., CAMPBELL, J., NEWON, J., MELTON, J., SALS, E., WILSON, K., *Crew Resource Management Training Effectiveness: A Meta-Analysis and Some Critical Needs*, International Journal of Aviation Psychology, Vol. 18, no. 4, pp. 353-368, Oct.-Dec., 2008.

[23] SALAS, E., BOWERS, C., EDENS, E., *Improving Teamwork in Organisations: applications of resource management training*, Lawrence Erlbaum, 2001.

[24] SEVA, R.R., MARIA, A., GUTIERREZ, J.A., BEEN, H., DUH, L., CHONG, J., *An Evaluation of CRM Attitudes of Filipino Pilots in Four Philippine Aviation Companies*, The International Journal of Aviation Psychology, 17:3, 285-298, 2007.

[25] SPAIN, M., *Adopting a learning management system: issues related to supporting program development in petroleum industry training*, Postgraduate Dissertation, Royal Roads University, 2006.

[26] SNEDDON, A., MEARNS, K., FLIN, R., *Stress, fatigue, situation awareness and safety in offshore drilling crews*, Safety Science, 2012.

[27] STRAUCH, B., *Human Factors: The Journal of the Human Factors and Ergonomics Society*, Vol. 52, no. 2, 246-263, April 2010, published online before print April 5, 2010, Doi: 10.1177/0018720810362238.

[28] SUTTON, G., *Evaluating multidisciplinary health care teams: taking the crisis out of CRM*, Australian Health Review, 33(3), p 445, ABI/INFORM Global, Aug 2009.

[29] TSANG, M.T.S., HOERMANN, H.J., *Adaptation of CRM for the Railway Industry. Operational Safety benefits*, 15th International Symposium of Aviation Psychology, Drayton Ohio, April 27-30, 2009.

[30] TROMPENAARS, F., *Riding the waves of culture: Understanding cultural diversity in business*, Economist Books, London, 1993.

[31] USCG, *Investigation into the explosion and sinking of the chemical tanker Bow Mariner*, US Department of Homeland Security, 2005.

[32] WIEGMANN, D.A., SHAPPELL, S.A., *Human error and crew resource management failures in Naval aviation mishaps: a review of US Naval Safety Center data, 1990-96*, Aviation, Space, and Environmental Medicine, 70(12), 1147, 2005.

[33] WRIGLEY, J.T., *Recognizing differences in ethnicities and increasing effective communication*, Department of Aviation, University of Central Missouri, November, 2011.

# DISTANCE TEACHING STANDARD

[1]CROSS JOHN, [2]TUCKER JOHN

[1,2]*Marine Institute, Memorial University of Newfoundland, Canada*

**ABSTRACT**

The Manila Amendment of STCW opens the door to distance delivery of courses to mariners that are required for advancement in certification level. The Marine Institute of Memorial University of Newfoundland has been working on preparing distance courses for deck officers and marine engineers which would prepare them for writing the Transport Canada challenge examinations as part of their certificate advancement.

With an eye to developing these courses, the authors have developed a distance delivery standard which is applied to their online course development. It is anticipated that the standard would allow courses to be developed in such a way that certifying authorities would find the courses and all evaluations delivered by the institution acceptable.

This paper describes the content of this new distance delivery standard to include the broad categories of:

- Delivery Infrastructure
- Receiving Technology
- Content Format
- Learner Management System (LMS)
- Instructor Standards

The standard will cover aspects of the delivery ranging from required bandwidth and minimum standards of computers and devices to be able to participate in a course to minimum expectations of students to be able to receive a response to a communication with the course facilitator while taking a course.

Much of the standard has been developed based on the authors experience in delivering online and blended delivery courses and is based on current course delivery methods employed at the Marine Institute.

**Keywords:** *Distance Education, Standards, Educational Technology.*

## 1. INTRODUCTION

While the concept of distance delivery is not new and has existed formally since 1753, the variety of new technologies available, coupled with the instantaneous communications allowed by the internet, has transformed distance education into a sophisticated and effective tool. The new technologies mean that educators can effectively engage with learners with different learning styles and learning speeds (Tucker and Cross, 2013). The effectiveness of these new technologies was recognized by the International Maritime Organization who in the Manila Amendments to the STCW stated that distance education was an effective tool.

For over 10 years, the Marine Institute of Memorial University has been experimenting with distance education in several formats. It is now offering degrees through distance education, as well as using it to supplement the traditional classroom courses. However, with the new interest in distance education and its application to training mariners, the Marine Institute has started the development of courses that will prepare students to challenge the exams needed for shipboard personnel to advance in their careers. Current efforts include the development of a suite of distance courses designed to prepare course participants for Transport Canada administered certification examinations. At the present time, there is no one standard that is being used to govern distance education in Canada. Institutions are left to follow their own routines and guidelines. While the routines address a significant portion of how and why, they are developed individually and very often independently. There is a need for a minimum standard that future institutions, and just as importantly current institutions, must adhere to.

This paper will look at the items that are necessary for the development of a standard based on the combined 15 years of experience that the authors have in developing distance education material. The standards have been organized into the following 5 broad categories to facilitate the logical organization of material:

- Delivery Infrastructure
- Receiving Technology
- Content Format
- Learner Management System (LMS)
- Instructor Standards

This paper identifies what should be considered in the development of standards for each category and also what the Marine Institute does in regards to some of the proposed standards.

## 2. DELIVERY INFRASTRUCTURE

At the core of most educational distance delivery systems is some form of electronic communications and in almost all cases the current communication system is the internet. This is expected to remain as the primary form of communications in the future; however, based on historic performance it is anticipated that the capacity will increase allowing better access and faster transmission of larger amounts of data at less cost.

While high speed internet access has become the norm for many places, ships still must use satellite communications while at sea, which makes internet access very expensive. Since the target audience for this distance education is the typical mariner, this cost is critical. As an example of cost, a company currently providing internet access to ships today sells what they call their standard package. The standard package costs $129 a month for which you get 10 Mb[1] (Megabytes) of data downloaded. However, if you go over the 10 Mb allotment each additional Mb will cost $13.99. There are other options available, for example a high end option costs $1,969 a month for which you get 6 GB of data and then $0.40 per Mb after that. However, compared to land lines which can be as inexpensive as $0.10 per Gb (or $0.0001 per Mb) sea access is still expensive (INMARSAT, 2013).

As with all technology we expect to see access increase and costs decrease in the future. INMARSAT is currently working on a system called Global Xpress which is expected to increase bandwidth considerably and within a year or two we can expect to see ships being able to afford multiple meg files. Nevertheless, currently we are stuck with prohibitively high costs and low transfer rates

Based on the above, as a standard we would recommend that two options be made available to the learners. The first would be similar to a current distance education program which would take place over a fixed connection. The high bandwidth of a fixed connection such as optic fibre allows fast communications and the exchange of large files. Even a relatively slow 56 kbps (56 kilo bits per second) would allow the download of a Mb size file in about 2 minutes. However, at sea the slow speed and high cost means that the transfer of multiple Mb sized files could be prohibitively expensive and time consuming. For these cases, other options must be available that would permit a learner to be fully engaged in the course, receive all course materials in an appropriate timing and order, and have adequate access to the course facilitator and fellow course participants for discussions and to be able to seek answers to questions. Such options might include delivery of material on a disk, or the delivery of material when in port and the ship is able to take advantage of a ground link supplemented by exercises to be done while at sea.

In addition to being aware of a ship's capability to receive data, an additional issue is the educational institute's ability to transmit data. As the demand for distance education grows for both marine related courses as well as more conventional educational courses, care must be taken to ensure that people are still able to receive their information in a timely fashion even at peak times. This is critical for a marine related course being taken on board a ship since, as mentioned above, access may be available for only brief periods while a ship is in port.

[1] Note that byte is defined as consisting of 8 bits so a Megabyte (Mb) is 8 million megabits.)

## 3. RECEIVING TECHNOLOGY

Receiving Technology means all the hardware and software associated with a learner. Technology of this nature has been advancing at a staggering rate and is probably the main reason that standards for delivery of distances courses using this technology are slow to develop. The old adage that it is hard to hit a moving target is very applicable. From 1995 to 2012 (the date of the most recent one), Microsoft has developed 10 major releases of their internet browser (Explorer) and within each release there are numerous updates. Firefox has had even faster change with 20 versions being released since it first appeared in 2004 and it is anticipated that in the interval between when this paper was written and when it is presented there will be an additional 4 versions released.

Of course that was just the web browser. We also have to deal with new versions of operating systems. Microsoft has stopped mainstream support of Windows Vista in 2012 and Windows 7 will not be supported after 2014 (although there is what is called extended support which must be bought but will extend support for a year or two). There are also changes to hardware, the most significant of which is the large numbers of tablets which are becoming common at this time (and of course tablets have other, different operating systems).

To begin to develop a standard it is useful to group the elements necessary for the receiving computer into the following categories:

- operating systems
- video and sound
- internet browsers

A standard for operating systems is going to be driven (to a large extent) by what the current system developers are supporting and what is commonly out there. For example, at the present time Microsoft will support Windows XP only through extended support however since 40% of the world's desktop computers are currently running XP it makes sense to still support it until Windows ends all support (NetMarketShare, 2013). Apple does not publish their operating system support criteria but appear to support the current version as well as the two previous versions. Nevertheless, it could lead to major problems trying to support a system that is no longer supported by the manufacturer. Thus it makes sense to link the minimum operating system standard to what is currently supported by the manufacturers. Relying on a manufacturer to dictate the change over dates may not be acceptable for all educational institutes, but in the absence of a better criteria it seems to be the best available.

Since the delivery of content relies on pictures and video and possibly sound, it is important to ensure that a learners computer is able to process what is required for the course. However, this is not a particularly restrictive condition since video card and sound card development have been driven by the video game industry and it is difficult to imagine online course content or applications that would have requirements exceeding those of the gaming industry. In fact, since about 1995 most computer manufactures have integrated sound cards with their motherboards. Likewise, video has progressed

significantly but the requirements for distance education are relatively simple and a resolution that all newer computers can meet and oldest ones can as well suffice. The video standard XGA would allow for 1024 x 768 resolution (the number of horizontal and vertical lines viewable on a monitor) and is sufficient for most purposes.

Where internet browsers are the most rapidly changing part of the receiving technology, they must be treated a little differently. New versions will have newer and different options so they must be evaluated as well as seeing if the older versions still work. Also, acceptable versions will depend to a certain extend on the software the institute is using to deliver educational material. Thus it makes sense to introduce a couple of categories for browsers. It is critical that a new browser is evaluated to make sure that it still supports the features required for the applications used for distance education. Consequently there must be an evaluation category where new browsers are tested with current content. If no problems are found, then the browser can become part of the recommended category and be one of a number of suggested browsers for learners. Finally, there should be a maintenance category where older versions of browsers are listed. The maintenance category must ensure that as new versions of learner programs become available, the browsers are able to support the content and display it correctly. Keeping in mind the changes illustrated above, as hard as it is for an institute to keep up to date on software and driver versions and operating systems upgrades, it must be impossible for all but the most dedicated of learners. So it is critical to have an easy way for a user to check their system. Several organizations have adopted an automatic System Check that you can visit and which will check your system automatically. The one used at Memorial University is shown in Figure 1.

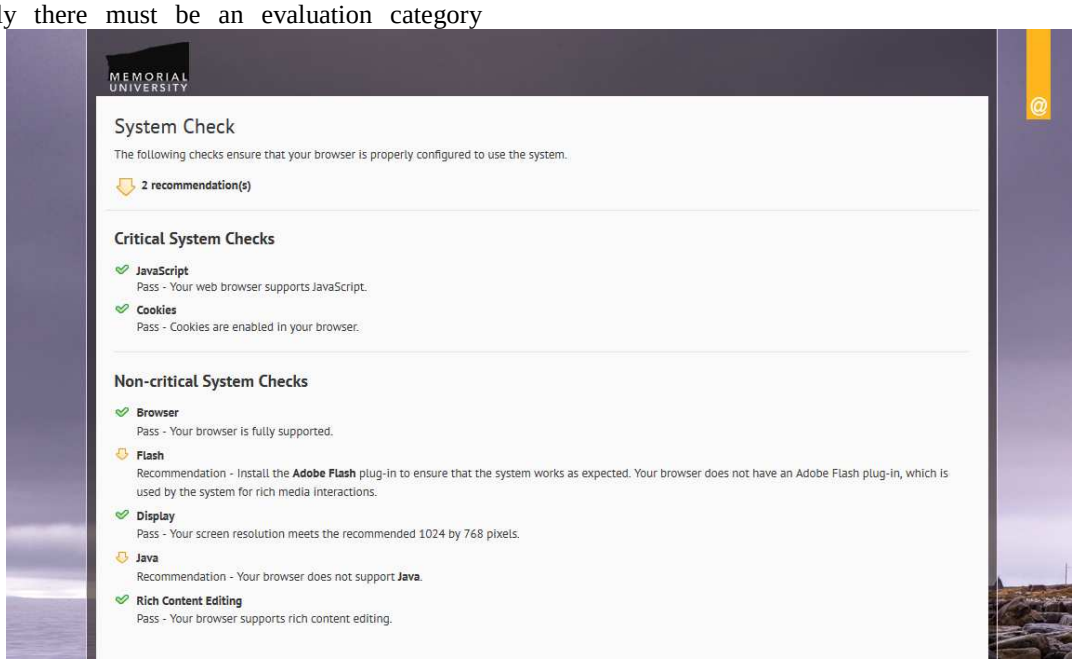



Figure 1 MUN System Check Website

By simply visiting a site the System Check is able to collect basic configuration information from a learner's computer and then make recommendations about whether upgrades are needed or not.

## 4. CONTENT FORMAT

Content format refers to two different concepts. The first is the software that is used to develop the content; the second is the actual content that will be presented to learners.

In regards to the software, a distinction must be made between the Learning Management System (LMS) and the software used to create content. Some creation of content is possible using a LMS and this content then will by default adhere to the standards in the LMS. However there will be times when other material is necessary.

If the content is textual or image based, then the preferred standard would be to create it using any available tool, but then deliver it as a portable document format (commonly called a PDF). While still associated with the company Adobe, since 2008 the PDF has been an open standard published by the International Organization for Standards. It is well accepted, readily available and does not carry a cost for users who only wish to view files or produce simple PDF files. The authors have been using PDFs for 10 years and have found them to be flexible, of good quality and robust.

However, care must be taken with other software. While there is excellent learning software available, caution must be taken to ensure it is available to areas with limited bandwidth and if it contains any personal information (i.e. a student name or number or any student work) it must be secure.

The authors have made extensive use of MapleTA

to develop exercises and even tests and exams (Cross and Tucker, 2012). MapleTA does not require a great deal of bandwidth and there is an option in the case of assignments to print a hard copy of the assignment which the student can complete and then log back into the system and enter the solutions to the assignment. In addition, all work is done on the server so it is secure against unauthorized access or accidental loss.

It must also be noted that this is an interesting time in regards to trying to develop standards for the use of software. We are currently in the middle of a change in some fundamental ways content is displayed on the internet. At the present time there are two main programs used to display enhanced internet content: Flash by Adobe and HTML5 which is an open standard. They both do essentially the same thing (allow enhanced content such as video to be displayed on websites) but they do it in different ways. Currently Flash is used by the majority of program developers, but Apple does not support Flash and Microsoft has stated that they will no longer support Flash (the two companies produce 99% of the desktop operating systems). So the future appears to belong to HTML5, but keep in mind there are a large number of systems, machines and software that use Flash and older computer systems may not be able to use HTML5 but can use Flash. In fact, almost 40% of the world's desktop computers run Windows XP which can not by default support HTML5 (however it can be upgraded to show HTML5 based information). While this is a large number, it is not as daunting as it may seem since it is expected that this number will drop off fairly quickly now (Windows has stated that they will stop supporting XP next year). To summarize, Flash has been used extensively in the past but HTML5 seems to be the way to go for future development.

Probably the most important part of any distance education experience is the content of the course. This is especially so for training related to shipboard activities since all training must deliver content developed by IMO in addition to other requirements of the country and even the educational institute.

Obviously the initial content must present the information required by the certifying authority; however, there must be continuous checks done to ensure that the content is accurate and current. It is critical that there is a formal process in place to recommend and track changes in a course so people are always aware of what the current content is. In addition, there must be a mechanism to ensure that course changes are recommended by knowledgeable people and reviewed by some group not directly involved with those changes.

In the current information age, it is also critical to ensure that all source information for a course is identified and referenced. In general, this would require extensive documentation of information in an appropriately referenced format. Since we are discussing distance courses, electronic based resources are expected to form an important part of the required information.

Such sources should be linked to in a direct and easy to access format. It is also critical that these links are reviewed prior to the start of each course to ensure that they still are valid links and direct the student to the correct information.

As well as web based resources, most courses will require more conventional references as well. Such references should be provided in a standard format (such as the American Psychiatric Association or APA format). Information that is based on an instructor's experience is appropriate and sometimes necessary content, but should clearly be indicated as such.

## 5. LEARNER MANAGEMENT SYSTEM

To facilitate distance education, the use of a Learner Management Systems (LMS) is recommended. Such a system provides a number of critical services that make the interaction between instructor and student more seamless.

One of the most important of these is security. Since there is personal information about students in the system (such as student contact information, grades and even medical information), such a system must be safeguarded against unauthorized access. Generally this means that only qualified people have access to the system and only the appropriate access for the function they perform. In addition, educational staff and faculty must ensure that the system remains secure. To ensure these only safe computers should be used for access, computerized student records should not be taken away from the educational site and there should be a policy of changing passwords on a regular basis.

Furthermore, appropriate backups must take place to ensure that curriculum material, as well as grades are not lost through a computer error (i.e. a computer crash) or an infrastructure failure (i.e. a fire at the institute). This is normally achieved through backup media being protected inside fireproof areas such as safes, but off site secure locations for storing backup data are becoming more common.

One of the advantages of distance education is that it can take place outside the regular educational institute timing. This is very beneficial to people who work on board ships since ship operations are completely removed from the educational timetable. Consequently, it is important for courses to be scheduled in a manner that is flexible enough to permit mariners to be able to start the course, fulfil all of the course requirements and finish the course given the wide and varied spectrum of schedules that mariners are subjected to. To be able to achieve this, course participants should be able to start the course within a flexible timeframe as opposed to an official course start date which is the norm. Similarly, participants should be able to complete all course evaluations and finish the course at times which would be dictated by their individual schedules and circumstances.

Another important aspect of a traditional education program is class attendance. While simple to do in a traditional class room setting it has been a problem for distance education – so much of a problem that most institutes just ignore it. However it is felt that attendance is an important metric so there should be some effort made to gauge student involvement and participation.

While systems can be established that monitor a student through things like fingerprint scanners or video monitoring, it is not recommended that this type of system be pursued. The cost of the technology involved, possible privacy issues and the fact that anyone with enough knowledge could work around the system makes this type of attendance problematic.

Instead it is recommended that the time that a student spends looking at a particular module or presentation be recorded and used to verify attendance. It is further recommended that presentations be created that require active participation from a learner at various points to ensure they are still watching. Such activity could be as simple as a click to progress type of response, or as sophisticated as asking a learner a material related question in order to gauge understanding as well as participation. Of course the ultimate gauge of attendance and involvement will take place when the student must write an exam.

## 6. INSTRUCTOR STANDARDS

In a way, instructor standards are one of the easiest categories to look at. After all educational institutes have been dealing with this issue ever since education was formalized. However, the introduction of the Manila Amendments (as well as providing guidance on distance education) has highlighted the importance of maintaining competency for seafarers through refresher training. This may require some additional requirements for officers who keep watch as part of their instructional duties. In addition, as shipboard routines and technology changes, there will be a requirement for continual training of personnel. For example, ten years ago there was no course available dealing with Ship Board Security, but now it is a critical part of most Nautical Science programs.

At the core of any nautical education program are the ship officers who are experienced and able to communicate this experience to the learner. Thus it is critical for any program to have people who have worked extensively on ships. However, there may be others required as appropriate. For example, a Marine Engineering program can draw from professional engineers to teach some of the fundamental technical engineering course, or language majors for communications. All institutes have their own hiring process which should fulfil the above, but everyone involved in a program should also hold some teaching credential or equivalent experience dealing with students.

## 7. DEVELOPING A STANDARD

The above discussion has provided a description of what should be considered in a standard and the reason for its inclusion. However, it will be beneficial at this point to summarize items that would belong in a standard. This is done in Table 1, Standard Elements.

Table 1. Standard Elements

| | |
|---|---|
| ***Delivery Infrastructure*** | Should take advantage of existing communications infrastructure (i.e. the Internet). |
| | Two options should be provided, one that is similar to traditional standards, the other that is oriented towards users with slow or intermittent connections. |
| ***Receiving Technology*** | Institutional support should be offered for computer operating systems that are still fully supported by the manufacturer. |
| | The user's computer should be sound capable and have at a minimum XGA resolution. |
| | A system must be in place to monitor the changes to the web browsers used and identify older technology or systems that will not be supported. |
| | The information about the supported operating systems and web browser versions must be disseminated to the user in an easily understood manner. A site that automatically tests and makes recommendations regarding is ideal. |

| | |
|---|---|
| ***Content Format*** | PDF files should be used where practical. |
| | Other software used should be robust and compatable with current versions of the hardware and software as discussed under receiving technology. |
| | Where programs are used for the delivery and evaluation of student work, such systems must be secure and robust. |
| | In order to support all users, content that is currently developed using Flash must also be capable of being developed using HTML5 and vice versa. |
| | Internet references should be checked for accuracy and relevance on an ongoing basis. |
| | Information not referenced from the internet should be referenced using an appropriate format such as APA. |
| ***Learner Management System (LMS)*** | A LMS should be used that provides a secure and convenient way to interact with students. |
| | Access is restricted to those who need it and only for the functions necessary to do their job. Passwords must be changed regularly and access from public computers be done with caution. |
| | A mechanism is available to track a student progress. Such progress would consist of the time spent viewing material as well as grading of information. |
| | A system is established that ensures backups are done on a regular basis (at least daily). |
| | Back up computer records are stored in a secure place that is reasonably safe from theft, fire or other incident. |
| | Course timing is flexible enough to allow people working at sea enough time to receive information and complete assignments. |
| ***Instructor Standards*** | Instructors must be experienced in their field of instruction. |
| | Instructors must have specific education or experience in the delivery of distance material. |

## 8. THE MARINE INSTITUTE AND THE STANDARD

The Marine Institute has been involved with the development and delivery on distance material since 2000. A suite of online courses are being prepared for online delivery for ships officers that will permit them to advance in certification level with Transport Canada. The development and preparation of these courses incorporates the latest advances in online delivery methods and technology at the disposal of the MI, and the following highlights a sample of these elements intended to satisfy distance standard requirements.

### *8.1 Interactive Video Lectures*

As outlined in their paper, Tucker and Cross (2013) employ online video lectures in Flash and HTML5 format as a means to present course material to students. When nested within an LMS, the video lecture will administer a quiz to students to ensure that they are engaged and report to the LMS with learner performance.

It is intended that these form the foundation of the formal course delivery, but to permit learners to continue with their studies when internet access is limited or not available. It is the authors' intention to provide workbooks for study and practice examples that they can access which can be accessed using very limited internet bandwidth or printed for access when no internet connectivity is anticipated.

### *8.2 Desire 2 Learn (D2L)*

The Marine Institute as part of Memorial University of Newfoundland uses an LMS entitled D2L as a primary resource in the delivery of all face to face, blended and online deliveries of courses administered at this university.

D2L is administered from a secure computer server and requires students to log into personal accounts to access any courses for which they are registered. Privacy

laws in Canada require that the highest levels of information security be maintained when personal data such as registration and individual course activity and performance are being recorded.

Such is the case in D2L where student activity such as communications and logs of accessing course material are recorded and saved. Computer servers housing such data are backed up to secure locations and protected from calamity such as fire or other damage.

Although recording attendance in a distance course delivery is not practicable, D2L does have a reporting facility where records of the details of student access to different course elements can be obtained. These details include which elements were accessed, the duration of access, total time accessing over multiple sessions and a variety of statistics analyzed over the course. From this reported data it is possible to extrapolate an index of student participation in the course and, subsequently, a rough correlation to the distance equivalent of attendance in a course.

### *8.3 Course Preparation*

The preparation of material for a distance course is somewhat different than for a class delivered in a class room. As such, the Marine Institute has developed a set of guidelines that show what is to be expected in a distance course. This information is provided in a table in The Appendix and is relatively straight forward.

## 9. CONCLUSIONS

Standards are a common and necessary part of the marine industry. However there has not been much published on the development of standards that could apply to the delivery of distance education to the mariner.

This paper has looked at the necessary elements that could go into forming a standard for the delivery of distance education for mariners. The actual elements that could form a standard are presented in Table 1. While the standards will change with country and institute it is felt that the above will serve as a solid starting point to build the required standard.

## 10. REFERENCES

[1] TUCKER, J., CROSS, J., *Engagement by Distance. A Distance Delivery Method Maximizing Student Engagement*, In Press, to be presented at the 14th International Association of Maritime Universities Conference, 2013.

[2] CROSS, J., TUCKER, J., *Developing a Culture of Attentiveness. Challenges and Opportunities in Maritime Education and Training*, Proceedings of International Association of Maritime Universities AGA 13 (pp 345-354), Fisheries and Marine Institute of Memorial University, 2012.

[3] INTERTANKO, *Crew Internet Access on board Ship – A best Practice Guide*, International Association of Independent Tanker Owners, Document Reference CJ-40229/100007, 2011.

[4] NETMARKETSHARE, *Desktop operating system market share*, retrieved from http://www.netmarketshare.com/operating-system-market-share.aspx?qprid=10&qpcustomd=0, 2013.

[5] INMARSAT, *Inmarsat Global Express*, retrieved from http://www.igx.com/, 2013.

[6] iNACOL, *International Association for K-12 Online Learning. National Standards for Quality Online Courses*, 2011.

**Appendix**

The following checklist is used as a guideline in the creation of MI courses:

| **Online Course Element** | **Face-2-Face** | **Blended** | **Fully Online** |
|---|---|---|---|
| **Course Information** | | | |
| • Intro & Welcome | ✓ | ✓ | ✓ |
| • Course Outline | ✓ | ✓ | ✓ |
| • Course Schedule (Class and online sessions - eLive) | ✓ | ✓ | ✓ |
| • Learning Objectives | ✓ | ✓ | ✓ |
| • Instructor (bio and contact information) | ✓ | ✓ | ✓ |
| • Office Hours (online or face-to-face) | ✓ | ✓ | ✓ |
| • Texts & Resources (required, recommended) | ✓ | ✓ | ✓ |
| • Evaluation (list and values) | ✓ | ✓ | ✓ |
| • Checklist of Activities & Assignments | ✓ | ✓ | ✓ |
| • System or Technical Requirements | ✓ | ✓ | ✓ |
| • Help and Technical Support (how to print, etc) | ✓ | ✓ | ✓ |
| • Link to the Library | ✓ | ✓ | ✓ |
| • Academic Integrity & Netiquette | Optional | ✓ | ✓ |
| • University Links: APA, Good Writing, Academic Dishonesty | Optional | ✓ | ✓ |
| **Communications** | | | |
| • Announcements | Optional | ✓ | ✓ |
| • Course Email | Optional | ✓ | ✓ |
| • Discussion Forums (for each Unit, Topic or Assignments) | Optional | ✓ | ✓ |
| • ELive! / Blackboard Collaborate | Optional | Optional | Optional |
| **Student Feedback Opportunities** | | | |
| • Course Evaluation Form | Optional | ✓ | ✓ |
| • Anonymous Discussion Forum | Optional | Optional | Optional |
| **Content** | | | |
| • **For each Unit, Module, Chapter** | | | |
| ◦ Content organized by Unit, Module | ✓ | ✓ | ✓ |
| ◦ Presentation Materials (PowerPoint with narration, Elive! Collaborate, etc.) | ✓ | ✓ | ✓ |
| ◦ Instructor Notes (html, video, animations, etc) | Optional | Optional | ✓ |
| ◦ Readings and Additional Resources (links) | Optional | Optional | ✓ |
| ◦ Assignments | If applicable | If applicable | If applicable |
| ◦ Self Assessment (Pre-Tests, post-Tests) | Optional | Optional | Optional |
| • **Assignments, Labs, Quizzes, Exams** | | | |
| ◦ Assignments (description & instructions) | ✓ | ✓ | ✓ |
| ◦ Assignment answer keys, general feedback | Optional | Optional | Optional |
| ◦ Labs (description & instructions) | ✓ | ✓ | ✓ |
| ◦ Lab answer keys & instructions | Optional | Optional | Optional |
| ◦ Quizzes (list, dates, study details) | ✓ | ✓ | ✓ |
| ◦ Quizzes offered online with feedback | Optional | Optional | ✓ |
| ◦ Exams (list, dates, study details) | ✓ | ✓ | ✓ |
| ◦ Exams offered online | Optional | Optional | Optional |

# INNOVATIVE APPROACHES AND TECHNIQUES IN MARITIME ENGLISH STUDY PACK DEVELOPMENT

DEMYDENKO NADIYA

*Kyiv State Maritime Academy, Ukraine*

**ABSTRACT**

The innovation project approved by the Ministry of Education and Science of Ukraine demonstrates the importance of the further improvements in Maritime Education and Training (MET) in the sphere of Maritime English proficiency. Within the framework of the national program "Computerized teaching/learning materials for professionally oriented subjects", The Study Pack for Seafarers (Student's Book, Work Book, Teacher's Book, and English-Russian Dictionary of Maritime Terms) is being developed. The methodological principle of "early specialisation" in ME teaching, developed on the basis of linguistically centred concept (LCC), allows planning ME training from its very beginning as the integrated process including general English, general Maritime English and specialist Maritime English. LCC makes the emphasis on the language itself. Its algorithm facilitates the progress of acquiring professional knowledge, skills and abilities owing to high level of English. Thus, a linguistically centered course model for the 1st and 2nd year non-native learners becomes a step-by-step problem-solving procedure making the system of ME teaching and learning flexible and efficient.

**Keywords:** *ME, teaching/learning materials, LCC, "earlyspecialisation".*

## 1. INTRODUCTION

The work at the project proposes the design of new types and formats of ME teaching/learning materials for full-time and part-time Maritime students. Being the supervisor of the project, the author outlines the conceptual approaches to ME training, describes the contents of the Study Pack components, and focuses on the basic principles of language training systems and complexes. The project is underway, and the first results have been obtained.

The Study Pack is being designed on the principles of *early specialisation* with the application of authentic texts and real-life situations. This entails some specific problems solution, such as: improving the students' General English proficiency, developing their communicative skills in GE and ME, introducing specialist knowledge through the interdisciplinary links (Maritime English + Navigation/Marine Engineering), expanding students' informational awareness by attracting materials from the Internet and other sources of information, implementing step-by-step assessment and self-assessment on the basis of the system of control. The work is accompanied by the intense linguistic and methodological research which has been described in publications by the project participants.

There is no secret: some students entering the Academy have a very low level of the English language proficiency. In this situation the only possible way to improve their language competences might be increasing their motivation. If a student is sure about the future career of a seafarer, he/she will come to the idea of mastering English. While acquiring the professional knowledge and skills he/she will definitely expand informational awareness required for vocational purposes with the help of English.

The paper gives the brief analysis of the information about the database created (terminology, texts, grammar instructions and exercises, pronunciation and listening assignments, speaking practice strategies, SMCP teaching/learning materials, assessment and self-assessment systems, including computerised testing systems).

## 2. LINGUISTICALLY CENTRED CONCEPT

*A linguistically-centred concept*, or *LCC*, was first introduced in the paper entitled "Teaching Maritime English: A linguistic approach" [1]. The purpose was to show the influence of language on the process of acquiring professional knowledge by Maritime students.

The fact is: all special terms belong to language or sublanguage (specialised professional subsystem) being a unit of a bigger entirety in which it exists. On the other hand, these terms all together are the integral part of a well-structured system of notions belonging to a special professional field. It is not a contradiction; it is a matter of a language functioning as it serves not only to name objects or designate ideas but to relate and combine words in different ways so that language is continually moving and transforming itself. Thus, it should be stated that as a part of English, Maritime English forms a system like any other terminological system (Legal English, for example) according to general linguistic laws which govern the usage of these terms. In this respect it should be noted that only 7% of marine word stock are absolutely unique terms, others are adaptations of common words.

As a rule, in their practical work language teachers concentrate on the knowledge of special terms hoping that this solves all problems of students' professional training. Unfortunately, it doesn't. The experience shows that communication in its broad sense and on-board communication, in particular, become the most challenging issues for non-native speakers who constitute the biggest part of the world work force

supplied for the global shipping industry. Hence, the students' language proficiency is the decisive factor which pre-determines the strategy of many projects aiming to improve the quality of teaching/learning materials which should lead to the higher level of students' language proficiency.

It becomes obvious that ESP methodology requires an impact, and it comes from linguistics. It doesn't mean immersing maritime students into the ocean of theories about language; it mostly implies the implementation of new approaches to the language training planning as a whole and innovative techniques in language classroom activities, in particular.

A linguistically centred concept (LCC) presumes priority of linguistic analysis in any study of ME oral and written texts meant for MET academic use. In case of any application of authentic materials for educational purposes, a language teacher should understand the input and outcomes of such application. For instance, when explaining the difference between the terms "to collide" and "to allide" a language instructor would rather emphasise on word formation: 'to collide – a collision", "to allide - an allision", then provide the students with definitions of the terms: "a collision - a violent impact of moving objects; crash", then specify the meaning in expression "ship collision" – "the collision of the two ships resulted in a serious damage, loss of lives, oil spills"; "an allision" – "the act of dashing against, or striking upon; the impact against a stationary object; collision of a ship with a fixed object, not a ship". Finally, the text studies will complete the work. It is expected that authentic texts will not be difficult for understanding after appropriate pre-text assignments. This example is given to draw attention to the latest terminographic sources which definitely save time when introducing new terms since direct translation is the shortest way to understanding a foreign term. Unfortunately, the terms "allide" and "allision" are not registered in majority of Maritime English dictionaries.

## 3. INNOVATIONS IN MARITIME ENGLISH TERMINOGRAPHY

*Terminography* is terminological lexicography. *Terminology* refers to a specific professional vocabulary which represents a collection of terms describing a single subject area. Terminography in the field of global shipping activities is assigned to register the scope of terms used by all its participants. Teaching terminology is a fundamental process connected with understanding main professional concepts. The creation of " English-Russian Dictionary of Maritime Terms" is an opportunity to analyse the scope of basic terminological entries, to select the most frequently used ones, to arrange them in the way which provides necessary references in spelling and meaning, suggests most frequently used collocations and examples, gives short descriptions of this or that term or phenomenon. Definitions make the basis of the bilingual dictionary. The theory and practice of terminography states the importance of close interdisciplinary contacts between a linguist and a specialist purposing the clear and professionally correct wordings for definitions. Professional expertise carried out for this type of a dictionary sometimes demonstrates diversity in understanding the same concept by different experts. The problem is solved through finding the definition which suits all parties and corresponds to the best samples found in different sources.

"The English-Russian Dictionary of Maritime Terms" (10 000 entries) has been designed for different users: students, seamen, employees of shipping companies and ports, etc. In the field of Maritime education and training "The Dictionary" is intended for students in Navigation and Marine Engineering of all forms of training specialised in sea and river transportations.

The bilingual dictionary with English-Russian equivalents is due to the use of English and Russian (alongside French, Spanish, Chinese and Arabic) as working languages according to the International Maritime Organisation regulations. The aim of the authors is to display a modern terminological corpus consisting of the most common words and phrases, selected on the basis of their frequency in the authentic English materials that belong to the sphere of the world's merchant fleet operations.

The innovative character of the "Dictionary" manifests in describing the latest trends in the shipping industry and technological equipment of the commercial fleet having caused the appearance of new terms and their subsequent entry into the database of Maritime English word stock. The work makes the emphasis on the priorities of the practical use of the "Dictionary".

With the increasing influence of global processes in economy including shipping industry, the development of national terminography is aimed to create contemporary pieces of reference literature as well as teaching/learning materials for the further use in the field of economy and education.

The dictionary focuses on the specific means of arranging the lexical items: in the first place, this is spelling of the item; the second, the meaning of the word or term presented in the form of a definition or explanation; the third, its usage in context demonstrating combinability; fourth, interpretation of a word or term with synonyms, antonyms or illustrations. Since a special term is always associated with a scientific concept (theory, idea) or an object with specific properties, its definition is verified with the help of existing lexicographic and terminographic sources and considered through the practical experience of experts involved in maritime navigation and operation of ship machinery.

Basic principles of the Dictionary's design are the authenticity of the language material and its communicative nature required for educational purposes.

Linguistic units are defined as items most widely used in the texts thematically relevant with requirements of the International Maritime Organization, including: Personal data and personal documents. Interviewing. Letters. Numbers. Colors. Messages and message markers. Languages, nationalities, flags. Maritime professions and ranks. Responsibilities. The location of objects. Countries, bodies of water. Other geographical names. Maps and nautical charts. Longitude. Latitude.

Vessel: size, parts, structure, functional areas. Types of ships, their names and purpose. Movement and direction: navigation, sailing directions. Engineering. Mechanics. Equipment onboard ships. Marine diesel engines. Auxiliary machinery. Tools and instruments. Shiphandling. Navigation bridge. Engine room. Watches and watchkeeping. Standard Marine communication phrases (IMO SMCP). Weather and climate. Natural disasters. Emergencies. Actions of the crew in case of emergency. Emergency equipment. Mooring, anchoring. Pilotage. Port and its infrastructure. Port's administration, sanitary inspection, customs. Navaids. Buoys. Beacons. Cargo. Types of cargo. Loading and unloading. Water and food supplies. Ordering and delivery of ship's supplies. Accidents. Injuries. Diseases. Onboard first aid. Basic ship documents.

The entries of the "The Dictionary" are:

-common words (room, response, direction);

-general science units (information, achievement, to promote, ability, experiment);

-general maritime terms (marine, maritime, boat, ship, vessel, engine);

-special terms used in navigation and marine engineering (crankshaft, mooring, list, capsize).

The entries are arranged in alphabetical order according to the pattern "English" - "Russian" equivalents.

The dictionary consists of two parts – the Main part and the Appendix. The Appendix provides the readers with linguistic and professional information.

## 4. LINGUISTICALLY-CENTRED CONCEPT AND MARITIME ENGLISH TEXT BOOKS

Innovations are introduced in the area of Maritime English Study Packs development. English for Specific Purposes is considered to be the methodological foundation of ME. It is known that ESP is a sphere of teaching English language including Business English, Technical English, Scientific English, English for medical professionals, English for waiters, English for tourism, etc. According to National Curriculum for Universities [2], ESP serves to meet specific needs of learners, makes use of underlying methodology and activities of the discipline it serves, is centred on the language appropriate to these activities in terms of grammar, vocabulary, study skills. It's worth mentioning that ESP is generally intended for intermediate or advanced students who are well trained in language. If so, Maritime English for beginners can't be cent per cent ESP creation. Then, what should it be?

Within the framework of the innovation project the Introductory Maritime English Course has been developed. The Introductory Maritime English Course is purposed for the first- and second-year non-native learners of English who are about to commence their Maritime academic career through a Bachelor Degree in Navigation or Marine Engineering. Three influences behind the development of the study book and as such its contents and the form are taken into consideration. These are the a) lack (or absence) of professional Maritime experience of the students, b) lack (or absence) of Maritime English language proficiency, c) lack of General English language competency.

The study book is supposed to meet the interests and requirements of the future seafarers in a new sphere of knowledge whereby the coordinated work of English language teachers and specialist teachers is required. The Course fills in the current gaps and adds new necessary requirements by combining English language and Maritime specialist skills with the existing General English language foundations. The Introductory Maritime English Course is a study pack consisting of four parts: Student's Book, Workbook, Teacher's Notes/Resource Book. The Course contains 23 Units:

1) Introducing oneself
2) Discussing personal details: Occupation
3) Discussing personal details: Country. Language. Nationality
4) Describing places and locations
5) Describing quantity.
6) Using geographical names for geographical places.
7) Discussing people: Home, family, education, likes and dislikes.
8) Describing daily routine, functions and duties.
9) Describing directions.
10) Describing motion (1)
11) Describing motion (2)
12) Describing living and non-living objects (1)
13) Describing living and non-living objects (2)
14) Describing events and activities.
15) Describing a process.
16) Describing machines, machinery and tools.
17) Describing results. Reporting recent events.
18) Describing the whole and its parts.
19) Comparing living and non-living objects.
20) Describing ways of doing things: Active and passive actions.
21) Describing past events.
22) Discussing future actions.
23) Classification of living and non-living object.

Revision. Self-assessment. Supplements.

Each Unit is represented by descriptions of the teaching goals and learning outcomes in Language Skills Development, Maritime English Professional Competence and General English Language Competences. Each Unit has a strict structure consisting of tasks, a series of exercises, self-assessment materials, supplementary materials, comments and keys. The concept of The Course presumes that both General English and Maritime English sources should be used in the process of learning. It certainly helps to broaden the potential skills of the language use in different life situations including professional ones. The learning materials used in the Course are mainly adaptation of real-life situations and scenarios with references provided. The exercises have been developed specifically for maritime students. Self-assessment materials take into account the idea of International Standards. The Course contains tasks purposing the individual work of students: notes, reports, PowerPoint presentations, etc.

The Study Pack is of blended type, which implies the combination of General English, General Maritime

English and Maritime English contents. The authentic materials of this professional spectre cover the students' needs in:

-vocational (thematically relevant) texts;
-supportive grammar instructions and exercises;
-reading practices;
-writing assignments;
-listening strategies;
-speaking strategies;
-materials of control;
-self-assessment programmes for each Unit.

The curriculum is built up on the basis of LCC. The priorities are given to general English competency which includes abundant communicative work on the level of a sentence/phrase and a text/description, narration, etc. Thus, LCC presumes the implementation of units of EGP (English for general purposes) at the input aiming the assessment of ESP in the format of ME abilities as the outcome through skills development. A linguistically-centred course model for the 1st and 2nd year non-native maritime English learners becomes a step-by-step problem-solving procedure. See Table 1 as a sample.

Table 1.Course Syllabus excerpt

| **INPUT** | **LANGUAGE PROFICIENCY** | **SKILLS DEVELOPMENT** | **PROFESSIONAL COMPETENCE** | **OUTCOMES/ ABILITY** |
|---|---|---|---|---|
| **Unit 6. Using geographical names for geographical places.**<br>*Unit structure:*<br>6.1. Describing geographical places: Chokepoints<br>6.2. Latitude/ Longitude system<br>6.3. Geographical names<br>6.4. Maps and charts | **Phonology:** Pronunciation of geographical names.<br>**Grammar:** Articles and no article with geographical names. Pronouns and the sentence structure.<br>**Vocabulary:** Nomenclature of names of oceans, biggest rivers. Nouns denoting water bodies. Latitude. Longitude. Maps and Charts. | **Reading:** for gist, for detail<br><br>**Writing**: Making notes. Summary.<br><br>**Listening:** understanding coordinates of places<br><br>**Speaking:** *Topics*: Describing a locality. | **SMCP:** Explaining ship's position<br><br>***Topics:***<br>Maps and charts. Weather maps. Latitude. Longitude. | Self-Assessment Test for Unit 6:<br>*Reading*<br>*Writing*<br>*Listening*<br>*Speaking*<br><br>**Ability** of reading a map or a chart, using appropriate geographical names, giving coordinates |

Working out the teaching and learning strategies is extremely important both for a teacher and students because it helps to distribute time and tospecify teaching/learning goals:

*Step 1.* Defining modules and units. This step pre-sets blocks of units based on the functional principles of GE materials arranged thematically.

*Step 2.* Developing skills. This section represents parameters of practical acquisition of GE and ME through interaction and textual work in speaking, reading, listening and writing. Selection of series of tasks for the language classroom activities is decisive in creating maritime communicative context.

*Step 3.* Attaining abilities in ME. This part describes the material, further skills development and abilities in ME according to IMO course model.

*Step 4.* Performing assessment. This step is represented by the parameters of academic control of language proficiency level, scope of materials, thematic contents and contents for different skills, frequency and types of control, tasks for individual work, etc. Efficiency of assessment is usually evaluated through ME national and international standards and may be measured in terms of certification.

The inner set-up of maritime English gives a clue to the format of a blended type of the Maritime English Introductory Course. For non-native learners of ESP it's important to have an additional support in grammar, phonology, word formation, in order to make further progress in ME learning.

## 5. INFORMATIONAL AWARENESS AND MARITIME ENGLISH PROFICIENCY

Linguistically centred concept makes it possible to evaluate the systemic and structural features of Maritime English. Systemic (pertaining to a system, or affecting an entire system) character of ME appear in the set of specialised (mainly, technical) sublanguages interacting among themselves to describe in the most appropriat emanner all material and non-material entities known in maritime affairs. General English is the foundation in ME training. General Maritime English is represented by language resources used in language samples (oral and written) on the subjects common for both navigators and marine engineers. Maritime English for navigation. ME for marine engineering. ME for ship's documents and correspondence. ME for radio communication. SMCP.

IMO conventions, regulations, manuals. ME semiotic systems (international code of signals, a phonetic alphabet, etc.). ME for visual aids (nautical charts, graphs, tables, pictures, diagrams, etc.).

This innovation gives a new approach in understanding what an informational search for educational purpose is and how to make it more efficient. This work focuses on the analysis of the strategy of informational search and aims to describe search tools/engines (defined as a software programme that searches a database and gathers and reports information that contains or is related to specified terms, or as a website whose primary function is providing a search engine for gathering and reporting information available on the Internet or a portion of the Internet). Virtual informational resources as Wikis encyclopedias (knowledge management systems) suggest examples of search modes. The process of using Wiki is accompanied by selection of wordings which are characterized by various degrees of non-native English learner's language proficiency. This factor greatly influences the final result of the search. The multifunctional character of maritime English, which manifests in its systemic and sub-systemic parameters,causes particular difficulties referring to terminological variations. In this situation good English language proficiency is required. Maritime English has many specific features in comparison with General English. Hence, there are many difficulties in the search process. For example: you want to find information about navigation and you come to know that this is a general term meaning "the act of setting and holding a course; navigation of an airplane solely by instruments; navigating according to the positions of the stars" and, of course, "the guidance of ships or airplanes from place to place". This is also the term of computer users meaning "the skill or process of plotting a route in the Internet, for example". When using the world-wide web, one should make a correct wording (i.e. corresponding to the search subject which sometimes appears in your head as a native-language version). The use of online dictionaries for better naming of the subject you look for is very helpful (For example: «судомеханик» - is not "an engineer" but "a marine engineer"; «морская карта» - is not "a sea map" but "a nautical chart"). It's a language teacher's work to explain the core Maritime words (often, the oldest ones) "marine, maritime, seafaring, sea, nautical, navigation, ship, deck, bosun" and others, which serve as markers referring the concept to the Maritime sphere, for example: "marine engineer, maritime education, marine diesel, ship's parts, bosun's chair, nautical school, etc." It's reasonable to consider these words as Maritime English basics which should be taught to students helping them to perform the Internet search and to differentiate spheres of knowledge.

For the search of information, our students usually use Google. Beginning in 1996, Stanford University graduate students Larry Page and Sergey Brin built a search engine called "Back Rub" that used links to determine the importance of individual web pages. By 1998 they had formalised their work, creating the company you know today as Google.

Wikis are a valuable source of information. Ward Cunningham, the developer of the first wiki software, WikiWikiWeb, originally described it as the simplest online database that could possibly work.

When choosing the website or selecting texts or statistics, copying pictures or images, one should be attentive about its content. For non-native learners in this situation good English language proficiency is required.

## 6. "EARLY SPECIALISATION" IN ME TRAINING AND SEARCH FOR NEW FORMATS IN EDUCATIONAL TECHNOLOGIES

The term "*early specialisation*" presumes acceleration of ME training process during the 1st and 2nd years of studies at higher Maritime institutions. Currently the two syllabi (one for English for general purposes and the other – for English for specific purposes) work in parallel in Ukraine.

It's expedient, in order to save time and finance, to implement the blend type of a syllabus and a study pack corresponding to the concept.

Advantages come primarily with the teaching/learning strategy:

- higher motivation in studying English as a whole;
- clearer goals for improving English in new educational environment;
- immediate introduction of general maritime English alongside the major subjects;
- transparent picture of students' language skills development;
- registration of individual student's progress dynamics.

Since the innovation project is underway, the main concern is the format of the study pack parts. The government programme "Computerised teaching/learning materials for professionally oriented subjects" pre-sets the possibility of choosing the most appropriate option. The research in digital education has shown a contradictory situation. *First*, educational technology is a growing academic field which recognises the centrality of technology in education. *Second*, digital technologies have greatly changed the ways in teaching and learning languages by opening a wealth of opportunities to interact with people and resources. *Third*, digital technologies are only a part of the entire scope of formats and methods of foreign language teaching. *Fourth,* foreign language teaching more often involves blended techniques (face-to-face vs. e-teaching practices) [3].

On the basis of the facts studied, it becomes clear that the ME teaching/learning materials have to be developed in particular formats assuming the following considerations as far as the students' needs are concerned:

- Face-to-face teaching/learning materials;
- Interactive character of e-materials;
- Additional e-training with a virtual teacher;

- 'Twinning' (combined language and specialist online training) on some topics.

## 7. CONCLUSIONS

It is well known that the labour market is the best criterion in one's professional achievements. The students of Maritime institutions are lucky to have the opportunity of assessing their ME language proficiency during on-board practice. The way from the Academy or University to the international crew of a merchant vessel usually lies via a crewing company which certifies the students' readiness to be enrolled for the work at sea. Fluent English is considered to be the gate pass in a long line to get the job of the type.

As far as the Maritime English is concerned, the competitive atmosphere in the field of MET is quite natural. According to BIMCO (Baltic and International Maritime Council), Eastern Europe has become increasingly significant with large officer numbers. The Far East and South East Asia, and the Indian sub-continent remain the largest sources of supply of ratings and are rapidly becoming a key source of officers. Thus, improved training and recruitment levels need to be maintained to ensure a future pool of suitably qualified and high calibre seafarers [4].

The majority of countries mentioned above are non-English speaking countries. So, the main task of the ME instructors is to develop efficient methods, techniques and up-to-date materials facilitating the process of teaching English to non-native learners.

Any advancement in education, in ME, in particular, is mostly successful with government support.

Basically, the changes and innovations influence the current situations by means of textbooks and curriculums. The ultimate goal of these changes is the work for improving national standards. In Ukraine, some of national standards in Maritime English are attached to Specialist National Standards. The separate set of ME requirements does not exist. The innovation project developed in Kyiv State Maritime Academy might become the beginning of such activity through

- specifying requirements for different levels of ME language proficiency;
- development of teaching/learning materials in different formats;
- implementation of new types of assessment including computerised testing for full-time and part-time students.

## 8. REFERENCES

[1] DEMYDENKO, N., *Teaching Maritime English: A Linguistic Approach*, Journal of Shipping and Ocean Engineering, Issue 2 (2012), 249-254.

[2] *English for Specific Purposes* (ESP), National Curriculum for Universities, Kyiv, 2005.

[3] KAZ O., *Problems with Interactive Innovations of E-learning for Foreign Language Studies in Japan*,asiapacific-odl2.oum.edu.my/C26/F527.doc –.

[4] BIMCO Web site, https://www.bimco.org/~/media/Press/Manpower_Study_handout_2010.ashx.

# STEPPING ASHORE FROM OPEN OCEAN CLASSROOMS

GHOSH MADHUBANI

*Massachusetts Maritime Academy, USA*

**ABSTRACT**

One can hardly over emphasize the contribution of the seafaring community in the global marketplace. However, many seafarers do not consider sailing aboard vessels to be a lifelong career and feel the need to transition ashore, which requires confidence, motivation and adequate knowledge base expansion. The paper examines the scope of a new Master's program in Global Maritime Business offered in a hybrid format with a significant online component in order to accommodate the student mariner. A scoping study was done for the proposed program that compared the post graduate offerings of several maritime colleges in the US and other IAMU member institutions around the globe. A market survey was conducted on current students and alumni of MMA as well as international students. The results of the survey were analysed to design the format, curriculum and delivery mode of the program. In conclusion, the paper underscores the role of cooperation and harmonization between member institutions of IAMU to provide a practical high quality educational solution addressing the problems of transition of a seafarer to rewarding shore side careers.

**Keywords:** *Global Maritime Business, Shore-side Career Transition, Global Marketplace*

## 1. INTRODUCTION

There has been a significant structural change in the global seafaring market since the last quarter of the twentieth century. The shipping industry has seen a surge of ship management companies managing large fleets, significant reliance on information technology for vessel operation and resource management, intense environmental protection and security related regulations and the development of a global labor market in the maritime sector. The ship's officers and crew are assembled to a large extent by these global managing agencies, resulting in several permutations and combinations of various nationalities aboard a vessel. Employment data over the past few decades show a significant decline in the number of seafarers from OECD nations and a rise in numbers from Asia and Eastern Europe.

A structural change is also noticeable in the length of a seafaring career, particularly in the OECD nations. Around 1.3 million seafarers around the world service the needs of 7 billion people transporting goods from the supply sources to the demand destinations. However, many seafarers do not consider sailing aboard vessels to be a lifelong career and feel the need to transition ashore, which is often quite difficult. A major push to move ashore comes from the needs of the modern family structure where it is expected that both spouses will pursue a career and share child rearing responsibilities. In a recent survey done by Faststream, a UK based maritime professional recruitment firm, of 2000 maritime industry professionals, it was observed that seafarers prefer positions like operations manager, surveyor and fleet manager when transitioning ashore which offered lucrative salaries. Some of the average salary related findings of the survey are depicted in Figure 1. The report also found that seafaring engineering officers were much more confident of finding jobs ashore than deck officers. However, moving forward with a mid-career shift requires confidence, motivation and significant knowledge base expansion, which is quite a daunting task.

| Job title | Asia | Europe | USA |
|---|---|---|---|
| Charterer | $153,113 | $121,246 | $141,444 |
| Fleet Manager | $120,613 | $129,786 | $130,887 |
| Marine Surveyor | $81,291 | $69,492 | $91,045 |
| Shipbroker | $98,325 | $78,298 | $90,981 |
| Ship Operator | $92,217 | $77,334 | $71,454 |
| Technical Superintendent | $98,175 | $97,896 | $110,287 |

Figure 1 Current average annual salaries
Source: Faststream

However, the maritime industry is much wider than the few career opportunities mentioned above. A much broader shore-side career opportunity in the maritime sector is reflected in Figure 2, demonstrated by Prof. Torger Reve. The career opportunities ashore for a maritime professional are quite diverse and require appropriate skill sets. In the past decade, the shore-side jobs have become more demanding and there is an emerging need for a new breed of professionals.

These individuals are required to master the intricacies of finance, logistics, chartering and brokerage, marine insurance, be proficient in the latest IT tools and promote safe and environmentally friendly work practices in a multicultural and diverse environment. In response to the growing need of the maritime professional to find the right career fit while transitioning ashore, Massachusetts Maritime Academy has designed a new Master's Program in Global Maritime Business. Training the next generation of maritime professionals who will be just as comfortable working ashore as in the high seas, requires multidisciplinary education in international shipping, economics, finance, maritime, global logistics, law, business management, and maritime science and

technology. The curriculum, content and delivery mode of the program is a culmination of a long process that was enriched by input from several maritime institutions around the world, many of whom are IAMU members.

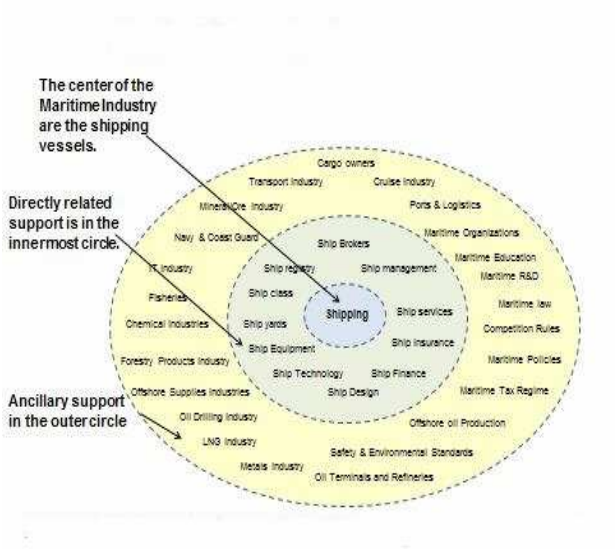



Figure 2 The Maritime Industry
Source: Prof. Torger Reve

## 2. A GLOBAL KNOWLEDGE HUB

There is a significant amount of research by Prof. Torger Reve on global knowledge hubs, particularly in the context of the maritime sector in Norway. Boston is a well-known global knowledge hub in bio tech and life sciences. It has the highest concentration of world class universities, labs and specialized biotech firms than any other place in the world and attracts the best talents worldwide. When it comes to the maritime cluster, as indicated by Figure 3, one typically places the shipping firms in the core, surrounded by cargo owners, ship services, ship equipment, marine insurance, ship brokers and charterers, registry etc. At the periphery of the cluster one finds maritime education, port and terminal along with a host of other service providers. The following countries/regions in the world are some examples of competitive maritime clusters:

1. Houston, USA: global oil and gas center with substantial maritime interests
2. UK: large maritime cluster with specialization in advanced maritime services
3. Norway: complete globally oriented cluster with focus on knowledge development
4. Singapore: open easy-to-access port sector cluster serving as a gateway to Asia
5. South Korea: world leader in ship-building, stimulated by an active industrial policy

As the abovementioned list shows, clusters can become engines of value creation and innovation. For example, the Norwegian cluster is responsible for providing 40% of marine insurance coverage to the world's tonnage. Though not as well centred as the bio tech and life sciences cluster, Boston is still a great location for a maritime cluster due to the following reasons:

1. Proximity to various ports and shipping business interests in the Massachusetts, Connecticut and New York, New Jersey region.
2. Many of the world famous maritime schools in the US are in the Massachusetts, Maine, and New York area.
3. Proximity to some excellent institutions engaged in maritime transport related research such as MIT, WHOI, Volpe National Transportation Systems Center, to name a few.

The objective is to build on the basic industrial cluster idea and transition into a global knowledge hub in maritime business, drawing resources from not just the local and regional partners, but global knowledge partners housed in various maritime universities and research institutions around the world. IAMU gave us an excellent platform in this regard. The concept was developed during my sabbatical tour around the world visiting several maritime colleges and universities in 2012 with the following objectives:

1. Extend our student and faculty exchange program to other reputed maritime institutions
2. Seek input from leading maritime institutions for our proposed Master's program in International Maritime Business and Logistics
3. Get a better understanding of maritime business education around the world for benchmarking purposes

I was graciously hosted by the following institutions during the Spring semester of 2012 where I spent time interacting with faculty, administrative staff and students:

1. AMET University, India
2. Singapore Maritime Academy, Singapore
3. Shanghai Maritime University, China
4. Dalian Maritime University, China
5. Kobe University, Japan
6. Liverpool John Moore's University, UK
7. City of Glasgow College, UK
8. Dokuz Eylül University, Turkey
9. Istanbul Technical University, Turkey

I selected the host institutions on the basis of their reputation in the maritime transportation and business management fields. Some of the institutions offered both undergraduate and post graduate programs and also granted Doctoral degrees in some majors. Many of my hosts shared their curriculum with me including course descriptions and syllabi. Almost all of them were members of IAMU (International Association of Maritime Universities) and I spent almost a year communicating with their representatives to plan my tour.

This tour proved to be a wonderful opportunity for me to learn from my hosts in designing a Master's program in Global Maritime Business at MMA and pave the groundwork for the concept of a global knowledge hub with international partners. This was an extremely enriching experience for me. I believe that such attempts to learn from the wide array of maritime institutions scattered around the world can be key catalysts in

initiating a cross-pollination of ideas among these institutions and provide value to all by allowing a common shared platform of learning.

## 3. BACKGROUND, CONTENT AND DELIVERY

Beyond the survey tour and information gleaned from international partners, a scoping study was completed by my colleague at MMA, Dr. Ragu Krishnasamy in the summer of 2012 who studied the Master's level programs in various maritime colleges in the US as well as general MBA programs with logistics concentration. Additional information on general business, finance and logistics/supply chain management post graduate programs in the US was compiled by my other Departmental colleague, Dr. Shu Tian. Dr. Krishnasamy compiled detailed program information on four of the maritime academies in the United States that offer Masters programs in similar areas. The program structure, entry requirements, mode of delivery and fees charged by the following institutions were studied:

1. California Maritime Academy
2. Maine Maritime Academy
3. Texas Maritime Academy
4. SUNY Maritime College

The main conclusion of the scoping study was that the market for general MBAs with a logistics/supply chain concentration in the Boston region is mature and quite saturated. MMA should be focused on providing a graduate program which had a maritime / transportation / logistics specialization for a competitive edge which is in tune with the mission of our institution and our Department. Full-time residency status may be preferred by a small group of students – those who have time to complete many courses quickly as well as international students. Most applicants, particularly the seafarers, however, would prefer a limited or no-residence requirement (on-line program). The scoping study also revealed that most of the maritime academies appear to gear their programs towards the "US maritime sector". A sustainable program would require us to market our program in other parts of the world, especially Asia. There are several maritime colleges and universities in Turkey, India, China and Japan with students who aspire to earn a foreign graduate degree. This program should be geared towards attracting those students as well.

In order to determine the preference of the market, the IMB department conducted a survey of the following market segments in the Fall of 2012. My Departmental colleague Dr. Paul Szwed and Ms. Katherine McLaren - Director of Institutional Effectiveness, Academic Affairs, MMA were instrumental in designing, disseminating and analyzing this market survey.

1. MMA alumni (both seafaring and shore-side)
2. International students
3. Current IMB seniors

The market survey yielded well over 400 respondents of which 32% of alumni, 55% of undergraduates, and 66% of international students indicated a high or very high interest in such a program. Additionally, 56% of graduates, 75% of undergraduates, and 72% of international students indicated that they intend to pursue a graduate degree in the next five years.

Of those respondents interested in pursuing a graduate degree, most were seeking to advance their career or obtain new knowledge.

The results helped us to understand the pulse of the market. More than half of MMA graduates and current seniors preferred a program that blends international business, maritime business, and logistics. 31.3% of international respondents preferred a global maritime business program. Most of the MMA graduates and current students preferred a program that blends in residence and online sessions and runs for 18-24 months. International students preferred a daytime program that runs for 12 months. Some of the response is compiled in Figures 3 and 4.

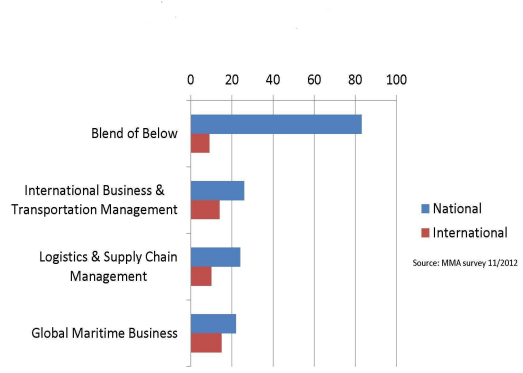



Figure 3 Survey response regarding program focus

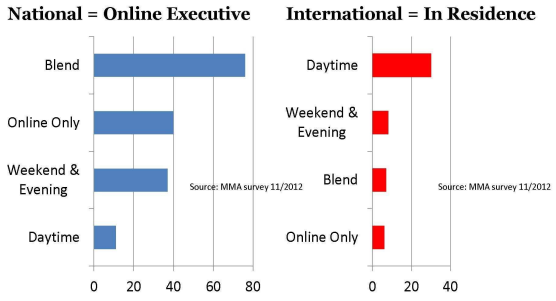



Figure 4 Survey response regarding mode of delivery

The following groups were considered in identifying potential market segments for prospective students. This was developed by senior students in the International Maritime Business program at MMA in their Marketing course.

The Graduate Management Admission Council (GMAC) 2012 Application trends survey indicated that the flow of applications from foreign citizens continued to be a source of strength. Also, women made up more than half of the 2012–2013 applicant pool for Master's programs in management, accounting, and marketing/communications. 744 programs were

represented in the GMAC survey from 359 business schools and faculties in 46 countries. 46% of all MBA and Master's programs combined saw increased female applicants in 2012 compared with 2011. Full-time one-year MBA programs had the most international applicant pool in 2012, with more than half (55%) of applicants residing outside the country where the program is administered. There was significant emphasis on distance learning. These findings were incorporated in our target market segments for the Master's program in Global Maritime Business.

In keeping with the findings of the market survey, the program was conceptualized. The proposed program closely aligns with the MMA mission to graduate "men and women to serve the maritime industry as licensed officers and to serve the transportation, engineering, environmental, and industrial needs of the Commonwealth and nation". It also pays special attention to those seafarers who are attempting to transition ashore and might find it difficult to attend full time day programs or weekend executive programs due to logistical constraints.


Figure 5 Potential market segments

Table 1. Master of Science in Global Maritime Business

| COURSE | CREDITS | MODE OF DELIVERY | CORE BUSINESS FIELDS |
|---|---|---|---|
| *END SUMMER (END AUGUST)* | | | |
| 1. All Aboard: Workshop on Global Maritime Business | 3 | Residence (one-week intensive) | General Management, Professional Skills in Business, Quantitative Analysis. This workshop will present an overview of how the different courses in the program shed light on critical components of the shipping business and how they are intricately tied together. |
| 2. Shipping, Trade and Globalization | 3 | Residence | Macroeconomics, Microeconomics, International Business and Trade, Global Logistics |
| *FALL SEMESTER* | | | |
| 3. Maritime Leadership and Strategic Management | 3 | On-line/Classroom | Ethics, Organization Management, Negotiation, Strategic Management |
| 4. Shipping Economics, Operations and Management I: The Market for Ships | 3 | On-line/Classroom | Microeconomics, Finance, Statistics and Quantitative Methods |
| 5. Shipping Economics, Operations and Management II: Liner and Bulk Markets | 3 | On-line/Classroom | Economics, Managerial Accounting, Global Logistics, Statistics and Quantitative Methods |

| | | | |
|---|---|---|---|
| *WINTER SEMESTER* | | | |
| 6. Maritime Law, Policy and Regulations | 3 | On-line/Classroom | Law, International Relations |
| 7. Maritime Finance and Risk Management | 3 | On-line/Classroom | Finance, Financial Accounting, OR, Statistics and Quantitative Methods |
| *SPRING SEMESTER* | | | |
| 8. Global Logistics and Supply Chain Management | 3 | On-line/Classroom | Global Logistics, Operations Management, Statistics and Quantitative Methods |
| 9. Port Operations and Management | 3 | On-line/Classroom | Operations Management, Global Logistics, Statistics and Quantitative Methods |
| 10. Maritime Technology and Innovation | 3 | On-line/Classroom | Information Systems, Information Technology |
| *EARLY SUMMER* | | | |
| 11. Capstone | 6 | Residence (two-week intensive) | Professional Skills in Business Integrative Exercise, Statistics and Quantitative Methods |
| TOTAL: 11 MONTHS (36 CREDITS) for Full-Time Students | | | |

In the market segmentation, the disciples are MMA graduate who are familiar with the school and faculty. The seafarers are the ones who are currently sailing but would like to move ashore. The insiders are from the maritime sector on the shore side looking for career progression. The catchment consists of prospective students in the New England region looking for interesting and rewarding graduate learning opportunity. The generalists are business professionals in the management/ logistics area looking for an inroad into the maritime sector. Distance learners, women and international students comprised significant chunks of the market.

The program is designed to include a significant online component and will appeal to a much broader population locally, regionally, and internationally by offering both a part-time and a full-time format. Currently, there is an abundance of general MBA programs across the nation that provides supply chain management specializations. Additionally, there is a high degree of saturation in the New England region of high quality business programs offered in a number of formats, including executive weekend formats. There are only a few programs focused on the maritime industry, primarily out of the other maritime academies, none of which are in Massachusetts (e.g. a residential program offered at Maine Maritime and an entirely online program offered by California Maritime). There are no programs nationally that offer a blended format and focus specifically on global maritime business and supply chain management. This represents a niche opportunity that does not duplicate offerings within the Commonwealth; further, as identified in the market survey, a strong demand for such a program exists. The survey conducted by the department indicated a strong preference for a blend of in-residence and online sessions by MMA alumni who may be currently sailing and a strong preference for a full time day program by international students.

The 36-credit proposed Master of Science in Global Maritime Business curriculum comprises an introductory overview course, a nine-course specialization and a culminating capstone project. Mindful of the findings of the market survey, existing competition and available resources, the proposed curriculum allows for an 11-month in-residence option, an 11-month blended (fast track) option, and extended track options for working professionals. The plan of the program is indicated in Table 1. The teaching resources for the program will be drawn predominantly from full-time Academy faculty and adjunct professors both local and global. The option of the online component will allow some of the best faculty from all over the world to join hands in this global learning process that will provide the opportunity for sustainable open ocean classrooms that lead to a fulfilling career ashore in the maritime field.

## 4. CONCLUSIONS

The paper underscores the role of cooperation and harmonization between member institutions of IAMU to provide a practical high quality educational solution addressing the problems of transition of a seafarer to rewarding shore side careers. Due to the significant online component of the program, valuable faculty resources can be combined from various IAMU member institutions across the globe offering maritime business courses in virtual open ocean classrooms.

## 5. ACKNOWLEDGMENTS

I take this opportunity to thank my Departmental colleagues, Dr. Ani Dasgupta, Dr. Ragu Krishnasamy, Dr. Paul Szwed and Dr. Shu Tian for their valuable input in conceiving this hybrid mode Master's program in Global Maritime business. I am also deeply indebted to all my hosts during my sabbatical that provided valuable guidance and support in program conceptualization.

## 6. REFERENCE

[1] ALDERTON, T., *The Global seafarer: Living and working conditions in a globalized industry*, International Labour Organization, 2004.

[2] *Faststream Survey Report*, 2012 http://www.faststream.com/media/58558/Perception%20vs.%20Reality%20Report.pdf.

[3] GMAC (Graduate Management Admission Council), *Application trends survey*, 2012. http://www.gmac.com/~/media/Files/gmac/Research/admissions-and-application-trends/2012-application-trends-survey-report.pdf.

[4] IMO (International Maritime Organisation), *International Shipping Facts and Figures – Information Resources on Trade, Safety, Security, Environment*, Maritime Knowledge Centre, 2012. http://www.imo.org/KnowledgeCentre/ShipsAndShippingFactsAndFigures/TheRoleandImportanceofInternationalShipping/Pages/TheRoleAndImportanceOfInternationalShipping.aspx.

[5] REVE, T., *A global maritime knowledge hub*, Research paper, BI Norwegian School of Management, Norway, 2009. http://www.oceanspacecentre.no/wp-content/uploads/2010/01/2009-05-reve.pdf.

# FILLING THE VOID: TRUE ASSESSMENT OF STUDENTS' ACTUAL OPERATIONS KNOWLEDGE

GREEN W. SCOTT

*California Maritime Academy, USA*

**ABSTRACT**

The goal of this paper is to illustrate a way by which the practical limitations of modern engine simulators and their automated assessment systems may be overcome, thus gauging the true knowledge of the student engineer. The technical capabilities of engine plant simulator systems have provided instructors with relatively consistent means through which student progress and performance can be monitored, but at the same time have given the student the ability to "play the game" according to a predefined metric. It is often difficult for the instructor to determine whether the success was to true comprehension or simply to memory.

A wide variety of strategies have been developed to demonstrate a student mariner's "qualification", but we are still frequently left with the question of whether or not a student's performance on an automated assessment truly reflects his or her knowledge. For standard tasks, one-time exercises against a benchmark test can be useful to gauge knowledge, as long as the goal of the exercise is met. However, we might agree that "standard tasks" rarely are performed in the real world as they are in a classroom setting. Significant differences exist that affect the manner in which the activities are performed.

This paper will present the "Talking Engine Room", a system used at the California Maritime Academy to fill the above void between detailed simulation systems and the real-world physical perspective. This interactive instructor-student query technique has shown that markedly increased student situational awareness can result in corresponding increases in actual knowledge, as well as in more valid assessment of each student's true ability. Students must prove their actions verbally, not just "push buttons". Potentially major error is thus reduced.

**Keywords:** *Assessment, Simulation, Interactive, Full-immersion, STCW, realism*

## 1. INTRODUCTION

The nagging question that often plagues an instructor in any technical course is: "Does Student X truly understand the material and/or procedures and systems necessary for successful completion and competency in the field?" We ask ourselves whether or not the student can adapt his or her learning to the real world, where decisions truly matter, or if not, what tools can we use to make sure that they can? For if we cannot find an answer to this dilemma and the graduate is subsequently fired from the job or involved in an accident, the instructor and institution come under extreme scrutiny of the community and regulators at large.

Within the myriad disciplines of traditional academics, for example Physics, Statics, History, Calculus, Political Science, etc., individual testing methods, essays, theses, and so on, are usually quite acceptable in gauging the student's abilities. But when faced with actually proving that a candidate truly knows what do to in highly specialized fields requiring certification by government or international bodies, an instructor is often left wondering what a particular student truly knows. Time constraints force us to form a broader opinion on a group of students in a lab, all at the same time, rather than trudging through each and every one of them individually.

In the field of medicine, matriculates usually work with various laboratory tools, test equipment, "dummies" and cadavers under the watchful eyes of their instructors. Only after rigorous observation in these safe environments is a potential medical student allowed anywhere near a live person. In our own highly specialized field of Marine Engineering training, various simulators often fill a similar task to that of the "dummy". However, the very nature of the exercises used to test a student's abilities and responses in difficult situations often also means that they are working in tandem with multiple other students in a simulation group - again leaving us with the questions: "Can Student X do that alone?"; "Did he get it, or did someone else figure it out for him….?" In order for an exercise to be truly cross-compatible with a shipboard environment, group size must reflect that found in that environment. Otherwise, the training mission is lost; it becomes incongruent with the real world, essentially calling into question the validity of the exercise platform.

This assessment protocol is further compounded in the Marine Simulation field by the hard fact that even modern simulator systems still suffer two acute weaknesses: they cannot fully replicate every environmental aspect of the engine room (size of the ship, hot components, etc); and they do not provide all of the diagnostic tools available to an Engineer in the plant (such as the ability to listen to a pump directly or to feel a casing for odd vibrations). Response to casualties and diagnosis of malfunctions in a ship propulsion plant almost always requires quick assessment of the situation at hand, followed by rapid decisions on actions to be taken (or not to be taken, as the case may be). In today's modern propulsion and steam power generation plant

world, fully automated systems are relied upon to control virtually everything. And yet, to date, few if any propulsion simulator systems allow for an instructor to fail particular field devices - the very devices upon which the computer systems rely to manipulate the plant's systems effectively. What's more, students cannot utilize their various senses to determine things a shipboard engineer would "catch" immediately - such as the smell of an overheating motor.

Most difficult of all, none of the simulators on the market provide a truly life-like representation of the element of time. Valves open instantly (and almost always without fault; all one does is "click" on it); you can jump almost instantly from one system to the next, even though they span the entire engine room or ship; repairs are merely a click away via the removal of a fault malfunction. All of these time-related short-comings render much of simulation training quite unrealistic, the veritable opposite case to what we are all trying to do with these expensive machines.

It is the viewpoint of this paper that, while challenges most certainly do remain, the CMA has found an effective way of replacing these missing elements of student engineer diagnostics and operations, while at the same time providing the instructor (and student) with a far greater picture of an individual student's actual knowledge. Through forcing the watch personnel to describe in words their methods, ideas and actions, each student learns more -- and thus cannot escape the scrutiny of assessment. Realism of the scenario is therefore enhanced along with an end-of-the-day tally of the participants' true knowledge.

## 2. THE USE OF ENGINE SIMULATION AT CAL MARITIME

### *2.1 A bit of history of the simulation program*

When the use of computerized simulators began at Cal Maritime back in 1981, terms such as "full mission" and "part-task training" did not exist; personal desktop computers did not exist. Simulators at that time, of course, consisted strictly of consoles driven by large main-frame computers. The school's original use of such systems stemmed from the need to provide students with an acceptable platform on which cadets could learn a slow speed diesel propulsion plant. As such, groups of students conducted various exercises toward bringing the plant fully online, largely through instructor-lead exercises that showcased the simulator's ability to insert malfunctions.

This sort of approach to the equipment resulted in the inevitable use of the system to "break things" without actual harm to a real plant. As no physical plant components were included with the facility, an assortment of console boxes provided the only means of accessing the various systems, valves and other devices one would find in the real world. Consequently, two primary problems arose: students had no real world space sense of what they would find aboard a ship; and the simulator itself was often turned into a game of "let's break this device and see what happens". Given that the exercises were conducted with groups of eight to ten students, all in a very small space (roughly eight by ten meters), no true assessment of individual students' knowledge was possible. All technical comprehension was gauged in the tangent lecture classroom exams.

As the mid-90s came round, so too did strict demand for assessment of every student's ability. By 1995, CMA now had an actual diesel training ship. In this new climate, however, the use of the diesel simulator strictly as a tool to drill cadets in casualty response grew even worse. Still there was no true physical size of the plant to contend with, or any of the other environmental aspects of a real ship. Exercises amounted to little more than the group learning to memorize a series of steps to accomplish a particular state of plant readiness. Unless the instructor took active steps to query each and every student as to why actions were taken, it was (and remains) all too easy for those with weaker comprehension to get through the course merely by being in the class with "smarter" students.

Further complicating matters of assessment was the United States' becoming a member of the Standards of Training, Certification and Watch-keeping (STCW) of 1995. This did force CMA to develop a more robust system of tracking each student's progress, but the same approach to the diesel simulator remained one of malfunction response. Most of the assessment of students' abilities was moved to the two training cruises all Engineers were required to take. But again, high levels of student-instructor interaction are necessary in order to ensure actual ability. Given the increase in student population during this same time frame, the school was also faced with the need for many more instructors than in previous years. Not all of these were quite as involved in student progress as they could have been, which resulted in an assortment of students with a wide range of actual knowledge.

The conversion of the diesel training program at this time to a combination of the training ship and simulators also left the Academy with void: how to maintain the steam propulsion training program. The answer became "let's get a simulator". But the newly acquired (ostensibly donated) facility turned out to be far unlike any such system anyone at CMA had ever seen - and with it, a complete underestimation of how to use it to its full advantage. The original Steam Plant Simulator included a full mock-up of an engine room for a fully automated tanker propulsion plant that provided students with some semblance of the real equipment they would encounter. But the scenarios at this time were still limited to response to malfunctions - and only at full sea speed, since that was the only initial condition available. In hindsight, however, this very system proved to be the catalyst for what has become a multi-level, inter-disciplinary program of marine engineering training. Much of the impetus for these major changes was the direct result of the Academy's work with various shipping companies, who themselves saw the need for the very type of team management and crisis response training that our unique steam simulator offered.

Through these cooperative ventures, many lessons have been learned as to the strengths, weaknesses and inherent problems encountered with today's high-spec marine simulators, particularly in regard to the ways in

which they are used to produce an engineer with knowledge and experience that can be transferred to actual shipboard operations. Chief among these is the cold fact that no simulator can provide student engineers with all of the physical environment and field parameters one would have on a real ship. All subsequent simulation systems at Cal Maritime have been developed and training implemented with mitigating this concept in mind.

*2.2 The Simulators Today: Adopting a Coordinated Approach*

With the approach of the 21st Century came the realization that the Academy's simulators were in need of significant update. The existing full-mission diesel simulator had been online since 1981 and was no beyond further improvement. The full-mission steam simulator had been designed in 1978, relocated to CMA in 1996, and was completely obsolete electronically. Both systems have subsequently been replaced with modern, state-of-the-art systems - the diesel simulator in 2003; the steam plant in 1999 - and have been consistently updated periodically ever since.

The primary design criteria for both systems centred on three main areas: extensive fidelity for main and auxiliary plant system modelling; a broad range of associated plant subsystems; and (most vital to individual assessment) a set of computer based part-task trainer stations on which each student could conduct exercises with automated assessment. Both steam and diesel plant simulation training now utilize the full spectrum of these systems. Every student is required to perform individually on the PTT, and in a team setting using the full-mission simulators. The facility layout for each of these latter systems is specifically arranged so as to force students to move around to various terminals, consoles and spaces in order to perform tasks, rather than allowing all actions to be done on a central terminal.

Figure 1 Mock Steam Plant (partial)

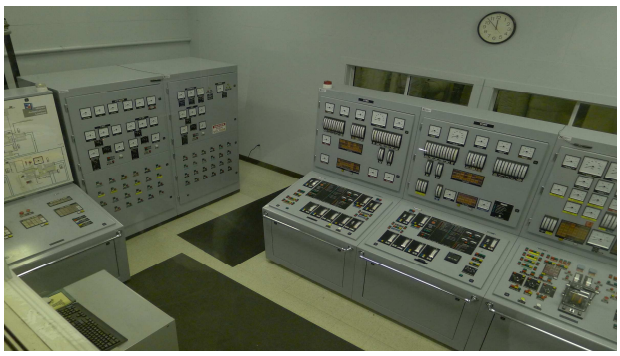


Figure 2 Engine Control Room

The Steam Plant Simulator depicted in Figures 1 and 2 is the focus of the pedagogical system described herein.

In addition to courses for undergraduate students, however, the Academy has also worked very closely with industry clients for various Engine Room Resource and Crisis Management courses. Indeed, it has been through these programs where the shortcomings of condensed full-mission simulators have been most problematic. But at the same time, it was through these same courses that other shortcomings have come to light. The solutions to these problems have resulted in marked improvement in engagement and focus: the students no longer "play a video game", but rather are now seen conducting themselves as actual Engineers.

*2.3 The difficulties encountered: What was missing?*

Despite the robust, complex and thorough modelling of the propulsion plants themselves, the simulators still cannot replicate key factors encountered in all marine engineering activities:

- The sheer size of the ship
- The noise of equipment when malfunctioning
- The distraction of crew and other people
- The distractions of unforeseen malfunction
- Uncoordinated operations of equipment
- Uncoordinated operations between departments
- Time needed for repairs or to transit the vessel
- Explosions, boiler panting, injuries, etc.
- Arc flash and other electrical sparking
- Disparate readings between gauges
- Poor communication and information relay
- Leaking pipes, vibrating pieces
- Actual personnel hierarchy and experience
- Situations occurring unrealistically
- Notable lack of a sense of urgency

All of the above issues have been cited by many of our industry clients as major detractions from the realism of all simulator classes. If the education we are trying to provide to our students is intended to be immediately cross-compatible with job site responsibilities, then striving for realism in all scenarios should be a primary focus. The manifestation of shipboard realism within a pair of 40-by-30 foot rooms, however, is very difficult to achieve. When six to eight students, each at the same academic level, are all vying to prove their abilities concurrently, all on the same task, the gap between real and simulated widens again. In fact, very often students will expect the instructor to step in to "fix" a problem or

to reset the scenario after a major error. We all know, of course, that shipboard crews must be far more prepared for all operational requirements and infinitely more cognisant of the potential disaster that could arise.

Ironically, the most glaring manifestation of unrealistic situational response has come in the form student watch-standing aboard the *Training Ship Golden Bear* ("TSGB"), the very venue in which they are expected to function as industry-ready professionals. While aboard a typical merchant vessel a watch might consist of perhaps two individuals (one of whom is licensed), a standard four-hour watch aboard TSGB is comprised of three First Class Engineers (Seniors) and seven Third Class entry-level engineers. The former are tasked with running and organizing all operational aspects of the watch - under the supervision of the actual Licensed Watch Engineer ("LWE") - ostensibly functioning as the ship's "licensed" engineering staff, while the Third Class are responsible for taking data rounds of the plant, conducting routine clean-up and other general activities associated with a supporting member's role. These staffing numbers are far from realistic by almost any measure in the commercial shipping world. The First Class must be kept under close scrutiny to ensure that they remain apprised of the plant's status and their duties, rather than rely wholly upon their Underclass Oilers (themselves completely inexperienced as yet) to notice abnormalities and other operational conditions that could potentially affect the watch.

Further exacerbating this watch-standing disparity is the fact that all repairs and maintenance aboard the training ship are done by an entirely different group of Engineering students, the "Dayworkers", comprised of an entire division of cadets (thirty to forty students). As a result, two separate groups must coordinate their activities on a day-to-day basis, whereas on an actual ship, the same eight or ten engineers do basically everything. Morning briefings are held amongst these sailing crews to ensure coordination; no such meetings take place on the training ship, except amongst the officers in charge of day work.

The irony of the staffing situation on the training cruise is best observed by the students themselves - all of whom would have just returned from a commercial cruise the previous summer. Without exception, the First Class recognize that the numbers aboard the TSGB simply do not equate to real world conditions in the least. Most have become frustrated with the number of people on watch and the often disconnected activity of day work and vessel operations. All planning around these factors is, in fact, still of necessity done by the vessel's actual engineering staff, with students serving in a role ranging from observational to mid-level oversight. These very First Class students have pointed out that *all* of their simulator courses are completed by the time they sail aboard the Golden Bear again in an operational role.

It would seem, then, that we have had it backwards in some regards. If the primary point of simulation training is to prepare our students for jobs at sea in the maritime industry, equipped with the essential organizational, technical and leadership skills they need for success, it stands to reason that more realistic use of the simulator classes simply had to be implemented. All operational aspects of the ship should be taken into consideration while decisions are being made; all contingencies to accomplishing daily tasks must be incorporated into scenarios. Simply assigning the students a particular task for that class session - for example, placing a generator online - is wholly unrealistic when that is the only thing they're expected to think about. That is not how a real ship operates, so why should the simulator? Elementary systems familiarization is quite effectively accomplished on part-task simulators, in a safe setting. Learning how to do things when an actual vessel could be in jeopardy is not acceptable, yet the levels of stress associated with that jeopardy could well provide the impetus for deeper learning. The pressure to know your job *before* disaster is at hand is often lost on a student standing in front of a computer terminal in a simulator, where no actual damage can occur - and perhaps provocatively, no penalty will be incurred for that damage, potentially leading to further disassociation between real and simulated. While the Academy has experienced excellent success using PTT simulators for essential systems training and assessment of individual students (particularly with regard to heavily documented STCW competencies), we have found that team training requires a very different approach if said deeper, high-level cognizance is to be achieved in the long term.

### *2.4 The Human Factor in Simulator Pedagogy*

The most critical problem facing the Engineering Technology Department at Cal Maritime has proven to be the inherent inconsistency brought about the sheer variety of instructors needed to cover all of the simulator courses. Between roughly 2000 - 2008, up to twelve different instructors were concurrently teaching the three simulation courses in the curriculum. While each instructor's methods and style certainly have merit on their own account, this very diversity of instruction had become the single biggest obstacle to ensuring consistency of student STCW assessment and validation of graduates' actual technical ability. For some time, in fact, only two of the Department's instructors were actually members of the Faculty; all of the rest were temporary adjuncts hired on a per-semester basis or, in some other manner, transient at best.

During the middle of this same time frame, significant changes had also been made to the Marine Engineering Licensing curriculum. The full impact of these major changes is beyond the scope of this paper, but it nevertheless was the catalyst for developing the new pedagogical method discussed herein. Tangentially, the two-cruise system CMA had been using since 2000 also had an effect. The ET Department simply did not have enough personnel to cover both training cruises, thus several more adjunct faculty were needed. The result was still more inconsistency. At the end of the day, however, it was the California Maritime Academy whose name would be attached to the qualifications of every student upon graduation.

Clearly, then, some sort of filter was required to "catch" weaknesses in a student's knowledge level. As is so often the root cause behind the majority of marine casualties and accidents, so too have all of the difficulties

above conspired to create a significant problem in guaranteeing that each and every student had met the school's requirements. No one problem was to blame; as always, it was the combination of these challenges that led to thoughts of a new approach.

In the end, however, the most painful problem encountered has been the fact that students often had little idea how their scenario grade was derived. Other than written exams, little quantitative information was provided to them regarding how the exercise went - other than whether or not they achieved a certain STCW competency. Even this was unrealistic, however, when students are simply lined up and tasked with performing the required steps. As a result, many students have left the classes with a sense of nebulous learning and dissatisfaction.

Conversely, of course, the instructor has often been left with the quandary of figuring out just how much a specific student knows versus how much benefit he or she derived from others' knowledge. This, in fact, was the crucial reason a solution had to be found.

## 3. THE "TALKING ENGINE ROOM" SYSTEM

None of the above would seem revelatory to anyone involved with the use of advanced marine simulators today. However, during any variety of such courses, perhaps instructors would agree that the single most frustrating attitude encountered with students working with such systems is the idea summed up by Undergraduates' statements such as these:

- "Ah, I'm just going to play with the sim for a couple of hours".
-"I'm not busy; I'll just be in the simulator".

Or in a debriefing, perhaps one has heard….

-"It's nothing but a video game, so why does it matter?"
-"It's only just a computer; nothing bad can happen"
-"Let's see if we can blow it up. That would be fun!"
-"Mr. X, can we see if we can make the ship sink?"
-"Ms. Q, my computer is acting slow/weird. How am I supposed to do the test?"
-"The light came on, so it's running"
-[looking at a PC screen] "It's got pressure, so everything's OK"

Or after a major error - usually brought on by poor or unconcerned forethought:

-"Mr. Y, can we start again?"
-"So what? It's not a real ship"
-"Well, it was unfair because we were missing one of our [eight watch-stander] guys. You ought to cut us some slack"

Even professional Marine Engineers, often brought to full-mission simulation facilities for Engine Room Resource Management training or other advanced courses, are very easily "lost" on the first day because they simply discount the realism of the facility's setting. Perhaps instructors for such courses can relate to comments such as:

-"That's stupid, I would have known about the 'standby engines' time hours ago"
-"Yeah, maybe that could happen, but what about the noise I would have heard beforehand?"
-"Yeah, right! Do you know how many motor-operated valves have frozen up on me just this year?"
-"Well, it's just the simulator, so we don't have to [take a certain precaution]"
-"There's no way that would have happened! We would have seen the leak by just standing there by the pump!"
-"There's no way I can do that. We don't have the money for it, or the Office would scream".

These are just some of the many comments the author has heard from students over the years. Significantly, the comments and feedback received from industry clients have had the most impact on addressing not only Continuing Education courses, but more profoundly on those heard from undergraduates at Cal Maritime. Indeed, it was realized that the quickest way to quell such dismissive comments from the budding engineers was to eliminate all vestiges of artificiality - as much as feasibly possible - in the simulator.

Using the Full-Mission Steam Plant Simulator for EPO235 Watch Team Management as the starting point, students no longer were to receive orders on a given day to conduct a particular exercise. Rather, they are now faced with operating an actual "ship" according to the mandated vessel's sailing orders. Imbedded within the orders are the "Milestone Dates" that prescribe the date on which major plant status conditions must be achieved. Each Watch Team group receives a different set of orders. When a group meets a deadline, maximum points are awarded. Should they fall behind schedule - correlating to a potential delay in the ship's schedule - progressively higher point penalties are assessed. Consequently, the group that learns to organize and to conduct business diligently, thus being ahead of schedule, is awarded bonus points. Again, anything that happens during a given class session carries over to the following week as the initial condition.

These simple changes were the logical extension to addressing another common fault experienced with undergraduate simulator courses: students felt they were being held accountable to no one but the instructor; their actions could be taken with impunity, regardless of potential real-world consequences. Resolving this issue has been explored successfully using the "Vessel Masters Program" begun in 2009 [1]. By extension, Engineering cadets are now required to take the entire engine room and vessel - including all personnel, whether physically present or not - into account while performing all tasks. All tasks now reflect the timeline history of that section's ship.

### *3.1 Orchestration of the Watch: The Whole Ship*

The key components to what has now become known as the "Talking Engine Room" system have, by virtually all student accounts, brought a heretofore unheard of sense of realism to the advanced levels of simulation training. The implementation (at least initially) was simple: rather than issue a set of instructions for the simulator class day, each class section receives a set of sailing orders for the entire semester. In order to accomplish these orders, students must access every part and person necessary to operate the ship, thus concurrently achieving all related STCW competencies

associated with EPO235. These weekly activities thus require the student Watch Team to see things, to do things, to hear things, to work on things are simply not included or possible with the simulators. Such activities range from:

-Local control to start equipment first, then switch to automatic remote;
-Conducting visual and auditory rounds of equipment while operating;
-Visiting other officers, workers and crew not present in the Control Room;
-Verification of actual valve position vs. indicated;
-Performing repair and maintenance tasks outside of the Control Room;
-Being in spaces in the ship not included in the actual simulator facility (e.g. Bridge, Cargo Control Room, pier)
-Repair and diagnostic efforts on equipment in the plant;
-Blow-down of the Auxiliary Diesel Generator;
-Emergency manual operation of equipment.

In essence, anything that the engineer would need to observe or to perform that is not explicitly included on one of the consoles or in the mock Engine Room Spaces, he or she must come up to the Instructor Operating Room (IOS) to describe the action to the instructor or to pose specific questions regarding equipment. This means that the instructor, by extension, can query the student as to why they wanted to do that, or why they ask that question. We can verify the thought process the student is using to analyze a certain problem and offer socratic suggestions to help them through understanding the situation at hand.

Initially, the idea for this tactic was brought about by two general observations in class: the aforementioned difficulties in providing realism; and having witnessed various student engineers perform actions that could easily have caused major physical harm in a real setting. It was evident that a "virtual" engine room was needed; something that could supply the needed missing components of the plant and ship. Somewhat entertainingly, it was the students themselves who devised the now-standard term for these virtual spaces, the "Talking Engine Room (TER)".

The concepts of recognizing a realistic time to do things and that all actions come with consequences have thus been largely mitigated simply by forcing the students to leave the Control Room and explain themselves. The instructor can force the student to stay upstairs, detached from the group, for an indefinite amount of time, somewhat replicating that needed in the real world (within reason). In addition, he can also witness benignly a myriad range of errors his or her own teammates are committing, simply by watching from above. This has helped to reduce the "tunnel vision" so common to marine engineers stuck in a control room on one task.

However, perhaps the most vital aspect of this new protocol - and one that represents the single biggest improvement in realism - is that the results of all actions the students take in the "engine plant" remain with them for the duration of the semester. This means that inadequate attention that results in a failed pump, for example, is their "history": the pump is out of commission, potentially affecting whether or not the vessel can meet its deadlines. When damage resulting directly from student actions requires repairs, money is taken from the group's nominal operating budget. The amount of money they have left at the end of the semester is a significant portion of the groups' overall grade, thus we have found that most groups make great effort to think before they act.

This "payback" effect upon Watch Team performance also includes the aforementioned Vessel Masters Program, whereby faculty of the Academy's Marine Transportation Department (MT) have graciously offered their consultation services to Engineers. Whenever a significant event occurs as a result of the Watch Team's decision-making process - for example, delay in departure time; injury to personnel; serious damage to primary equipment - the Chief Engineer and other watch-standers involved in the incident are require to meet with their assigned faculty "Captain". As most of the Engineering students are not well acquainted with MT faculty, this mandate has forced them to recognize that they are definitely not functioning as stand-alone crew; they are part of an extremely dangerous and expensive operation. It has also been shown to foster far greater integration and familiarity of Engineering cadets with the Deck. Throughout the history of CMA, Engineers have virtually zero contact with faculty in the MT Department, thus this program, as an extension of the Talking Engine Room, has served to provide more realistic decision-making. Many students have commented that "the last thing they want to have to do is talk to some [person] they barely know and explain their stupidity".

In forcing students in the Watch Team to recognize the roles other crew members play in vessel's operation and that they must take into account all aspects of the Engine Room (not just the ones they can "click" on), the structure of the watch has become more fluid and realistic. Decisions on what to do are no longer purely dependent on what the assignment for that day is; they are made based on the ramifications on their ship overall.

### *3.2 Orchestration of the Watch: Personnel and Spaces*

Throughout almost the entire history of simulation training at CMA, students in each of the class sections have been assigned specific titles primarily for purpose of keeping them focused on very specific tasks. While some overlap of tasks did take place, the integration of STCW Competencies resulted in these assignments being further restricted to a very specific task at hand. Table 1 describes the general assignment system previously used for most simulation exercises:

Table 1. Standard Student Watch Positions

| Crew Position | Primary Responsibility |
|---|---|
| First Assistant (1) | Watch Engineer |
| Second Assistant (1) | Boilers and Steam Generation |
| Third Assistant (1) | Electrical Plant and Auxiliaries |
| Non-licensed Ratings (1-3) | Assistance as directed |

The student demonstrating an ability to control boiler water level therefore was, by definition, specifically the Second Assistant Engineer. Any industry engineer knows, however, that the watch would never include the entire Engine Department, nor would only one person be allowed to manage water level: everyone on a modern-day watch would be keeping an eye on this critical parameter. Again, the previous system often detracts from realistic immersion training in the simulator.

The TER system, however, by virtue of requiring personnel to leave the Control Room (or even the Engine Room entirely), forces the student Watch Team to function in more realistic fashion. Consequently, enhancements have demonstrated in:

-Greater attention to managing personnel and their whereabouts;
-More refined and careful communications amongst people in and out of the plant;
-More flexible arrangement of actual tasks;
-Greater impact of distractions upon focus;
-Greater attention to the hierarchy of decision-making;
-More careful planning of each day's activity;
-Better pre-planning and practice before class;

In effect, all six students no longer perform as a large Watch Team, but rather as an Engineering Department. Only a couple of them are on the actual "watch" at any given time or in the Control Room. Inspiration for this arrangement was the direct result of work CMA has done with shipping companies, all of whom have commented that the number of people at hand in the Control Room previously was unrealistic and incompatible with true decision-making. Similarly, one member of the class section is now appointed as the "Chief Engineer", upon whose shoulders the overall organization of the entire activity toward achieving the Milestones rests. In all previous simulation classes, the Instructor has served as the Chief, the Captain and all other people on the ship, thus providing the student with a "safety net" who would step in with key information or directions. Essentially, this was little different from arrangements on the training cruises, where students take absolutely no part in planning or decision making. If the product of the program is intended to be a graduate who is accustomed to such planning and decision-making, then the author would argue that they must be allowed - indeed forced - to take part in these aspects of vessel operation at some point in their matriculation.

This new protocol system has placed far more stress upon the student assigned to the Chief Engineer position, but all students thus far have remarked that "this forced [them] to be ready and to be on [their] toes".

## 4. FINDINGS AND FEEDBACK

Undeniably, the TER program does require intense concentration and engagement of the instructor involved. The stress levels amongst the Watch Team members forces them to pay attention to all of their actions and to utilize all information at their disposal - especially that obtainable only in the TER - but so too do they require extremely well organized and thought-out scenarios. But because class sessions are no longer dedicated merely to specific tasks for the day, just about anything can happen. Students have quite often changed the entire course of the proposed day's plan simply by hitting the wrong button or by turning off the wrong burner in a boiler, for example. However, this very possibility is exactly what forces the Team to be "on its toes".

Students have reported that this "Unknown" leaves them with no choice but to learn about the systems, components, operations and watch management techniques that define the course content. More than a few Watch Teams have described this as the "Randomness Factor" that causes each and every session to feature unexpected events that force them to double check equipment, to be extra careful in placing systems on line, and to be more diligent on rounds of equipment they cannot "see" nor monitor on the physical consoles. Indeed, it has also enlightened them as to the inevitable potential unreliability of electronic transmitters and computer networks: all professional mariner engineers are well familiar with inaccuracies of tank level indicators, vibrating pressure gauges, and other erroneous or suspect instrumentation. Although the automated assessment monitoring systems most modern simulators employ can help with tracking common errors and general operations, they simply cannot realistically be programmed to respond to all possible situations or outcomes; they cannot adapt to changing scenarios. Once the scenario has veered from the pre-determined path, the assessment system is usually rendered inaccurate.

Nevertheless, these very observations also indicate that the system requires that *all* students be up to task. What's more, they have realized that must become at least familiar with the general responsibilities outlined in Table 1, for at any time, a student may be absent from class or be taken "out of the action" through being delayed in the Talking Engine Room. They *must* know their jobs each and every day, for to fail invariably leads to the suffering of the entire team - usually in the form of a significant delay in reaching a Milestone.

### *4.1 Unforeseen benefits*

At its early stages in the Fall of 2010, each Watch Team was given a similar set of Sailing Orders. This was done in order to keep each section of class on roughly the same schedule. As a result, during the first several weeks of the semester, most "ships" were at quite similar points in bringing the full plant online. While some sharing of experiences amongst the various students could be seen as beneficial, it all caused a bit of predictability as weeks went on.

The latest iterations of the TER System have instead begun each class with a totally different set of Sailing Orders and initial conditions. No longer can each class contaminate others by reporting what they did, for every ship is completely different. Coupled with the inherent uncertainty of actions described above, this heightened unpredictability has actually increased student satisfaction with their learning experience. All classes, all students must each face their own challenges. While some similarities do eventually arise, they are now always within a totally different context or situation,

forcing the Watch Team to be more proactive in being prepared.

As each crew member position rotates on a two-week cycle, the students have also discovered that "being stuck upstairs" (in the TER) is actually not a penalty, as they'd originally thought it might be. Instead, they have learned the value of being able to observe actions, communication errors, breakdowns in command structure and a host of other human factor issues that they otherwise would not have noticed had they been "stuck" in the Control Room or Engine Room instead. In actual practice, in fact, many have experienced simulated injury and death as a result of Control Room personnel operating equipment remotely, having forgotten that some person at the TER had been sent to the same machine locally (i.e in the TER). Previously, students routinely would operate machinery on a Control Room terminal or console in complete oblivion to the fact that someone might actually be in danger at the actual machine. This level of precaution is common practice on real ships; completely ignored in most simulation exercises.

The students and instructors in the Watch Team Management course occasionally have ostensibly disparate missions. Instructors must be certain that the engineer candidate meets international, federal and institution levels of competence. Most students want this too; they want to learn about being an "Engineer". But a few are content simply to "get by" with the bare minimum of knowledge to get through the curriculum as quickly as possible, with a sharp eye toward graduation. With the Talking Engine Room mandates of routine rounds, explanation of actions and theory, and situational awareness in the broad context of an entire ship, however, students now realize that they cannot simply get by just by being in class and relying on the wisdom and diligence of others. At any given time, they now *know* that they, in fact, will be called upon to prove their ability.

### *4.2 Student response: the true indicator*

Universally, the majority of students have commented that the TER System has helped to prepare them more effectively for situations they might encounter in the real world. The fact that their duties aboard ship will never be conducted within the sanitized conditions of a traditional simulator exercise is not lost on them. Some sample comments received from various students might sum up the overall response to this new approach:

"The [TER] helped the students have a better understanding of running a steam plant by assisting us to (sic) have a deeper thought process of why and how equipment functions".

"The class felt more as being in an actual ship than just a class and clicking on a computer screen."

"[It] helped the students to think outside the box and how to troubleshoot a problem with simple questions that lead to the final answer."

"The [TER] helps to transform the class from running a simulator to running a steam plant."

"There could be a strange smell, smoke… frayed wires that a simulator or computer screen won't tell you."

"It … enhances the real world time factor that would affect people in the plant. For example, on a real ship it takes 10 minutes to walk up to the EDG, but in the simulator it's right there."

"Having people out of the Control Room provides a more realistic environment with respect to crisis management."

"I feel that I was well prepared for most alarming situations I experienced in the Engine Room this [training] cruise."

All of these comments would seem to show that the students, for whom we in the education field work, have been well pleased with the improvements seemingly indicated through the use of the Talking Engine Room System.

## 5. CONCLUSIONS

In the end, this new protocol has given instructors a far more accurate picture of each student's knowledge. It does require extreme levels of attention on his or her part, but the confidence gained in student progress arguably makes the effort beneficial in the long term.

Since the program began, all class sections have shown marked improvement in preparation, communications, planning, crisis response and - most importantly - far fewer incidences of major casualties to the plant. In Fall 2009, all sections of EPO235 experienced in some form significant plant error that required a visit to the Vessel Master assigned from the MT Department. As of Spring 2013, only two such cases occurred. Tangentially, this improvement could be related to the concurrent increase in student use of after-hours practice sessions: approximately 65% of students utilized practice time in 2009; in 2013, 92%. More exact metrics for tracking specific changes are under development at this stage.

## 6. ACKNOWLEDGMENTS

This paper could not have been accomplished without the steadfast enthusiasm, dedicated professional input and unwavering support of the Marine Engineering Technology and Licensed Mechanical Engineering students of the California Maritime Academy. In particular, the author would like to express deep appreciation to following students for their comments and input, specifically: Matthew Hysell, Kyle Vanderspek, Eric Johnson, Joshua Keller, Matthew Steffy, Glenn Fuller, Jesse Skeets, Richard "Ricky" Ocon, Jeffrey Squier, Adam Farnsworth, Owen Hurley, Emily Dackins, Russell Penniman, and countless other dedicated students. In addition, the feedback and contributions of the engineering staff and crews of Polar Tankers (formerly ARCO Marine), Exxon-Mobil SeaRiver Shipping, and Chevron Shipping have been instrumental in developing this program.

## 7. REFERENCES

[1] GREEN, S., SCHMID, W., *Maritime Education Summit*, Massachusetts Maritime Academy, 2009.

# AN EVALUATION FRAMEWORK IN MARITIME EDUCATION AND TRAINING FOR E-LEARNING USER'S ENVIRONMENT SATISFACTION

[1]HU QUIYOU, [2]NIKITAKOS NIKITAS, [3]PAPACHRISTOS DIMITIROS

*[1]Merchant Marine College, Shanghai Maritime University*
*[2,3]Shipping, Trade and Transport Department, University of Aegean*

**ABSTRACT**

This paper presents the development of an evaluation research framework of user's satisfaction based on gaze tracking and voice recording for sentiment analysis and applies this to the evaluation of learning in maritime education and training. The research methodology that will be used has its roots in the Neuroscience field and connects the behavioral evaluation with the gaze track and head movements' data, sentiment and opinion analysis of speech and traditional methods (interview, questionnaire). The research purpose is defined in detecting, recognizing and interpreting the emotional information in conjunction with other information created during the execution of a scenario in a maritime e-learning system (simulators or training software). The proposed method and experiment (ECDIS course in SMU) contributes to the enhancement of evaluation method in adult maritime education and can be taken up by maritime learning systems developers to improve their learning content and process in educational project.

**Keywords:** *Evaluation, e-learning, gaze tracking, sentiment analysis, neuroscience*

## 1. INTRODUCTION

In the maritime education and training, the user's satisfaction based on objective criteria poses an important research subject because via this we can determine the background that explains the satisfaction phenomena, recommending at the same time new considerations that will expand the up-to-date educational conclusions on the adult education in educational programs and software development ([1],[2],[3]).

Eye observation on handiness tests is a rather but promising new field especially for the system designers, as it may offer information on what may attract the user's attention and which are the problematic areas during using the system. Also, another factor that can be investigated in relation to the emotional experience (satisfaction) is the sentiment analysis (language processing). The research area on use of the optical recording tools is the quest for an exact interpretation of the optical measurements and voice recording for sentiment/opinion analysis, which is their connection to the satisfaction and the learning effectiveness of the users. Suggested research aims at this direction with the use of neuroscience methods in combination with the use of qualitative-quantitative researches aiming at the extraction of useful conclusion that will help simulator system designers to develop the systems (especially the interface, delivering and organizing education material), the class designers to better organize of the material and modern tools use (better planed educational scenarios that thriftily develop the trainees abilities but also can offer a more objective evaluation of their abilities and their function as future captains or mechanics) and finally the expansion of the adult education field by offering new conclusions regarding the e-learning use (introduction modes, evaluation) and possible revision of the marine education models of the respective apposite organizations (IMO) ([2],[3],[4],[5]).

The phenomenon of the subjective satisfaction of the user is the ultimate goal (Fig.1). It is complicated in its nature as it is affected by many factors varying from situation to situation and from individual to individual. The ultimate goal is to find an average, concerning the maritime education and training and any special factors concerning: the education suitability (maritime educational models), the ability to simulate the functional abilities regarding the actual maritime environment, the realism of situations in correspondence with the real-time situations, the controlled functional environment, the satisfactory interface for the users and the ability to conduct full-time system control by the educator-trainer.

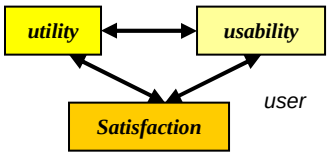



Figure 1 Structural vision of the users-students "subjective satisfaction" phenomenon

We propose a research evaluation framework for Satisfaction Evaluation of e-learning user's environment. The main elements of the proposed approach include ([5],[6]):

- Natural parameters' measurement (head movement, gaze tracking, sentiment/opinion analysis) and
- Registering user opinion/viewpoint/view (statistical analysis).

This procedure is a primary effort to research the educational and usability evaluation with emotion analysis (satisfaction phenomenon) of the users-students

in maritime e-learning environments.

## 2. LITERATURE REVIEW AND SCOPE

Usability testing procedures used in user-centered interaction design to evaluate a product by testing it on users. This can be seen as an irreplaceable usability practice, since it gives direct input on how real users use the system. Usability testing focuses on measuring a human-made product's capacity to meet its intended purpose ([4],[7]).

Usability has been defined by ISO 9241 as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use". Effectiveness means accuracy and completeness with which users achieve specified goals. Efficiency means resources expended in relation to the accuracy and completeness with which users achieve goals. Satisfaction means freedom from discomfort and positive attitudes towards the use on the product. It is widely acknowledged that the first two goals of usability (efficiency and effectiveness) can be measured in an objective manner (usability tests), but he third goal (personal satisfaction) is subjective in nature and depends on the characteristics of the user groups addressed [5].

International bibliography provides many sources on the Eye-tracking research in education. For instance, Schiessl et al. (2003) used an eye-tracker to investigate gender interfaces in attention behavior for textual vs. pretorial stimuli on websites. An investigate outcome was that, when the participants were asked where in the interface they thought they looked their perceptions often differed from reality, showing that accurate attention patterns could only be found with an eye-tracker. In Jakob (1998) explores issues surrounding the real-time processing of eye data such as efficient noise reduction and the organization of gaze information into tokens from which relevant data may be extracted. He then discusses the potential of eye-tracking as a tool in several forms of interface manipulation, including object selection/movement, scrolling text and navigating menus. Salvucci and Anderson (2000) applied these ideas to design IGO (Intelligent Gaze-added Operating system), a system that allows users to use their eyes to perform interface operations such as opening, closing and dragging windows. Sibert et al., (2000) describe the use of gaze trucking to assess reading performance in the Reading Assistant, a system for automated reading remediation that provides visual and auditory cues if user gaze patterns indicate difficulties in reading a word. Qu and Johnson (2005) use eye-tracking for interaction adaptation within the Virtual Factory teaching systems (VFTS), an computer tutor for teaching engineering skills. Eye-tracking is used to discern the time the user spends reading something from the time the user spends thinking before taking action, with the goal of assessing and adapting to the motivational states of student effort and confusion. Gluck and Anderson (2001) studied the use of eye-tracking to assess student problem-solving behaviors within the PAT Algebra I tutor, including attention shifts, disambiguation of problem statements and errors, processing of error messages and other information critical to problem solving [8].

Investigating the emotional gravity of words spoken by a speaker and defined its emotional state (current or past) constitutes a state of the art issue. Most of the emotional state categorization suggested concern the English language. To overcome this problem, studies have been conducted that approach the matter cross-culturally and study the assignment of the categories to various languages. This assignment has conceptual traps since the manner in which an emotional state is apprehensible; an emotional state is influenced by cultural factors as well.

International bibliography contains various approaches – techniques (sorting algorithms) concerning linguistic emotional analyses, which are followed and are based mainly in the existence of word lists or dictionaries with labels of emotional gravity along with applications in marketing, cinema, internet, political discourse etc. There are studies also concerning sorting English verbs and French verbs that state emotions based on conceptual and structural-syntactical characteristics ([9],[10],[11]).

The major idea of this paper is propose a general approach for satisfaction evaluation of the students-users' (subjective) satisfaction of the marine education via user interface evaluation of several types of educational software (i.e. simulator). The proposed research is a combination of qualitative – quantitative methodology, on one hand, and a use of neuroscience tools (gaze tracker, sentiment analysis), on the other hand.

## 3. THE EVALUATION RESEARCH FRAMEWORK

The suggested *E*valuation *REsearch FRamework (EREFR*) aims at interpreting, determining and evaluating the figures of the gaze tracker and voice recording in combination with the conventional methods (qualitative, quantitative) results based on the factors that is possible to influence the user's satisfaction (Fig.2). Therefore it is essential to continuously and thoroughly analyze factors and parameters that contribute in the determination of the user's satisfaction level aiming at the evolution of the interpretation framework into a complete interpretation and evaluation model of the students-users' satisfaction in maritime education and Training.

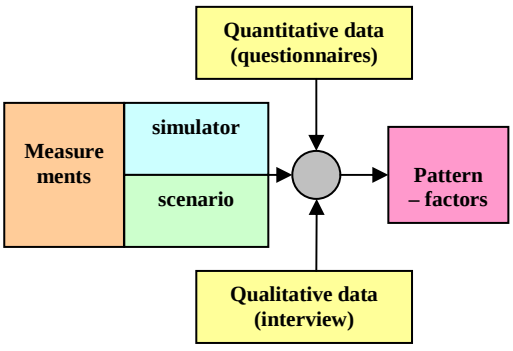



Figure 2 Interpretation procedure of EREFR

The structure of proposed EREFR concerns the following sections ([4],[5]):

(a) Mood/Emotion before the scenario/exercise (oral text)

(b) Behavioral action (head movement, gaze) during the scenario and

(c) Emotional post-experience – satisfaction (oral text).

Measuring the emotional information will be realized using the following processes:

(a) Natural parameters' measurement: Movement parameters (head movement, gaze movement) and oral text as text and

(b) Registering user opinion/viewpoint/view.

The EREFR is comprised by the following parts (Fig. 3) ([4],[5]):

- Influence Part (IP)*:* We suppose based on Action Tendency Theory (concern view) and on Practical Reasoning Theory by M. Bratman that there are possible interactions (influences) in the user's emotional state / satisfaction through intentions-desires-predisposition.
- Emotion Measurement Part (EMP): The emotional analysis theories based on measurement process concern the meta-experience of the emotional state, either during measurement before the experiment (mood before the educational act) or after the experiment (sensation/view/opinion/stance).
- Appraisal Part (AP): In this section, the Satisfaction recording takes place but also commenting related to the day when measurement is taking place and in total up to that moment, as far as the software tool is concerned, after the experimental conduct of the scenario/exercise (usability), personal self-evaluation, scenario evaluation (benefits) in combination with the weighed usability measurement tool (DEC SUS Tool).

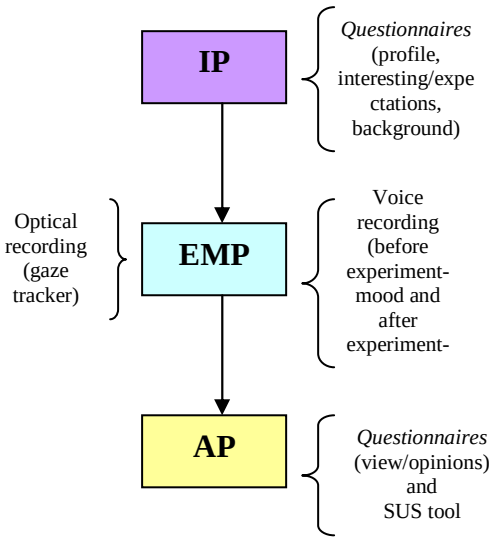



Figure 3 Internal structure of EREFR

Defining satisfaction concerns the following issues, which are being investigated ([2],[3],[4],[5]):

- concerning software and educational scenarios,
- system usability as far as the system per se is concerned (total functionality),

as well as the individual training and technical characteristics that complete the teaching act.

The detection of emotional information (satisfaction) will be realized using the Technical and Theoretical Tools ([4],[5],[12],[13]):

- Tool-I (T-I*):* In the protocol the optical data registration will be conducted by the 'Face Analysis' software that was developed by the IVML Lab of the National Technical University of Athens, in connection with a Web camera set on the computer in which there is the subject of the research (educational software i.e. ECDIS, Engine Simulator). That particular software records a large number of variables but we focus on the following parameters that refer to the user's eyes and head movement: (i) eyes movement: vertical and horizontal eye movements (Eye gaze vector), (ii) user's head position in regard to the eyes up/down – right/left movement (Head Pose Vector: pitch, yaw), (iii) eye distance from the computer screen (Dist_monitor) and (iv) rolling of the head (eye angle from a horizontal level) (Fig.4).

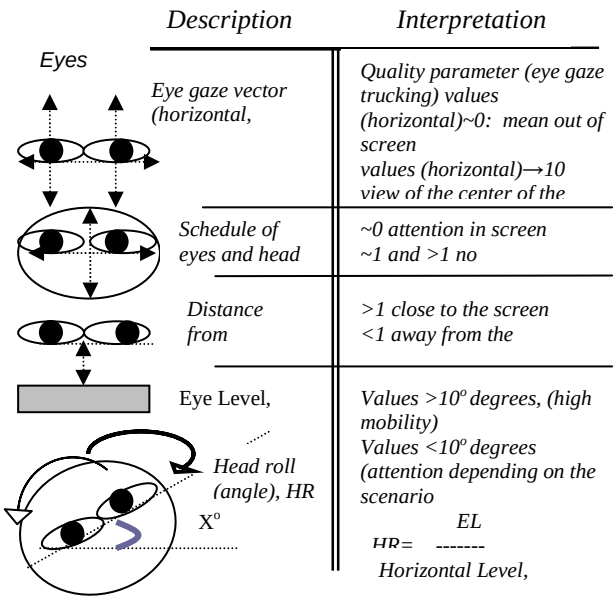



Figure 4 Parameters interpretation of 'Face Analysis' Tool-I

- Tool-II (T-II)*:* Use of a microphone for voice recording of spoken words (speech-text). This will be used for the registration of 3 temporal marks: (i) First Point ($T_1$) - the temporal mark before recording for measuring mood. This executes the voice recording (1 file) of the user where the user explains how he/she feels and why, (ii) Second Point ($T_2$) - a temporal mark after the recording for the measurement of mood-emotion after the recording. This executes the voice recording (1 file) of the user where the user explains how he/she feels and why and (iii) Third Point ($T_3$) - a temporal mark after the recording where the satisfaction choices are justified (software, scenario). The voice recordings

consisting of 3 .WAV type files will be analyzed further during the processing section in three dimensions: Lexicological (emotional analysis), Style analysis of linguistic characteristics, and Qualitative analysis of the spoken word so that the user emotional state/satisfaction can be justified (Fig.5).

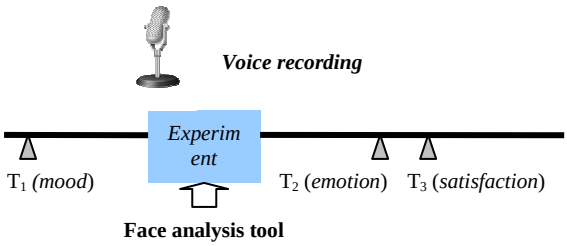



Figure 5 Voice recording

- Tool-III (T-III*):* Questionnaires using for opinion/attitudes/expectation/self-evaluation. It concerns 3 questionnaires: (a) T-III-1, influence data, (b) T-III-2, mood, scenario label, recording data and (c) T-III-3, User appraisal concerning software, scenario, educational environment, errors, total assessment and suggestions (Fig.6).

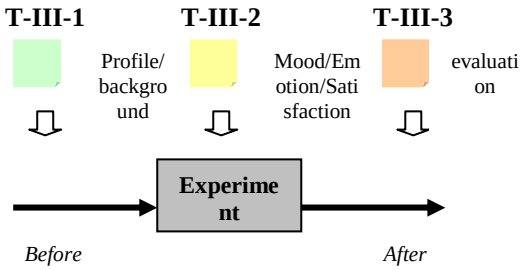



Figure 6 The structure of T-III

- SUS Tool-IV (T-IV): The System Usability Scale (SUS) is a simple, ten-item scale giving a global view of subjective assessments of usability. The SU scale is generally used after the respondent has had an opportunity to use the system being evaluated, but before any debriefing or discussion takes place. Respondents should be asked to record their immediate response to each item, rather than thinking about items for a long time. The SUS scores have a range of 0 to 100 (Table 1).

Table 1. System Usability Scale (DEC-1986)

| No | Question | Coef |
|---|---|---|
| 1 | I think that I would like to use this system frequently | 4 |
| 2 | I found the system unnecessarily complex | 1 |
| 3 | I thought the system was easy to use | 1 |
| 4 | I think that I would need the support of a technical person to be able to use this system | 4 |
| 5 | I found the various functions in this system were well integrated | 1 |
| 6 | I thought there was too much inconsistency in this system | 2 |
| 7 | I would imagine that most people would learn to use this system very quickly | 1 |
| 8 | I found the system very cumbersome to use | 1 |
| 9 | I felt very confident using the system | 4 |
| 10 | I needed to learn a lot of things before I could get going with this system | 3 |

The data processing concerns the composition of all the above mentioned relationships so that patterns of the natural parameters in relation to emotional states (Satisfaction) can be found. The composition of elements from questionnaires, SUS, optical and voice recording data had as final goal the support or rejection of hypothesis Research (Fig.7):

Hypothesis-1: There is an assigned relationship between the emotional state to the eye and head movement or meta-emotional experience via spoken words?

Hypothesis-2: There is a relation between the personal data of user (gender, place of work, experience, education, and age) and the user satisfaction by the equipment and the work operation?

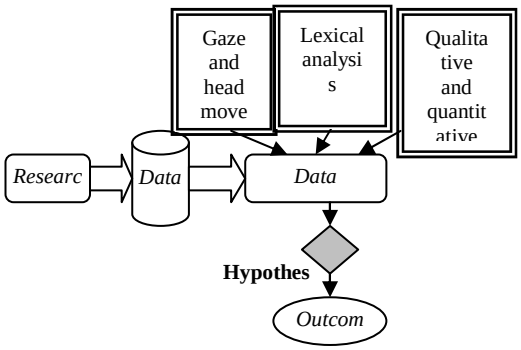



Figure 7 the data processing flow

Finally, the main purpose of the research via EREFR is the investigation of usability-satisfaction of a user of maritime e-learning systems via the assistance of biometric tools, language tools but also other traditional methods (questionnaires, SUS tool).

## 4. OBJECT

The experimental procedure presented here is a primary effort to research the satisfaction phenomenon of the users-students in e-navigation environments (Electronic Chart Display and Information Systems-ECDIS) by using a combination of qualitative – quantitative techniques with a biometric tool (gaze tracking tool) and sentiment analysis (voice recording)(Fig.8). The 'Goals' ECDIS are set as 'to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout voyage' based on SOLAS V/19.2.1.4 [14].

Especially the case study aims the following:

- the evaluation of the user satisfaction from using the *ECDIS* software and scenario and

- Educational evaluation of *ECDIS* from the user's point of view (opinions).

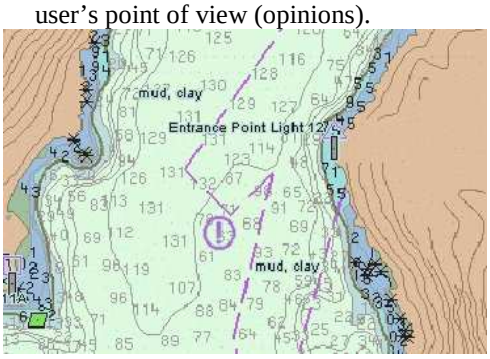



Figure 8 ECDIS image (Electronic navigational chart – NOAA, source: Wikipedia)

## 5. PARTICIPANTS

The sampling will be done in the course ECDIS in Shanghai Maritime University (SMU) (Fig.9) [15]. This course is provided in the third year. The ECDIS course contains two parts: theory and simulator lab practice. The next table shows the students profile for Age. 29 maritime Students of SMU (ECDIS course) will take part in the experiment (Fig.10).


Figure 9 The Merchant Marine College of SMU (web site)

Table 1. Student profile of age

| Sex | Age | |
|---|---|---|
| | *Mean* | *STD* |
| Male | 22.6 | 21.5 |
| Female | 1.4 | 0.7 |
| Total | 22.5 | 1.38 |

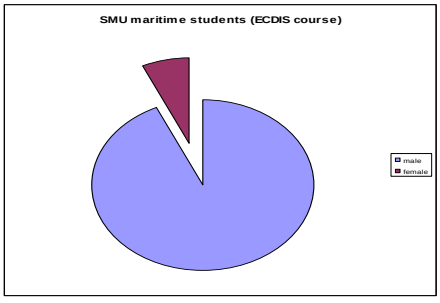



Figure 10 SMU maritime students (ECDIS course) profile of sex (male, female)

## 6. PROCEDURE

The experiment research process will include the following levels (Fig.11):

- *First Level 1st*: Information about the experiment, Presentation of the acceptance document by the user-student (estimated time duration 5 - 10 minutes).
- *Second Level 2nd*: Completion of a user's profile and of the assessment survey concerning educational and technical characteristics (questionnaire, T-III-1) and voice recording T-II and T-III-2 for mood recording by the student (estimated time period 10 - 15 minutes).
- *Third Level 3rd*: Equipment installation ('Face Analysis' T-I) and configuring the parameters.
- *Four Level 4th*: Optical recording (T-I) (estimated time duration 20-25 minutes).
- *Five Level 5th*: Completion of the process (T-I disconnect) through a structured interview (T-II and T-III-2) and questionnaire (T-III-3 and T-IV) with the user (estimated at 5 – 10 minutes).

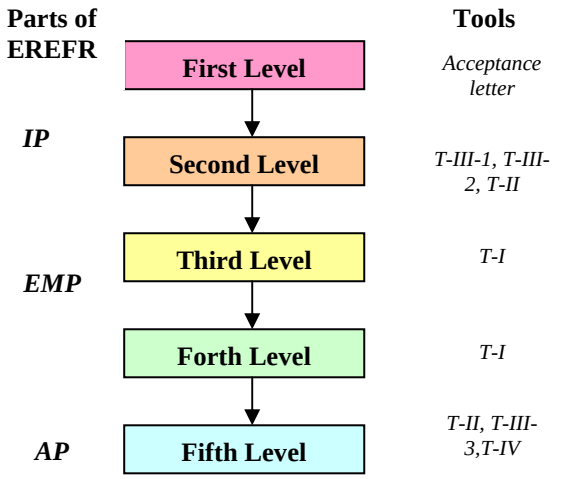



Figure 11 The levels of proposed research procedure

## 7. DISCUSSION

In Marine Education (ME), the use of neuroscience methods and tools (biometric tools) is a useful contribution in its amelioration. ME follows certain education standards (STCW'95) for each specialty (Captain, Engineer) and for each level (A', B', C'). Its scope is the acquisition of basic scientific knowledge, dexterities on execution (navigation, route plotting, administering the engine etc.) as well as protecting the ship and crew (safety issues and environment protection issues) [16].

The main purpose of the research via EREFR is the investigation of satisfaction of a user of maritime education equipment (engine-navigation simulators, ECDIS) via the assistance of biometric tools, language tools for sentiment/opinion analysis but also other traditional methods (questionnaires-interviews).

The suggested research framework (EREFR) focuses in the following dimensions of research work: (i)

investigation of basic emotional state (happiness-sad) of a user of a marine system of electronic learning as far as the dipole happiness-sad through interaction, (ii) investigation of the emotional state connection to *satisfaction* as far as the educational use of such systems is concerned, of training programs of scenario-exercises, (iii) investigation of possible detection means for emotional states – physiological parameters in electronic learning environments (visual and language recording), and (iv) interactions of all of the above with relation to Maritime education and training (standards, etc.) (16],[17]).

In particular, the biometric tools and the neural sciences methods will help expand the adult education field and especially marine education opening new broad ways to the learning and tutoring sectors within the new educational framework established by the use on new technologies.

## 8. REFERENCES

[1] IMO, *Issues for training seafarers resulting from the implementation on board technology*, STW 34/INF, 2003.

[2] PAPACHRISTOS, D., NIKITAKOS, N., *Application Methods and Tools of Neuroscience, in Marine Education,* Conference Proceedings "Marine Education and Marine Technology" (ELINT), Athens, Greece, 2010.

[3] PAPACHRISTOS, D., NIKITAKOS, N., *Evaluation of Educational Software for Marine Training with the Aid of Neuroscience Methods and Tools*, Symposium Proceedings, TransNav2011 Symposium, Gdynia Maritime University, Poland, 15-17 June, 2011.

[4] DIX, A., FINLAY, J., ABOWD, G., BEALE, R., *Human-Computer Interaction*, UK, Pearson Education Limited, 2004.

[5] PAPACHRISTOS, D., KOUTSABASIS, P., NIKITAKOS, N., *Usability Evaluation at the Ship's Bridge: A Multi-Method Approach*, in Proceedings of The 4th International Symposium on "Ship Operation, Management and Economics - SOME12" SNAME, Greek Section, Athens, Greece, Dec 8-9, 2012.

[6] PAPACHRISTOS, D., NIKITAKOS, N., ALAFODIMOS, C., *Emotion Evaluation of Simulation System in Educational Practice*, In Proceedings of The International Conference on E-Learning in the Workplace 2012 (ICELW2012), www.icelw.org, New York, NY, USA, June 13th-15th, 2012.

[7] NIELSEN, J., *Usability Engineering*, Academic Press Inc, 1994.

[8] CONATI, C., MERTEN, C., *Eye-tracking for user modeling in exploratory learning environments: An empirical evaluation*, Knowledge-Based Systems 2007, 20:557-74.

[9] LAMBOV, D., PAIS, S., DIAS, G., *Merged Agreement Algorithms for Domain Independent Sentiment Analysis, Pacific Association*, For Computational Linguistics (PACLING 2011), Procedia - Socila and Behavioural Sciences, 27, pp 248-257, 2011.

[10] LI, N., WU, D.D., *Using text mining and sentiment analysis for online forums hotspot detection and forecast*, Decision Support Systems, 48, pp 354-368, 2010.

[11] PANG, B., LEE, L., *Opinion Mining and Sentiment Analysis*, Foundations and Trends in Information Retrieval, Vol. 2, pp 1-135, DOI:10.1561/1500000001, 2008.

[12] ASTERIADIS, S., TZOUVELI, P., KARPOUZIS, P., KOLLIAS, S., *Estimation of behavioral user state based on eye gaze and head pose-application in a e-learning environment*, Multimedia Tools and Applications, Springer, Vol. 41, No3, pp 469-493, 2009.

[13] BROOK, J., *SUS, - A quick and dirty usability scale", Usability Net*, EU project, 2003, Available online:http://www.usabilitynet.org/tools/r_questionnaire.htm, (last access 5 April 2013).

[14] IMO, *Development of an e-Navigation strategy implementation plan*, NAV 58/INF.13, 27 April 2012.

[15] SMU, Merchant Marine College, official web site http://mmc.shmtu.edu.cn/index.php?lang=en, (last access 14 April 2013).

[16] IMO, *Role of the Human Element Report on investigation into near misses*, MSC 74/15/1, 2001.

[17] TSOUKALAS, V., PAPACHRISTOS, D., MATTHEU, E., TSOUMAS, N., *Marine Engineers' Training: Educational Assessment of Engine Room Simulators*, WMU Journal of Maritime Affairs, Vol.7, No2, 2008, pp. 429-448.

# THE SHORT- AND LONG-TERM EFFECTS OF THE DESIGN, CONSTRUCTION, AND TECHNOLOGY UTILIZED IN A CITADEL ON A SEAFARER, INCLUDING SEAFARER SAFETY AND WELLBEING BOTH DURING AND AFTER A PIRATE ATTACK, AND THE LONG-TERM SUSTAINABILITY OF SEAFARERS SHOULD A PIRATE ATTACK OCCUR

[1]KUNZA L. KAYLA, [2]MILESKI JOAN

*[1,2]Texas A&M University at Galveston, USA*

**ABSTRACT**

The following paper discusses the history of the citadel, or safe room, aboard vessels and their success rates in the instance of pirate attacks in high-risk areas, such as the Gulf of Aden and the waters surrounding Somalia. By analyzing the design, construction, and technology currently utilized in citadels, and the short- and long-term effects that these topics pose to seafarers after a pirate attack and hostage situation, the sustainability of seafarers in the maritime industry could be predicted, and possibly increased.

**Keywords:** *Citadel, crew sustainability, hostage, piracy, safe room, technology.*

## 1. INTRODUCTION

Piracy has been a major issue in the maritime industry for centuries, even after many technological advances have been utilized onboard vessels worldwide. While there are many ways to locate pirates and thwart their attacks in certain areas, there are still ways for the pirates to board the vessel, hijack the cargo, and hold the crew hostage. While cargo and vessels, though costly, are able to be replaced, the prolonged welfare of the crew onboard is sometimes omitted from the vessel's security plan.

While the use of a citadel, or safe room, onboard vessels has somewhat assisted the crew to remain safe in the case of a pirate attack, the construction and technological advancement of the citadel leaves quite a bit to be desired. While most citadels are secure from all outside forces, there have been cases where pirates, when discovering that seafarers had locked themselves inside the citadel as a method of evasion, began firing weapons at the door of the citadel and even pumped smoke into the safe room in an effort to asphyxiate the crew and force them to surrender. Also, citadels are not built to be completely impenetrable. In recent years, the crew of a Beluga ship was taken hostage after seeking safety in the citadel for roughly 48 hours after the pirates were able to open the ceiling of the safe room. This incident and the failed rescue mission of the crew that followed resulted in the death of one of the crew.

The wellbeing of the crew should be a primary concern of any ship owner, and the construction and technological abilities of the citadel could be a primary cause of the positive or negative effects that the crew endures after such an attack. Simple design and construction flaws, such as outside ventilation that could be compromised or the ability of the citadel to be dismantled from the outside, could be the difference between losing and saving an entire crew, cargo and vessel. Could better technology inside the citadel aid in the rescue attempts from the flag state, or other armed forces? Could stronger design and construction of the citadel, as well as more technological equipment inside the safe room, better protect the crew onboard from pirates, therefore keeping the crew's mental health intact after such an event? And finally, could these technological advances, if they were to be utilized in the citadel, help to ensure the safety of the seafarer, and possibly entice him or her to return to sea once the incident has passed?

The organizational behavior exhibited by companies and how their employees are treated by the company during and after a pirate attack may have significant bearing on whether the seafarer returns to sea after such an occurrence. Information will be gathered and analyzed on the employee's safety and wellbeing both during and after a pirate attack and hostage situation, the efficacy of piracy protection onboard vessels that are prone to pirate attacks and the long-term sustainability of seafarers in the industry after such an occurrence. By analyzing the design and construction of the citadel onboard vessels, as well as the technology that is currently being used and technological advances that could be utilized, this research will evaluate if the implementation of updated technological systems onboard the vessel, specifically in the citadel, will increase the return rate of seafarers after a pirate attack, as well as decrease the success of vessels being boarded and hijacked by pirates.

## 2. VESSELS AT RISK OF PIRATE ATTACK, AND THE EFFICACY OF PIRACY PROTECTION ONBOARD THESE VESSELS

Piracy has been a major source of concern for the maritime industry for centuries, but in recent years figures have been researched and published stating just how prevalent the piracy situation has become. According to the World Shipping Council (2013), in

2011 there were 439 pirate attacks and 45 merchant vessels hijacked worldwide. Of these, 237 of the attacks and 28 hijackings occurred off the coast of Somalia. As of spring 2012, there had been more than 51 pirate attacks, 11 hijackings, and more than 158 hostages taken off the coast of Somalia (*Piracy*, 2013).

While there are personal pleasure craft that are subjected to pirate attacks, the most financial gain for the pirates comes from the larger commercial vessels. Although liner vessels, such as container ships and roll-on/roll-off vessels, are considered to be at lower risk for hijacking based on their higher operating speeds and freeboard, these vessels have consistently been targeted by Somali pirates in recent years. According to the World Shipping Council (2013), in 2010 there were 32 liner vessels attacked by pirates and six that were successfully hijacked. In 2011, the number of liner vessels attacked increased to 65, while only one liner vessel was hijacked (*Piracy*, 2013).

As of 2006, the United Nations Office on Drugs and Crime reported that the majority of pirate attacks off the coast of Somalia occur within 350 miles of the coastline (*Maritime Piracy*, 2010), and vessels have been more adamant about remaining out of range of the pirates. However, Somali pirates are now using hijacked merchant ships as "mother ships" to carry out attacks in the north Arabian Sea and near the coastline of India, which is more than 1,500 nautical miles from their home country (*Piracy*, 2013).

The number of pirate attacks in the Gulf of Aden and Red Sea has dropped from mid-2012, which is likely due to the increased active military action on suspected pirate skiffs, and preventative measures used by the possible target vessels (Piracy & Armed Robbery News & Figures, 2013). These preventative measures include the use of citadels along with the employment of Privately Contracted Armed Security Personnel (Piracy & Armed Robbery Prone Areas and Warnings, 2013). While the threat of pirates is still prevalent, the IMB recommends that seafarers and Masters not become complacent while travelling through this area. According to Piracy & Armed Robbery Prone Areas and Warnings (2013), all vessels in this area are "advised to take additional precautionary measures and maintain strict 24 hours visual and radar anti-piracy watch using all available means." These warnings state that the crews keeping watch on these vessels should be on the lookout for small boats that appear to be converging on their vessel (Piracy & Armed Robbery Prone Areas and Warnings, 2013). If the suspected pirate skiffs are sighted early enough, the Master will have more time to increase speed and take evasive maneuvers to escape the pirates, while requesting assistance from other vessels or military agencies in the area.

## 3. EMPLOYEE'S SAFETY AND WELLBEING BOTH DURING AND AFTER A PIRATE ATTACK OR HOSTAGE SITUATION

Although there are piracy protection methods onboard vessels which are actively utilized, pirates are still able to wreak havoc on the crew of targeted vessels. According to *The Human Cost of Somali Piracy 2011* (2012), there were still many crimes committed by pirates against seafarers in the High Risk Area in 2011, who were either on ships that were fired upon, boarded, or hijacked; sailors aboard personal yachts; or people onshore, including humanitarian aid workers and tourists.

*The Human Cost of Somali Piracy 2011* (2012) states that in 2011 a total of 3,863 seafarers were assaulted by pirates during the initial stages of an attack by firing weapons such as assault rifles and rocket-propelled grenades, and 968 seafarers came in close contact with pirates aboard their vessel. Of these 968 individuals, 413 were rescued from citadels by naval forces after waiting for hours or days, while the pirates attempted to breach the safe room (*The Human Cost of Somali Piracy 2011*, 2012). In 2011 a total of 1,206 individuals were held captive by pirate gangs, including 555 seafarers who were attacked and taken hostage in 2011, 645 that were captured in 2010, and six tourists and aid workers (*The Human Cost of Somali Piracy 2011*, 2012).

Of the hostages that were held in 2011, a total of 35 died while still in the custody of pirate gangs. Eight of these hostages were killed by the pirates either during the attack or after they were taken captive, eight died from disease or malnutrition while in the custody of the pirates, and the remaining 19 were killed during rescue efforts by naval vessels or attempting to escape (*The Human Cost of Somali Piracy 2011*, 2012). The majority of these individuals were being used as human shields by the pirates when faced with opposing naval forces.

All hostages face the risk of violence day after day while in the hands of pirates, and are subjected to a range of inhumane treatment in violation of their basic human rights. Many times, the hostages are subjected to restricted freedom of movement and privacy, in addition to living with the constant threat of physical and psychological abuse. The living, hygiene and sanitary conditions onboard hijacked vessels can decline rapidly, and is generally not improved throughout captivity.

*The Human Cost of Somali Piracy 2011* (2012) gathered post-incident reports from 23 vessels that were held under pirate regimes and released in 2010 and 2011, which described the experiences of hostages. While the total number of crew onboard these vessels was not listed, at least three seafarers from the reporting vessels died after release as a direct result of their treatment during captivity. The physical and psychological abuse suffered by the hostages were reportedly triggered by the pirates' basic ignorance regarding the workings of a ship, a breakdown of or slow progress in ransom negotiations, disagreements among the hostages, and better treatment to some crew in exchange for information on others (*The Human Cost of Somali Piracy 2011*, 2012).

While the range of abuse suffered by the hostages is wide, some hostages received more severe forms of abuse at the hands of the pirates. No direct numbers are given, but *The Human Cost of Somali Piracy 2011* (2012) states that half of all hostages in 2011 were subject to moderate abuse by their captors which included punching, slapping, and pushing. Roughly 10 per cent of the hostages were subject to more extreme abuse, such as being tied up in the sun for hours, being locked in a freezer, and having fingernails pulled out with pliers (*The Human Cost of Piracy 2011*, 2012).

The psychological effects that were suffered by hostages varied, as well as the physical effects. Many hostages are able to cope with their experiences after their release, but others may require more assistance. The psychological effects that are suffered by seafarers that are not taken hostage – rather, they are subjected to weapon-fire in unsuccessful attack attempts – are still serious health issues. While these attempted attacks may not be successful in obtaining hostages for the pirate gangs, they are the maritime equivalent of attempted murder and should not be brushed aside when looking at the psychological impact on seafarers.

*The Human Cost of Somali Piracy 2010* (2011) states that there was very little official information available to the public on pirates' treatment of hostages during captivity. As a result of the lack of information, the Declaration Condemning Acts of Violence Against Seafarers (the Washington Declaration) was formed, which commits flag state signatories to submit reports on seafarer welfare during captivity to the International Maritime Bureau. As of June 2012, four of the largest flag states – Liberia, the Marshall Islands, Panama, and the Bahamas – have signed on to the document. The intent of the Washington Declaration is to provide a reliable source of information for organizations looking to assist seafarers who have either been subject to a pirate attack or who are at risk of an attack.

## 4. EFFECTS OF SEAFARERS IN THE INDUSTRY AFTER PIRATE ATTACKS AND HOSTAGE SITUATIONS, AND PREVENTION MEASURES ASSOCIATED WITH PIRATE RISKS

The Marine Piracy Humanitarian Response Programme has issued a Good Practice Guide for Shipping Companies and Manning Agents for the Humanitarian Support of Seafarers and their Families, which was developed to support seafarers and their families' through three phases of a piracy incident; pre-departure, the crisis, and post-release/post-incident (*Good Practice Guide*, 2011). According to this report, an increase in the number of pirate attacks has increased awareness of the risk of such incidents amongst seafarers, and seafarers sailing in piracy risk areas are apprehensive due to fear of what might happen when they are onboard. The fear of captivity, in terms of physical conditions and duration, may provoke anxiety from initial awareness of an impending attack. Many seafarers feel that they are "worthless as individuals and pawns in the bigger ransom negotiations" (*Good Practice Guide*, 2011).

There are certain things that could help to reassure the seafarer who can relate to these feelings, including knowledge of a pre-planned use of convoys with associated security resources and familiarity with the protective measures adopted by the ship, including muster points and secure areas such as a citadel, decreases the feeling of physical vulnerability and helplessness (*Good Practice Guide*, 2011). According to this Guide, knowledge of a pre-planned method of communication with the ship owner or nearby security sources to indicate an attack and call for assistance is considered by seafarers to be of the utmost importance.

Psychological reactions to traumatic experiences can occur within days, weeks or months of an incident. The Good Practice Guide states that the probability exists for re-stimulation of reactions when sensory reminders such as similar smells and sounds occur (2011). Post-Traumatic Stress Disorder may be seen in some cases, as well as depression, anxiety disorders, and substance abuse, which may require mental health professionals to moderate. The increased stress for released hostages and their family members may be reported when the seafarer returns to work and when travelling into pirate risk areas. Some seafarers may avoid seeking help for fear of their future employment (*Good Practice Guide*, 2011).

After prolonged captivity, there may be periods of anger, hope, despair, feelings of helplessness, and potentially renewed shock reactions at differences in physical deprivation or inhumane treatment experienced (*Good Practice Guide*, 2011). Seafarers that have dealt with pirate attacks and/or hostage situations, along with their families, may experience a period of adaptation back to "normal life" after the experience. The seafarer may not wish to share their memories of the experience, but these memories should be processed so the seafarer can deal with them on a daily basis (*Good Practice Guide*, 2011). The seafarer not successfully coping with these memories may prevent the seafarer from returning to their daily lives or affect their ability to return to work.

One safety tactic that could be easily utilized by crew onboard vessels boarded by pirates is the use of a citadel, or safe room. The prevention of hostage situations by using a citadel offers the possibility of retained crew after such an incident occurs, by offering psychological piece of mind to the seafarer. Not only will the seafarer be safe in the event of a pirate attack, but they may also be more at ease even if an attack does not occur when the vessel is travelling through high-risk areas.

## 5. HISTORY OF CITADELS ONBOARD VESSELS

According to the Greg Girard (2013), a citadel is a

"designated pre-planned area specifically built into the ship where – in the event of imminent boarding by pirates – all crew can seek refuge with the objective of preventing the pirates from gaining control of the vessel." This safe room should contain methods to control the vessel, emergency rations, a safe air supply, good external communications, and a closed-circuit television control to view areas onboard.

The safe rooms onboard vessels have been rather successful, according to Greg Girard (2013), and have even improved the effectiveness of naval forces during rescue attempts. If the crew is safely inside the citadel, it can then allow the rescuing naval forces, who in the past have been hesitant to intervene on a vessel once the pirates are on board for fear of harming the crew, to engage the pirates knowing the crew is safe.

## 6. SUCCESS RATE OF CITADELS

In 2011, at least 3,863 seafarers were fired upon by Somali pirates armed with assault rifles and rocket-propelled grenades (*The Human Cost of Somali Piracy 2011*, 2012). Of that number, 968 seafarers faced armed pirates who managed to board the vessel. According to *The Human Cost of Somali Piracy 2011* (2012), 413 of these seafarers were rescued from citadels on their vessels by naval forces after waiting for hours or days, while the pirates attempted to break into the safe room.

Glen Forbes (2011) states that the recent successes in the use of citadels have only gone to further endorse their good reputation. In April of 2011, a member of Marine Pirate Busters was a Team Leader onboard the *MV Arrilah-I*, which was attacked by pirates. This individual stated that the "crew hid in the citadel to evade the pirates. It appears they not only entered a safe room but were forced to don breathing apparatus. The pirates, on discovering that the seafarers had locked themselves in a citadel, began shooting at the door and then pumped in smoke in an effort to asphyxiate the crew and force them to surrender" (Forbes, 2011). The crew not only had breathing apparatus with them, but food and water as well as equipment to communicate with nearby ships and aircraft. From this safe room, the crew also had the ability to disarm the ship and prevent the pirates from operating the vessel.

There were 21 sailors and three security guards onboard this vessel, and all were able to enter and remain in the citadel during the entirety of the attack. Rhynhardt Berrange, the head of Global Maritime Security Solutions who provided the security guards, stated that the safe room and other defense precautions, such as regular anti-piracy emergency drills, were key to keeping the crew safe. Mr. Berrange stated that the pirates "continually tried to breach the citadel. The successful resolution of this incident demonstrates the importance of adopting best management practices. Safety standards must be in place for dealing with all emergency situations" (Huang, 2011). The pirates were never able to successfully flush out the captives from the safe room, and all of the crew was released from their hideout after military personnel stormed the ship, forcing the pirates to surrender.

Pirates have become familiar with the use of a safe room onboard vessels, and have gone so far as to complain to the ship owner about the use of a safe room. In September 2010, the *Magellan Star* was boarded by pirates in the Gulf of Aden, off the coast of Somalia. Even though this vessel was travelling in a convoy, which is usually a sound security measure, the other vessels spread apart and caused one vessel to become a target. The crew fled from the attacking pirates into a safe room onboard the vessel, which was supplied with drinks, medical equipment and other supplies, including a satellite phone (*Pirates and the Panic Room*, 2010). According to the ship owner, precautions were taken in case the pirates decided to sink the vessel when no hostages could be taken, and an emergency exit was incorporated into the safe room so the crew could get off board at any time. The ship owner states that "what is most important is that they could not take any hostages" (*Pirates and the Panic Room*, 2010).

One other precautionary measure that was taken during the attack on the *Magellan Star* was the captain setting up the engine so that it could not be started in the usual way. The ship owner stated that the pirates, upon finding no crew in sight onboard, called the shipping company in desperation, wanting to know where the crew was located. The pirates complained in the same phone call that they were not able to start the engine as usual. This vessel was held for 22 hours by pirates, but was released without any further incident (*Pirates and the Panic Room*, 2010).

While there are success stories of the citadel onboard vessels, there are still instances where the pirates are able to board the vessel and retrieve the crew from the safe room. On January 22, 2011, Somali pirates captured the *Beluga Nomination* in the Indian Ocean. The crew hid in the citadel onboard the ship for the first 48 hours of the incident, but then pirates were able to open the ceiling of the safe room and take the crew hostage (*Pirates Enter Safe Room via the Ceiling*, 2011). It was not further reported if the crew was released, or if any injuries or fatalities occurred.

## 7. ANALYZING DESIGN AND CONSTRUCTION OF CITADELS

There are many vessels in service today that have working citadels onboard, but there are still many that are not equipped with sufficient anti-piracy measures. In the case of the *Magellan Star*, the crew was fortunate, as the ship owner has a total of 71 ships and has not been able to modify all of them with safe rooms. The ship owner states that these modifications take time, especially with the large supertankers that are at sea for many days at a time. And while these vessels are still travelling in the Gulf of Aden, the ship owner reassures Spiegel that they do not send vessels on jobs with a clear

conscience, and realizes that over time the pirates will learn more about the vessels and further invest in their profession (*Pirates and the Panic Room*, 2010).

Current safe rooms onboard vessels are stocked with provisions and medical supplies for the crew and any other personnel who may be onboard, as well as satellite phones and GPS locators for communication with shore-based agencies, steering mechanisms and emergency engine shut-off switches to keep the vessel from being directed by the pirates. To protect the crew from the possibility of the pirates sinking the vessel when negotiations do not turn in their favor, emergency exits that are otherwise undetectable by the pirates are incorporated into safe rooms onboard some vessels (*Pirates and the Panic Room*, 2010).

There are now companies that specialize in the safety of vessels and the installation of equipment in safe rooms. One such company, Fleetcom, offers a total package of The Citadel Safe Room/Anti-Piracy solution. According to their website, this solution aims to "allow crews on a vessel under attack by pirates to retreat to a safe area while still maintaining communications links with the shore" (Citadel Safe Room/Anti-piracy, 2012). The Citadel safe room solution includes an Iridium satellite voice service and GPS reporting, which are kept separate from the usual vessel communications systems to remain undetected by the pirates. This product is installed in the safe room, providing emergency and periodic GPS reports as well as voice calling services. A battery backup system can power the system for 24 hours in a powered standby mode, or for a few days in a periodic mode. This system includes an outdoor transceiver, cable, lockable cabinet, corded phone and optional battery backup. The key features of this system are Iridium voice communication, GPS emergency and periodic reporting, single cable, easy installation anywhere on the vessel, no antenna distance problem, and complete global coverage.

## 8. CONCLUSIONS

While the reported accounts of pirate attacks in the high risk areas of the Gulf of Aden and the coast of Somalia seem to be decreasing, other hot-spots are becoming prevalent. In recent months the western coast of Africa has become a growing area of concern regarding pirate attacks. While the Nigerian Navy has become more adamant regarding the punishment of captured pirates, the threat still remains. On August 25, 2013, the Nigerian Navy "killed six pirates and injured one other in a gun battle" off the coast of Calabar in Nigerian and Cameroonian waters (Schuler, 2013).

While the actions of the Nigerian Navy may deter some pirates from taking action against cargo vessels in the future, the threat of piracy remains in other areas of the world. With threats occurring in otherwise safe areas, even in areas that are deemed protected due to political agreements, the safety of the crew onboard may be a determining factor in continuing the operation of the vessels. Benefits such as health insurance and paid vacation may not be all that is required to entice mariners to the employment opportunities onboard cargo vessels worldwide, and the use and performance record of safe rooms aboard these vessels may become a deciding factor in which contracts they undertake.

The basic amenities that are currently included in safe rooms onboard vessels may be successful in their actions, but there are still setbacks in the construction and design of the citadel. If an enclosed ventilation system is installed in each safe room, the attacking pirates may not be able to "smoke out" the crew in the safe room by compromising their air. Also, the location of the safe room should be intently considered before construction begins, as to not be too obvious to the pirates and to deter the attacking pirates from firing upon the safe room.

Citadels onboard vessels may be viewed by some as a luxury and not a necessity, which could have a negative impact on the technology that is used when creating the safe room. As stated by the owner of the *Magellan Star*, not all vessels are currently equipped with a safe room, even though they are travelling in high-risk areas off the coast of Somalia and in the Gulf of Aden. The construction of safe rooms onboard all vessels travelling in this area, while costly, could decrease the success rate of ransom payments to pirates, which could in turn decrease the amount of attempts made by pirates to board or hijack vessels.

While the use of citadels onboard vessels have minimized the number of seafarers taken hostage, the use of citadels have not caused the pirates to abandon their attempts to board a vessel. However, citadels have impacted the industry by giving the crew the opportunity to remain safe during a pirate attack, preventing the pirates from gaining control of the vessel, and offering naval forces time to reach the vessel and engage the hijackers. By requiring a safe room to be built in each vessel that will traverse the high-risk areas surrounding Somalia and the Gulf of Aden, the safety of not only the crew could be heightened, but the sustainability of crew after such an attacked may be increased.

If a ship owner offers employment on a vessel that houses a citadel, be it state-of-the-art or a simple room with the basic amenities, experienced crew may be easier to come by. If that vessel is in the unfortunate circumstance of a pirate attack, this citadel could save not only the lives of the crew, but also the vessel and cargo onboard. Should a citadel protect the crew onboard from becoming hostages, that crew may be physically and mentally able to return to work quickly and remain in the industry longer than if they were taken hostage by the pirates.

## 9. REFERENCES

[1] Citadel Safe Room/Anti-piracy (2012). Retrieved from www.fleetcom.no on March 23, 2013.

[2] FORBES, GLEN (October 12, 2011). "Citadels Must Be Appropriately Set Up to Work." Retrieved from www.marine-pirate-busters.com on February 5, 2013.
[3] GIRARD, GREG (2013). *Citadel Rooms: An Option, Not a Solution*. Maritime Security Council. Retrieved from maritimesecurity.org on March 18, 2013.
[4] *Good Practice Guide for Shipping Companies and Manning Agents for the Humanitarian Support of Seafarers and their Families* (2011). Maritime Piracy – Humanitarian Response Programme. Retrieved from www.mphrp.org on March 18, 2013.
[5] HUANG, CAROL (April 5, 2011). *Crew of hijacked vessel hid in 'citadel' to foil attack.* Retrieved from www.thenational.ae on March 23, 2013.
[6] *Maritime Piracy* (2010). United Nations Office on Drugs and Crime – A Transnational Organized Crime Threat Assessement. Retrieved from www.unodc.org on February 5, 2013.
[7]*Piracy* (2013). World Shipping Council. Retrieved from www.worldshipping.org on January 21, 2013.

# THE EFFECTIVE USE OF TECHNOLOGY – SOME IMPEDIMENTS AND SOLUTIONS

[1]LEWARN BARRIE, [2]RANMUTHU GALADEV

*[1,2]Australian Maritime College, University of Tasmania, Australia*

**ABSTRACT**

Shipboard operations, as well as Maritime Education and Training (MET), now have a wide range of technology available to enhance their effectiveness, but there are still impediments. In broad terms the paper addresses issues including crewing structures, seafarer qualifications, as well as training and assessment technologies. Specifically, the paper examines how some impediments to the effective use of technology could be resolved to enhance economic efficiency and effectiveness. Within the context of both shipboard operations and MET, the key objectives of the paper are to:

- Consider the use of technologies;
- Examine impediments to the effective use of technology; and
- Identify potential solutions to enhance the effective use of technology.

Two overarching impediments to the effective use of technology aboard ship were identified as crewing structures and the rigidity of the certificate of competency structure. In the context of MET, overarching impediments to the effective adoption of technology were identified as conservative approaches to teaching and assessment, as well as perceptions and tradition. Many of the specific impediments which were identified could be categorised as being due to the unintended consequences or rigid interpretation of STCW. Potential solutions identified by the research included:

- Identify precisely what the 'modern' seafarer does or should do.
- Devise crewing structures which better reflect the use of technology and focus on what seafarers actually have to do.
- Reorganise the certificate of competency structure to recognise the wide range of skills which are required, e.g. shipboard equipment specific skills, vessel type specific skills and generic skills common to all vessels, as well as those skills required to effectively carry out duties within the industry and society.
- Use technology to improve the quality of teaching, assessment and feedback in MET institutions.
- Strengthen STCW to reflect the way in which the use of technology can enhance the effectiveness of shipboard operations and training, e.g. provide options to integrate within the STCW framework, create multiple pathways etc.

**Keywords:** *Crewing structures, certificate of competency structure, maritime education and training, MET, maritime technology impediments and solutions, STCW.*

## 1. INTRODUCTION

The relentless use of technology to enhance efficiency continues to increase. Technological innovations and solutions are progressively more powerful, have become more reliable, are widely available, and have become cheaper over time. Shipboard operations, as well as maritime education and training (MET), now have a wide range of technology available to enhance their effectiveness, but there are still impediments.

In broad terms, the paper addresses issues including crewing structures, seafarer qualifications, as well as training and assessment technologies. Specifically, the paper examines how some impediments to the effective use of technology could be resolved to enhance economic efficiency and effectiveness. Within the context of both shipboard operations and MET, the key objectives of the paper are to:

- Consider the use of technologies;
- Examine impediments to the effective use of technology; and
- Identify potential solutions to enhance the effective use of technology.

## 2. TECHNOLOGY AND ITS APPLICATION

### *2.1 Technology aboard ship*

The progressive introduction of technology aboard ship over the past century has led to greater specialisation of ship types. The more specialised the ship, the less flexible its use becomes and significant changes to the roles, skills and number of the crew are needed [1].

The use of technology aboard ships falls broadly into four categories, namely: navigation systems, engineering systems, cargo systems, and communication systems. Traditionally these systems have been treated separately, however, as automation and reliability have improved, these systems have become progressively more integrated. Crew members are increasingly dependent on technology based systems which requires them to accurately interpret and use data, monitor the systems, and correctly react to alarms. This surely requires a re-evaluation of the roles and skills of the crew, and the development of appropriate organisational structures to reflect the use of technology aboard ship.

### *2.2 Technology in MET*

Education is in an era of rapid and sustained change and the old paradigms are being replaced by new paradigms. The traditional primary medium for knowledge, books, is being rapidly replaced by information on demand from the internet; learning in a classroom is being replaced by the capability to learn anywhere; and technology is no longer viewed as an expense, rather it is viewed as a differentiator amongst learning providers and is also an important, almost essential tool for the facilitation of learning services. MET operates in this changing educational environment and, in this respect is no different from other providers of education and training services. [2].

In our present age of continually evolving desktop, laptop and tablet computers, smartphones, internet access and social media, the use of technology in learning and teaching presents many challenges. Not least of these challenges is finding one's way through the maze of information resources and choosing the most appropriate technology to use to enhance the learning process. Ten years ago Newhouse [3] suggested, "We need to prepare students to learn, work and live successfully in a knowledge-based, global society." The question for MET is, have we done this, and if not, why not?

## 3. IMPEDIMENTS TO EFFECTIVE USE

### *3.1 Impediments aboard ship*

Unlike other compatible industries, such as the aviation industry, the maritime industry tends to 'hold on' to older practices, despite the introduction of new technology. Modern technology has made equipment and platforms significantly safer and more reliable, however on board practices have been slow to adapt and take advantage of these changes, as the crewing structure, crew competence and training regimes are reluctant to modernise and embrace change. Although some argue that this is due to the hazardous nature of the industry, compare this to the aviation industry where technology has made the flight engineer redundant, while most harbour tugs continue to hold on to a dedicated on board engineer.

Such practices beg the questions: Why do we yet hold on to the old? What prevents us from changing? Are there internal and/or external factors affecting these changes? A general perception is that seafarers are traditionalist and function within a highly regulated industry. But the reluctance to change cannot be explained in such a simplistic manner. The industries surrounding seafarers are changing, ships have changed significantly, and those servicing the industry have adapted to weather the economic and social changes. A cursory glance at the ship building, ship repair, logistics, and supply industries clearly show transition. This in turn has affected the training regimes targeted at those sectors, greatly benefiting the employers as well as employees. There is a significant shift in education, both upwards as well as in breadth.

A reason why the personnel within the seafaring industry are reluctant to change is the rigid and authoritative hierarchical management structure prevalent in most ships. This is possibly a carryover from the naval links in the past and a perceived need to have absolute obedience to avoid dangers at sea. However, a number of aircraft crash investigations have shown that such management structures in high stress situations can lead to accidents [4]. This is now being recognised within the seafaring industry with attempts to address such situations through research targeting bridge and engineroom crew interaction and their effects on marine accidents [5], resulting in mandated training programmes for crew dealing with such scenarios [6].

To summarise, the crew aboard a ship are compartmentalised by rank, i.e. officers and ratings, and by function, i.e. deck, engine and catering/hotel. However, as shipboard systems are increasingly integrated and become more technically complex, there is some evidence to suggest that the current organisational structure of crews is becoming less relevant to the effective operation of many technically advanced ships. Put simply, the traditional approach to shipboard organisation has failed to keep pace with the changes being wrought by the increased use of technology aboard ship. This is not surprising, as shipboard organisational structures reflect a well tried traditional approach, however the digital age with its sophisticated technology calls for a different approach.

The shipping industry is a global one, with international trade resulting in ships crossing national jurisdictions, each having different and sometime contradicting requirements. International trade regulations and shipping laws attempt to create a common set of rules that allow ships to operate in this otherwise complex environment. Although these rules are developed to meet the needs of all nations concerned, in reality they form a series of compromises and concessions, which usually provides little if any room for innovation, with most outcomes favouring a traditionalist approach where changes are carried out in stages and small steps in an attempt to gain consensus and acceptance.

The international rules governing seafarer certification, competencies and training are defined in such an agreement, the International Maritime Organisation (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) [6], and is reflective of the above sentiments. Thus, the competencies stated in the convention are a compromise between the desire to adapt and change to meet technological advancements, environment needs and modern society; and the need to accommodate the capabilities and wishes of the vast majorities of the signatories [7]. In some cases, the stated competencies are obsolescent, inappropriate, and/or inadequate to deal with modern technology and practices. An example is the increase in electronic/electrical equipment on modern vessels not being matched by the associated manning and training requirements.

The pathway to achieving the highest certificate of competency is lengthy, as it requires seafarers to complete both approved STCW specified training programs and sea service [6]. However, just what is the purpose of sea service and how it is to be conducted is ill defined. Is it to gain experience of real life shipping; is it to learn and practice skills which cannot be readily learned or practiced elsewhere; is it to demonstrate skills learned; is it tradition; or is it all of these? [8].

Whilst there is little dispute over the need for sea service experience, there is considerable evidence to suggest that the quality and purpose of sea service is not taken as seriously as it should be.

The competencies within the standards are highly skewed towards the technical attributes, rather than providing a proper balance between technical and generic skills. Most graduate programmes in developed countries place equal value on both set of competencies [9], however most maritime programmes explicitly focus on the technical skills, while a few attempt to address the generic skills, although most when quizzed struggle to explain how these skills are delivered, assessed, or monitored. Again this is a symptom of inadequately designed competency standards, evident when compared against those in other industries, where many have embedded generic attributes, while others clearly identify them as mandatory attributes [9]. Although many within the seafaring profession would argue that this is not critical to the industry, others would beg to disagree, stating that generic attributes provide graduates with the knowledge and skills to broaden their horizon and seek innovative and modern solutions, essential to those willing to encompass new technology and methods [10].

The certificate of competency structure is rooted in history and has served the shipping industry well. However, as ships make greater use of technology, it is observable that there are significant changes to the roles, skills and ways that crew carry out their work. As new technologies are introduced, the IMO slowly includes more and more requirements for certificates of competency; however little that has become irrelevant is removed. It is postulated that the certificate of competency structure in its current form is too rigid to accommodate the full and effective use of some technologies. The structure is still predicated on the traditional one size fits all approach.

### *3.2 Impediments in MET*

A comment by Northage [11] highlights an inconvenient truth, i.e. “Unfortunately proper teaching is what we have been short of for a very long time in all but a few privileged institutions and for the fortunate few aboard ships with people aboard in a position to do it”.

Education institutions are moving away from classroom delivery towards the greater use of delivery technologies. Teacher centric learning is being displaced by student centric learning as students utilise technology to move away from being passive learners towards being active learners. However, many marine administrators and MET teachers have a conservative view of education and training which is based upon their own limited, teacher centred learning experiences. Marine administrations are responsible for the implementation of STCW and, in the context of seafarer training, are responsible for approving and auditing training institutions including staff, facilities and equipment, as well as courses. It is within these systems that clashes between current education practice and administrative interpretations can be observed [8].

As previously stated, STCW [6] attempts to define what seafarers must be able to know/do to be deemed competent. However, STCW is the result of a process of compromise and is also cumbersome to update. The compromise between traditional and emerging knowledge, skills and technology leads to the conclusion that STCW in its current form has the potential to impede teaching what is genuinely relevant.

There are a number of reasons for MET not to have fully embrace technology, and in many cases the blame does not lie purely with the MET providers, as they are constrained by the restrictions imposed by marine administrations and the reluctance of the industry stakeholders to change and adapt [12]. Generation Z is considered to be the most electronically connected generation having been born into a digital world. However, most MET providers are reluctant to embrace innovative technologies or strategies, again a reflection of the perceptions and perceived views within the industry. Unfortunately, this is a double edged sword, as the reluctance to use technology that is part of the everyday world of the newer generations also acts as a barrier in attracting and retaining high performing students from these generations.

Many MET providers struggle to find the correct balance between vocational training and academic education when developing, delivering, and assessing seafarer programmes [13]. This stems from difficulties in understanding the differences and synergies between the two, and preconceived ideas of those within the industry and MET on what the competencies should be and how they can be achieved. Knowledge is the underpinning component of competence [10], and MET providers must use a raft of strategies to impart these to the students, which should include a mix of tools, including modern and innovative technology. The provider has to think beyond the standard boundaries realising that different students learn in different ways.

A further impediment can be the IMO model courses. These are designed asguides for teachers upon which they can build and develop appropriate teaching and learning experiences. However, in a number of countries marine administrations have taken the pedagogically restricting view that the courses they approve must follow exactly an IMO model course. The highly prescriptive nature of model courses, which focus on classroom based, teacher centric learning and the number of hours required to achieve competencies, is at odds with the competency based approach espoused by STCW 95 [6]. This prescriptive approach also restricts the use of technology as a means of expanding delivery methods and enhancing learning outcomes.

Maritime educators and trainers are generally hired because of their maritime skill sets and experiences, and reputable MET institutions generally provide some form

of training to assist their employees to become good teachers. Traditional face-to-face teaching methods can be enhanced or replaced by innovative blended learning methods which use the right technology to provide good pedagogy. But how many MET institutions provide professional development for their employees in blended and flexible learning techniques, instructional design and the use of appropriate technologies to enhance the learning process? Holt et al [14] suggest that information literacy has been, and remains a fundamental skill for educators but digital literacy, as an essential skill, is still gaining momentum.

Thus it is possible to conclude that MET is conservative by nature, wrapped up in quasi-legal and administrative constraints, provides limited opportunity for teaching staff to learn/enhance teaching skills including the use of technology and has a traditional teacher centred approach to learning; all of which reduces its capability to provide what the student requires, when, where and how it is wanted [2].

## 4. SOLUTIONS TO ENHANCE THE EFFECTIVE USE OF TECHNOLOGY

### *4.1 Solutions aboard ship*

A fundamental solution is to devise crewing structures which better reflect the use of technology and focus on what seafarers actually have to do. This willentail a total revision of the organisation, roles and skills of the crew. It will mean that crews on different ship types may have different organisational structures, roles and skills. It will also mean that the certificate of competency structure will need to be reorganised to recognise the wide range of skills which are required, e.g. shipboard equipment specific skills, vessel type specific skills and generic skills. In addition, STCW will need to be strengthened to reflect the way in which the use of technology can enhance the effectiveness of shipboard operations and training, e.g. provide options to integrate within the STCW framework, create multiple pathways, etc.

To identify the changes needed aboard ship, socio-technical design techniques are useful as they deal with the interrelatedness of social and technical aspects of an organisation as a whole and emphasise achievement of both excellence in technical performance and quality in people's work lives [15].

It is important that the global maritime industry develops clear and appropriate competency standards targeting the roles of the modern seafarer on modern ships. It is accepted that a significant number of ships across the world are dated or use older technology. However, the industry has to look forward and prepare the workforce for the future. Thus, STCW must have clear and targeted competencies for the relevant performance outcomes, linked to the appropriate attributes to enable and assist MET providers to develop suitable programmes.

The technology of today and that on board ships, together with the technology savvy younger generations, offers the industry and MET institutions a number of opportunities to provide innovative education and training [13]. However, the on board environment has to be conducive to such training, with the ship's operators and crew realising the need to train students and provide them with access to the relevant technologies. They cannot hide behind …'that is how we learnt the ropes'… or …'they got to start at the bottom'… to deny trainees access to the required technology, systems, or programmes. Not only do operators and crew need to realise the changes in technology and procedures, but also the changes within the social and generational evaluation processes.

However, changing the perceptions and attitudes on board ships alone will fail to achieve the desired training objectives if marine administrations are unable due to legislation, or unwilling due to perceptions, to accommodate and encourage modern practices. This is where IMO through appropriate conventions and regulations such as STCW can guide the industry to create an environment that is conducive to modern training needs, and is adaptive, flexible, and tolerant to meet the changing needs of the industry, society, and the modern seafarer student [12].

### *4.2 Solutions in MET*

To be educationally sustainable and provide its users with relevant services, education and training providers have to successfully negotiate a number of educational paradigm shifts, pedagogy and technology challenges. Using technology to improve the quality of teaching, assessment and feedback in MET institutions is an absolute necessity.

For too long, MET providers have hidden behind the regulations to resist change. As stated previously, the regulations can stifle innovation. Providers, or more accurately instructors, tend to favour 'tried and tested' methods for training seafarers [12]. Whilst new technologies are utilised, for example the use of simulators, they tend to be used as a tool to deliver the same old curriculum [12]. Providers need to move away from this mindset and look at developing training focused on the outputs; how do the programmes meet the performance competencies and provide the required personal competence? This must be considered in context of the modern society and technology, taking advantage of the positives, while mitigating the negatives.

When considering technology in MET it is important to make the distinction between technology as a tool, as opposed to a change in the delivery strategy due to technology [12 & 13]. The latter will create a new model, while the former is just tinkering around at the edges. MET providers need to look to other compatible industries and learn from their achievements.

It is important to recognise the different needs of the individual learner and provide pathways for their success. Technology plays a major part in the younger generations and should thus be used to engage them with the curriculum, rather than looking upon it as a hindrance or a threat.

Most of MET is driven by STCW, but Goldberg [16] suggests "there is another training component which is largely unregulated and only minimally specified, but

is arguably just as important to safe operations: vessel-specific training. This is the training required for safe operations given the unique combination of vessel characteristics, layout, equipment, routines, routes and corporate policies of the vessel operator. Vessel-specific training has always been critical to safe operations, but in recent years has grown much more so in light of the continuously increasing sophistication and complexity of modern vessel-based systems. To make matters worse, simply knowing how to operate these sophisticated systems is not sufficient. A deeper understanding is required in order to facilitate intelligent problem solving when the systems are not behaving as expected or, worse yet, when interactions between multiple sophisticated on-board systems produce unexpected behaviours. Crews must be armed with the knowledge necessary to make an informed analysis and arrive at a logical decision.

There has been some recognition of this problem by the STCW. The best example is recent regulatory change for ECDIS training. ECDIS machines are essentially little computers and training is required in order to understand how to operate them correctly. This training is now mandatory. But why do the regulations stop there? ECDIS machines are not the only sophisticated systems on board - far from it.

Douglas [17] takes another view and states "The minimum safety standards required by IMO and national certifying bodies are no longer appropriate in the fast-moving and technological driven work environment of the seafarer. A good starting point would be to establish industry standards of competence covering all the actions and behaviors". He further suggests that "DNV has been doing this for years in its SEASKILL projects and has established over 20 such standards" [18].

Again, this leads to the view that STCW will need to be strengthened to reflect the way in which the use of technology can enhance the effectiveness of shipboard operations and MET. This needs to occur so that seafarers receive the education and training they need rather than what a dated convention currently prescribes.

## 4. CONCLUSIONS

The evidence for these points of view is found in many guises. Talk to students and serving seafarers; follow and participate in the lively online debates, e.g. Maritime Professional, Linked In and the Nautical Institute. This may well convince you that considerable changes are needed to make effective use of technology aboard ship.

The STCW Convention was written in 1978 and has been revised seven times in the ensuing period [19]. The last major revision was in 1995, some eighteen years ago, and although the 2010 Manila Amendments attempted to update the convention, it is evident that shipboard technology and its use moves far faster than the process of updating STCW.

It is postulated that a fundamental review is needed to clearly identify the competencies and attributes required by the seafarers of today and the future, so that ships can be effectively and safely operated. Identification of the skills needed to operate shipboard equipment and specific vessel types, as well as generic skills forms a framework for such a review. The results of a comprehensive review should allow for the revision of the certificate of competency structure and more appropriate on board organisational structures. But, most importantly, it should allow MET to become far more flexible, adopt modern pedagogical practices and technology, and provide what is wanted, when it is wanted, where it is wanted and how it is wanted.

A further consideration is that MET needs to be more proactive in its use of technology if the effectiveness of teaching and learning is to improve. Changes to STCW are clearly needed and MET institutions have the means to influence these changes. Both IAMU and Global MET have observer status at IMO, which presents the opportunity to take a lead in the much needed debate for change. But, is IAMU willing and able to take a proactive role in leading the much needed debate on the many challenges facing MET?

## 5. REFERENCES

[1] MOREBY, D., *The Human Element in Shipping*, Seatrade Publications, 1975.

[2] LEWARN, B., T*echnology challenges and opportunities in the delivery of distance education*, in IAMU AGA 13, *Expanding Frontiers, Challenges and Opportunities in Maritime Education and Training*, Fisheries and Marine Institute of Memorial University of Newfoundland, 2012.

[3] NEWHOUSE, C.P., *A Framework to Articulate the Impact of ICT on Learning in Schools*, Western Australian Department of Education, 2002.

[4] Air Accidents Investigation Branch (AAIB), *Report No: 3/2003. Report on the accident to Boeing 747-2B5F, HL-7451, near Great Hallingbury on 22 December 1999*, London, 2003.

[5] BARNETT, M.L, *Searching for the root causes of maritime casualties*, WMU Journal of Maritime Affairs, Vol 4, Issue 2, pp 131-145, Oct 2005

[6] INTERNATIONAL MARITIME ORGANISATION, *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers*, 1978(as amended 2010*)*, IMO, 2010.

[7] KENNERLEY, A., *Writing the history of merchant seafarer education, training and welfare: Retrospect and prospect*, Northern Mariner, Vol 12, 1-22, 2002.

[8] LEWARN, B., *Seafarer training-Does the System Defeat Competence?*, IAMU AGA 3, 2002.

[9] SYMES, M.F., THOMAS, G.A., RANMUTHUGALA, S.D., *Graduate Attributes: Industry and Graduate Perceptions*, The 2nd International Conference on the Education and Professional Development of Engineers in the Maritime Industry, 26 - 27 Feb, Singapore, 2013.

[10] BURKE, J., *Competency based education and training*, The Falmer Press, Sussex, 1989.

[11] NORTHAGE, T., *Do our present training and exam systems adequately deliver and measure competence in the Officer of the Watch?*, Linked in, 19 March 2013,http://www.linkedin.com/groupAnswers?viewQuestionAndAnswers=&discussionID=223162790&gid=1107227&commentID=126437240&goback=%2Eamf_1107

227_214649256&trk=NUS_DISC_Q-subject#commentID_126437240, accessed 26 March 2013.
[12] Precious Associates Limited, *Availability and Training of Seafarers*, Prepared for the OECD Maritime Transport Committee, OECD, Jan 2003.
[13] ZIARATI, R., *Combining vocational and Academic Requirements in the Maritime Education and Training*,1, 2 &3, Turkish Shipping World, Oct, Nov & Dec 2012.
[14] HOLT D., SMISSEN I., SEGRAVE S., *New students, new learning, new environments in higher education:literacies in the digital age*, in MARKAUSKAITE L., GOODYEAR P., and REIMANN P., (eds), *Who's learning? Whose technology?*, Proceedings of the 23rd annual conference of the Australasian Society for Computersin Learning in Tertiary Education, University of Sydney, 2006.
[15] WIKIPEDIA, *Sociotechnical system*, Wikipedia, 28 February 2013, http://en.wikipedia.org/wiki/Sociotechnical_system, accessed 11 April 2013.
[16] GOLDBERG, M., *Making Vessel-Specific Training Effective and Practical Using Adaptive Learning*, Maritime Professional, 28 January 2013,http://www.maritimeprofessional.com/Blogs/Maritime-Training-Issues/January-2013/Making-Vessel-Specific-Training-Effective-and-Prac.aspx, accessed 23 February 2013.
[17] DOUGLAS, J., *Do our present training and exam systems adequately deliver and measure competence in the Officer of the Watch?*, Linked in, 2 April 2013,http://www.linkedin.com/groupAnswers?viewQuestionAndAnswers=&discussionID=223162790&gid=1107227&commentID=126437240&goback=%2Eamf_1107227_214649256&trk=NUS_DISC_Q-subject#commentID_126437240, accessed 3 April 2013.
[18] DET NORSKE VERITAS, *DNV SeaSkill Competence Wheel*, DNV, 2013, http://www.dnv.com/industry/maritime/servicessolutions/competence/competencemanagement/competencemanagementcertification/dnvseaskillcompetencewheel.asp, accessed 4 January 2013.
[19] INTERNATIONAL MARITIME ORGANISATION, 2013, http://www.imo.org/OurWork/HumanElement/trainingcertification/pages/stcw-convention.aspx, accessed 3 April 2013.

# ASSESSMENT OF SITUATION AWARENESS OF STUDENTS BY SPAM: DEVELOPING QUESTIONS

LOGINOVSKIY VLADIMIR

*Admiral Makarov State University of Maritime and Inland Shipping, Russian Federation*

**ABSTRACT**

In accordance with researches about 70% percent of accidents at sea during recent years occurred due to the loss of situation awareness (SA) by Seafarer. The Situation Awareness is a part of a total competency of Seafarer, which is included in STCW 78 Convention and Code. The assessment of SA is extremely important and should be the part of MET process in maritime institutions. The paper is devoted to assessment of situation awareness of students in accordance with the provisions of STCW 78, as amended and which is worded as "obtaining and maintaining the situation awareness". The Situation Present Assessment Method (SPAM) for assessment of SA is described. Developing the questions to assess SA for students by SPAM and Leximancer software technique is presented.

**Keywords:** *Human element, situation awareness, STCW 78 Convention and Code.*

## 1. INTRODUCTION

Provisions of situation awareness included in STCW 78 Code by Manila amendments are important in maritime education and training (MET) of seafarers and have direct influence on safety, efficiency of shipping and protection of the marine environment, and therefore the assessment of SA levels has a great value. The deep understanding of this field can positively affect the process of training of Seafarers and reduce the negative influence of Human Element in accidents at sea.

It is quite clear that SA is the substantial portion of competency of Seafarer [1], but it is also obvious that it may be one of the most complex parts of it due to the high level of dynamics of environment. The student should understand and use the SA principles from the first steps of his/her education and training.

That is why, in this paper we propose two ideas to start with SA assessment, which can be used from the very beginning and based on the concept of present situation. The first is to include contextual SA into the subjects of MET process, based on chess approach, i.e. based on understanding present situation [2], described by the studied texts. The second basic idea is the following: any text describes some situation by means of concepts related between them and united by the general context. It can be structured and visualized by means of Leximancer software, which gives the teacher and students the picture of concepts relations (conceptual map) for better comprehension of the theme.

The assessment of SA and training of SA are interrelated processes. So, the results of SA assessment can be applied to improve training procedures.

We paraphrase classical definitions [3] of SA levels, having included the key terms as "the studied text" and "concept" in them. So, in this case the levels of SA can be defined as follows:

- Level 1 SA – Perception of main concepts from the studied text. This level includes the detection, recognition, and identification of significant concepts within a given text.
- Level 2 SA – Comprehension of main concepts in the studied text. It encompasses how students combine, interpret, store, and retain this information. Level 2 SA reveals a comprehension of the current state and an ability to make inferences about why some concepts are related.
- Level 3 – Projection of situation, described by the main concepts - the highest level of SA - includes the ability to forecast future situation events and their dynamics. This ability to project from current events and dynamics to anticipate future events allows for timely decision making.

  Being guided by functional and logic relations between text concepts, there is a possibility to introduce the artificial dynamics into the situation in the text space, i.e. to model this dynamics.

  In the given case - it can be the forecast of the alteration of certain concept in text space, instead of projection in time, i.e. we need to answer the question "What can happen with the related concepts in the text if to change values of their attributes?"

## 2. WHAT IS SPAM?

SPAM is an example of a query technique. The logic of query technique is that SA is reflected in the ability of operator (student) to answer questions about the situation they are, or have been controlling or managing [2].

Using SPAM techniques [5], slightly modified in this paper, students after they have learned the appropriate text, are asked individual questions in the course of a scenario while performing normal tasks. According to publication [2], either task-relevant SA information is held directly in memory or the location of this information is held in memory. Therefore, in SPAM, SA is measured as both the number of correct responses and the time to answer the question correctly. If the information being queried is held in the student's memory, he or she can respond quickly. If the information is not in memory, but available in the text,

response time will be faster if the student knows where to find the information.

To separate the effects of workload from SA, the student is usually asked if he/she is ready for a question, and the question is not asked until the student responds affirmatively to the ready prompt. The time interval between the ready prompt and the student's acceptance is taken as a measure of workload, see Figure 1. The questions must be presented in a manner to be consistent with the text.

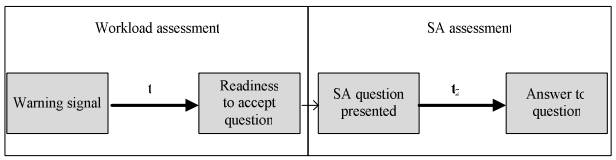



Figure 1 Illustration of SPAM technique

Here $t_1$ is time to assess the workload and $t_2$ is SA assessment.

Briefly, following [2], students are presented queries about the situation described in the text while the situation remains present and while they continue to the primary task. Response time in addition to accuracy is recorded. Response time should vary with the level of SA. For example, if the student has an answer to the query in active memory, response time should be short. If the student needs some evaluation of the particular value, then response time should be slower. Still slower would be a student who did not know where to look for an answer.

The technique is intended to measure comprehension when the situation remains present. Frozen chess situation can help us to construct such kind of query. In principle, in the paper we propose to use text as an equivalent to present chess situation and not to assess the workload by $t_1$.

SA assessment within the limits of the concrete text fits the ideology of open-book exam, i.e. the student has the studied text, which is at his/her hand and can use it while answering questions. Moreover, according to SPAM ideology, the student should carry out any task related to the studied material, but here we will be limited only to an assessment of the studied text.

There are some techniques of assessment of SA levels, but we use the SPAM technique for the following reasons [2]:

- SPAM's use of response time promises to provide more statistically sensitive measure rather than accuracy as is usually the case when both accuracy and speed are recorded in the same cognitive task.
- SPAM's use of response time allows researchers to assess when it succeeds rather than only when it fails.
- SPAM is consistent with the pre-theoretical position that understanding of a situation is best accomplished when the situation is present and the operator (student) is engaged.

In a lot of cases, it may be more efficient to know where to find information, than it would be to use limited cognitive resources to remember it.

## 3. CONCEPTUAL MAP OF THE TEXT

We define the *situation* as a combination of key concepts logically connected between them in space of the text studied by the student, causing a certain information picture which induces mental activity of the student. This picture can be presented visually by means of a conceptual map.

The principle of construction of a conceptual map is presented in Figure 2.

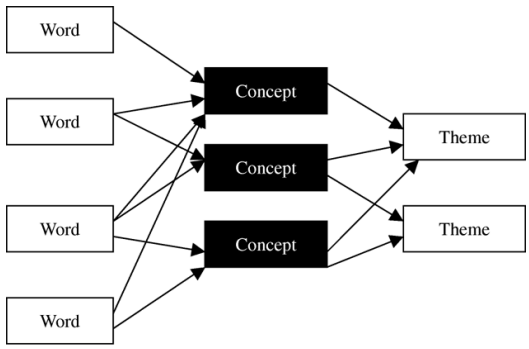



Figure 2 Leximancer concept map construction

The information is displayed by means of a conceptual map that provides an overview of the material, represents the main concepts contained within the text. Their relations are also presented. It is assumed here as an equivalent of chess situation.

A map produced by Leximancer software for Chapter 1 "Introduction to Marine Navigation" [4] is shown in Figure 3.

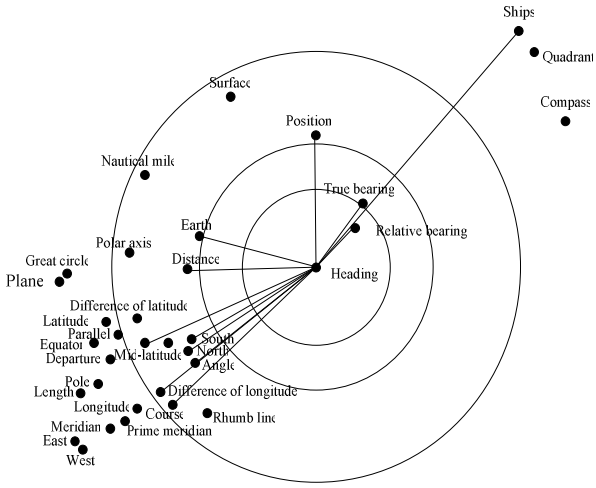



Figure 3 Leximancer conceptual map for Chapter 1[4]

"Introduction to Marine Navigation"

Following [2], we philosophically compare a situation which is caused by the text with a chess situation which is described by relative positioning of pieces. In other words, we put in conformity the chess situation, which induces the player to certain actions, and a situation constructed by concepts of the text, which also induces the student to certain mental activity.

For example, the relevant SA questions that can be put to chess player to assess if he/she is aware of the

present situation are [2]:
Level 1 SA: Where is the white queen?
Level 2 SA: What piece is the white bishop attacking?
Level 3 SA: What piece can white move to pin black's rook?

The analogical questions for the text can be as follows:
Level 1 SA: Show the key concepts in the text you have learned;
Level 2 SA: Are there any contextual relations between concept 1 and concept 2 in the text?
Level 3 SA: If some attributes of concept 1 are altered, how does it affect the concept 2?

When the student has learnt the text and perceived the conceptual map, his/her self assessment positive results can be as follows:

- I can identify the main concepts in the text.
- I understand the relations between these concepts.
- I can predict changes in the attributes of a certain concept if the attributes of others are changed.

Having applied the Leximancer software for Chapter 1[4] "Introduction to Marine Navigation", as an example, we have received the conceptual map where the concept Heading is statistically and contextually linked with some other ones, Figure 3. Map shows the relative location of concepts of the text and defines the certain contextual situation. Statistical relations existing between concepts are marked by springs of various lengths. The closer the concepts locate to each other, the more similar they are contextually. It gives the teacher a key for designing questions of various complexities, using also the hidden intra-text information.

Below there is a possibility to compare some text selections, which includes the concept *Heading* with the locations of appropriate concepts related to *Heading* on the map:

*Concepts: Heading and Relative Bearing*

Text selection 1: "A *Relative Bearing* is measured relative to the ship's heading from 000° (dead ahead) clockwise through 360°. However, it is sometimes conveniently measured right or left from 0° at the ship's head through 180°. This is particularly true when using the table for *Distance* of an Object by Two Bearings. To convert a *Relative Bearing* to a *True Bearing*, add the *True Heading*: *True Bearing = Relative Bearing + True Heading*", [4]. The spring between these two concepts is short, and the relation between them is direct and simple.

So, the questions for SA assessment can be the following:

- Show me where in the text you can find the term *Heading* (SA1)
- Can you find the relations between two text concepts as *Heading* and *Relative Bearing* (SA2)?
- The ship is moving but the *Relative Bearing* to the lighthouse is constant, what can you say about the value of *True Heading*,(SA3)?

*Concepts: Heading and True Bearing*

Text selection 2: "*Heading* (Hdg., SH) is the direction in which a vessel is pointed, expressed as angular distance from 000° clockwise through 360°. Do not confuse *Heading* and *Course*. *Heading* constantly changes as a vessel yaws back and forth across the course due to sea, wind, and steering error. *Bearing* (B, Brg.) is the *direction* of one terrestrial point from another, expressed as *angular distance* from 000° (North) clockwise through 360°. When measured through 90° or 180° from either *north* or *south*, it is called *bearing angle* (B).", [4].

This concept also locates very close to the concept *Heading*. It means that they are also contextually similar, that is why SA assessment questions can be the easiest, like in the first case.

The next pair of concepts locates at longer distances on the conceptual map due to their contextual relations and are more complex and less specified; that is why the understanding of these relations requests more workload.

The following extracts from the text were used by Leximancer to produce the relation springs between concepts *Heading* and *Middle Latitude*:

*Heading and Middle Latitude*

Text selection 3: "Do not confuse *Heading* and C*ourse*. *Heading* constantly changes as a vessel yaws back and forth across the course due to sea, wind, and steering error", [4]. The concept *Middle Latitude* does not exist in this text selection, but Leximancer identified the link, which means that there are relations between these concepts.

Possible questions:

- Show the concepts *Heading* and *Middle latitude* in the text (SA1)
- Is it possible to identify their relations? (SA2)
  If to peruse the text, the logical chain can be identified between these concepts. This chain is *Heading – Course - Difference of Latitude - Difference of Longitude – Departure - Mid Latitude*. Here *Departure* is the connecting link. Why not it looks like a chess combination? The third question might be as follows:
- How will the *Course (Heading)* of the ship be altering if *Difference of Latitude* between two consequent way points is approaching to $0^0$? (SA3).

More complex relations between the concepts *Heading* and *Middle Latitude* were identified by Leximancer in text selection 4: "The sailings refer to various methods of mathematically determining *course, distance,* and *position.* They have a history almost as old as mathematics itself. Thales, Hipparchus, Napier, Wright, and others contributed the formulas that permit computation of *course* and *distance* by plane, traverse, parallel, *middle latitude*, Mercator, and great circle sailings." Try to put three questions using SA approach for above concepts.

The next selections were automatically identified by Leximancer to show the complex relations between the concepts *Heading* and *Difference of Longitude*.

*Concepts: Heading and Difference of Longitude*

Text selection 5: "*Heading* (Hdg., SH) is the *Direction* in which a vessel is pointed, expressed as *Angular Distance* from 000° clockwise through 360°. Do not confuse *Heading* and *Course*. *Heading* constantly changes as a vessel yaws back and forth across the *Course* due to sea, wind, and steering error. *Bearing* (B, Brg.) is the *Direction* of one terrestrial point from

another, expressed as *Angular Distance* from 000° (North) clockwise through 360°. When measured through 90° or 180° from either *North* or *South***,** it is called *Bearing Angle* (B), [4]".

The contextual chain here is *Heading – Course - Difference of Latitude - Difference of Longitude.*

Text selection 6: "The *Difference of Longitude* (DLo) between two places is the shorter *arc* of the parallel or the smaller *angle* at the pole between the meridians of the two places. If both places are on the same side (*east* or *west*) of Greenwich, DLo is the numerical difference of the *longitudes* of the two places; if on opposite sides, DLo is the numerical sum unless this exceeds 180°, when it is 360° minus the sum. The *distance* between two meridians at any parallel of *latitude*, expressed in distance units, usually nautical miles, is called *departure* (p, Dep.). It represents *distance* made good *east* or *west* as a craft proceeds from one point to another. Its numerical value between any two *meridians* decreases with increased *latitude*, while DLo is numerically the same at any *latitude*. Either DLo or p may be designated *east* (E) or *west* (W) when appropriate" [4].

Try to find common words in text selections 5 and 6, which help you to make three SA queries.

## 4. CONCLUSIONS

The importance to develop and research the SA assessment techniques in MET is obvious and SPAM in this case, by our opinion, has some advantages:

- SPAM is the measuring tool and it gives the chance to assess the levels of SA quantitatively and objectively.
- By means of SPAM the additional information to correctness and accuracy of student answers is assessed. It is $t_2$- the time between question presented and student answer.
- The SPAM assessment results are suitable for statistical processing and can be applied for improvement of MET procedures.
- Application of Leximancer software allows easily to create a conceptual map of the text. It gives the student an opportunity to observe the basic concepts, and helps the teacher to design SA set of questions designed on these concepts. The Leximancer software is attractive tool for designing the open-book SA exam questions based on several texts.

## 5. REFERENCES

[1] LOGINOVSKY, V., *Situation awareness is a new provision of STCW 78, as amended;* Proceedings of 13 IAMU AGA, GMU, Poland, 2012.

[2] DURSO, F.T., DATTEL, A.R., "SPAM: the real time assessment of SA", *A cognitive approach to Situation Awareness: theory and application*, Ashgate, 2004.

[3] ENDSLEY M., *Theoretical Underpinning of Situation Awareness*, a critical review in Mica R. Endsley and Daniel J. Garland (Eds.) *Situation Awareness Analysis and Measurement*, Lawrence Erlbaum Associates, Mahwah, New Jersey, 2000.

[4] BOWDITCH, N., *The American practical navigator*, National Imagery and mapping agency, Bethesda, Maryland, 2002.

[5] STRYBEL, T.Z., et al., *Assessing the Situation Awareness of Pilots Engaged in Self Spacing*, Proceedings of the Human Factor and Ergonomics Society, 52nd Annual Meeting, 2008.

# ELECTRO-TECHNICAL OFFICER TRAINING FOR THE MODERN ERA

[1]MANCILLA E. TERRANCE, [2]GREEN SCOTT

*[1,2]California Maritime Academy, USA*

**ABSTRACT**

This paper addresses new requirements for the *Electro-Technical Officer* curriculum, as defined in the provisions of *Regulation III/6* of the *2010 Manila Conference regarding the International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW),* as well as training in major additional categories for the Electro-Technical Officer's role in mission critical marine applications in the areas of electrical power plants, data acquisition/control, satellite/radio communications, multiple high speed digital communications, navigation and radar applications. Although the need for an officer trained and qualified to deal with the ever increasing complexity of systems aboard modern vessels has existed for many years, the standards set at the Manila Conference formalized the framework of training, which should be implemented for such officers. The emphasis of this paper is to explore and identify the training and skills that an optimum Electro-Technical Officer training program requires.

**Keywords:** *Electro-Technical Officer, training curriculum, 2010 Manila Conference (STCW) provisions.*

## 1. INTRODUCTION

Shipboard systems have evolved from relatively simple electrical and electromechanical systems to more advanced propulsion, control, telecommunications and radar systems requiring very specialized training in a variety of technical areas. The industry has responded to these needs by creating a new rating called the *Electro-Technical Officer*. These officers will equip the Engine Department with new skills needed for mission critical applications.

This paper documents the curriculums currently proposed at the California Maritime Academy to address industry needs by creating and implementing the following two majors.

### *1.1. Electrical and Computer Engineering Technology major*

This is a non-licensed track designed to address shore-side engineering needs, as well as non-maritime industry applications in the automation, electronics, computer and aerospace/defense industries. It is currently designed to be a 120 semester-unit program. Because this major does not require USCG or STCW compliance, it will be implemented only with the California State University system approval.

### *1.2. Electro-Technical Officer major*

Upon implementation of the Electrical and Computer Engineering Technology major and the United States of America adoption of STCW guidelines for Electro-Technical Officers, the California Maritime Academy will launch an Electro-Technical Officer major. Our efforts in this regard will be the basis for this paper.

## 2. ELECTROTECHNICAL OFFICER - STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING

Per IMO Circular Letter STCW/CONF.2/33 outlining the *Conference of Parties to the International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978-Agenda item10*, 1 July 2010 [1]: *Regulation III/6:*

*Mandatory Minimum Requirements for Certification of Electro-Technical Officers.*

*(1) Every electro-technical officer serving on a sea-going ship powered by main propulsion machinery of 750 KW propulsion power or more shall hold a certificate of competency.*

*(2) Every candidate for the certification shall –*

*1. Be not less than 18 years of age on the last date of application.*

*2. Have completed not less than 12 months of combined workshop skills training and approved sea going service of which not less than 6 months shall be seagoing service as part of an approved training program which meets the requirements of section A-III/6 of the STCW code and is documented in an approved training record book, or otherwise not less than 36 months of the combined workshop skills training and approved seagoing service of which not less than 30 months shall be seagoing service in the engine department.*

*3. Have completed approved education and training and meet the standard of competence specified in section A – III/6 of the STCW Code.*

*4. Meet the standard of competence specified in section A–VI/1, paragraph 2, section A-VI/2, paragraphs 1 to 4, section A-VI/3, paragraphs 1 to 4 and section A-VI/4, paragraphs 1 to 3 of the STCW Code.*

*(3) Every Party shall compare the standard of*

*competence which it required of electro-technical officers for certificates issued before 1 January 2012 with those specified for the certificate in section A-III/6 of the STCW Code, and shall determine the need for requiring those personnel to update their qualifications.*
*(4) Seafarers may be considered by the Party to have met the requirements of this regulation if they have served in a relevant capacity on board a ship for a period of not less than 12 months within the last sixty months preceding the entry into force of this regulation for that Party and meet the standard of competence specified in Section A-III/6 of the STCW Code.*
*(5) Notwithstanding the above requirements of paragraph 1 to 4, a suitably qualified person may be considered by a Party to be able to perform certain functions of section A-III/6.*

## 3. ADOPTION OF ELECTRO-TECHNICAL OFFICER RATING IN THE UNITED STATES OF AMERICA

Current plans for implementation in the USA are determined by the United States Coast Guard (USCG) and the Department of Homeland Security.

The IMO started a comprehensive review of the entire STCW Convention and Code in 2007. The IMO adopted amendments from this review on June 25, 2010 in Manila Philippines. These amendments went into force January 1, 2012. On August 1, 2011, the United States Coast Guard published the Supplemental Notice of Proposed Rulemaking (SNPRM)*[2]* which proposed implementation of all STCW amendments, and changes to domestic endorsements. A timeline for that ruling is shown in Figure 1. Implementation in the United States will be driven by the final STCW rulemaking and associated policies.

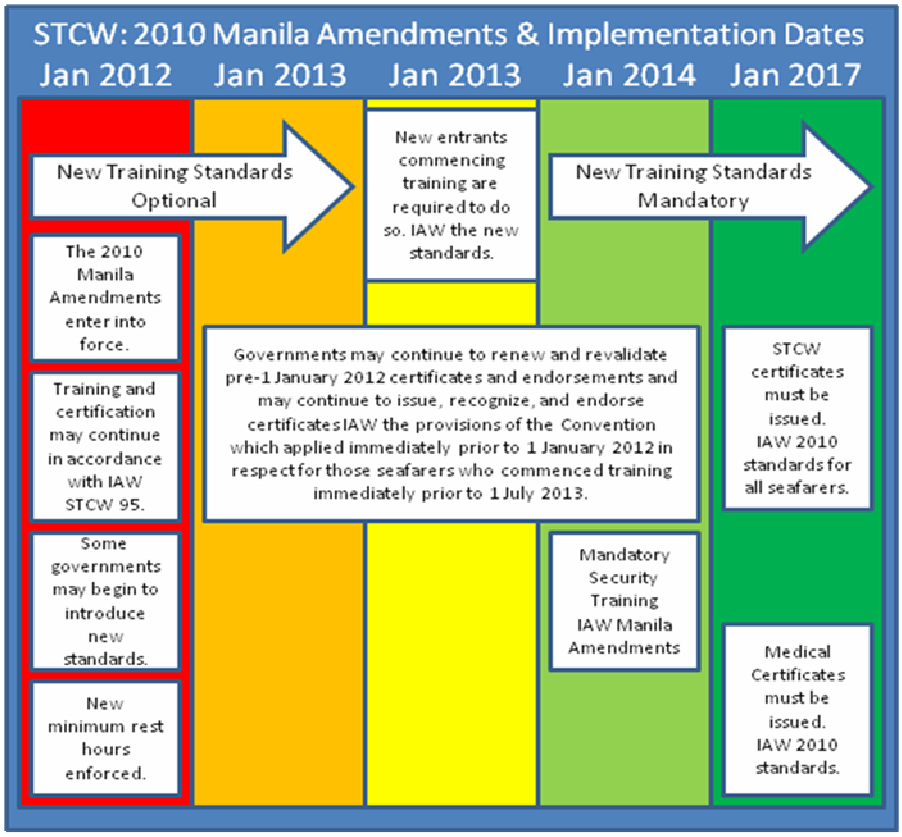



Figure 1 2010 Manila Amendments and Implementation Dates [2]

## 4. KEY KNOWLEDGE AREAS FOR ELECTRO-TECHNICAL OFFICER TRAINING

The duties of an Electro-Technical Officer can be varied, but will require a high degree of technical competence with emphasis on matters pertaining to electrical, electronic, automation and software issues.

Any training must provide expertise in these areas. Table 1 addresses the key seven knowledge areas we consider relevant and essential. All courses should include comprehensive laboratories to complement theory whenever possible. Detailed explanation of the curriculum contents and goals are provided below.

Table1. Electro-Technical Officer Knowledge Areas

| KNOWLEDGE AREA | TOPIC | APPLICATIONS |
|---|---|---|
| 1. Basic Electrical Circuits | - DC Circuit Theory<br>- AC Circuit Theory | Foundation for all electrical and electronic applications |
| 2. Electro-Mechanical Machinery | - AC/DC Motors<br>- AC/DC Generators<br>- Power Electronics<br>- Motor Controllers | Winches, elevators, compressors, pumps, ventilation systems, propulsion systems, and other auxiliary machinery and equipment<br>Ship power and propulsion systems<br>Regulation and control of machine speeds, power, voltage and currents |
| 3. Electronics | - Analog & Digital Solid State Technology | Electro-mechanical, data acquisition/ control, and networking systems.<br>Used extensively in telecommunications and radar systems. |
| 4. Automation | - Instrumentation and Automation | Hardware and software needed to acquire data and control shipboard systems. |
| 5. Networking | - Computer Networking Technology | Transfer of computer-generated information within and outside a ship. |
| 6. RF/MW Telecommunications and Radar | - RF/MW Technology<br>- Radio and Satellite Technology<br>- Radar Technology | Transmission and reception of all shipboard communications, navigation, satellite and radar systems. |
| 7. GMDSS | - Operation and Repair | Shipboard radio systems |

*4.1. Knowledge Area 1: Basic Electrical Circuits*

A *Basic Electrical Circuits* course must cover AC and DC electric circuits. It is the foundation course for all advanced studies in electricity and electronics. Learning goals for the course should include proficiency in:

- analyzing simple AC and DC circuits using network reduction, mesh and node analysis;
- using the Thévenin and Norton Equivalent circuits to model real voltage and current sources;
- creating and using phasor representations of sinusoidal voltages and currents;
- calculating apparent, real and reactive power and power factor in AC circuits;
- determining circuit modifications to adjust circuit power factor.

*4.2. Knowledge Area 2: Electro-Mechanical Machinery*

An *Electro-Mechanical Machinery* course covers fundamentals of:

- magnetism, magnetic flux and transformers;
- principles and operation of series, shunt, and compound DC generators and motors;
- single phase and three phase AC generators, synchronous and induction motors;
- DC and AC motor controllers, and stepper motors.

The understanding of system protective devices and safety is a core requirement of the course.

Three-phase circuit theory and basics of power electronic devices as they apply to speed controllers such as Variable Frequency Drives (VFDs) are a key competency for understanding state-of-the-art machinery.

*4.3. Knowledge Area 3: Electronics*

An *Electronics* course covers the basics of electronic theory and devices. Course goals include an understanding of:

- theory and operation of diodes, Bipolar Junction Transistor (BJT) and Metal Oxide Semiconductors Field Effect Transistor (MOS FET) technologies;
- two port devices, transfer functions and filtering;
- numbering systems, Boolean logic and digital devices.

An advanced course includes the basics of microprocessors, embedded systems and basic programming as applied to robotics. In preparation for the Instrumentation and Automation courses, a basic course on physical measurements, sensors and actuators is to be included in the curriculum.

*4.4. Knowledge Area 4: Automation*

*Automation* courses build on the knowledge gained in previous electrical courses. The goals of a course in *Basic Instrumentation* include:

- instrumentation devices and their uses in monitoring processes;
- instrumentation and sensors used for measuring temperature, pressure, level, flow, position and motion.

Other types of analytical measurements are intrinsic to all automation systems, and are therefore presented as fundamental subjects. Further key components of the curriculum are:

- principles of signal conditioning including operational-amplifier applications, filtering, applications to pneumatic systems and digital signal conditioning;
- an emphasis on how instrumentation relates to modern data acquisition and control systems;
- discussion of optimization of measurements in each relevant area.

An advanced Automation course includes applications in power plants, engineering processes, and manufacturing processes leading to an understanding of modern control systems. Important for the understanding of closed loop controlled systems is knowledge of the principles of analog and digital control systems, measurement methods and actuator devices. Proportional Plus Integral Plus Derivative (PID) control applications as well as Programmable Logic Controllers (PLC's) are included in the course.

*4.5. Knowledge Area 5: Networking*

Networking as it applies to telecommunications systems and computer networks is an important foundation for the understanding of communications systems. A *Networking* course includes the basics of signal conversion methods, sampling, quantization, pulse modulation techniques, error analysis methods, digital modulation techniques, encoding schemes, data transmission methods, Open System Interconnection model (OSI), frame transmission methods, multiplexing low-speed channels, Local Area Network (LAN), Transmission Control Protocol/ Internet Protocol (TCP/IP), Ethernet and IEEE 802 networking technology. Course goals include:

- understanding of Pulse Code Modulation (PCM), Delta Modulation and the transmission of digital signals over analog media;
- error detection, correction and analysis;
- Open Systems Interconnection (OSI) network model, network architecture and protocol;
- Local Area Network (LAN) technologies

*4.6. Knowledge Area 6: RF/MW Telecommunications and Radar*

Many marine wireless applications use Radio Frequency (RF) and Microwave (MW) frequencies. A thorough understanding of this knowledge area is fundamental for telecommunications and radar applications. The course includes:

- generation and transmission of signals;
- a survey of modern RF/Microwave applications, including radio, radar, terrestrial and satellite communication systems;

Course goals include:

- basic understanding of RF and Microwave theory and measurement techniques;
- understanding of the differences between lower frequency measurement methodology and higher frequency techniques;
- complete briefing on safety issues pertaining to higher frequency and higher power applications .

*4.7.Knowledge Area 7: GMDSS Operation and Repair*

The *Global Maritime Distress Safety System (GMDSS) Operation and Repair* course includes:

- use of a marine VHF radio, the Maritime Mobile Service and the Maritime Mobile Satellite Service;
- theoretical knowledge of equipment compliance, electronic communications systems, calling procedures, distress alerting techniques, and marine safety information;
- overall knowledge of the system, and modular approaches to its repair.

The course should lead to FCC licensing for *Marine Radio Operator Permit* (Element 1) and the *GMDSS Operator's License* (Element 7).

## 5. ELECTRO-TECHNICAL OFFICER CURRICULUM AT THE CALIFORNIA MARITIME ACADEMY

The adoption of the Electro-Technical Officer curriculum at The California Maritime Academy will depend on the U.S. Government's implementation of the 2010 Manila Convention Amendments. The California Maritime Academy plans to incorporate the knowledge areas mentioned above into the current Marine Engineering Technology curriculum and create an Electro-Technical Officer major.

## 6. CONCLUSIONS

A variety of Electro-Technical Officer training programs have been implemented throughout the world. Each has its own merits, and all do a fine job in providing skilled graduates to the maritime industry. The California Maritime Academy's approach aims to create a solid foundation in those pertinent technology areas that form the basis of an engineering technical degree. However, due to the ever-changing nature of technological innovation, it is ultimately the responsibility of each Electro-Technical Officer to constantly stay abreast of new technologies, and incorporate them in their daily work. Life-long learning is a skill that must be acquired as a student and kept in practice throughout a working career. Employees as well as employers should encourage and facilitate this effort in their work place.

## 7. REFERENCES

[1] IMO Circular Letter STCW/CONF.2/33 outlining the *Conference of Parties to the International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978-Agenda item10*, 2010.
[2] SNPRM Docket ID: *USCG-2004-17914.*

# RESEARCH OF HYDRODYNAMIC LOADINGS AT IMMERSING OF SECTIONALLY FLAT BOTTOM CONTOURS

[1]MAYBORODA N. ALEXANDER, [2]NIKITIN W. PAVEL

[1,2]*Kyiv State Maritime Academy, Ukraine*

**ABSTRACT**

The present paper is devoted to the construction of nonlinear unsteady hydrodynamics mathematical model of bodies during interaction with free water surface. The using of vortex sheets method is supposed. Wetted surface of bottom and free fluid surface are represented by vortex sheets. The fluid perturbed motion velocity is described by means of integral in Cauchy form and singular-integral equation for bottom vortex density is constructed. The mathematical model of ship waves is constructed in order to determine the free surface vortex density. The summary and distributed loads as well as the laws of motions for the wedges of infinite and finite mass are obtained and compared with known experimental and theoretical results. Numerical experiment results on base of coming mathematical model may be taken as scientific basis for the prediction of slamming loads and designs of high-speed ships.

**Keywords:** *immersing of bottom, mathematical modeling of hydrodynamic loadings, vortex sheets method.*

## 1. INTRODUCTION

Many tasks of modern hydrodynamics are bound to driving of bodies in a fluid with free boundaries, the form which one is determined during solution and on which one the nonlinear boundary conditions should satisfy in a general case. The known research of such tasks, as a rule, are limited to the simplified kinematics and geometry of a body or linearized representation of free boundaries [1, 2, 3 etc.]. The problem of calculation of nonlinear hydrodynamic parameters of bodies of the complicated form intersecting a free surface of a weighty fluid is important for the majority of technical applications.

To the given paper the nonlinear non-stationary mathematical model and results of numerical research of imbedding of wedges of infinite width is described. The matching with known designed and experimental data is given.

## 2. FORMULATION OF PROBLEM

Let us assume that non viscous incompressible fluid is posed in a lower half-space with boundary which consists of a wetted part of a body $S_1(t)$, isobaric free surface $S_2(t)$ and hydrodynamic body wake $S_3(t) \subset S_2(t)$. Not upsetting a generality it is possible to suppose the known law of motion, including deformation, of a body and to consider the non-stationary flow with the given initial form of free boundary and wetted part of a body at a contact by it of a fluid.

A field of perturbation velocities in internal points of a fluid is potential on a Lagrange's theorem. A condition of impenetrability is satisfied on $S_1(t)$ and a dynamic condition of isobar is satisfied on $S_2(t)$.

As generally free boundary is not a stream-surface, in points of boundary the equation of the Euler should be fulfilled. The kinematical condition on free boundary is provided with its moving together with fluid particles. The fluid velocity is final in all points of $S_1(t)$ (generalization of the Chaplygin–Joukovsky postulate). Perturbation velocities of a fluid should equal to null at infinity outside of a hydrodynamic wake. According to the Thomson theorem we shall demand equality to null of a velocity circulation on an arbitrary fluid outline including area of disturbed motion.

## 3. MATHEMATICAL MODEL

Let us represent boundary of a fluid $S = S_1 \cup S_2, S_3 \subset S_2$ by a surface vortex pattern $\vec{\gamma}(S) = \{\vec{\gamma}_1(S_1), \vec{\gamma}_2(S_2), \vec{\gamma}_3(S_3)\}$.

When determining a velocity potential of disturbed motion in an upper half-space, we shall receive special analog of the Sohotsky formulas

$$\vec{w}^{+}(\vec{x},t) - \vec{w}^{-}(\vec{x},t) = \vec{\gamma}(\vec{x},t) \times \vec{n}(\vec{x},t);$$

$$\vec{w}^{+}(\vec{x},t) - \vec{w}^{-}(\vec{x},t) = \frac{1}{2\pi} \int_S \frac{\vec{\gamma}(\vec{\xi},t) \times (\vec{x} - \vec{\xi})}{|\vec{x} - \vec{\xi}|^3} dS,$$

where $\vec{w}^{\pm}(\vec{x},t)$ – limiting values of a fluid perturbation velocity at tendency of a point x to $S$ accordingly from an upper (lower) half-space, $\vec{n}(\vec{x},t)$ – external in relation to a fluid a normal to $S$.

It is possible to determine the module $\vec{w}^{-}(\vec{x},t)$ of velocity on $S_2$ from the Cauchy–Lagrange integral, and its direction can by determined from the analysis of the

Euler equation due to orthogonality of a pressure gradient to isobaric free surface. In particular, a tangent component of fluid velocity on $S_2$ is collinear with projection of the acceleration due to gravity g, and their directions coincide for falling sides of surface and are opposite – for rising sides. This outcome is conformed to kinematics of Gerstner waves.

$$\vec{n}\left(\vec{x},t\right)\int_S \frac{\vec{\gamma}\left(\vec{\xi},t\right)\times\left(\vec{x}-\vec{\xi}\right)}{\left|\vec{x}-\vec{\xi}\right|^3}dS = 4\pi\vec{n}\left(\vec{x},t\right)\vec{v}_1\left(\vec{x},t\right), \qquad \vec{x}\in S_1(t);$$

$$\vec{\gamma}_2(\vec{x},t) = 2\vec{n}\left(\vec{x},t\right)\times(E-\vec{n}\vec{n}^{\mathrm{T}})\left\{\int_S \frac{\vec{\gamma}\left(\vec{\xi},t\right)\times\left(\vec{x}-\vec{\xi}\right)}{\left|\vec{x}-\vec{\xi}\right|^3}dS + \frac{\mathrm{sgn}(w_n(\vec{x},t))}{\left|\vec{n}(\vec{x},t)\times\vec{g}\right|}\vec{g}\left[v^2(t)-\left(w_n(\vec{x},t)-v_n(t)\right)^2 - 2\left(\varphi_t(\vec{x},t)+gh(\vec{x},t)\right)\right]^{\frac{1}{2}} - \vec{v}(t)\right\}, \qquad \vec{x}\in S_2(t);$$

$$\frac{d\vec{x}}{dt} = \frac{1}{4\pi}\int_S \frac{\vec{\gamma}\left(\vec{\xi},t\right)\times\left(\vec{x}-\vec{\xi}\right)}{\left|\vec{x}-\vec{\xi}\right|^3}dS - \frac{1}{2}\vec{\gamma}\left(\vec{x},t\right)\times\vec{n}\left(\vec{x},t\right) - \vec{v}(t), \qquad \vec{x}\in S_2(t),$$

where $\vec{v}(t)$ – velocity of an origin of body coordinates; $\vec{v}_1\left(\vec{x},t\right)$ – velocity of points of a body surface $S_1$; $h(\vec{x},t)$ – perturbation of free surface $S_2$; $E$ – unit matrix; $(E-\vec{n}\vec{n}^{\mathrm{T}})$ – operator of projection of a vector on a surface, the multiplying on the transposed normal vector $\vec{n}^{\mathrm{T}}$ is understood in sense of multiplying of matrixes; the point marks a local derivative on time.

A impenetrability condition of a wetted part of a body and the Sohotsky formulas in view of continuity of normal velocity component on free surface $S_2$ allow to construct the system of the singular integro-differential equations for definition of vortex sheets density and forms of free surface, the wake and the body wetted surface.

## 4. NUMERICAL IMPLEMENTATION OF MATHEMATICAL MODEL

At numerical implementation of a mathematical model the integrals are conversed to multivariate integrals such as the Cauchy [4], many properties which one are generalization of known outcomes of a one-dimensional case [5]. Let's suppose surfaces $S_1$ and $S_2$ piecewise smooth on Lyapunov, admitting only lines of angular points (location of a spraying on a water-line $S_1\cap S_2$, keel both bilges on a body $S_1$ and nonlinear wave crests on $S_2$. Possible zones of so-x called out-of-limit nonlinearity (cusp and collapse points of wave crests, free jets etc.) thereby are eliminated from reviewing.

Postulating continuity of a velocity field shall demand vanishing of density of integrals such as Cauchy on lines of angular points, that corresponds condition on edge as Sommerfeld [6] for keel both bilges on a body $S_1$ and indirectly reflects collapse of nonlinear waves and free jets on $S_2$. On a part of a water-line $S_1\cap S_2$ the appearance of spray jets is generally possible, the speed in which ones is finite [7]. The tops of these jets are angular points; it is possible and indefinitely remote. Density of an integral such as the Cauchy in them also should vanish [8]. We shall consider that vortex sheets density is satisfied the Gelder condition.

The numerical implementation of an offered mathematical model was realized by a method of discrete vortexes on algorithm of iterative approximation. At build-up of vortex model of a wetted surface of a body and wake the requirements of the Thomson and Helmholtz theorems were satisfied. The spray jets were simulated by additional vortexes in a water-line neighbourhood under the Joukovsky scheme [9] for obtaining solution with restricted load in a spray zone. The indispensable methodical researches of the calculating scheme of a wetted surface were conducted. At small trajectory corners of a body splashdown the rediscretization of a diving time step was envisioned.

It is known that the considered task with the initial data (Cauchy problem) for an unlimited time slice is ill-conditioned because of instability of free vortex surfaces [10]. Conditionally corrected numerical implementation of a mathematical model was obtained due to special regularization ways.

At first, usage of a mathematical formalism of the theory of integrals such as the Cauchy, allows considering zero vortex sheets density in free surface angular points and ensures its stability. Secondly, for long processes of interaction of a body with free surface, in particular, at diving, it turned out necessary to execute the Courant–Friedrichs–Levi condition [11] and in appropriate way to distort the calculating scheme.

The form and sizes of a body wetted surface can here noticeably vary as against the conventional tasks of hydrodynamics. That not only adds nonlinearity to a formulation, but also considerably complicates the solution of task. In particular, conformity of points at finite-difference calculation of a local derivative of potential can be ensured only at usage of an affine similarity with a current characteristic size of a wetted surface. Besides, at calculation of non-stationary loads on a body it is necessary to allow for rapidity of wetted surface change. In some cases it appears to expedient consideration of an integral of the Cauchy–Lagrange in a

moving axis, bound with a characteristic point of a water-line.

## 5. CALCULATIONS

With the purpose of testing of a mathematical model

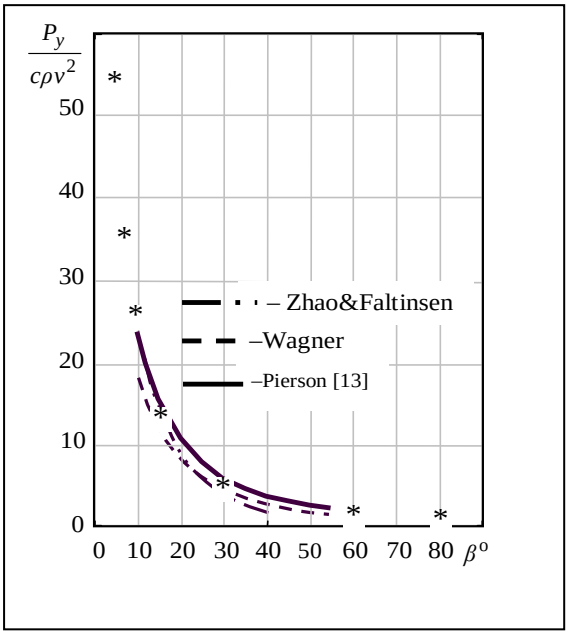



Figure 1 The calculation results of resistance force of wedges with different deadrise angleS

the known non-stationary tasks about a start of gliding (Wagner's task) and vertical diving of a plate with constant velocity and trim angle were considered.
The calculation results of a gliding were compared to precise Sedov's solution for a weightless fluid. In calculation, the rarefaction in an after-body at the beginning of gliding is obtained, what was theoretically. forecasted by Wagner and was watched by Sokolyansky and Malyarova in experiments of CAHI. The calculation results of a plate diving are satisfactorily agreed with experiment of Shorigin (CAHI). For forward edge of a plate a rarefaction area also is detected.

The task about a gliding of a deformable plate making elastic vibrations was considered. The time dependences of coefficients of normal force, moment, position of pressure center and pressure distribution on a plate for different parameters of oscillations is obtained. Vertical diving of symmetric wedges with different deadrise angles was considered. The calculation results of resistance force and pressure distribution at diving with constant velocity are shown on Figure 1 and Figure 2, in comparison to known theoretical estimations for a weightless fluid.

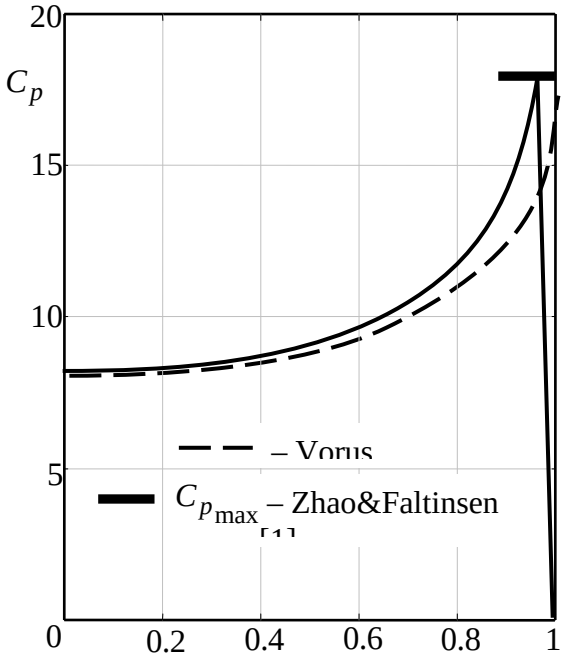



Figure 2 The calculation results of pressure distribution on a wedge with deadrise angles $\beta = 20^o$

The task about a diving wedge of a final mass was solved at final Froude numbers. The integral and distributed hydrodynamic loads, and also law of motion for different deadrise angles were calculated. The results of calculation of overload $n_y$ and law $H(t)$ of diving for a wedge with a deadrise angle $30^o$, linear mass density 112 kg / m and initial velocity 2.44 m / s in comparison to the experimental data of Shorigin [14] are shown in Figure 3. As in experiment the law $H(t)$ of

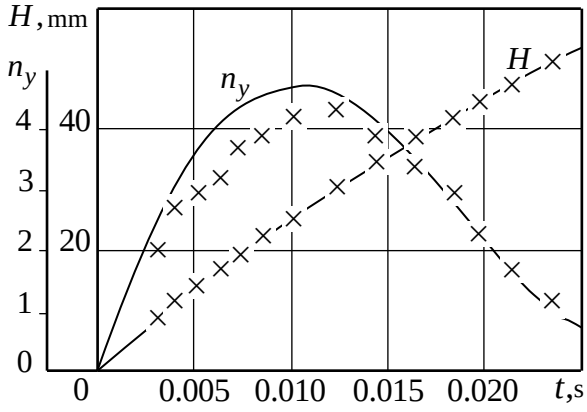



Figure 3 Diving of a wedge with finite mass: points – experiment of Shorigin [14]

diving (decryption of high-speed filming) was most authentically defined, the satisfactory coordination with it demonstrates that the calculated overload is defined more precisely than in physical experiment.

| | |
|---|---|
| $v$ | Diving velocity |
| $p_{¥}$ | Pressure on free boundary of a fluid |
| $\rho$ | Mass density of a fluid |
| $P_y$ | Resistance force of a wedge |
| $H$ | Imbedding a wedge |
| $G$ | Weight of a wedge |
| $n_y$ | Overload $n_y = P_y / G$ |
| $c$ | Wetted half-width of a wedge |
| $\beta$ | Deadrise angle of a wedge |
| $C_p$ | Pressure coefficient $C_p = (p - p_{¥}) / \rho v^2 / 2$ |

## 6. CONCLUSION

The built mathematical model can be applied for definition of loads with the purpose of an estimation of fastness and dynamics of bodies interacting with a free surface of a fluid.

## 7. REFERENCES


[1] ZHAO, R., FALTINSEN, O.M., *Water Entry of Two-Dimensional Bodies*, Journal Fluid Mech., 246: 593-612, 1993.

[2] VORUS, W.S., *A Flat Cylinder Theory for Vessel Impact and Steady Planing Resistance*, Journal of Ship Research, Vol. 40, №2: 89-106, 1996.

[3] FALTINSEN, O.M., *Water Entry of a Wedge with Finite Deadrise Angle*, Journal of Ship Research, Vol. 46, №1: 39-52, 2002.

[4] BELOTSERKOVSKY, S.M., LIFANOV, I.K., *The numerical methods in singular integral equations*, Moscow, Science Publ., 256 pp. (in Russ.), 1985.

[5] KAKICHEV, V.A., *Bounding, properties of integrals such as the Cauchy of many variables*, Proc. of the Shacht. Ped. Inst., **2**, № 2: 25-91 (in Russ.), 1959.

[6] HENL, H., MAUE, A., WESTPFAL, K., *Theory of diffraction*, Moscow, World Publ., 428 pp. (in Germ.), 1964.

[7] LOGVINOVICH, G.V., *Hydrodynamics of flows with free boundaries*, Kyiv, Naukova Dumka Publ., 209 pp. (in Russ.), 1969.

[8] MOTKIN, A.S., *Singular integral equations on an infinite contour*, Trans. of Academy of Sciences of BSSR, Ser. Phys.-math. Sc., №4: 36-46 (in Russ.), 1967.

[9] JOUKOVSKY, N.E., *About the lifting airfoils such as "Antuanet"*, in 2 vol., Moscow–Leningrad, Publ. of Academy of Sciences of USSR, v.1: 168-190 (in Russ.), 1948.

[10] BETJAEV, S.K., *Separated flows*, Novosibirsk, Prepr. ITAM, Sib. dep. of Academy of Sciences of USSR, 46 pp. (in Russ.), 1983.

[11] FLETCHER, C.A.J., *Computational Techniques for Fluid Dynamics 1*, Moscow, World Publ., 504 pp. (in Russ.), 1991.

[12] WAGNER, H., *Uber stoss – und gleitvorgange an der oberflache von flussigkeiten*, ZAMM, H.4: 193-213 (in Germ.), 1932.

[13] PIERSON, J.D., *The Penetration of a Fluid Surface by a Wedge*, Inst. of the Aeronautical Sciences, Rep. №381, 1950.

[14] SHORIGIN, O.P., *About overloads operating on a wedge at symmetric diving it in a fluid*, Trans. of CAHI, №. 797, 23 pp. (in Russ.), 1960.

# HEAT TRANSFER AND ENTROPY ANALYSIS AS TOPICS DELIVERED TO FUTURE MARINE ENGINEERS GRADUATING IN CMU

MEMET FEIZA

*Constanta Maritime University, Romania*

**ABSTRACT**

Students enrolled in Constanta Maritime University (CMU) / Naval Electromechanics Faculty are dealing with heat transfer mechanisms combined with entropy analysis, during Undergraduate (Thermodynamics) and Master Studies Programs (Optimizing of Thermal and Refrigeration Plants).

Real processes, including thus the ones occurring on board the ship, are irreversible process, inside the thermal systems being produced entropy. This irreversible production of entropy inside the systems is accompanied by the loss of potential work. This is an important statement because it permits the determination of efficiency decrease in any particular case. Heat transfer is a typical irreversible process. Conduction heat transfer problems are encountered in many engineering applications on board the ship.

This paper deals with entropy generation during heat transfer through a plane wall, being presented cases exposed to students enrolled in Master Specialization called "Advanced Technologies of Electromechanic Engineering". This knowledge will permit to future marine engineers to be able to deal with problems related to design optimization.

**Keywords:** *entropy generation, conduction, Master course.*

## 1. INTRODUCTION

Entropy generation and its minimization have been seen as an effective tool used to improve the performance of any heat transfer process. Skills specific to entropy generation investigation are gained by students enrolled in CMU, Naval Electromechanics Faculty, Master Specialization called "Advanced Technologies of Electromechanic Engineering". One of the goals of this Master course is to supply information regarding solving problems related to entropy generation which should be minimised in order to arrive to optimum heat exchange design.

To be able to deal with this topic are needed concepts delivered during courses of Thermodynamics, as seen in Figure 1.

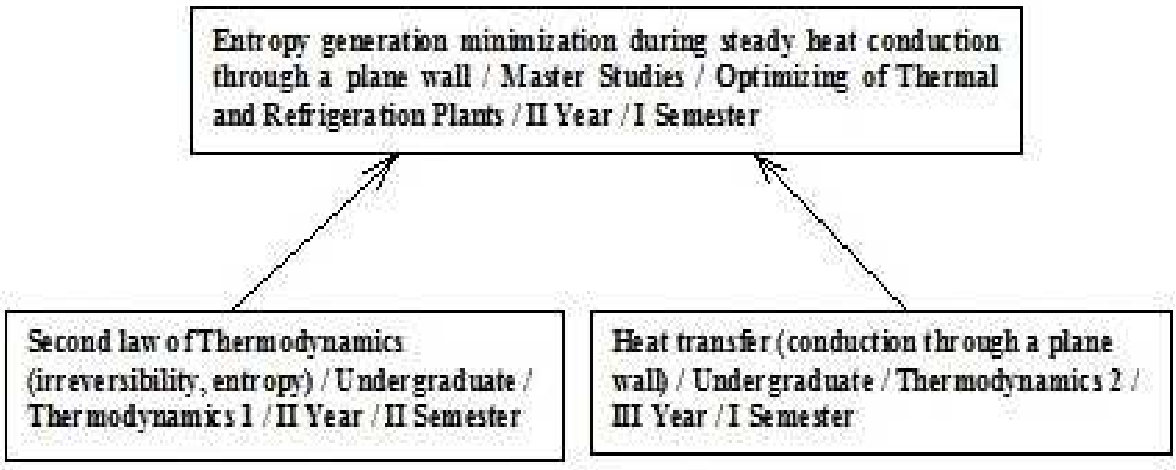



Figure 1 Background of entropy generation minimization

Future marine engineers are familiarised during "Thermodynamics 1" with the concept of entropy and with the fact that entropy change is a measure of how reversible a process is.

The most efficient processes possible for converting energy from one form to another are processes where the net entropy change of the system and the surroundings is null. Irreversibility is inherent in all processes, being impossible to make them reversible.

Heat transfer between systems having different temperatures is one typical irreversible process example. Heat transfer notions are delivered in CMU to future marine engineers during "Thermodynamics 2" course. Heat transfer by conduction will take place if there is a temperature gradient in a solid medium. Heat conduction is important for many engineering applications, being met on board the ships during conduction through walls (plane, cylinder).

Heat losses are seen as a loss of energy, specialists working on the minimisation of these. In all types of heat transfer processes, including conduction, irreversibility is associated with entropy generation, which leads to the destruction of available work.

In a pure heat conduction process, the entropy generation occurs due to heat transfer through a finite temperature difference (Torabi, Aziz, 2012).

An entropy generation analysis related to steady heat conduction through a plane wall is presented below, as it is delivered to future marine engineers graduating from CMU.

## 2. EQUATIONS OF THE ANALYSIS

It is considered a plane wall for which will be studied the local entropy generation during steady heat conduction.

For the case regarding the uniform thermal conductivity and internal heat generation, the one-dimensional steady state heat conduction equation is:

$$\frac{d^2T}{dx^2}+\frac{q(x)}{k}=0 \tag{1}$$

where: T – temperature, K,
x – coordinate axis, m,
q – internal heat generation rate, W/m$^2$,
k – thermal conductivity, W/(mK).

The internal heat generation is given by:

$$q(x)=-\frac{k}{T}\left(\frac{dT}{dx}\right)^2 \tag{2}$$

The local entropy generation in the wall is:

$$s'''=\frac{k}{T^2}\left(\frac{dT}{dx}\right)^2+\frac{q(x)}{T} \tag{3}$$

or

$$s'''=\frac{k}{T^2}\left(\frac{dT}{dx}\right)^2-\frac{k}{T^2}\left(\frac{dT}{dx}\right)^2=0 \tag{4}$$

It results that the entropy generation can be removed with the help of an internal heat generation expressed by Eq. (2).

The temperature variation is found as

$$T(x)=T_1\left(\frac{T_2}{T_1}\right)^{x/L} \tag{5}$$

where: L – thickness of the plane wall, m,
$T_1 = T(x = 0)$,
$T_2 = T(x = L)$.

Temperature variation T (x) as in Eq. (5) satisfies the heat conduction equation and yields null entropy generation rate. In order to maintain this temperature variation an internal heat generation is needed, which is obtained by introducing Eq. (5) in Eq. (2), resulting:

$$q(x)=-\frac{kT_1}{L^2}=\left[\ln\left(\frac{T_2}{T_1}\right)\right]^2 T_1\left(\frac{T_2}{T_1}\right)^{x/L} \tag{6}$$

By integrating the above equation along the thickness of the considered wall, results the total heat generation as:

$$Q=\int_0^L q(x)dx=-\frac{kT_1}{L}\ln\left(\frac{T_2}{T_1}\right)\left(\frac{T_2-T_1}{T_1}\right) \tag{7}$$

If the plane wall separates two fluids of different temperatures, heat transfer occurs by convection from one fluid to the left surface of the wall – with a convective heat transfer coefficient "$\alpha_1$", and also by convection from the other fluid to the right surface of the wall – with a convective heat transfer coefficient "$\alpha_2$" (see Figure 2).

Corresponding boundary conditions according to the one dimensional steady state heat conduction equation through the considered wall are:

$$k\frac{dT}{dx}(x=0)=\alpha_1[T(x=0)-T_1] \tag{8}$$

$$k\frac{dT}{dx}(x=L)=-\alpha_2[T(x=L)-T_2] \tag{9}$$

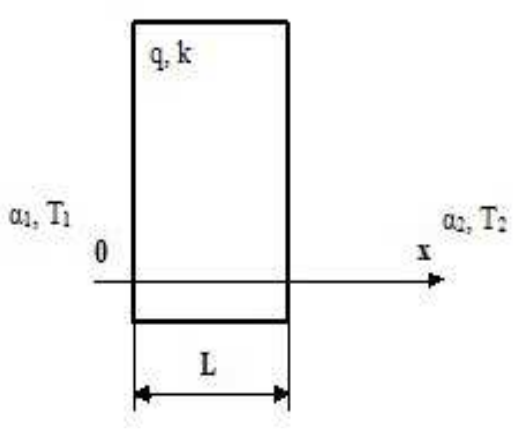



Figure 2 Heat transfer through a plane wall exposed to two fluids with different temperatures

The dimensionless parameters given below are introduced (El Haj Assad, 2011):

$$\theta=\frac{T-T_2}{T_1-T_2},$$

$$X=\frac{x}{L},$$

$$M = m\,L,$$

$$Q=\frac{a\,L^2}{k(T_1-T_2)},$$

$$Bi = \frac{\alpha L}{k},$$

where: m – internal heat generation constant, $m^{-1}$,
a – internal heat generation at x = 0, [W $m^{-3}$],
Bi – Biot number

Thus the heat conduction equation (1) becomes:

$$\frac{d^2\theta}{dX^2} + Qe^{-MX} = 0 \tag{10}$$

Having the boundary conditions:

$$\frac{d\theta}{dX}(X=0) = Bi_1[\theta(X=0)-1] \tag{11}$$

$$\frac{d\theta}{dX}(X=1) = -Bi_2\theta(X=1) \tag{12}$$

The solution of Eq. (10), considering the boundary conditions described by (11) and (12) is:

$$\theta(X) = -\frac{Q}{M^2}e^{-MX} + CX + D \tag{13}$$

Above, C and D are given by:

$$C = \frac{Bi_1Bi_2\left(Qe^{-M} - Q - M^2\right)}{M^2\left(Bi_1 + Bi_2 + Bi_1Bi_2\right)} - \frac{Q\left(Bi_1e^{-M} + Bi_2\right)}{M\left(Bi_1 + Bi_2 + Bi_1Bi_2\right)} \tag{14}$$

$$D = \frac{Bi_1Bi_2\left(Q + M^2\right)}{M^2\left(Bi_1 + Bi_2 + Bi_1Bi_2\right)} + \frac{Q\left(Bi_2e^{-M} - Me^{-M} + Bi_2M + Bi_1 + M\right) + M^2Bi_1}{M^2\left(Bi_1 + Bi_2 + Bi_1Bi_2\right)} \tag{15}$$

The expression of the local entropy generation rate in the case of one-dimensional steady heat conduction through a plane wall (Bejan, 1995) is:

$$\dot{S}''' = \frac{k\left(\frac{dT}{dx}\right)^2}{T^2} \tag{16}$$

The total entropy generation in the wall is obtained by integrating Eq. (16) over the thickness of the wall:

$$\dot{S} = \int_0^L \dot{S}'''Adx \tag{17}$$

"A" above is the wall surface normal to the heat flow direction.

The dimensionless local volumetric rate of entropy generation is noted as "$N_S$", given by the formula:

$$N_S = \frac{\dot{S}'''L^2}{k} = \frac{1}{(\theta + t)^2}\left(\frac{d\theta}{dX}\right)^2 \tag{18}$$

where: t – dimensionless temperature ratio,

$$t = \frac{T_2}{T_1 - T_2}$$

The dimensionless total entropy generation rate is noted as "$N_T$":

$$N_T = \frac{\dot{S}L}{kA} = \int_0^1 N_S\,dX \tag{19}$$

## 3. RESULTS FOR A CASE STUDY

In the following are given results obtained for the case of the plane wall which is separating two fluids having different temperatures ($T_1$ and $T_2$).

In Table 1 it is given the dependence between the dimensionless parameters "$N_T$" and "$Bi_1$", for specified heat transfer parameters:

Q = 2
M = 0,5
t = 1

Observation of founded values for dimensionless "$N_T$" indicates that its values decrease together with the increase of dimensionless "$Bi_1$" values.

For a certain value of "$Bi_1$" ($Bi_1$ = 5), dimensionless "$N_T$" reaches its minimum value which is kept constant for $Bi_1 > 5$.

Also, dimensionless "$N_T$" presents higher values for the same value of "$Bi_1$" and higher values of "$Bi_2$".

Table 1. Variation ($N_T$ – $Bi_1$), for two given values of $Bi_2$

| $Bi_2$ = 2 | | | | | |
|---|---|---|---|---|---|
| $Bi_1$ | 1 | 3 | 5 | 7 | 9 |
| $N_T$ | 0,13 | 0,12 | 0,11 | 0,11 | 0,11 |
| $Bi_2$ = 5 | | | | | |
| $Bi_1$ | 1 | 3 | 5 | 7 | 9 |
| $N_T$ | 0,32 | 0,30 | 0,29 | 0,29 | 0,29 |

## 4. CONCLUSIONS

Entropy generation is an indicator able to measure the loss of useful work caused by irreversibilities occuring in all real processes, including conduction.

That is why, in order to have an improved heat transfer by conduction, it is needed to approach

conduction from the point of view of entropy generation minimisation.

Two cases specific of the conduction through a wall plane, taken from the entropy generation analysis delivered to Master students in CMU were given.

In the case of uniform thermal conductivity, entropy generation can be removed by introducing an internal heat source.

If the plane wall separates two fluids having different temperatures the expression of dimensionless total entropy generation rate „$N_T$" was found. For a particular case it resulted that dimensionless „$N_T$" is never null. But it is possible to get minimum values for „$N_T$" for high values of „$Bi_1$" and low values of „$Bi_2$".

## 5. REFERENCES

[1] BEJAN, A., *Entropy generation minimization*, CRC Press, Boca Raton, 1995.

[2] EL HAJ ASSAD, M., *Entropy generation analysis in a slab with non-uniform heat generation subjected to convection cooling*, International Journal of Exergy, Vol. 9, No 3, pp.355-369, 2011.

[3] SAHIN, A.Z., *Entropy production minimization in steady state heat conduction*, International Journal of the Physical Sciences, Vol. 6 (12), pp. 2826-2831, 2011.

[4] TORABI, M., AZIZ, A., *Entropy generation in a hollow cylinder with temperature dependent thermal conductivity and internal heat generation with convective-radiative surface cooling*, International Communications in Heat and Mass Transfer 39, pp.1487-1495, 2012.

[5] ZIVIC, M., GALOVIC, A., FEREDELJI, N., *Local entropy generation during steady heat conduction through a plane wall*, Technical Gazette 17 (3), pp, 337-341, 2010.

# AN ENVIRONMENTAL AND THERMODYNAMIC ATTEMPT TO REPLACE R-134 A FROM MARINE REFRIGERATION SYSTEMS

MEMET FEIZA

*Constanta Maritime University, Romania*

**ABSTRACT**

When talking about the need to preserve the environment, the evaluation of a refrigerant is associated also with its Global Warming Impact (GWP), together with its Ozone Depletion Potential (ODP). R-134a is one of the most used refrigerants in marine refrigeration, but this refrigerant, like all others belonging to HFC family, presents a high GWP. International concern over global warming directed researches in marine refrigeration towards finding more environment friendly substitutes of R-134a.

In this respect, the present article deals with the environmental and physical properties comparison and also with a thermodynamic assessment of R-134a and one of its possible substitute - the mixture between propane (R-290) and isobutane (R-600a), in different rates. These refrigerants present a null Ozone Depletion Potential and a neglectible Global Warming Impact, resulting that their mixture is benign for the environment. Also, the thermodynamic analysis will reveal the acceptance of the mixture (R-290 - R-600a) instead of R-134a, since the volumetric cooling capacity and the Coefficient of Performance present close values.

**Keywords:** *refrigeration, global warming, mixture.*

## 1. INTRODUCTION

In the last years, Global Warming Potential (GWP) is considered as important as Ozone Depletion Potential (ODP), when it is about assessing a refrigerant. CFCs have been widely spread as refrigerants, but they became regulated because of their chlorine content (CFCs consumption was banned in 1996).

Thus, the investigation on their substitutes started. HFCs are chlorine free, but they still have a high value for GWP.

This is the reason for growing interest in developing natural refrigerants, in particular Hydrocarbons (HC), for new applications in refrigeration and air-conditioning systems.

Generally speaking, when choosing a refrigerant, it should have required thermo-physical properties, should be compatible with available lubricants and other materials from the refrigerating system, should not require operation at extreme pressures, should be non-toxic, non-flammable, benign to the environment, completely stable inside the system, easy to be produced, handled, detected, recycled or destroyed and cheap.

R-134a (or HFC-134a) belongs to HFC family; this refrigerant is widely used in marine refrigeration, but increasing concern over its GWP and its effect on the environment has led specialists to focus on other options.

These alternatives must act in the refrigerating system similar to R-134a and also the substitution should be economically feasible and profitable from an environmental point of view.

This paper presents a thermodynamic discussion regarding the possibility to replace R-134a with a mixture of two natural refrigerants: propane (R-290) and isobutane (R-600a), both of them belonging to Hydrocarbon family.

This option is based on the fact that Hydrocarbons have good physical and thermodynamic properties, present material compatibility, are low cost, safe in operation and more environmentally safe than R-134a (null ODP – as R-134a, but lower GWP). Some properties of the three refrigerants mentioned up to now are given in Table 1.

Table 1. Thermo-physical properties of R-134a, R-290, R-600a

| Refrigerant | R-134a | R-290 | R-600a |
|---|---|---|---|
| Chemical formula | $CH_2FCF_3$ | $CH_3CH_2CH_3$ | $CH(CH_3)_2CH_3$ |
| Class | HFC | HC | HC |
| Molecular Mass (g/mol) | 102,03 | 44,10 | 58,12 |
| Critical Temperature ($^oC$) | 101,1 | 96,7 | 134,7 |
| Critical Pressure (MPa) | 4,06 | 4,25 | 3,64 |
| Boiling Point ($^oC$) | –26,1 | –42,20 | –11,7 |
| Lower Flammability (% Volume in Air) | Non flammable | 2,10 | 1,70 |
| Autoignition Temperature | 770 | 470 | 460 |

| ($^oC$) | | | |
|---|---|---|---|
| ODP | 0 | 0 | 0 |
| GWP | 1300 | 20 | 20 |
| Atmospheric lifetime (years) | 16 | <1 | <1 |

The mixtures on which we focus are (55% R-290 – 45% R-600a) and (50% R-290 – 50% R-600a).

## 2. ON VAPOR COMPRESSION REFRIGERATION MACHINES

Refrigeration is a process aiming at temperature decrease in a space or its contents under the one of the surroundings. Refrigeration is used in the carriage of some liquefied gases and bulk chemicals, in air conditioning systems, to cool bulk $CO_2$ for fire fighting systems and to preserve perishable foodstuff during their transport on sea.

Refrigeration plants on board the ship may be small domestic refrigeration unit types (for provisions) up to large plants (for reefer vessels).

A simple vapour compression refrigeration system is given in Figure 1. It consists of four main components: compressor, condenser, expansion valve and evaporator.

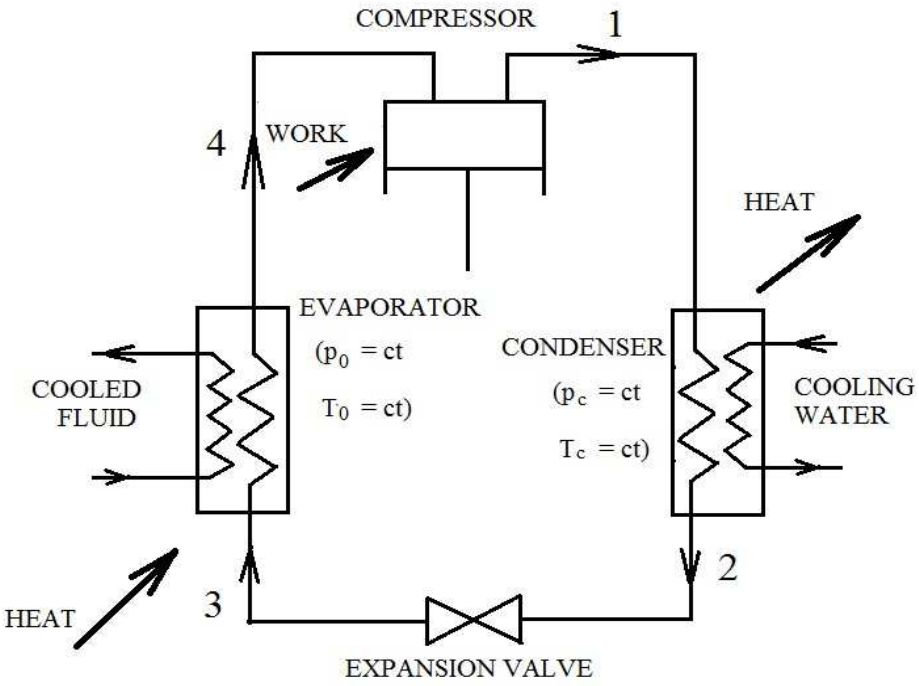



Figure 1 Schematic representation of simple vapor compression refrigeration system

The working principle is described below.

Low pressure and temperature vapor refrigerant (state 4) is compressed by the compressor and reaches high pressure and temperature (state 1).

This vapor is condensed at constant pressure and temperature ($p_c$, $T_c$) in the heat exchanger called condenser, by rejecting heat, resulting refrigerant in liquid state (2).

The decrease of the pressure of the refrigerant (from $p_c$ to $p_0$) is done by the help of the expansion valve. Low pressure liquid refrigerant (at state 3) is led to the evaporator. Here, the refrigerant absorbs heat from the circulating fluid, which is cooled.

The transition from liquid state to vapor state takes place at constant pressure and temperature ($p_0$, $T_0$). Vapors of refrigerant (state 4) result and the cycle is repeated.

Regarding energy, the following are to be stated:

- the compressor requires work; this work is supplied to the refrigeration system from the surroundings;
- changes in state take place in the evaporator and condenser from liquid to gas (the energy required being named *heat of vaporization*) and from gas to liquid (the energy released being named *heat of condensation*);
- in the expansion valve there is no heat exchange since throttling process is isenthalpic (it proceeds without any change in enthalpy).

## 3. THERMODYNAMIC EQUATIONS

- The volumetric cooling capacity (VCC) is a measure of the compressor size for needed operating conditions; it represent the effect of cooling obtained per 1 $m^3$ of refrigerant entering in the compressor (Almeida et al, 2010):

$$VCC = \frac{(h_{00} - h_{i0}) \cdot \eta_{vol,ideal}}{v_{ic}} \quad (1)$$

where:

$h_{i0}$ /$h_{00}$ – specific enthalpies inlet/outlet evaporator, [kJ/kg],

$v_{ic}$ – specific volume at compressor inlet, [$m^3$/kg]

- The pressure ratio (β) is the ratio between the condensation pressure ($p_c$) and the evaporation pressure (β):

$$\beta = \frac{p_c}{p_0} \quad (2)$$

- The Coefficient of Performance (COP) is the rate between the heat extracted at low temperature and the work supplied; COP is essentially a measure of the plants operating efficiency:

$$COP = \frac{Q_0}{P_c} \quad (3)$$

- The cooling capacity, or the refrigerating effect, $Q_0$, and the power needed to drive the compressor ($P_c$) are found as:

$$Q_0 = m_{ref}(h_{00} - h_{i0}) \quad (4)$$

$$P_c = m_{ref}(h_{0c} - h_{ic}) \quad (5)$$

where:

$m_{ref}$ – mass flow of the refrigerant, [kg/h],

$h_{ic}$ / $h_{0c}$ – specific enthalpies inlet/outlet compressor, [kJ/kg]

- The specific enthalpy of superheated vapors at the end of the irreversible isentropic compression is given by:

$$h_{irr\,c} = h_{ic} + \frac{h_{rev\,c} - h_{ic}}{\eta_{iz.c}} \quad (6)$$

where:

$h_{rev\ c}$ – specific enthalpy of superheated vapors at the end of the reversible isentropic compression, [kJ/kg],

$\eta_{iz.c}$ – isentropic efficiency of the compressor

- The refrigerant mass flow is calculated with:

$$m_{ref} = \frac{Q_0}{q_0} \quad (7)$$

where:

$Q_0$ – cooling capacity, [kW],

$q_0$ – specific cooling effect, [kJ/kg]

## 4. CASE STUDY

In the following a comparison of cycles working with R-134a is made and two mixtures between propane and isobutane.

Input data are: condensation temperature $t_c$ = 55°C, evaporation temperature $t_0$ = –20°C, cooling capacity $Q_0$ = 140 W.

In Table 2 results of the comparative analysis are given.

Table 2. Comparison between refrigeration cycles

| Refrigerant | R-134a | R-290/ R-600a (55/45) | R-290/ R-600a (50/50) |
|---|---|---|---|
| Volumetric cooling Capacity VCC (kJ/$m^3$) | 744 | 785,33 | 750,21 |
| Coeficient of Performance COP | 2,05 | 2,10 | 2,13 |
| Temperature at compressor outlet $t_{0c}$ (°C) | 141 | 128,4 | 127,3 |
| Specific volume at compressor inlet $v_{ic}$ ($m^3$/kg) | 0,213 | 0,375 | 0,401 |

One of the considered mixtures might replace R-134a if it presents similar values for VCC and COP, because similar VCC means that it is not needed to modify the compressor size, while at least same COP means that the performance of the refrigeration system will not decrease.

Founded values show that R-290 / R-600a mixture (50/50) presents similar VCC as R-134a and a slightly higher COP.

Also, refrigerant vapors leave the compressor at a lower temperature than R-134a vapors, meaning that a better chemical stability of the refrigerant and of the lubricant oil is assured.

## 5. CONCLUSIONS

Marine refrigeration systems remove heat from spaces, objects or materials on board the ship and move it to another location, maintaining them at the temperature below that of the sourrounding atmosphere. Vapor compression cycles with reciprocating compressors are most often met on board the ship.

Commonly used refrigerants CFCs (Chlorofluoro-carbons) and HCFCs (Hydrochlorofluorocarbons) were replaced because of their chlorine content.

Substitutes of these refrigerants are HFCs (Hydrofluorocarbons), among them the most spread being R-134a (HFC–134a). But R-134a is only non-ozone-depleting. International concern over relatively

high global warming potential of R-134a has directed efforts towards identification of potential substitutes.

This paper presents a comparison between the behaviour in a vapor compression refrigeration system of R-134a and two mixtures resulted from propane (R-290) and isobutane (R-600a), 55 / 45% and 50 / 50%.

The refrigerant given by the propane–isobutane mixture presents null ODP (like R-134a), but much lower GWP.

The mixture (50/50%) presents similar VCC values as R-134a, thus a possible substitution would not need a change in compressor size (VCC related to the mixture: 750,21 kJ/m$^3$; VCC related to R-134a: 744 kJ/m$^3$).

The mixture (50/50%) presents a slightly higher COP value than R-134a, meaning that the performance of the refrigeration system is somewhat improved (COP related to the mixture: 2,13; Cop related to R-134a: 2,05).

The mixture (50/50%) presents a lower value for the compressor's discharge temperature, thus a longer use of the compressor being possible.

## 6. REFERENCES

[1] ALMEIDA, I.M.G., BARBOSA, C.R.F., FONTES, F.A.O., *Thermodynamic and thermophysical assessment of hydrocarbons application in household refrigerator*, Engenharia Termica (Thermal Engineering), Vol.9, No.01 e 02, pp. 19-27, 2010.

[2] BASKARAN, A., KOSHY MATHEWS, P., *A performance comparison of vapor compression refrigeration system using ecofriendly refrigerants of low global warming potential*, Intl. Journal of Scientific Research Publications, Vol.2, Issue 9, 2012.

[3] GHODBANE, M., *An investigation of R-152a and hydrocarbon refrigerants in mobile air conditioning*, Intl. Congress and Exposition, Detroit, Michigan, 1999.

[4] KHMEL'NJUK, M., VOZNY, V., MAZUR, V., *Experimental characterization of small reciprocated compressor working with azeotropic blends of alternative and natural refrigerants*, Intl. Refrigeration and Air Conditioning Conference, Purdue, 2004.

[5] MOHANRAJ, M., JAYARAJ, S., MURALEEDHARAN, C., *Comparative assessment of environment–friendly alternatives to R-134a in domestic refrigeration*, Energy Efficiency, No.1 pp. 189-198, 2008.

# KALININGRAD STATE SEA FISHING PORT: CURRENT PROBLEMS AND ENHANCING ITS EFFECTIVENESS BY ACTIVITY DIVERSIFICATION

[1]MEYLER LEONID, [2]MOISEENKO SERGEY

[1,2]*Baltic Fishing Fleet State Academy, Kaliningrad, Russian Federation*

**ABSTRACT**

An analysis of the Kaliningrad State Sea Fishing Port (KSSFP) activity makes it possible to define the actual problem: the choice of a rational strategy for the development of productive economic activity of the port and improving economic efficiency in conditions of a limited capacity to increase the volume of cargo flows and uncertainty of demand for port services. Currently, the transit potential of the port is not used efficiently. The analysis of trends in domestic and transit cargo flows does not give a base to expect a significant increase in transshipment port complex in the near future. However, it is possible to reveal potential opportunities to improve the efficiency of port operations at existing volumes and to attract cargo flows. To solve the problem two basic strategies for development and improving the port activity were identified: strategy of the port diversification and strategy of integrations and renewal. The paper suggests a way to increase effectiveness of the port operation by means of the local Transport-Production Logistical Centre (TPLC) development. The important object of TLPC could be specialized floating fish processing factory.

**Keywords:** *Sea fishing port, Strategy of development, Diversification of activity, Logistics, Effectiveness.*

## 1. INTRODUCTION

Development of transport-logistic complexes and their integration in intercontinental transport systems is considered as the priority field of the Russian economy and, in particular, for the Kaliningrad region [1]. Taking into account its unique geopolitical features, transport complex is an important part of the industrial infrastructure and service trade of the region. After the Soviet Union disintegration, the Kaliningrad region of Russian Federation has become a half-exclave region separated from the main territory of the country and surrounded by Poland on the South and Lithuania on the East and the North and having an outlet to the Baltic Sea. Branches of two Trans-European transport corridors: №1A (Riga-Kaliningrad-Gdansk) of the route № 1 "Via-Baltica" (Helsinki – Tallinn – Riga – Kaunas – Warsaw) and № 9D (Kaunas-Kaliningrad) of the route №9 (Kiev – Minsk – Vilnius – Kaunas – Klaipeda) cross the Kaliningrad region [5]. It gives an opportunity to attract freights between Europe and Russia and also on the Trans-Siberian Railway from countries of Asia to Europe. It is possible to say that the Kaliningrad region is integrated in a European transport system taking into consideration some transport-technological aspects. As it is shown in Figure 1, specific features of the economic-geographical situation of the Kaliningrad region are: geographic isolation from the mainland of Russia; neighbourhood with European countries-members of EU and the 'Schengen Agreement'; special economic zone (SEZ) regime. The regional transport strategy covers construction of a new deep-water port, modernization of existing ports and terminals, setting-up of information-logistic centres and infrastructure objects because of innovative technologies application [7], [8].

The "Transport Strategy of Russia for the period up to 2030" [13], the conceptual document defining the main directions of the state transport policy, has identified several categories of ports with the possibility of improving their competitiveness, specialization and the prospects for further development. The first category includes the ports that provide the main volumes of foreign trade and transit goods reshipment competitive with the ports of bordering countries.

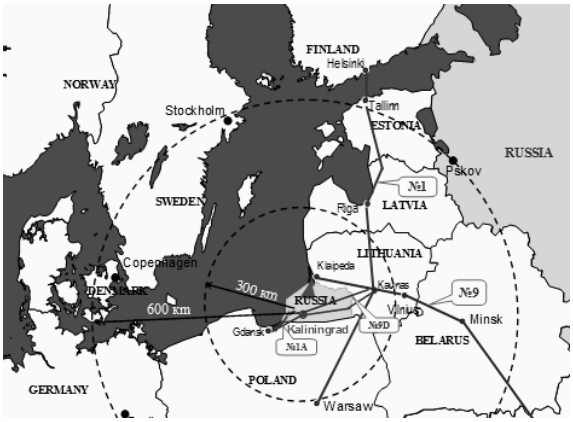



Figure 1 Geographical location of the Kaliningrad region and branches of international transport corridors

The port of Kaliningrad is among the ports of this category. The whole range of existing and prospective regional ports and terminals is implied by that name.

## 2. THE PORT OF KALININGRAD

The port is connected with the sea by the Kaliningrad's canal, having a length of 43.0 km. The canal depth is 10.5 m, the width is 80 – 180 m on the halfway from the entrance in Baltiysk; the rest part of the canal has the depth of 9.0 m, the width of 50 m. Vessels with the length up to 170.0 m and the draft up to 8.0 m., tonnage up to 20.0 thousand tons can pass along the canal. The port of Kaliningrad provides services on accumulation and storage of different types of cargo, including storage capacities for oil, oil-products and liquid fertilizers. Construction of the cargo passenger

automobile-railway ferry complex is completed in the out-port Baltiysk; construction of the new transfer terminals in the Kaliningrad sea canal water area is on-going. There are ferry connections between Baltiysk and St-Petersburg, ports of Germany, Sweden and Lithuania. The port Kaliningrad is connected by container lines with ports of Germany, Netherlands, Denmark, Belgium and Baltic states.

There are several main stevedoring companies at the port of Kaliningrad, such as: the Joint-Stock Company "Sea Commercial Port of Kaliningrad" which provides overloading and storage of general, dry bulk, liquid bulk cargoes and containers; the State Enterprise "The Kaliningrad State Sea Fishing Port" which has specialization: overloading and storage of perishable cargoes, liquid and bulk fertilizers; the Joint-Stock Company "Lukoil-Kaliningradmorneft" - is specialized in overloading of oil and petroleum; the Joint-Stock Company "Sodruzhestvo-Soya" handles grain, soya beans and food oil, etc. The scheme of the port of Kaliningrad cargo terminals is shown in Figure 2.

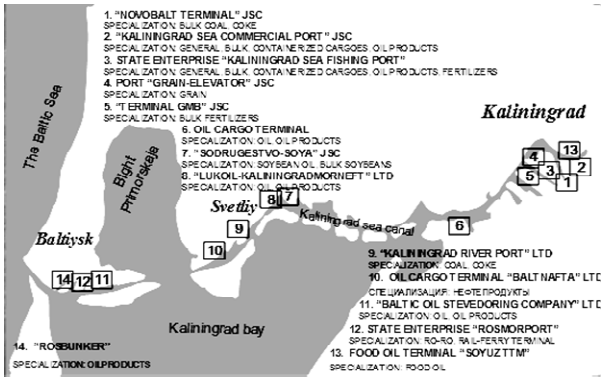



Figure 2 Map of the port of Kaliningrad cargo terminals

The main cargo nomenclature handled in the port complex of the region includes: oil and oil-products, coal, coke, timber cargos and timber processing cargos, ferrous materials, ferroalloys, mineral fertilizers, reefer cargos, grain, cargos in containers and wheeled technics. Since 2000 volumes of cargoes handled in the regional port complex had been steadily growing, while its transit potential considerably exceeds the real demand for cargo transhipment. But, at the end of 2008 the global financial and economic crisis negatively influenced the activity data of ports and terminals. The real annual throughput of all cargo terminals is up to 33 mln tons. The dynamics of the annual cargo turnovers of the Kaliningrad port in total and the Kaliningrad State Sea Fishing Port (KSSFP) since 2007 are shown in Figure 3. It is possible to see that both the total turnover of the port and KSSFP turnover have been decreasing since 2010 [7].

The analysis of the processes of functioning and development of Kaliningrad ports shows that essential factors determining low level of the use of transit potential of the region are: geopolitical factors, economic factors and, as a consequence, low growth dynamics of cargo flows volumes. Problems of efficiency and development of the region maritime transport complex mostly depend on its isolation from the mainland of Russia. High discriminating tariffs for cargo transportation by rail from Russia and transit countries are making the port complex of the Kaliningrad region uncompetitive with respect to other Baltic ports like ports of Klaipeda, Gdansk and Gdynia.

In this regard actual problems of the regional maritime transport complex are its activity diversification, development of competitive directions and provision of services sector oriented on attraction of transit cargo flows, development of the inner and external logistics.

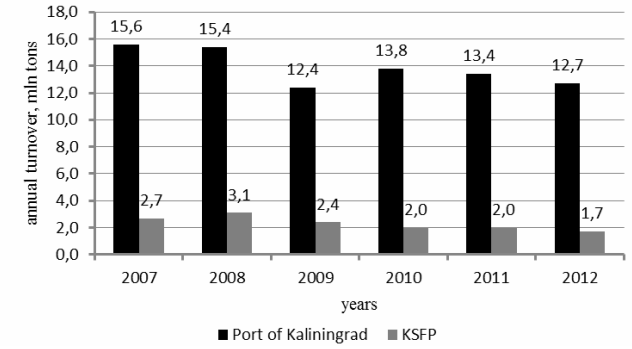



Figure 3 Kaliningrad port in total and KSSFP cargo turnovers

## 3. ENHANCING EFFECTIVENESS OF KSSFP ACTIVITY

Therefore, at present it is necessary to pay more attention to activity of KSSFP which is one of the important objects of the regional port facilities. KSSFP specialization is transshipment and storage of the frozen imported fish, meet and other reefer cargos, as well as export of the mineral bulk and liquid fertilizers. It should be noted that KSSFP activity effectiveness was on the low level even in the pre-crisis period. Hereby some of the reasons for it are presented:

– a dramatic drop (in comparison with the «Soviet» period) of fish products cargo flows;
– relatively high tariffs for a ton of cargo processing in comparison with the ports of neighboring countries;
– a dramatic drop of demand for the related service concerned with vessels preparation for the voyages;
– instability of general and bulk cargo flows due to «discriminatory» tariffs for the transit through Lithuanian territory;
– moral and physical obsolescence of fixed capital assets (port berths and port facilities stand idle; part of the equipment is technically out of date and requires modernization);
– low-level management.

Nowadays KSSFP uses only half of its capacities. However, KSSFP is a powerful transport hub, where necessary infrastructure exists already. The analysis of the KSSFP possibilities gives prospects of this enterprise to be modified into the multifunctional logistics complex of the regional level [10]. It allows increasing transit cargo flows and quality of the cargo service.

Generally, regional logistic centers represent large infrastructure complex objects, within the framework of which complete logistic support of the transport process

is realized, including the choice of transport-customs procedure with the formation of logistic parameters, choice of the assurance company, shipment of the forwarding, providing of the reshipment at the border, etc. Considering such a KSSFP object it is possible to draw conclusion about its correspondence to such logistic center in many positions.

The analysis of the key factors of KSSFP activity and reasons preventing the growth of demand for services on the cargo flows handling allows determining the following contradiction. On the one hand, the port has rather high transit potential and technological possibilities for services sector development which could find the demand on the regional market as well as on the export market. But, on the other hand the port's strategic interests remain within the framework of traditional activities development: handling «traditional» cargoes.

The mentioned contradiction allows to state the problem: the choice of the rational strategy of the port's production and commercial activities development, economic effectiveness enhancing under conditions of limited capacities on the traditional cargo flows' volumes increase and ambiguity of the demand for the services [11].

### *3.1 Aims and main directions of KSSFP activity diversification*

It is necessary to define the general aim and development strategy of the port, based on the situation analysis in the past and in the present, taking into account predicted future conditions for solving the problem of KSSFP activity effectiveness enhancing. Decomposition of the general goal usually allows to determine the main objects-demands and directions of the activities [3]. The main goal of KSSFP is to provide effective activity of the port and proportional development of its infrastructure as the industrial-economic and transport-logistic system.

The main goals-demands are:

- to improve effectiveness of transport and production potential usage;
- to improve effective use of fixed capital assets or to renew them (berths, refrigerators, warehouses, handling equipment etc.);
- to improve effectiveness of labour and financial resources usage;
- to expand a range of services in the sphere of transport management, additional cargo handling (additional cost creating), production and information activity;
- to develop partnership with foreign companies and potential investors, within the framework of private-public partnership;
- «to incubate» innovative ideas;
- to increase the port staff professionalism level.

Main directions of the port activity should be oriented on the aims-demands realization. In particular, it is necessary to attract cargo flows for improvement of the port's transport and production potential usage effectiveness [6]. It is a complex problem in the present situation. But, if to expand the range of services on creation of the additional cost, this goal of cargo attraction will be partly achieved. In a case of production creation (for example, fish processing), it will be necessary to have enough raw material. This means additional cargo flows (the raw material import and the end products export). Therefore, two basic strategies of KSSFP activity effectiveness enhancing and development may be considered, namely:

- a strategy of the diversification of the port activity;
- a strategy of integration.

The second strategy means interaction with foreign partners on the first stage and renewals (technologies renewal, capital funds, innovative technologies and information technologies implementation).

First of all, it is necessary to develop handling refrigerated containers that will require construction a new terminal. Proposed modernization will not change the initial function of the port and will keep it as an important object of such a city-forming branch as fisheries industry. Capacity building on the handling of containers corresponds to the Concept for Fisheries Industry Development of the Russian Federation for the period until 2020, according to which the infrastructure development of marine terminals is planned to be oriented on complex services for fishing fleet vessels, as well as creation of state fisheries corporations on its basis.

Secondly, KSSFP has a sufficiently large refrigerating warehouse for storage of frozen fish and meat. It is possible to create a modern refrigeration complex on a basis of this equipment. There are such important infrastructure objects as railroad and automobile driveways, open cargo areas, warehouses for different cargo storage which can be used for KSSFP perspective development. Furthermore there are some free areas for construction of industrial and infrastructure facilities in the port and on the adjacent territories. These offers show opportunities for the port's activity diversification, i.e. other types of activity development which will not contradict to the port's core operations: handling of vessels and cargo transhipment. The demand and supply analysis on the food market in Russia and Belarus [1] shows the stable demand in fish products. According to this analysis the following conclusion can be made:

- one of the port activity diversification trends may be more thorough processing of frozen fish products with the purpose of additional cost creation and therefore getting additional income;
- the second trend is connected with the organization of own fish production which considers construction or obtaining of own fish factory;
- the third trend is connected with reefer containers handling and its multimodal transport to places of destination;
- the forth trend is connected with freight-forwarding activity, in particular with raw material (frozen fish and meat) delivery to the fish and meat factories of the region and delivery of the fish production from the factories for the reefer containers forming with following shipment to the buyer;

– the fifth trend is connected with cargo attraction for further shipment by linear ships and cargoes transit organization;
– the sixth trend is creation of an information-analytical centre providing full range of services (from submission of the information on various activities trends and designing of the transport-logistic systems of cargo delivery to organization of researches in marketing, logistics and strategy planning).

Having defined the KSSFP essential trends and activity diversification types it has become possible to determine the real possibilities for their realization.

*3.2 Perspective structure of the KSSFP transport-production logistics complex*

Thus, an analysis of KSSFP possibilities shows perspectives of this enterprise to be transformed into a multifunctional transport-production logistics complex (TPLC) at the regional level. TPLC of KSSFP may be presented as a complex of logistic objects:
– specialized berths;
– a fish processing factory;
– technological lines on the bulk cargoes packing (for example, fertilizers);
– a container terminal;
– a refrigerating warehouse for cargo distribution and refrigerating warehouse for long-term cargo storage;
– warehouses and open areas for cargo storage/accumulation;
– technical, technological and other infrastructure services/objects;
– information - analytical centre which includes a multifunctional freight forwarding company;

*3.2.1 Fish processing factory features*

This paper pays main attention to the fish processing factory because of the basic KSSFP specialization. Having the purpose to enhance the port effectiveness in the post-crisis period (maybe as a temporary variant) it is suggested to organize the factory on the basis of a reefer type fish super-trawler made fast to the berth. Such a floating fish processing factory has to be equipped with:
– canned fish food line having a productivity rate of 100,000 cans per day;
– fish-dressing line (28 tons of fillet per day);
– fish-dressing line (headless fish - 50 tons per day);
– preserves line (12000 cans each 1.3 kg per day);
– retail package line (16 tons per day);
– fish meal plant (150 tons per day – according to the raw material).

The canned fish food line is intended for canned fish production of a rather wide assortment out of various fish species which affords an opportunity of choice of the market oriented on the most rational assortment range. There are two holds for frozen fish production storage: a hold for the preserves and a hold for the fish meal on the vessel. The vessel is equipped with the cargo handling gears for the load handling execution, as well as internal transport arrangements system (conveyors, lifts) for the finished product delivery directly from the technological lines to the holds. The fish processing factory may operate on a three labour shift basis. The raw material for processing is delivered both from the port refrigerating warehouses and fishing or transport vessels calling the port for unloading. Raw material stocks are stored in the holds.

*3.2.2 Fish processing factory optimization*

Let consider the problem of optimization of this fish processing factory. It is suggested that the factory can produce different range of products from various kinds of the raw material (fish). There are also main technical and economic characteristics of the production technological lines and the wholesale price for a unit of a commercial output, as well as resource constraints. Then the optimal working scheme for fish products can be developed using methods of linear programming with an objective function for a maximum of commercial output in value terms [3], [4]. In general, the mathematical model of optimal planning for fish products is as follows:

the objective function:

$$\sum_i \sum_j C_{ij} X_{ij} = \max \quad (1)$$

with limitations:

$$\sum_i \sum_j K_{ij} X_{ijk} \le \sum_i \sum_j Q_{ij} \quad (2)$$

$$\sum_i \sum_j X_{ij} \le \sum_i \sum_j \Pi_{ij} \quad (3)$$

$$\sum_i \sum_j N_{ij} X_{ij} \le T_p \quad (4)$$

$$X_{ij} \ge 0; i = 1,2,...I; j = 1,2,...J \quad (5)$$

where $X_{ij}$ - value of fish products of $i$ assortment made from $j$ kind of fish; $K_{ij}$ – coefficient of $j$ kind of raw materials consumption for fish products of $i$ assortment; $\Pi_{ij}$ - capacity of a technological processing line for fish products of $i$ assortment made from $j$ kind of fish; $N_{ij}$ - time rate for fish products of $i$ assortment made from $j$ kind of fish; $C_{ij}$ - wholesale price of a ton of commercial fish products of $i$ assortment made from $j$ kind of fish; $T_p$ – labor resources of the factory, man-hour.

An important task of manufacturing is maintaining a reasonable stock of production resources or component parts to ensure continuity of the productive process. Traditionally, the stock is regarded as inevitable costs [9]. It leads to costly shutdowns of production when the stock level is too low and to "necrosis" of capital when it is too high. The problem of stocks management is to determine the level that balances the two mentioned extreme cases. An important factor [12] in determining the formulation and solution of the stocks management problem is that the demand for stored reserves (per unit time) can be either deterministic (fairly well-known), or the probabilistic one (described by a probability distribution). In case of fish products the demand and constant supplies of raw materials consumed uniformly, because production capacity is constant. Thus, the

deterministic static model of stocks management will be used, that is each next order is made at regular intervals time. Also it is important for interaction with the fleet in the fishery, because it is necessary to synchronize the supply of goods to the coastal fishing complex with an optimal plan of storage and release of fish products. Since the fish products manufactured by KSSFP fish-processing factory (the vessel) in large volume will be realized onto the domestic market of the region, the storage (holds) of the vessel can be considered as a distribution warehouse. To best meet the consumer demand there is need for some stocks of fish products that provides the satisfaction of the demand at any time, even under the conditions of "failures" of production and "bursts" of the demand.

The simplest model of optimization [2] of the current stock of raw materials is considered here. It allows to improve the efficiency of the fish processing complex and commercial enterprises selling fish products. The model is designed in the following situation: fish processing complex has a plan to realize a certain product assortment range in a fixed period of time that will require a certain kind of raw materials in certain values. It is necessary to simulate the complex production activity in order to obtain the minimal total costs of the raw material storage. This model uses the following initial conditions:

- one product or one product group stocks are planned only;
- stocks level is reduced uniformly according to the manufacturing of products in accordance with the plan;
- the demand in the planning period is fully defined in advance;
- costs of stocks management consist of the costs of delivery and storage only.

Total costs will be assumed to depend on the size of a delivery $q$. Thus, the optimal stocks management reduces to finding the optimum size of one delivery $q_0$. Then other parameters of the model, namely: the number of deliveries $n_0$, the optimal time interval $t_{so}$ between two consecutive deliveries, minimal (theoretical) total cost $Q_0$ can be calculated. The following designations for the predetermined model parameters are introduced: $T$ - full time period for which the model is designed; $R$ - the whole volume (the total demand) of raw materials for time $T$; $C_1$ - storage cost of one unit of raw materials per unit of time; $C_s$ - costs of a raw materials lot delivery. The total cost of stocks is denoted as $Q$ that is the objective function. The task of modeling consists in plotting the objective function $Q = Q(q)$. The total cost will consist of the costs of delivery and storage of goods. Total costs of the storage of the current stock will be equal to $C_1 T q/2$ - cost for storage per goods unit - the "average" current stock product. As stated above, the stock level is reduced uniformly by uniformly produced sales, i.e. if at the initial moment of the stock it is equal to $q$, then at the end of the period of time $t_s$, it was equal to 0. Total costs for the delivery of the goods will be equal to: $C_s R/q$, that is a product cost of one lot of goods delivery to the number of deliveries $n = R/q$.

Then the total cost of current stocks management will be:

$$Q = Q_1 + Q_s = \frac{C_1 T q}{2} + \frac{C_s R}{q} \to min \tag{6}$$

i.e. the objective function $Q$ is a nonlinear function of $q$, changing in the range from 0 to $R$ and trends to minimize. The solution of the task proceeds by well-known scheme. It is calculated the derivative $Q'(q)$ and equate it to zero:

$$Q'(q) = 0;\ q_0 = \sqrt{\frac{2C_s R}{TC_1}} \tag{7}$$

$$Q''(q) = \frac{2C_s R}{q^3};\ Q''(q_0) > 0 \tag{8}$$

Thus, the optimal size of one delivery:

$$q_0 = \sqrt{\frac{2C_s R}{C_1 T}} \tag{9}$$

The optimal average current stock:

$$\frac{q_0}{2} = \sqrt{\frac{C_s R}{2C_1 T}} \tag{10}$$

The optimal number of deliveries:

$$n_0 = \frac{R}{q_0} = \sqrt{\frac{C_1 RT}{2C_s}} \tag{11}$$

The optimal interval between two deliveries:

$$t_{s0} = \frac{T}{n_0} = \sqrt{\frac{2C_s T}{C_1 R}} \tag{12}$$

Optimal (theoretical) costs are:

$$\mathrm{Q}_0 = \frac{C_1 T q}{2} + \frac{C_s R}{q} = \sqrt{2C_1 C_s RT} \tag{13}$$

Let it be assumed that the fish processing factory plans to deliver and to process fish with the total value $R$ = 50,000 tons per a year ($T$ = 12 months). The cost of one raw materials lot delivery $C_s$ = 650,000 USD, and the storage of one ton of fish costs $C_1$ = 320 USD per a year. The value of $Q$ can be calculated according to the above formulae. Thus, the optimal size of a delivery $q \approx$ 4500 t; the optimal number of deliveries $n_0 \approx 11$; the optimal interval between two deliveries $t_{s0} \approx 33$ days; minimal total costs $Q_0 \approx 4560700$ USD.

It should be noted that the conditions of this problem are mainly the idealized ones. In practice it is not always possible to adhere to the theoretical parameters of the stocks management model. For example, in the considered problem, it is found that the optimal size of delivery is about 4,500 tons. But it may be that the total required amount of raw material is not

satisfied in the case of a failed fish catching. It means that the optimal size of delivery has to be changed. Therefore it is important to define such limits of a change that does not lead to a significant increase in total costs.

Taking into account that the estimated cost of the floating fish processing factory with additional equipment can be about USD 12 mln and using the "pessimistic" values of the main indicators of the annual work plan, it can be concluded that the cost of such project will be repaid over a maximum of 3-4 years. Meanwhile, the variant to build the factory at the port area can be considered. Such a variant would probably be more productive, but its implementation involves organizational, technical and environmental problems.

Also a refrigerating complex for 20,000 tons of simultaneous storage of cargo turnover at 150-200 thousand tons per year and a new container terminal with the estimated capacity of 75,000 TEUs per year are designed for KSSFP.

## 4. CONCLUSIONS

The federal government of Russia and local authorities pay great attention to the Kaliningrad region economic growth, considering it as the Russian fore post in Europe. Such position applies fully to the transport, and in particular, to the maritime complex of the region. Transit opportunities in the region and ports are the basis for the effective operation of international transport corridors passing through the territory of the Kaliningrad region. With creation of a logistics center in the Kaliningrad region, the Russian part of the transport corridor East - West will be closed. It has a great importance for the transportation of goods from countries in South-East Asia.

The problem of the Kaliningrad State Sea Fishing Port arising due to global economic crisis and the geo-political situation of the region is closely connected to mentioned transborder transport links. The paper suggests a way to increase effectiveness of the port operation by means of the local Transport-Production Logistical Centre (TPLC) development. The important object of TLPC could be specialized floating fish processing factory.

As it was preliminary calculated, the estimated total capital investment for the proposed TPLC project need around USD 120 mln, and the payback period is three years for fish processing factory and container terminals, and five years for refrigerating complex. Such conditions should be admitted as effective project for investments.

Creating TPLC will allow to solve the following problems for KSSFP:

- to attract the additional volume of cargo flows and lowering its cost;
- to optimize interaction processes of transport modes;
- to increase production and logistic services volume which will allow to create additional working places and more effectively solve social problems.

## 5. REFERENCES

[1] BARASHKOV, V., VALISHIN, A., KALASHNIK, O., KRASNIANSKIY, Y., MEYLER, L.,YAFASOV, A., *World economics and the transport complex of Russia: perspectives of Kaliningrad region transport logistics development*, Innovative ways of Kaliningrad region economics development, Collected paper, St.-Petersburg, pp. 84-138, (in Russian), 2008.

[2] BELLMAN, R., KALABA, R., *Dynamic programming and modern control theory*, Moscow: Nauka, 435 p., (in Russian), 1969.

[3] BOWERSOX, D., CLOSS, D., *Logistics: Integrated supply chain*, Moscow, Olimp-Biznes, 640 p., (in Russian), 2006.

[4] GROMOVOY E., *Mathematical methods and models in the planning and management on sea transport*, Moscow, Transport, 359 p., (in Russian), 1979.

[5] KALASHNIK, O., *Kaliningrad Region Transit Potential and its Place in the Transport System of Europe: Advantages and Challenges*, Proceedings of the Hamburg International Conference on Logistics (HICL 2011): Maritime logistics in the global economy. Current trend and approaches, Hamburg, Germany, pp. 313 – 326, 2011.

[6] LEVIKOV, G., *Management of transport and logistic business*, Moscow, RosKonsult, 128 p., (in Russian), 2004.

[7] MAMENKO, N., *The Kaliningrad port development: new challenges and responses*, Proceedings of the VIII International Conference Maritime Industry, Transport and Logistics in the Baltic Sea region states: new challenges and responses, Kaliningrad, 2010 (in Russian).

[8] MEYLER, L., KLIUNEEV, A., *The Kaliningrad region's transport complex and its integration in the transport system of the Baltic Sea Region*, Materials of the TransBaltic Project Final Conference, Pafos, Cyprus, 2012.

[9] MIROTIN L., *Logistics: management of cargo transport - logistical systems*, Moscow, Jurist, 416 p. (in Russian), 2002.

[10] MOISEENKO S., MEYLER, L., *Ways to improve the efficiency of the fishing port*, Proceedings of the VIII International Conference Maritime Industry, Transport and Logistics in the Baltic Sea region states: new challenges and responses, Kaliningrad, pp. 354 – 363, (in Russian), 2010.

[11] MOISEENKO S., MEYLER, L., *Development Prospects for the Maritime Transport Complex of the Kaliningrad Region and Professional Training*, Proceedings of IAMU AGA11 – Technical Cooperation in Maritime Education and Training, Busan, Korea, C.207-216, 2010.

[12] SULITSKIY V., *Methods of statistical analysis in the management*, Moscow, Delo, 520 p. (in Russian), 2004.

[13]http://www.mintrans.ru/documents/detail.php?ELEMENT_ID=13008.

# THE CONSTRUCTION OF LOGISTICS INDUSTRIAL PARKS IN SEAPORTS IN PROSPECT

[1]MOROZOVA IRINA, [2]ONYSHCHENKO SVETLANA

*[1,2]Odessa National Maritime University, Ukraine*

**ABSTRACT**

The Article highlights the issues on creation of logistic industrial parks in seaports. System description of industrial park is drafted. The term "logistic industrial park" is defined and effect of the industrial parks creation in sea ports is determined: for the Lead Company, partner (participating) companies, port and region. Prerequisites' identification has been analytically determined to outline economic benefits of manufacturers' participation in the parks, also the possibility to follow the principle "right on time" for the account of better coordination and decrease in time loss has been verified.

**Keywords:** *logistic industrial park, seaport, economic benefits.*

## 1. INTRODUCTION

Tendency of last decades is a transformation of sea trade ports into centres with variety of services which exceed understanding of traditional services provided to vessels and cargoes. Therefore, major ports attract manufacturing oriented to import raw materials and export of goods, they concentrate enterprises of manufacturing industry and this is a specific feature of so called ports of fourth generation.

Regardless of the port evolution, a new form of business organization known as "industrial park" speeds up its development on the territories that have nothing to do with sea.

## 2. INDUSTRIAL PARK

Let's outline that "industrial park" is a kind of "park" which has been organized quite frequently within the last decades. We can identify the following parks as industrial ones: techno-park, industrial park, innovative centre (park), business incubator, university research centre, scientific centre, etc. (see Figure 1).

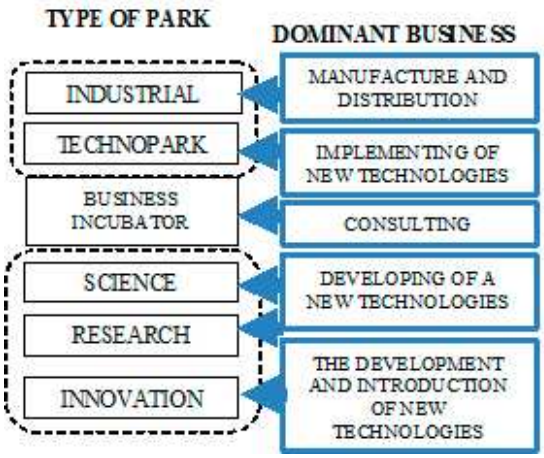



Figure 1 Park scheme depending on its major activity

Specifics of each park are defined by prevailing of one of the components in its functional distribution – whether it is science, manufacturing, commerce or education.

Verkhovna Rada has adopted a law "On Industrial Parks" in March 22, 2012, and consequently made the term valid on the territory of Ukraine. This legal instrument has identified the basic principles, procedures and terms for creation and functioning of industrial parks to secure economic development and improvement of territories' competitiveness, activate investment and innovative projects, create new opportunities for employment and develop modern manufacturing or market infrastructure. As identified, industrial park - is a certain territory within the boundaries of which participants of industrial park can perform economic activity in sphere of industrial manufacturing, science and research, communication and information technologies. The right to create industrial parks on the private territories is entrusted to economic unions, sole proprietors that possess the territory and, according to the given instrument, meet the requirements in relation to their use in frames of industrial park. Minimum size of industrial park in stipulated within 7 ha. The Lead Company developed by the initiative party obtains the land for 30 years for a rent.

From the Owner's point of view, Industrial Park is a specialized object of profitable real property and its activity is arranged by the leading company. Today there are two basic ways to create Industrial Parks in Ukraine: manufacturing and administrative buildings are reconstructed and territory is cleared out for new users; new premises for offices and stores are built by the landowner under the warranty of long-term rent by the leaseholder.

Industrial parks may also appear on the initiative of the local administration, which takes over the design and equipping of pre-engineering infrastructure of industrial zones on municipal land, while attracting tenants or buyers for designated sites.

Figure 2 shows systematic understanding of industrial park.

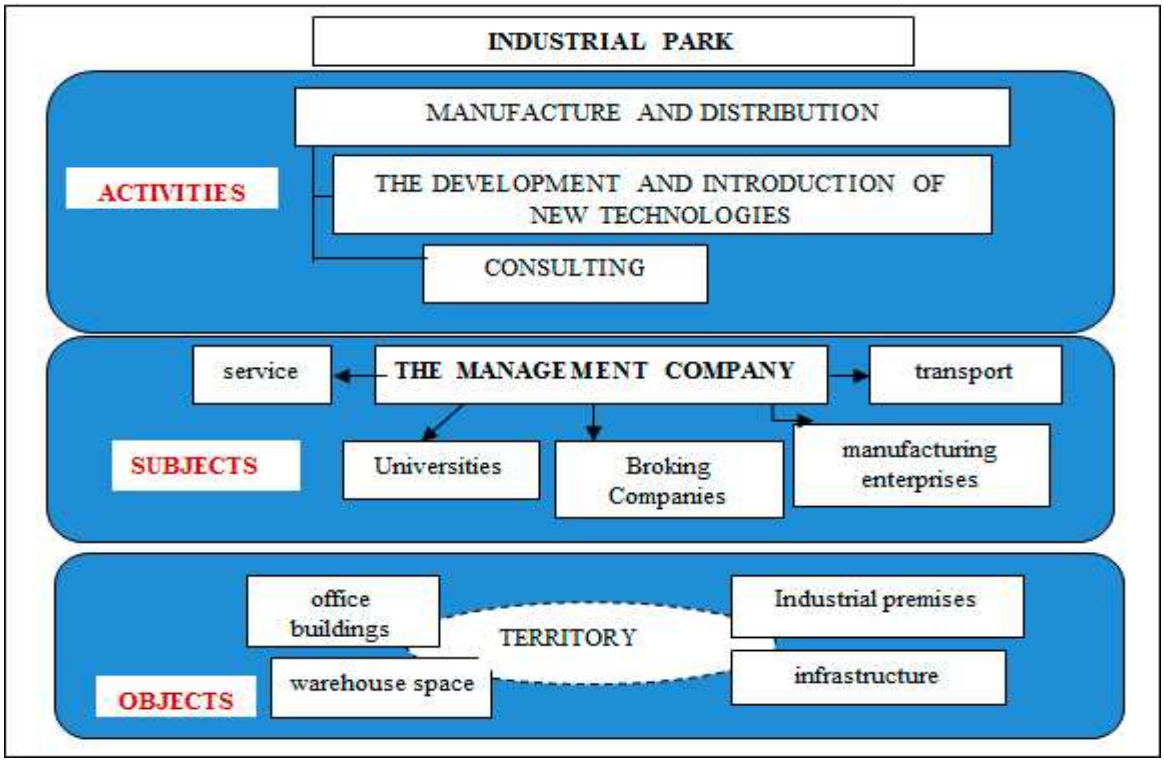



Figure 2 Systematic image of industrial park

Decomposition is performed in three dimensions, each of them deals with identified aspect of industrial park - material objects, subjects and activities. The whole idea of industrial parks is very promising and cost-effective for both the companies and the state. However, it should be outlined that the experience of creating separate industrial parks in Ukraine cannot be considered a success. It might have resulted from wrong choice of location, the lack of design prerequisites and poor management level.

## 3. LOGISTIC INDUSTRIAL PARK IN THE SEAPORT

Services provided by industrial parks may include a complex of logistic services and in case the latter is the dominant over the rest of the activities or it is equal with the manufacturing, another separate type can be identified – Logistic Industrial Park.

Therefore, Logistical Industrial Park can be identified as a territory with a complex of objects for manufacturing purposes, united by a single infrastructure system, with a certain objective to lead economic activity in sphere of industry and logistics.

Taking into account that a modern port is an assembly of the whole logistic services variety, one of the variants to create logistic industrial parks is the employment of the territory and infrastructure of sea trade ports or territories adjacent to them. As it is known, ports provide services for storage, stowage, warehousing, packing, etc., of the goods that, broadly speaking, are not necessarily for external trade. Thus, use of ports' property and logistic service to create logistic industrial parks is a perfect opportunity to develop national industrial parks.

On the other hand, creation of logistic industrial parks may serve as a basis for the ports' development as well, especially if to speak about circumstances in the country when new by-law on the Ukrainian ports has already entered into force and has altered the port operation system completely.

The expected outcome of the new legislative provision is the involvement of private funds in the form of concession, it may provide financial basis for the creation of logistic industrial parks in ports. Here it is necessary to outline that ports' existing economic and technical basis complies with the majority of requirements for industrial parks, and this fact specifies minor financial inflows comparatively with situations when industrial parks are built on territories not occupied before.

Considering the accent in logistic industrial parks located on the ports territories the very logistic service and park structure has to include the following elements: expediting companies (or their branches), customs brokers, warehouse's representatives and offices of shipping companies. Such structure shall provide essential logistic service for enterprises.

## 4. EFFECT OF PARTICIPATION IN LOGISTIC INDUSTRIAL PARKS AT SEAPORTS

It is obvious that the primary motive for the enterprises to join industrial park is the economic benefits. The effect obtained from creation of logistic industrial parks can be seen in various levels:

- the stakeholders get reduction of cost for manufactured goods due to effective logistics, minimization of transport operations and optimization of customs procedures;

- the port can use the territories and infrastructure in a more effective way and broadens its activities due to services provision to the cargoes which technically do not belong to external economic activity;
- the region on the whole shall get considerable improvement of economic situation on the account of the creation of new jobs, investments and increase in manufacturing ratings.

Let's analyse more precisely the economic effect for enterprises. The main criterion to identify effective logistics is minimization of logistic operations and at the same time compliance with the main logistic rules. Principal logistic criteria are money and time and in compliance with the given approach let's provide further analysis. We shall compare expenditures on logistic operations for an enterprise in situation when it is a participant (member) of logistic industrial park and its manufacturing premises are located in another place.

In practice, the following three situations might be possible:

1) The enterprise works with import raw materials, its finished commodity is disseminated on the territory of Ukraine (terms of goods delivery EXW);
2) The enterprise works with national (domestic) raw materials, its finished commodity basically is disseminated for the export (terms of goods delivery FOB);
3) The enterprise works with national (domestic) raw materials, its finished commodity is disseminated on the territory of Ukraine (terms of goods delivery EXW).

Situation when enterprise works with import raw materials but export its products is not common in Ukraine. We shall provide analysis for the first situation (Figure 3) and in other cases the methodology is identical. Formation of logistic expenditures due to basic variant:

$$R = \sum_{i=1}^{8} R_i \ , \qquad (1)$$

Where $R_1$ - expenditures for the raw materials delivery (shipping and discharging); $R_2$ - expenditures for customs procedures; $R_3$ - expenditures for other formalities in the port; $R_4$ - expenditures for raw materials storage in the port; $R_5$ - expenditures for vehicle/railway transportation of raw materials to the warehouses of the enterprise; $R_6$ - expenditures for raw materials storage on the premises of the enterprise; $R_7$ - manufacturing expenditures; $R_8$ - expenditures for finished commodity storage.

The main parameters that have impact on the level of expenditures (1) are the annual volumes of raw materials delivery $Q_r$ and finished commodity $Q_g$, distance between port and manufacturing premises (warehouses) of the enterprise $L$, average time for raw materials storage in the port $T_r$, in the warehouse $T_w$ and average time for finished commodity storage in the warehouses of the manufacturer $T_g$.

Let's analyse in details the expenditure articles which depend on the manufacturer's location.

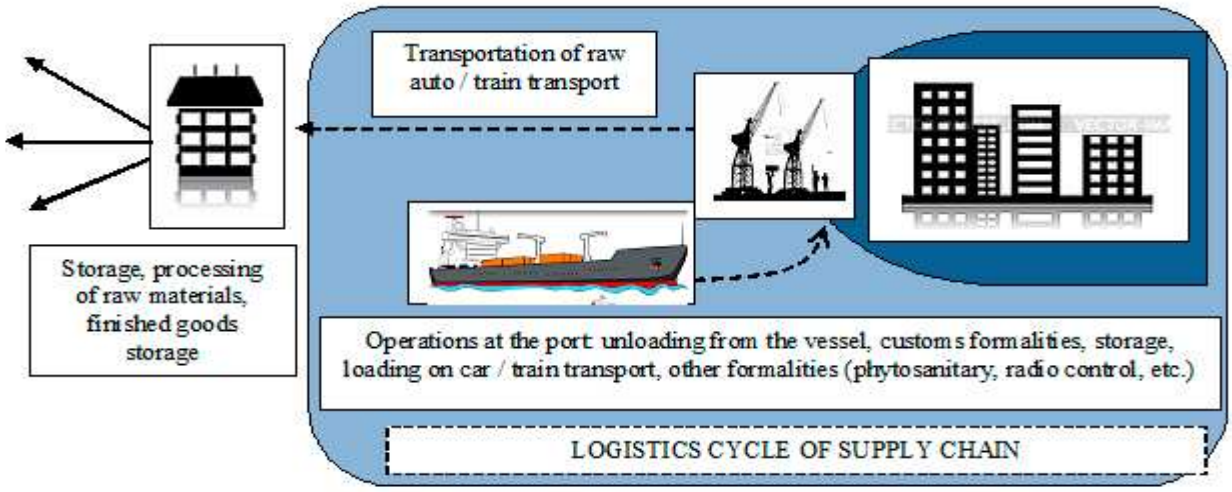



Figure 3 Considered situation for expenditures analysis

Expenditures for vehicle/railway transportation of raw materials to the warehouses of the enterprise:

$$R_5 = f_a \cdot L \cdot Q_r / q_a \ , \qquad (2)$$

$$R_5 = f_{rw}(Q_r, L, q_{rw}) \cdot Q_r \ , \qquad (3)$$

where $f_a, q_a$ - tariff for the transportation by vehicle and its loading; $f_{rw}, q_{rw}$ - tariff for railway transportation and loading of carriage.

Expenditures for storage of raw materials in the warehouses of the enterprise:

$$R_6 = c_w \cdot S_w(Q_r) + r_w(Q_r) \ , \qquad (4)$$

$c_w$ - cost of warehouse rent (per sq.m.); $s_w$ - essential area of the warehouse (sq.m.); $r_w$ - operating costs in the warehouse.

Manufacturing expenditures

$$R_7 = c_m \cdot S_m(Q_g) + r_m(Q_g) + r_{mc}, \quad (5)$$

$c_m$ - cost of manufacturing premises rent (per sq. m.); $S_m$ - rented manufacturing premises (sq. m.); $r_m$ - variable manufacturing expenditures; $r_{mc}$ - constant manufacturing expenditures (premises rental, as a rule, also relates to constant manufacturing expenditures, though, in context of the given task, it is significant to define its relation to the planned volume of production).

Expenditures for the finished commodity storage:

$$R_8 = c_w \cdot S_w(Q_g) + r_w(Q_g) \quad (6)$$

Essentially the warehouses expenditures may be unified:

$$R_{6+8} = c_w \cdot S_w(Q_r, Q_g) + r_w(Q_r, Q_g) \quad (7)$$

If the similar manufacturing is located in the logistic industrial park in the port the expenditures for the storage $R'_{6+8}$ and manufacturing $R'_7$, will be identified as follows:

$$R'_7 = c'_m \cdot S_m(Q_g) + r'_m(Q_g) + r_{mc} \quad (8)$$

$$R'_{6+8} = c'_w \cdot S_w(Q_r, Q_g) + r'_w(Q_r, Q_g) \quad (9)$$

In their turn, transport expenditures for the raw materials delivery on the territory of the port ($f'$ - transport tariffs) to the manufacturing premises will be calculated as follows:

$$R'_5 = f' Q_r, \quad (10)$$

When the rest of the expenditures are equal, the disparity of general expenditures due to basic variant and variant when the manufacturing is located in the port may be as follows:

$$\Delta = R_5 + R_{6+8} + R_7 - R'_5 - R'_{6+8} - R'_7 \quad (11)$$

At $\Delta > 0$ the economic benefits of industrial park in the port are obvious. It's clear that given effect is obtained not only due to ratio of cost parameters but manufacturing and storage volumes (amounts).

Besides the expenditures retrenchment due to manufacturing premises location, there is also the time factor, which is of utmost importance. When manufacturing is located in the port such essential operations as reloading, customs proceedings and other obligatory formalities can be easily controlled and coordinated. All these factors in their turn allow applying the logistic principle "right on time" in practice [1].

Let's introduce the following terms: $\bar{t}_i$ - average time of $i$ - operation performance in the logistic cycle: $\bar{t}_1$ - raw material delivery (shipping and discharging), $\bar{t}_2$ - customs formalities, $\bar{t}_3$ - other port formalities; $\bar{t}_4$ - raw material storage in the port; $\bar{t}_5$ - raw material transportation from the enterprise warehouse. Given logistic cycle deals with raw material delivery and does not include manufacturing logistics, which itself can be the subject for separate research. The average time for the given logistic cycle:

$$t = \sum_{i=1}^{5} \bar{t}_i \quad (12)$$

It is essential that probabilistic nature of time for each operation reveals necessity to take into consideration the standard deviation $\sigma_i (i = \overline{1,5})$. The absence of correlation between period of each operation allows to define time standard deviation for logistic cycle in the following way:

$$\sigma_t = \sqrt{\sum_{i=1}^{5} \sigma_i^2} \quad (13)$$

The probability of timely executed logistic cycle within the given period $[t_1, t_2]$:

$$P(t_1 \le t \le t_2) = \Phi\left(\frac{t_2 - \bar{t}}{\sigma_t}\right) - \Phi\left(\frac{t_1 - \bar{t}}{\sigma_t}\right) \quad (14)$$

For the case when the manufacturing is located in logistic industrial park, the value (13) is going to be considerably lower in comparison with the other option and, evidently, the probability to perform the whole logistic cycle on time is much higher.

## 5. CONCLUSIONS

We consider port territories to be a beneficial branch for creation of industrial parks in Ukraine, especially taking into consideration that ports meet almost all the requirements for industrial parks and parks' creation on the premises of the port does not require big amounts of financial inflow as it usually does when industrial parks are created on the territories not previously occupied. Due to the fact that ports are the concentration of logistic services, the specific feature for industrial parks located on the territory of the port is considerable logistic component in the functional objective of the park, in view of this, such parks can be defined with the term «logistic industrial parks». Advisability for entities to participate in logistic industrial parks is determined by economic benefits and opportunity to optimize logistic operations.

## 6. REFERENCES

[1] LUKINSKY, V.S., *Models and methods of the logistics*, Piter, 2007.

# ANALYSIS ON LEARNING STYLES IN ADAPTIVE MODELS FOR E-LEARNING MARINE STAFF

[1]NIKOLOVA NATALIA, [2]DECHEV JAVOR, [3]MEDNIKAROV BOYAN, [4]KALINOV KALIN, [5]TENEKEDJIEV KIRIL

[1,2,3,4,5]*Nikola Vaptsarov, Naval Academy, Bulgaria*

**ABSTRACT**

The report analyzes the application of different learning styles according to Felder-Silverman in-built adaptive model in Learning Management Systems Moodle. Four parameters describing the learning process are identified – two continuous and two discrete ones. Two groups of statistical tests are applied over the data – one group for the discrete, and one group for the continuous parameters. Comparisons are made between the experimental and the control group on one hand, and between the advanced and the basic group on the other hand (divided in terms of level of knowledge). The statistical tests are realized in MATLAB and extensively use Bootstrap simulation. Results show that the basic group benefits from the proposed learning techniques, whereas more attention should be paid to providing stimuli to students from the advanced group to strive for higher and higher academic results.

**Keywords:** *adaptive, model, style, e-learning, statistical tests, Bootstrap*

## 1. INTRODUCTION

At this stage of development of information technology, management systems for training and curriculum (also called LMS - Learning Management Systems), and systems for e-learning in particular, are getting more and more popular in the area of maritime education. To cover a wider range of students (people receiving training) with their specific learning goals and capabilities, it is possible to use adaptive models. Learning styles can define the model of adaptability according to the characteristics of the student.

This paper describes a survey conducted among students from the N. Vaptsarov Naval Academy, Varna, Bulgaria. Participants are divided into two groups – experimental and control group. The experimental group comprises cadets majoring in mechanical engineering. The control group consists of civil students majoring in the same area. The analysis covers the results from the learning process in Informatics. The experimental group is additionally divided into advanced and basic group, depending on their level of knowledge and ability to comprehend the material. Different learning techniques are applied to the experimental subgroups, including different additional learning materials and different ways of presenting the material. Different scoring procedures are also applied. To analyze the results, four parameters (two continuous and two discrete) are identified and analyzed: duration of test, test scores, quality of education and lecturer evaluation. A series of statistical tests (one-tail and two-tail tests) using Bootstrap simulation are applied over the data in order to generate results regarding the effectiveness of the proposed learning technique.

In what follows, Section 2 gives the rationale of the experiment. Section 3 discusses the statistical tests to be applied to the discrete parameters, with appropriate reference to the tests to be applied to the continuous parameters. Section 4 presents the results from the statistical tests for each of the four parameters, for each of which there are two comparisons applied: 1) between experimental and control groups, 2) between advanced and basic groups. A detailed discussion of the test results is provided. Section 5 offers main conclusions from the test results.

## 2. DESCRIPTION OF THE EXPERIMENT

The Felder-Silverman model [Hawk et al., 2007] is employed as a basis for the study of learning styles in adaptive models. Several important aspects must be defined in that respect:

- What kind of student perceives information - sensory or intuitive;
- By what kind of external data analysts perceived best – visually or verbally;
- How do you process information – active or reflex;
- What is the way of understanding – gradual or complete.

Each style has the following characteristics [Graf et al., 2009; Viola et al., 2007]:

- sensing – practically oriented, works with facts and procedures;
- intuitive – oriented to concepts and theories, an innovator.
- visual - receives richest information on the basis of visual materials - images, diagrams and charts.
- verbal – remembers best read or heard information, prefers lectures and discussions.
- active – learns by doing something, experiments and summarizes the ideas of others.
- reflective - learns by analysing the object, prefers to work independently.
- sequential – perceive and understand the information if provided on small linked portions, straightforward and works by instructions.
- global – think globally, able to find the relationship between different categories.

When creating the model of e-learning and when conducting the experiments, the following restrictions apply:

- limited number of subjects included in the study;
- small volume curriculum - textbooks, exercises, tests, which prevents the creation of a large database;
- dynamic nature of the curriculum that does not allow the experiment to be carried out for several school years.

The experiment is carried out at the N. Vaptsarov Naval Academy, Varna, Bulgaria, in an e-learning *Moodle* environment, with an additional adaptable module. It comprises a total of 87 first year students attending classes in "Informatics", Module "Systems for table processing". The experimental group consists of 17 students (cadets), whereas the control group consists of 70 students (civil students), majoring in Ship Machines and Equipment. The criteria for adaptability in the function model are focused on the adaptability of the characteristics of the student: according to her knowledge and style of learning. The limited number of students in the study does not allow creating groups that could be characterized by all styles identified in the Felder-Silverman model.

To carry out the experiment it is assumed that division by knowledge may replace the division by characteristics. For that reason, the cadets are divided into two groups – basic and advanced. Each of them can adopt different features of the Felder-Silverman model. The criterion employed to divide the students is the score from their previous modules on the subject. It is assumed that students from the basic level experience difficulties when learning the discipline. The course provides them with training materials and exercises, which they need so that to acquire a basic level curriculum. In addition to that, students at the advanced level receive more complex tasks in order to stimulate their development and acquire particular skills and knowledge, so that to obtain higher scores in the final examination.

Separation by success assumes that students from both streams have the following features, according to the Felder-Silverman model:

- basic – active, sensing, visual, sequential;
- advanced – reflective, intuitive, verbal, global.

The learning content is divided into several categories, each of them directed to a particular learning style:

- lectures in PDF format – intuitive, verbal, global students;
- lectures in PPT format – sensing, visual, sequential students;
- flash animations – sensing visual students;
- online help – intuitive, verbal students.

To check the level of knowledge acquired, students are asked to answer a test. Different questions and styles of answering are included in order to address all styles of learning. Questions can be defined as text or illustrated by images. In the same time, they may be of the following types: description – describe an action; claim – to choose a statement; situation – describe the real situation. Technologically, the responses are divided into four types: multiple choice – choice of several specified actions; short answer – write the exact text or numeric response; relations – connect two statements; binary – true or false. Answers can be: path selection – pre-written way to perform an action; statement – a choice between assertions, and free response. The employed combinations of questions and answers are given in Table 1.

Table 1. Type of questions

| type of questions | | type of answers | |
|---|---|---|---|
| presentation of question | type of question | technology of answer | type of answer |
| text | description | multiple choice | path selection |
| text | statement | multiple choice | path selection |
| text | situation | multiple choice | path selection |
| visual | description | multiple choice | path selection |
| visual | situation | multiple choice | path selection |
| text | statement | multiple choice | statement selection |
| visual | statement | multiple choice | statement selection |
| visual | situation | multiple choice | statement selection |
| text | situation | multiple choice | statement selection |
| text | statement | multiple choice | statement selection |
| text | situation | multiple choice | statement selection |
| text | statement | short answer | statement selection |
| visual | statement | short answer | statement selection |
| text | statement | short answer | free response |
| visual | situation | short answer | free response |
| visual | statement | relations | statement selection |
| text | statement | relations | statement selection |
| text | statement | true / false | statement selection |

Four parameters shall be subjected to further analysis in order to test the results of the learning experiment, all coming from the test that the participants filled in. The first two parameters are continuous, whereas the others are discrete parameters, and their possible discretes are given below:

1) *Duration of test*, measured in minutes;

2) *Test scores*, measured in points;

3) *Quality of education*, with five possible discretes: "Excellent", "Very good", "Good", "Satisfactory", "Bad".

4) *Lecturer evaluation*, with five possible discretes: "Excellent", "Very good", "Good", "Satisfactory", "Bad".

In the course of further analysis, statistical tests over discrete and over continuous features shall be employed. Description of the tests that would apply to discrete features shall be provided in Section 3. The work [Nikolova et al., 2013a] gives a detailed description of the tests that apply to continuous parameters. The work discusses three analytical tests over one-dimensional continuous features – Wilcoxon rank sum test, analytical Kolmogorov-Smirnov test, and analytical Kuiper test, and also offers an algorithm to find the $p_{value}$ of Kuiper statistics using Bootstrap simulation. A discussion on Bootstrap statistical tests under the described setup is also provided in [Nikolova et al., 2013b; Nikolova et al., 2013c].

## 3. STATISTICAL TESTS

Two samples shall be compared, both one-dimensional and containing the values of a selected discrete feature. The elements of the two samples

comply with different restrictions. Of course, those restrictions cannot be the same for both samples, because samples would be identical. In fact, the elements in the samples differ by a single factor, which allows comparing the influence of this factor over the samples.

Assume there are two one-dimensional samples of a discrete feature with $r$ number of discretes, called Sample 1 and Sample 2. Assume also that Population 1 contains the values of the discrete parameter in the population of all data points that comply with the restriction for Sample 1. In the same fashion, assume that Population 2 contains the values of the discrete parameter in the population of all data points that comply with the restriction for Sample 2.

There is a total of $(2+4r)$ tests in such a setup, divided into $(r+1)$ groups: one group to compare the discrete distributions, and a group per each discrete.

### *3.1. First group*

This first group presents tests that search for difference in the discrete distribution of Population 1 and Population 2. The null hypothesis is that the distributions of the Populations are equal, and the alternative hypothesis is that the distributions of the Populations are different. This group contains two statistical tests – Bootstrap ANOVA contingency table test [Efron, Tibshirani, 1993] and analytical ANOVA contingency table test [Hanke, Reitsch, 1991].

### *3.2. The (i+1) group, where i changes from 1 to r*

The tests in these groups search for differences in the probabilities for occurrence of the $i$-th discrete in both Populations. If Sample 1 and Sample 2 have zero frequencies for occurrence of the $i$-th discrete, then this group of tests is not conducted. The null hypothesis is that the two Populations have equal probabilities for occurrence of the $i$-th discrete. This group contains four statistical tests – two-tail and one-tail Bootstrap test for equality of proportions [Efron, Tibshirani, 1993], two-tail and one-tail analytical hyper geometric test for equality of proportions [Groebner et al., 2011]. The value of $p_{value}$ for the latter pair is derived by integration of the hyper geometric distribution using the function *higecdf* of MATLAB [Mathworks, 2013]. For the two-tail tests, the alternative hypothesis is that the probability for occurrence of the $i$-th discrete under Population 1 is different from the one in Population 2. For the one-tail tests, the alternative hypothesis depends on the calculated frequencies for occurrence of the $i$-th discrete for both samples. If Sample 1 has higher frequency for occurrence of the $i$-th discrete than Sample 2, then the alternative hypothesis states that the probability for occurrence of the $i$-th discrete for Population 1 is higher than the one for Population 2. If Sample 1 has lower frequency for occurrence of the $i$-th discrete than Sample 2, then the alternative hypothesis states that the probability for occurrence of the $i$-th discrete for Population 1 is lower than the one for Population 2. In some rare cases, when Sample 1 and Sample 2 have equal frequencies for occurrence of the $i$-th discrete, then the one-tail tests are not performed.

## 4. EXPERIMENTS

The statistical tests, discussed in the previous section shall be applied over the data from the study. All tests and analyses are performed at a significance level $\alpha = 0.05$.

### *4.1. Duration of test – comparison of experimental and control groups*

The results from the statistical tests are given in Table 2. None of the tests shows statistically significant difference in the characteristics of position; however the experimental group has significantly shorter duration of test compared to the control group (mean of 53 min vs. 63 min; median of 52 min vs. 63 min). All tests show statistical significance of the characteristics of dispersion ($p_{value} \leq 0.0166$). The practical significance of the differences is in the much higher variance in the experimental group (standard deviation two times higher: 28 min vs. 14 min; IQR (interquartile range) is more than three times higher: 59 min vs. 17 min). The Bootstrap tests show statistically significant difference in the distributions ($p_{value} \leq 0.0166$), where the distribution of the experimental group is shifted right and is much wider.

Table 2. Numerical characteristics of experimental and control group regarding duration of test

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 17 | 55 |
| Mean | 52.96 | 63.1 |
| Median | 51.9 | 63 |
| STD | 28.33 | 13.72 |
| IQR | 59.29 | 17.34 |

### *4.2. Duration of test – comparison of advanced and basic groups*

The results from the statistical tests are given in Table 3. None of the tests shows statistically significant difference in the characteristics of position and the advanced group has practically the same mean, but has significantly lower median compared to the basic group (mean of 52 min vs. 53 min; median of 52 min vs. 60 min). None of the tests shows statistically significant difference in the characteristics of dispersion. The practical significance of the differences is small, which is justified by the direction of difference in the standard deviation and IQR (standard deviation of the advanced group 29 min vs. 30 min in the basic group; IQR of 60 min in the advanced group vs. 54 min in the basic group). None of the tests shows statistically significant difference in the distributions.

Table 3. Numerical characteristics of advanced and basic group regarding duration of test

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 9 | 8 |
| Mean | 52.21 | 53.81 |
| Median | 51.9 | 60.44 |
| STD | 28.86 | 29.67 |
| IQR | 60.02 | 53.65 |

*4.3. Test scores – comparison of experimental and control groups*

The results from the statistical tests are given in Table 4. All tests show statistically significant difference in the characteristics of position ($p_{value} \leq 1.115e\text{-}9$). The experimental group has significantly better scores than the control group (mean in the experimental group of 41 points vs. 33 points in the control group; median in the experimental group of 41.5 points vs. 34 points in the control group). All tests show statistically significant difference in the characteristics of dispersion ($p_{value} \leq 0.0055$). The practical significance of the differences is in the much lower variance in the experimental group (standard deviation two times lower: 2.7 points vs. 6 points; IQR is about three times lower: 3.4 points vs. 10.3 points). All tests show statistically significant difference in the distributions ($p_{value} \leq 3.291e\text{-}5$), where the distribution in the experimental group is shifted right and is much tighter.

Table 4. Numerical characteristics of experimental and control groups regarding test scores

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 17 | 56 |
| Mean | 40.67 | 33.27 |
| Median | 41.5 | 34.33 |
| STD | 2.685 | 5.955 |
| IQR | 3.443 | 10.34 |

*4.4. Test scores – comparison of advanced and basic groups*

The results from the statistical tests are given in Table 5. The Bootstrap tests show statistically borderline significance of the difference in the characteristics of position, where the advanced group has practically slightly better scores than the basic group (mean in the advanced group of 42 points vs. 40 points in the basic group; median in the experimental group of 42 points vs. 40 points in the basic group). None of the tests shows statistical significant difference in the characteristics of dispersion, and the slightly lower values in the advanced group are of little practical importance (standard deviation in the advanced group of 2.1 points vs. 2.9 points in the basic group; IQR in the advanced group of 2.5 points vs. 3.6 points in the basic group).

Table 5. Numerical characteristics of advanced and basic groups regarding test scores

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 9 | 8 |
| Mean | 41.69 | 39.53 |
| Median | 42.33 | 39.59 |
| STD | 2.137 | 2.904 |
| IQR | 2.5 | 3.645 |

*4.5. Quality of education – comparison of experimental and control groups*

The results from the statistical tests are given in Table 6. None of the tests shows statistically significant difference in the frequency of any of the discretes regarding quality of education. There is slight improvement of opinion in the experimental group, because: a) in the experimental group there is no satisfactory and bad opinion, whereas in the control group 6% have such opinion; b) in the experimental group, there are participants with excellent opinion that are 5% more than in the control group (59% vs. 54%). None of the tests shows statistically significant difference in the discrete distributions.

Table 6. Numerical characteristics of experimental and control groups regarding quality of education

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 17 | 68 |
| Percentage of the discrete 'Excellent' in the Sample | 58.82% | 54.41% |
| Percentage of the discrete 'Very good' in the Sample | 23.53% | 30.88% |
| Percentage of the discrete 'Good' in the Sample | 17.65% | 8.82% |
| Percentage of the discrete 'Satisfactory' in the Sample | 0.00% | 4.41% |
| Percentage of the discrete 'Bad' in the Sample | 0.00% | 1.47% |

*4.6. Quality of education – comparison of advanced and basic groups*

The results from the statistical tests are given in Table 7. None of the tests shows statistically significant difference in the frequency of occurrence of any of the five discretes of quality of education. In any case, there is practically significant improvement of opinion regarding quality in the advanced group: a) in the advanced group there are only 11% good estimates for the quality of education, vs. 25% for the basic group; b) in the advanced group, the participants with excellent opinion are about 17% more than those in the basic group (67% vs. 50%). None of the tests shows statistically significant difference in the discrete distributions.

Table 7. Numerical characteristics of advanced and basic groups regarding quality of education

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 9 | 8 |
| Percentage of the discrete 'Excellent' in the Sample | 66.67% | 50.00% |
| Percentage of the discrete 'Very good' in the Sample | 22.22% | 25.00% |
| Percentage of the discrete 'Good' in the Sample | 11.11% | 25.00% |

*4.7. Lecturer evaluation – comparison of experimental and control groups*

The results from the statistical tests are given in Table 8. None of the tests shows statistically significant difference in the frequency of occurrence of any of the five discretes of the lecturer evaluation. However, in the experimental group there is slight improvement of the lecturer evaluation, because: a) in the experimental group there are no participants with good or bad opinion, whereas in the control group respectively 10% and 6% of participants have that opinion; b) in the experimental group, the participants with good opinion are about 16% more than those in the control group (29% vs. 13%). None of the tests shows statistically significance in the discrete distributions.

Table 8. Numerical characteristics of experimental and control groups regarding lecturer evaluation

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 17 | 68 |
| Percentage of the discrete 'Excellent' in the Sample | 64.71% | 64.71% |
| Percentage of the discrete 'Very good' in the Sample | 29.41% | 13.24% |
| Percentage of the discrete 'Good' in the Sample | 0.00% | 10.29% |
| Percentage of the discrete 'Satisfactory' in the Sample | 5.88% | 5.88% |
| Percentage of the discrete 'Bad' in the Sample | 0.00% | 5.88% |

*4.8. Lecturer evaluation – comparison of advanced and basic groups*

The results from the statistical tests are given in Table 9. None of the tests shows statistically significant difference in the frequency of occurrence of any discrete regarding lecturer evaluation. In any case, in the advanced group there is practical improvement of the opinion regarding lecturer evaluation, because: a) in the advanced group there is no satisfactory opinion for the lecturer, whereas in the basic group, 12.5% have such an opinion; b) in the advanced group, the people with excellent opinion are around 28% more than those in the basic group (78% vs. 50%). None of the tests shows statistically significant difference in the discrete distributions.

Table 9. Numerical characteristics of advanced and basic groups regarding lecturer evaluation

| | Sample 1 | Sample 2 |
|---|---|---|
| # of observations | 9 | 8 |
| Percentage of the discrete 'Excellent' in the Sample | 77.78% | 50.00% |
| Percentage of the discrete 'Very good' in the Sample | 22.22% | 37.50% |
| Percentage of the discrete 'Satisfactory' in the Sample | 0.00% | 12.50% |

## 5. CONCLUSIONS

All statistical tests performed in this study are realized using original software in MATLAB R2013a environment. The program functions are available free of charge upon request from the authors.

The following conclusions can be made from the statistical results:

- there is statistically insignificant difference in the duration of exam between the experimental and control groups;
- there is no statistically significant difference in duration of test between the advanced and the basic group;
- there is statistically significant difference in the test scores between the experimental and control group, with better scores in the experimental group;
- there is statistically borderline significance of the better test scores in the advanced group, but with no difference in terms of dispersion;
- the assessment of the quality of education in the experimental and the control group are almost the same , with slight improvement of the opinion in the experimental group;
- the assessment of the quality of education in the advanced and the basic group are statistically almost the same, with practically significant improvement of opinion in the advanced group;
- there is no statistically significant difference in the lecturer assessment in the experimental and control groups, with only slight improvement of the opinion in the experimental group;
- there is no statistically significant difference in the lecturer assessment in the advanced and basic groups, with practical improvement of the opinion in the advanced group;

Based on that, there are several conclusions to be made regarding this study:

- the use of learning materials and test questions, targeted at different learning styles, improves the utilization of the information provided;
- the separation into groups depending on exam results has positive impact on students. More particularly, the statistical results show that the basic group has improved in performance thanks to the proposed learning techniques and it has high chances of becoming competitive to the advanced group in time;
- the overall satisfaction of students from the learning process has increased, which is a strong justification to continue applying the proposed approach;
- more attention has to be paid to the members of the advanced group; the results show that for all students the major motivation is to pass the exam, so once this is guaranteed students have no ambitions of achieving higher academic results; therefore stronger stimuli should be provided to the advanced students, such as providing more complex tasks, financial support of excellent students, inclusion in specialized academic programs for learning and mobility, etc.;
- the lack of usage of the e-learning communication modules by the students does not allow studying the communication aspects of the Felder-Silverman model.
- it is mandatory to expand this research over larger and varying student groups in order to justify the positive effects of the proposed learning technique;

## 6. REFERENCES

[1] EFRON, B., TIBSHIRANI, R. J., *An Introduction to the Bootstrap*, Chapman and Hall, 1993.

[2] GRAF, S., KINSHUK, A., TZU-CHIEN, L., *Supporting Teachers in Identifying Students Learning Styles in Learning Management Systems An Automatic Student Modelling Approach*, Educational Technology and Society, 12 (4), 3–14, 2009.

[3] GROEBNER, D.F., SHANNON, P.W., FRY, P.C., SMITH, K., *Business Statistics: A Decision Making Approach* (2011) Prentice Hall.

[4] HANKE, J. E., REITSCH, A. G. *Understanding Business Statistics*, Irwin, 1991.

[5] HAWK, T.F., AMIT, J., SHAH, A., *Using Learning Style Instruments to Enhance Student Learning. Decision Sciences*, Journal of Innovative Education, pp. 8-9, January 2007.

[6] MATHWORKS, T. *Statistics Toolbox: User's Guide*, The MathWorks, Inc., USA, 2013.
[7] NIKOLOVA, N.D., MIHAYLOVA, N., TENEKEDJIEV, K., *Bootstrap Kuiper test for equality of one-dimensional continuous distributions*, Proceedings of the International Conference on Automation and Informatics, Sofia, October 2013, (in print), 2013b.
[8] NIKOLOVA, N.D. et al., *Statistical Evidence of Differences Between Samples by Bootstrap Tests for Hypothesis Testing*, Science, labor and capital, 2013b (in print).
[9] NIKOLOVA, N.D., TONEVA-ZHEYNOVA, D., KOLEV, K., TENEKEDJIEV, K., *Monte Carlo Statistical Tests for Identity of Theoretical and Empirical Distributions of Experimental Data*, DOI: 10.5772/53049. In: CHAN, V. (Ed.) *Computer and Information Science: Theory and Applications of Monte Carlo Simulations*, INTECH Open Science, 2013c.
[10] VIOLA, S.R., GRAF, S., LEO, T., *Investigating Relationships within the Index of Learning Styles. A Data-Driven Approach*, Interactive Technology and Smart Education, 7-18, 2007.

# MARITIME SECURITY: FUTURE TRENDS AND CHALLENGES

NINCIC DONNA

*ABS School of Maritime Policy and Management, California Maritime Academy, USA*

**ABSTRACT**

There has been a sudden and dramatic drop in maritime piracy in recent years leading security analysts to voice concern that the global community may feel it is an appropriate time – especially in years of economic recessions and constrained national budgets – to reduce its counter-piracy measures around the world, particularly in the Horn of Africa. At the same time, some shipping companies may also be inclined to conclude that the threat of maritime piracy has passed, and the more expensive "best management practices" are no longer needed. These would be premature conclusions. As this paper argues, a current decline in maritime piracy off the coast of Somalia does not mean it has been reduced elsewhere; indeed, we are seeing increases in pirate attacks off of Nigeria and resurgence in the Strait of Malacca. There are also other areas of the world that are possibly poised for increases in maritime piracy. Additionally, the threat of maritime terrorism can never be wholly dismissed, and the global shipping community remains at continued risk for exploitation by the illegal drugs and weapons trade, and human trafficking.

**Keywords:** *Maritime piracy; maritime terrorism; drug, weapons, human trafficking; maritime criminality.*

## 1. INTRODUCTION

The global maritime community has witnessed a sudden and somewhat unexpected and dramatic decline in maritime piracy attacks worldwide in the period from 2011 to 2012 and accelerating into 2013, particularly off the coast of Somalia and in the greater Gulf of Aden/Horn of Africa (HOA) region. This development has been attributed to multi-national naval efforts (including the Combined Task Force 151 and the European Union's Operation Atalanta); increased implementation of best management security practices by the world's global maritime fleet, and some strategic developments on land in Somalia.

As a result, there is speculation that there may be a drawdown of the (very expensive) international task forces, a pullback of patrols by some of the independent nations offering security for their vessels in the region, as well as a retrenchment of the number of vessels willing to implement many of the more expensive technical (lethal and non-lethal) anti-piracy measures (including the use of armed guards).

At the same time, the international community has witnessed a decrease in concern about maritime terrorist events; predictions about a "move to the sea" by groups such as al Qaeda in the Arabian Peninsula (AQAP), al Shabaab (Somalia), or Jemaah Islayiyah (Indonesia) have yet to materialize and there have been no known direct maritime attacks by al Qaeda since the *USS Firebolt* incident in the Persian Gulf. The most recent maritime terrorist event was the minor attack on the Japanese-flagged VLCC MV *M. Star* in the Persian Gulf near the United Arab Emirates in 2010 attributed to the al Qaeda-affiliated Abdullah Azzam Brigades.

With maritime terrorism currently at a seeming low point, and maritime piracy for the moment on the decline, this raises the question for the future of maritime security. Given the relative recent quiet on the maritime front, how concerned should we be about maritime terrorism and piracy, particularly in a time of significant economic constraints? The answer, unfortunately, is that we should continue to be very concerned.

## 2. MARITIME PIRACY: CURRENT TRENDS AND THE DECLINE OF THE SOMALI THREAT

As can be seen from Figure 1, maritime piracy has fluctuated significantly between the years 2002 and 2012 (unless otherwise noted, all pirate attack data is from the International Maritime Bureau). For the period 2002-2005, most of the world's reported maritime pirate attacks were situated in the area in and around the Strait of Malacca. However, with the increased security measures adopted in the region between Malaysia, Singapore and Indonesia, maritime piracy dropped substantially in this area in 2005 (the drop in maritime piracy in the Strait of Malacca region was also due in part to the Indian Ocean tsunami).

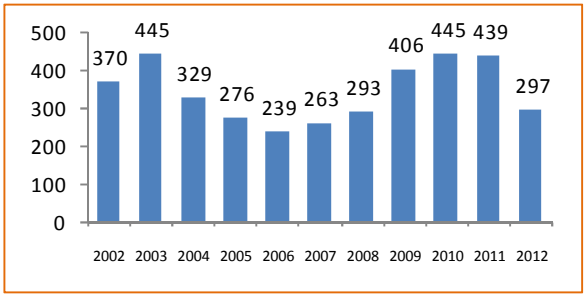



Figure 1 Global Maritime Piracy: 2002-2012 [1]

However, at the same time maritime piracy began to decline in the Malacca region specifically and Asia in general, it began to increase in the Gulf of Aden; rises in global maritime piracy after 2005 are attributed almost exclusively to the rise in acts of maritime piracy committed by Somali pirates.

The continued rise in global attacks from 2007 to its peak in 2010 is due largely to the geographical progression and expansion to the south and to the east of Somali pirates as a result of their adoption of

increasingly sophisticated methods of operation and attack. By the time they were functioning well into the Indian Ocean east to within 400 nautical miles of the Indian coast and south to Madagascar, and near the entrance of the Persian Gulf, the Somali pirates had perfected the use of "mother ships" capable of operating at sea for months at a time. This, and the use of multiple smaller attack boats, a seemingly endless supply of RPGs and other light arms, and an ability to adopt GPS, satellite phones and ship tracking methods, have made attacks by Somali pirates increasingly difficult to prevent.

However, from this high point, the global maritime community witnessed an unexpected sharp and significant drop in maritime piracy in 2012 (and into the first quarter of 2013) due exclusively to the sudden and dramatic drop of Somali piracy in the Gulf of Aden. As can be seen in Table 1, attacks attributed to Somali pirates on merchant shipping, yachts and fishing vessels dropped from a high of 237 attacks in 2011 to a low of 75 incidents in 2012. This represents a remarkable drop of over 300% in just one year.

Table 1. Somali Piracy: 2009-2012 [2]

| Year | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| # Attacks | 218 | 219 | 237 | 75 |

The reasons for the drop in Somali piracy are important to understand, especially since we are seeing increases in piracy in other parts of the world and will need to determine how "applicable" anti-piracy operations in Somalia will be to these new areas of maritime piracy.

The drop in Somali piracy is due largely to three separate and interrelated events: 1) The increasing success of the global multi-national naval task forces and independent operators, 2) the increasing adoption of best management practices by merchant ships, and 3) developments on the ground in the internal political situation in Somalia.

### *2.1 International Task Forces*

Three separate international naval task forces have operated in the Gulf of Aden/Horn of Africa region with the mission of combating maritime piracy: Combined Task Force 151 (CTF 151), the European Union's *Operation Atalanta*, and NATO's *Operation Ocean Shield*.

At the same time, the naval forces of additional countries operating independently from the task forces have offered significant and cooperative anti-piracy support in the region as well. Known as "independent deployers," these include naval deployments from China, India, the Islamic Republic of Iran, Japan, Kenya, Malaysia, Russia, Saudi Arabia, South Africa and Yemen. (While the naval vessels of these countries are not part of the multinational maritime coalition operations, they do participate in the Shared Awareness and Deconfliction (SHADE) mechanism).

CTF 151 was established as a multinational operation in January 2009 in response to the rise of maritime piracy in the Gulf of Aden. Its mission, in accordance with United Nations Security Council Resolutions authorizing international action against Somali pirates, and in cooperation with non-member forces, has been to "disrupt piracy and armed robbery at sea and to engage with regional and other partners to build capacity and improve relevant capabilities in order to protect global maritime commerce and secure freedom of navigation" [3].

CTF 151 is a multinational force operating to protect merchant vessels in over one million square miles off the coast of Somalia, in the Gulf of Aden/Horn of Africa region, Indian Ocean, and approaching the Persian Gulf. Command of CTF-151 is rotated between participatory nations on a four to six month basis. Contributing members include over twenty countries, with a rotating command; previous commands include the United States, the Republic of Korea, Singapore, Turkey and New Zealand.

Combined Task Force 151 is one of three task forces operated by Combined Maritime Forces (CMF), the other two being CTF 150 tasked with maritime security (largely anti-terrorism) more generally, and CTF 152, dedicated to maritime security in the Persian Gulf. In conjunction with the European Union Naval Force Somalia (EU NAVFOR), the North Atlantic Treaty Organization (NATO), and together with independently deployed naval ships, CTF 151 helps to patrol the Internationally Recommended Transit Corridor (IRTC) in the Gulf Aden between Somalia and Yemen in the Bab al Mandeb Strait.

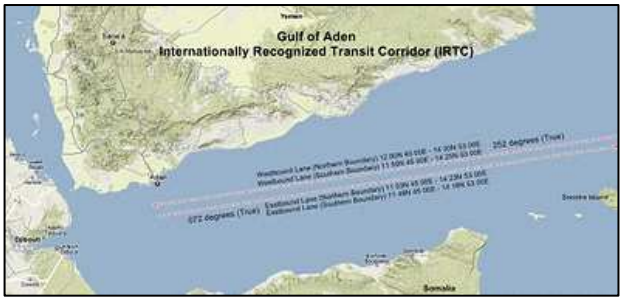



Figure 2. IRTC [4]

EU NAVFOR's *Operation Atalanta* was formed in December 2008, with the initial objective of protecting the humanitarian relief vessels of the United Nations World Food Programme. Additional mission components include:

- The protection of shipping in support of the African Union Mission in Somalia (AMISOM);
- The deterrence, prevention and repression of acts of piracy and armed robbery at sea off the Somali coast;
- The protection of vulnerable shipping off the Somali coast on a case by case basis;
- Monitoring of fishing activities off the coast of Somalia [5]

In March 2012 the European Union extended the mandate of *Operation Atalanta* until December 2014. At the same time, the Council of the European Union also

extended its area of operation to include Somali coastal territory and internal waters (within the 12 nautical mile territorial water limit).

Working alongside CTF 151 and *Operation Atalanta*, NATO's *Operation Ocean Shield* (formed in 2008) is the third leg of the multi-national counter piracy mission in the Gulf of Aden and off the Horn of Africa. NATO's *Ocean Shield*'s role is to "provide naval escorts and deterrence capabilities, while increasing cooperation with other counter-piracy operations in the area in order to optimize efforts and tackle the evolving pirate trends and tactics" [6]. In March 2012, the North Atlantic Council, along with EU NAVFOR, also extended its counter-piracy operation through 2014.

In addition to the multi-national task force efforts, several countries independently contribute to the global fight against Somali piracy. Previously mentioned above, these include China, India, the Islamic Republic of Iran, Japan, Kenya, Malaysia, Russia, Saudi Arabia, South Africa and Yemen. Working in communication and cooperation with the task forces, the navies of these countries have also been responsible for a number of successes against Somali pirates, including the capture and arrest of pirates and rescue of ships under attack.

#### *2.1.1 Task Force Success*

In early 2013, the near unanimous conclusion reached by the international community has been that the task forces and the naval forces of the independent deployers have made a significant dent in the success and will of the Somali pirates. Several high profile rescues – including that of the *Maersk Alabama* – have made it clear to Somali pirates that engaging in maritime piracy has increasingly high costs – from being arrested, tried and imprisoned, and even to the loss of life.

For example, while complete statistics are understandably lacking, interviews with Somali elders show that many villages have lost "hundreds" of young men who go out to sea and never return (a very large part of this is due to drowning).

Additionally, as of July 2012, eighty-seven alleged pirates were on trial in various countries around the world; by May 2013 over 1,100 Somali pirates were in prison in twenty-one countries. This shows both that international forces are no longer willing to engage in "catch and release" (capturing pirates, taking away their weapons, and returning them to shore) and are doing their best to ensure the captured pirates are charged and tried for their crimes; and that piracy is no longer considered as "glamorous" as it once might have been.

### *2.2 Best Management Practices (BMP)*

In addition to the work of the international task forces and the naval forces of the independent deployers, the global shipping community itself has taken a strong stand against Somali piracy and has begun to implement "best management practices" more thoroughly and successfully. While actions such as standing extra watch and increasing speed, mustering all hands, sounding the alarm, etc., have always been recommended for ships transiting dangerous waters anywhere in the world, merchant vessels are increasingly adopting these measures in greater numbers, particularly off the coast of Somalia and in the greater Horn of Africa region.

The reason for this is clear. While the international task forces provide a strong deterrent to piracy and may assist in rescue operations, the international task forces cannot be everywhere and cannot prevent every attack – this means the ship itself must be prepared to be the "first responder" and, given enough notice, it still has a good chance of avoiding successful attack altogether if it takes aggressive best management practice actions against the pirates. To this end, BMP continue to be recommended as the first line of defence both by international organizations and many private shipping organizations.

The most recent advice for shippers was made available in August 2011. *BMP4: Best Management Practices for Protection against Somalia Based Piracy* continues to recommend three basic actions for all ships transiting the Somali pirate area of operations [7]: 1) Register with the Maritime Security Centre Horn of Africa (MSCHOA) prior to entering the high risk area; 2) Report daily to the United Kingdom Marine Trade Operations (UKMTO), which acts as the primary point of contact for merchant vessels and liaison with military forces in the region. The UKMTO is also the primary point of contact during an attack and should be aware the vessel is transiting the region; 3) Undertake ship protection measures – the logic here being if pirates cannot board the vessel, they cannot hijack it and hold it and the crew hostage for ransom.

Private maritime security companies (PMSC), or "armed guards", continue to be in the "grey area" of best management practices. While it is true that no ship carrying private maritime security companies has been successfully attacked, the use of PMSCs has not been universally adopted for a number of reasons.

First, there are concerns about legal liability if injuries or fatalities occur. Second, the cost alone is prohibitive to many shipping companies; PMSC protection for a vessel is reported to cost $80,000 per transit; a figure well out of the reach of many shipping companies [8]. And third, acceptable universal rules of engagement have yet to be adopted. This latter concern may change, however, with the recent (March 2013) promulgation of *ISO/PAS 28007:2012, Ships and marine technology – Guidelines for Private Maritime Security Companies (PMSC) providing privately contracted armed security personnel (PCASP) on board ships (and pro forma contract)* [9].

### *2.3 Political Developments in Somalia*

In addition to the international task forces, the consistent adoption of best management practices, and the use of private maritime security companies onboard vessels, a number of political developments have occurred within Somalia to reduce the occurrence of acts of maritime piracy. These include internal events such as:

- African Union military gains against the Al Shabaab terrorist group;

- Attacks on pirate attack vessels by French forces;
- Pirate kingpin "retirements";
- Amnesty being negotiated for children in piracy (this involves over 900 children who had been functioning as part of pirate organizations).

While it is too early to draw firm conclusions, there is some evidence that the current Somali government, assisted by its international partners, may be gaining a stronger control over parts of the country. African Union forces have managed a few key successes against the Al Shabaab insurgents which, while not directly linked with piracy, have managed to weaken their control over pirate strongholds in favour of more government influence. Examples include the joint African Union/Kenya land attack on Merca in August 2012, and the African Union/Somali government assaults on Kismayo in September 2012.

At the same time, European Union forces – without committing "boots on the ground" – engaged in the public destruction of a number of known pirate attack boats. This occurred in helicopter attacks on Xarardheere in May 2012. To the extent that these vessels need to be replaced, it is an additional cost imposed upon the pirates.

Additionally, in a highly publicized statement in January 2013, prominent Somali pirate leader Mohamed Abdi Hassan, also known as "Afweyne," announced his retirement. Men under Afweyne's command were responsible for two very high-profile pirate attacks: the 2008 capture of one of the largest vessels ever hijacked, the Saudi-owned oil tanker *Sirius Star*, carrying two million barrels of oil worth $100 million and the attack in the same year on the *MV Faina*, a Ukrainian vessel loaded with weaponry including tanks, anti-aircraft guns and 800 tons of ammunition.

In addition to high-profile retirements, other events have occurred which may portend further declines in Somali piracy. In February 2013, Somali President Hassan Sheikh Mohamud stated his intention during meetings with top pirate leaders to offer partial amnesty to boys under the age of eighteen involved with pirate groups: "We have been negotiating with pirates indirectly through the elders to see if we can organize a partial amnesty for the young boys lured in this criminal activity." This amnesty, if successful, could affect more than 900 youths [10].

## 3. NEW CHALLENGES IN MARITIME PIRACY

At the same time the global community has witnessed the sudden and dramatic drop in maritime piracy in the Gulf of Aden, maritime piracy has risen in other parts of the world. Attacks are up in the Strait of Malacca area over previous year highs, and concerns continue to grow in the Gulf of Guinea due to continued and escalated threats from Nigerian pirates. As can be seen in Table 2, while the world has focused its attention on the drop in Somali piracy, far less attention has been paid to the increases in pirate attacks in other parts of the world.

This is especially apparent in the first quarter (January-March) of 2013. During this period, there were only five pirate attacks in Somalia, representing 7.6% of all attacks during this period. At the same time, there were 11 attacks in the Gulf of Guinea, and 25 attacks in the region in and around the Strait of Malacca, accounting for 16.7% and 37.9% of total attacks in this period, respectively.

Table 2. Regional Attacks: 2011-2013 [11]

| | Somalia | Gulf of Guinea | Malacca Region |
|---|---|---|---|
| 2013 (1st Qtr) | 5 | 11 | 25 |
| 2012 | 75 | 37 | 95 |
| 2011 | 237 | 33 | 63 |

### *3.1 Strait of Malacca*

The rise in maritime piracy in the Strait of Malacca is one of the less well-reported occurrences in the current period, especially with so much attention focused on the decline in Somali piracy. However, the increases in Malaccan piracy are important to note for at least two reasons.

First, maritime piracy in this part of the world (which had already been at previous global highs) had declined substantially in the 2004-2006 period due, in large part, to the increased air and naval patrols and anti-piracy commitments of Indonesia, Malaysia and Singapore, assisted by intelligence and financial support from other interested nations (such as Japan and Thailand, for example). However, these efforts appear to have been unsustainable, given the recent increases in attacks in the last few years.

Second, the success rate (percentage of attempted attacks that result in a successful boarding or hijacking) of Malaccan pirates is among the highest in the world. Due to the vast ocean space in which the Somali pirates have operated, they never achieved a success rate (successful boarding of the vessel) much higher than 50%; this dropped substantially after the deployment of the multinational task forces.

However, due to the narrow geographical constraints of the Strait of Malacca which forces vessels to transit at very slow speeds, nearly all pirate attacks in the Strait of Malacca can be regarded as successful (from the pirates' point of view), in that the pirates manage to board the ship, and rob the crew and/or steal various goods from the vessel. For example, of the twenty-five attacks noted in the Malacca region in the first quarter of 2013, twenty-four of the attacks were successful – a 96% success rate. Continued rises in piracy in this region of the world mean that more ships are likely to find themselves victim of actual attacks, versus attempted attacks.

### *3.2 Gulf of Guinea*

As noted in Table 2, there have been more attacks in the Gulf of Guinea region in the first quarter of 2013 than there have been attributed to Somali pirates. While pirate attack statistics are considered to be under-reported worldwide, what is worth noting is that Nigerian piracy is considered to be even more under-

reported, largely due to the number of attacks on fishing vessels and smaller supply vessels for the offshore oil industry (smaller regional vessels are far less likely to report attacks to the international reporting agencies).

For example, the Nigerian Maritime Security Task Force on Acts of Illegality in Nigerian Waters (IAMSTAF) reported at least 293 documented sea robberies and pirate attacks between 2003 and 2008 on the country's fishing vessels alone [12]. Additionally, another source reported 100 attacks on fishing vessels just in 2007 [13]. And the Piracy Reporting Centre in Kuala Lumpur stated it was aware of 100 unconfirmed attacks in 2008, in addition to the 40 confirmed attacks reported by the International Maritime Bureau in that year. If these trends in under-reporting are even somewhat stable from year to year, maritime piracy in the Gulf of Guinea is almost certainly more problematic than current statistics would suggest.

In addition to the rise in attacks by Nigerian pirates, the situation is further complicated by the various "models" of maritime piracy in the region. Unlike in Somalia, where the general model is attack for ransom of ship, cargo and crew, Nigerian piracy is emerging to follow at least four distinct models.

First, theft of the lucrative oil carried by many ships leaving Nigerian ports – bunkering – is problematic in many areas, due to a lack of oversight on a significant corruption problem in many areas. A recent report commissioned by Royal Dutch Shell estimated that 10% of Nigeria's daily oil output (approximately 100,000 barrels) is stolen every day, worth approximately $1.5 million [14]. Over the last 50 years, the amount of oil stolen or wasted has amounted to between $300 and $400 billion [15].

Second, Nigerian piracy also follows a hostage-taking model; however, unlike Somali piracy, Nigerian pirates are more interested in kidnapping oil workers for ransom and have shown less interest in seeking ransom payments for the ship and cargo. This makes it considerably more difficult to find and track those captured by Nigerian militants and pirates, especially when ransom demands are not immediately forthcoming.

Third, some attacks carried out against ships in the Gulf of Guinea do not follow the traditional pirate model of seeking economic gain. For example, in 2009 militants attacked the *MT Meredith*, loaded with 4,000 tonnes of diesel, badly damaging it (in some reports, actually dynamiting the vessel), while, at the same time, abducting a crew member. The ship called for assistance as its engine and superstructure were reported to have been seriously damaged. The Movement for the Emancipation of the Niger Delta (MEND), which continues to seek greater autonomy for the Niger Delta region, claimed that an "affiliate group" carried out the attack. If this is the case, this could point towards an increasing trend in pirate attack violence in Nigeria. This is significant as Nigerian piracy has always been considered more dangerous than Somali piracy, as seafarers have traditionally run a greater risk of injury and death at the hands of Nigerian pirates than Somali pirates.

Fourth, many attacks are directed specifically at the fishing industry. Fishing in Nigeria is the second highest non-oil export industry in the country. Pirate attacks on fishing trawlers have reached the point where many fishing boat captains have refused to sail. Attacks range from minor harassment to theft of fish cargoes, engines and other material on board, financial shakedowns, and to the killing of fishermen. Nigerian pirates are increasingly reported to have effectively taken over the coastal waters of the country; and similar piracy problems are reported among fishermen elsewhere in the African continent. All told, Nigeria stands to lose up to $600 million in export earnings due to the piracy threats to its fisheries [16].

All predictions point to an increased rise in Nigerian piracy in 2013. Most of the pirate attacks are directed against smaller ships involved in oil exploration in Nigeria. Piracy is especially common in the Niger Delta region, the center of oil exploration and production activities in the country. These include supply and support vessels, barges and small security vessels. Attacks on general merchant cargo ships are still relatively rare, but could stand to increase as pirates in the region become more bold and able.

The wealth represented by the region's oil industry is significant, meaning the implications of increased attacks could be significant as well: Nigeria is the world's eighth largest exporter of crude oil, and one of the largest producers of highly-valued light sweet crude. The Gulf of Guinea region supplies more than 15% of the hydrocarbons imported by the United States alone, and by 2015 may supply more than 25%. This wealth, and the presence of a large number of foreign companies in the Delta, is a huge draw for those engaged in criminal activities.

### *3.3 On the horizon*

In addition to the known increases in maritime pirate attacks in Nigeria and the Strait of Malacca, there are a few regions of the world showing some signs of possible increases in piracy as well. Between January and April 2013, Vietnam, Bangladesh, India, Columbia and Peru are already showing attack figures equal to – or nearly equal to – their numbers for all of 2012. Others point to Haiti as an area of possible piracy/maritime criminal potential. While there have been no reported maritime crimes in Haiti though the first quarter of 2013, and only one to two attacks per year in recent years, the socio-economic conditions present there point to possible exploitation by maritime criminal elements.

It is, of course, too early to speak of "new trends" in these areas as the current and recent attack numbers are still too low; however, as one of our roles as maritime security analysts should be the ability to predict new areas of maritime criminal activity (as well as describe existing activity), these are all areas worth watching in the future.

## 4. ADDITIONAL CHALLENGES: MARITIME TERRORISM [17]

Ten global organizations have been identified as having maritime terrorist capabilities, or at least of having demonstrated maritime capabilities in the past:

al-Qaeda, Abu Nidal Organization, Abu Sayyaf Group, Basque Fatherland and Liberty, Hamas, Hizbollah, Jemaah Islamiya, Lashkar e-Tayyiba, Liberation Tigers of Tamil Eelam (currently defunct) and the Palestine Liberation Front – Abu Abbas Faction [18]. In addition, al-Shabaab, al-Qaeda in the Arabian Peninsula (AQAP), and the Abdallah Azzam Brigades, are known to be acquiring – or would like to acquire – maritime capabilities.

Despite earlier high-profile attacks – the Abu Sayyaf attack on *SuperFerry 14* in Manila Bay in February 2004, which killed 116 people, and the al Qaeda attacks on the *USS Cole* and *MV Limburg* – most maritime terrorist concerns seemed to have shifted to al-Qaeda-related affiliates, many of which operate in Africa. In February 2010, Yemen-based al Qaeda in the Arabian Peninsula (AQAP) stated it would coordinate with "Islamic fighters" from Somalia to secure both sides of the Bab al-Mandab strait, through which 30% of the world's trade passes annually. While there are doubts about AQAP's current ability to close the strait, both the Yemeni and Somali governments have urged the international community to take steps to eliminate AQAP and al-Shabaab "to avert the risk to the global economy posed by a seizure of Bab al-Mandab."

However, since these concerns were noted, the international community has witnessed a decrease in concern about maritime terrorist events; predictions about a "move to the sea" by groups such as al Qaeda in the Arabian Peninsula, al Shabaab, or Jemaah Islayiyah have yet to materialize and there has been no known direct maritime attack by al Qaeda since the *USS Firebolt* incident in the Persian Gulf. The most recent maritime terrorist event was the minor attack on the VLCC MV *M. Star* in 2010, attributed to the al Qaeda-affiliated Abdullah Azzam Brigades.

With maritime terrorism at a low point, many wonder how concerned the global shipping industry should be about maritime terrorism, particularly in a time of significant economic constraints. The answer, unfortunately, is that we should continue to be very concerned. A former UK First Sea Lord and Chief of Naval Staff deemed maritime terrorism "a clear and present danger" that may "potentially cripple global trade and have grave knock-on effects on developed economies." USN Captain Jim Pelkofski (Ret.) has noted that "indications point to an acceleration of the pace of maritime terrorism, heralding a coming campaign."

The real concern however is not so much that a maritime terrorist attack might or might not be imminent; rather the threat is the potential for harm were even one minor maritime terrorist event to occur in a major port or maritime facility. Hijacking and using a ship as a weapon or to sink and close a major shallow chokepoint such as the Strait of Malacca or the Suez Canal could have significant economic implications for the global economy. Similarly, an improvised explosive device (IED), chemical or biological weapon, or other weapon of mass destruction discovered in a container could have dramatic economic repercussions [19]. As recent events in Boston unfortunately show us, terrorist incidents do not have to be associated with know terrorist organizations; the "lone wolf" remains the most significant threat and the most difficult to locate in advance and apprehend.

## 5. MARITIME CRIMINALITY: WEAPONS, DRUG AND HUMAN TRAFFICKING [20]

An emerging area of concern for maritime crime is the expansion of known pirates and terrorists into other forms of illicit activity, such as drug, weapons and human trafficking.

Drugs are routinely shipped from all continents of the world, primarily to markets in Europe and North America. To give a sense of the scope and size of the problem, looking only at US Coast Guard figures for the United States from 1997 through mid-2012, the US Coast Guard (responsible for all US maritime drug interdiction) seized 806,469 pounds of cocaine and 333,285 pounds of marijuana, and accounted for 52% of all US government cocaine seizures [21].

Arms smuggling occurs freely and openly throughout many parts of the world as well, particularly in Africa and Asia, with the shipping industry wittingly or unwittingly carrying many of these illegal cargoes. For example, in Nigeria, it is already noted that criminal elements not only commit acts of maritime piracy, they are engaged in the arms trade as well. In support of this conclusion, a recent report commissioned by Royal Dutch Shell estimated that 10% of Nigeria's daily oil output (approximately 100,000 barrels) was stolen every day, worth approximately $1.5 million. This would buy enough weapons to sustain a fighting force for two months [22].

In addition to arms trafficking, maritime transport accounts for the majority of seizures and suspect shipments of military equipment, dual-use goods and missile technology to and from Iran and North Korea. Merchant shipping is also a primary means of delivering large shipments of heavy conventional weapons and military equipment to countries such as the Democratic Republic of the Congo (DRC) and Sudan. Additional studies have found that sea transport has been the primary means of illegal deliveries of small arms and light weapons to non-state actors in Colombia, Somalia and Sri Lanka [23].

Finally, human trafficking is another example of the criminal exploitation of the maritime industry, with women and children frequently transported across borders by sea. Trafficking in human beings is estimated to be the third largest criminal enterprise in the world, behind illegal drugs and arms trafficking, with between 600,000 and 800,000 people trafficked across international borders annually [24].

The modes of transportation used to traffic humans around the world are numerous and include transporting people across borders hidden in cars or trucks, as well as people trafficked into countries as stowaways or packed into shipping containers. Human traffickers are currently exploiting the maritime domain by using vessels as means to transport the victims of human trafficking. Smugglers and traffickers are also using passenger ferries as a way to transport people across bodies of water. They are hidden among crates to avoid detection from officials [25].

While of concern in and of themselves, trafficking in drugs, weapons and human beings are even more problematic when it is noted that they are all part of an increasingly overlapping "web of criminality" connected through the global maritime domain. Figure 2 shows these connections in explicit detail. The green lines show global cocaine routes; red routes connote the global trade in heroin; purple are pathways of illegal migrants, and yellow represent the routes used for trafficking in women and children.

It should be noted that many of these converge on known pirate areas such as Nigeria and the Strait of Malacca. At the same time – and even more significantly – is the number of these routes that are explicitly maritime, specifically linking global supply to demand in European and North American markets.

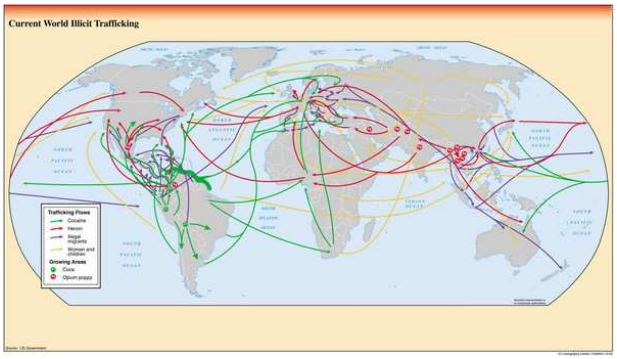



Figure 3 Current World Illicit Trafficking [26]

## 6. CONCLUSIONS

Maritime criminality will regretably always be a fact of life at sea, despite the current 2012-2013 downturn in global maritime piracy, particularly since the downturn is driven by the decline in Somali piracy; numbers are actually increasing in Nigeria and the Strait of Malacca.

Additionally, the potential for maritime terrorism still exists – particularly from the single, "lone wolf" acting without any affiliation with a current or known terrorist organization. At the same time, criminal elements are finding it increasingly lucrative to exploit the maritime domain for the transport of illicit drugs and weapons, and for human trafficking.

What is not yet fully known – but is increasingly suspected – is that many of the individuals involved in maritime piracy, terrorism and illegal trafficking are working together in an expanding "web of criminality." The criminal exploitation of the maritime domain, with all of its interlinkages between areas of criminal activity, is an area needing far more research and attention in the future.

## 7. REFERENCES

[1] INTERNATIONAL MARITIME BUREAU, *Piracy and Armed Robbery Against Ships*, 2013.
[2] *Ibid*.
[3] COMBINED MARITIME FORCES, *CTF 151: Counter-Piracy*, retrieved from http://combinedmaritime forces.com/ctf-151-counter-piracy/.
[4] Internationally Recommended Transit Corridor. Retrieved from: http://www.maritimesecurity.org.
[5] EU NAVFOR, *Somalia*, Retrieved from: http:// eunavfor.eu/mission.
[6] NORTH ATLANTIC TREATY ORGANIZATION, *Operation Ocean Shield*, retrieved from: http://www.mc.nato. int/ops/Pages/OOS.aspx.
[7] *BMP4: Best Management Practices for Protection against Somalia Based Piracy; Suggested Planning and Operational Practices for Ship Operators and Masters of Ships Transiting the High Risk Area*, Witherby Publishing Group Ltd, August 2011.
[8] ONE EARTH FUTURE, *The Economic Cost of Maritime Piracy*, 2011.
[9] LAZARTE, M., *Fighting piracy - ISO guidelines for armed maritime guards*, 14 March 2013, retrieved from: http://www.iso.org/iso/home/news_index/news_ archive/news.htm?refid=Ref1717.
[10] CNN, *Somalia's president wants partial amnesty for boy pirates*, February 28, 2013, retrieved from: http:// www.cnn.com/2013/02/28/world/africa/somalia-boy-pirates-amnesty.
[11] *Piracy and Armed Robbery Against Ships*, *op. cit.* See also, NINCIC, D., *Nigeria: The "other" maritime piracy*, Journal of Ocean Technology, 4(2), May 2009.
[12] AKINSANMI, G., *Nigeria*: *Nation Loses N25bn to Piracy*, Sea Robberies, 6 December 2008, retrieved from: *Allafrica.com*
[13] SIMPSON, S., *Turmoil in the oil-rich Niger Delta region is spreading out to sea as gangs in speedboats attack trading ships*, Christian Science Monitor, March 20, 2008, retrieved from: *csmonitor.com.*
[14] Nigeria: Piracy report says Nigerian waters the most deadly. *IRIN: Humanitarian News and Analysis*, 27 July 2004, Retrieved from: *Irinnews.org*.
[15] CNN, *Nigerian militants release photos of British hostages*, 12 January 2009, retrieved from: *CNN.com*.
[16] GABRIEL, O., BIVBERE, G., UGWUADU, I., *Renewed piracy attacks: Fish scarcity looms, Nigeria may lose $600m export earnings*, The Vanguard, 1 June 2008, retrieved from: Vanguardngr.com.
[17] See also, NINCIC, D., *Maritime Terrorism: How real is the threat*?, Fair Observer, July 16, 2012, http://www.fairobserver.com/article/maritime-terrorism-how-real-threat.
[18] US DEPARTMENT OF STATE, *Country Reports on Terrorism 2011*, 2012, retrieved from: http://www. state.gov/j/ct/rls/crt/2011/
[19] NINCIC, D., *Maritime Terrorism*, *op. cit.*
[20] See also, NINCIC, D., *Maritime Security in the Arctic: The Threat from Non-State Actors*, in Mercer, R. ed., *Proceedings of the 12th Annual General Assembly of the International Association of Maritime Universities*, St. John's, Newfoundland, Canada: Fisheries and Marine Institute of Memorial University of Newfoundland, October 2012.
[21] US COAST GUARD, *Drug Interdiction*, US Department of Homeland Security, (n/d.) http://www.uscg.mil/hq/cg5/cg531/drug_interdiction.asp
[22] *"Nigeria, Piracy Report," op. cit.*
[23] GRIFFITHS, H., JENKS, M., *Maritime Transport and Destabilizing Commodity Flows*, SIPRI Policy

Paper, Stockholm International Peace Research Institute, January 2012.
[24] US DEPARTMENT OF STATE, *Trafficking in Persons Report*, 2007, retrieved from: http://www.state.gov/documents/organization/82902.pdf
[25] McGILL, C, Human *Traffic*, London, UK: Vision Paperbacks, 2003.
[26] *Current World Illicit Trafficking*, retrieved from: http://decryptedmatrix.wordpress.com/2011/09/12/infographic-current-world-illicit-trafficking/.

# TOWARDS AN IAMU SIMULATOR SUITE: SIMULATION OF A BURNER ASSEMBLY REPLACEMENT AND LINE SNAPBACK USING UNITY3D GAME-MAKING SOFTWARE

[1]PEREZ-GRUSZKIEWICZ E. SERGIO, [2]KUMAR SHASHI, [3]BAUMGART ELWOOD, [4]RYAN JOHN, [5]LINDMAN WILLIAM

[1,2,3,4,5]*U.S. Merchant Marine Academy, USA*

**ABSTRACT**

In this work we use Unity3D game-making software for two simulations: the replacement of a fuel burner assembly on a marine boiler and line snapback. The burner assembly simulation is unique in that it requires a considerable amount of physical manipulation – in addition to shutting off the flow of steam and fuel, the clamping mechanisms holding the assembly must be unscrewed and manipulated downward, and the burner must be pulled out and properly oriented. The line snapback simulation will enable the student to set-up mooring and tow lines in a variety of configurations, and to see the effects of these configurations on the likelihood of line fracture/snapback. Our long-term goal is to build a suite of open-source training simulations in collaboration with other institutions.

**Keywords:** *Simulator, burner assembly, line snapback, game-making software, Unity3D.*

## 1. INTRODUCTION

At the 2012 IAMU conference we presented our simulator for the start-up of a steam turbine, made with Unity3D game-making software. The goal of the project was to demonstrate that Unity3D could be used to make realistic and useful PC-based simulators "from the ground-up".

At that conference we found some interest in the idea of IAMU institutions joining in making simulators for the training of professional mariners. Probably the most feasible way to do this is for institutions to make simulators independently, and to then join the simulators to make a suite of training tools. Another possible method of collaboration is for some institutions to create the 3-D (3-dimensional) artwork required and others to use the art-work for the creation and programming of the simulation.

For the upcoming IAMU conference we chose to create simulations for the replacement of a fuel-oil burner assembly, and for the factors influencing line snap-back. We hope to gain STCW approval for the burner assembly simulation, which would relieve us of some of the staffing problems caused by administering tests in this competency.

At the onset of the project we were uncertain if a task requiring as much mechanical manipulation as the changing of a burner assembly could be effectively simulated, but we have come to conclude that the simulation is an effective one that would well-train students for this task, and help them pass the STCW assessment.

The line snap-back simulation is to help train our sailors in this very important safety issue, with the goal of eliminating injuries. At the time of this writing the simulation is not completed, but we hope to do so by the time of the IAMU meeting and present our results there.

The making of any simulator requires two separate tasks: the creation of the 3-D artwork (for example, for the line snapback simulation we needed models of a tugboat and line-handling hardware), and the programming of the simulation (that is, to enable the user to click on 3-D objects and obtain a desired result, or to move around in 3-D space). In the following sections we will describe how we completed each of these tasks.

## 2. 3-D ARTWORK

There are numerous software products available for the creation of 3-D artwork. Products such as Maya and Studio 3DS Max cost thousands of dollars to purchase; in the right hands these products can produce 3D art of stunning realism. Other products such as Silo cost only about $120 per copy, and are still quite powerful. The freeware Blender can also produce beautiful and realistic 3D artwork, but has a steeper learning curve than the other products; in addition, the documentation is not as thorough as with the commercial products.

The choice of Studio 3DS Max was an easy one to make for this project, as the USMMA has a license for this product. This software was very easy to learn, and the documentation extensive. There are countless videos on YouTube detailing how to make almost any shape.

We estimate that the artwork for the burner assembly simulation was done in about 100 hours of work, much of which involved learning how to use the software. An experienced artist could have performed the same work in a fraction of the time – about 10 hours or less, and probably achieve a better result. This is the reason why most game-making studios have dedicated 3D artists on their staff.

The burner assembly artwork can be seen in figure 1, and consists of the burner assembly, the clamps holding the assembly in place, the pipes and valves, and the boiler itself. The warehouse-like building was purchased on the internet for about $20, and included the plastic boxes and storage shelf visible in the scenes.

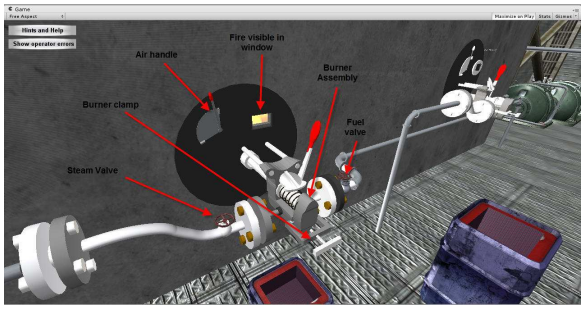



Figure 1 Burner assembly scene. These 3D objects were created with Studio3DS Max or purchased on the internet.

Figure 2 shows the 3D model of the tugboat used for the line-snapback simulation. This model was purchased from the internet for about $150. Some modifications with Studio 3DS Max will be necessary to the towing equipment on the aft deck in order to simulate a range of line tying scenarios. The money spent on this model was justified, as the authors of this paper could not have created artwork this realistic in a reasonable amount of time.

Figure 2 The tugboat model purchased for the line snapback simulation.

## 3. PROGRAMMING

Once the 3D artwork was available the simulation could be programmed. Both simulations were to be used as training and evaluation tools requiring no intervention from instructors – even the assessment of student performance was required to be automatically done by the software. The inordinate amount of time which would otherwise have to be spent performing the training and STCW assessment of the burner assembly replacement was a major driving force in the selection of the burner assembly for simulation.

Unity3D is arguably the most powerful game-making software product available on the market. As detailed in our previous work, Unity requires programming in one of two languages: Java or C#. We selected the Java platform because it is somewhat simpler and we were more familiar with the Java syntax.

The user of the burner assembly simulator must first select the proper safety gear from a list of protective clothing, otherwise a warning message will be created which will be visible to both the instructor and the user. Figure 3 shows the menu for this feature.

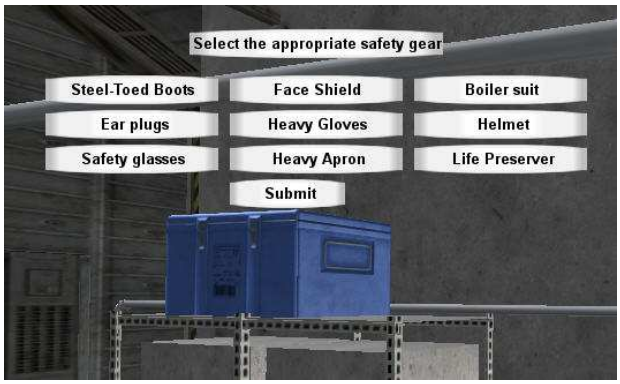



Figure 3 The user of the simulator must select the appropriate safety gear from the menu.

After selecting the proper protective gear, the user must close the fuel, atomizing steam and air valves. The proper sequence must be followed or a warning message will be displayed. Clicking on the valves makes a menu appear which permits opening and closing the valves as well as displaying the steam or fuel pressure. Please see Figure 4.

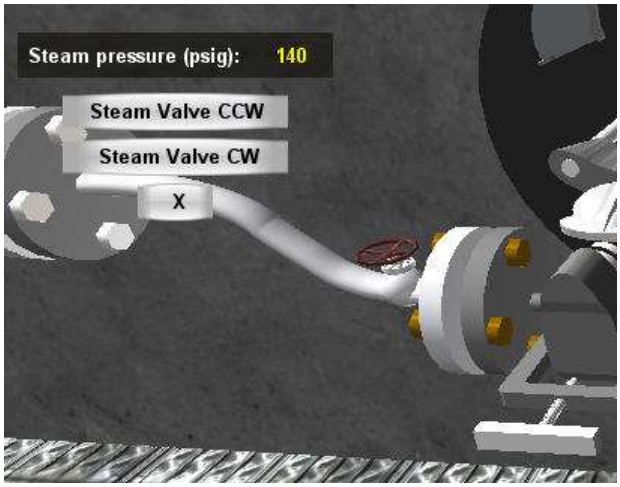



Figure 4 A menu appears when the steam or fuel valves are clicked, and the pressure displayed.

Once the valves have been opened, the user can remove the clamps which hold the burner assembly in place. This is accomplished by clicking on the clamp assembly. The screw holding the clamp must first be loosened by clicking on its menu item, after which the clamp can be moved down. Figure 5 shows the screw and clamp after moving into a position which will allow removal of the burner assembly.

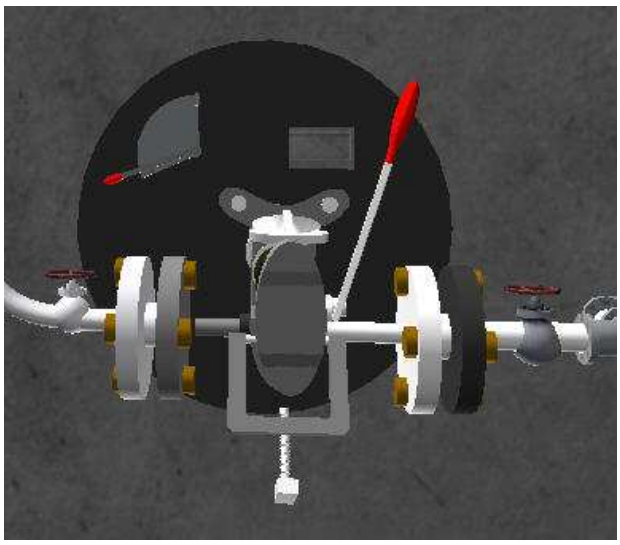


Figure 5 Clamp in the down position, allowing removal of the burner assembly

If the user neglects to shut off the oil or steam before loosening the clamp, the simulation will spray oil and steam on the scene. In this way, the simulator is superior to learning on the actual equipment, as exposing the student to spraying steam and oil could be impractical as well as unsafe. Figure 6 shows the spraying oil and steam.

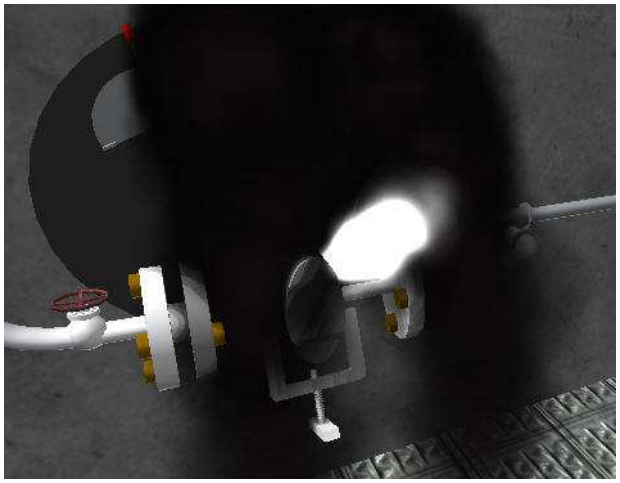


Figure 6 Steam and oil spray if the user neglects to turn off the flow of fuel and steam before loosening the burner clamp.

If the user closes the valves properly, he or she will be able to click on the burner in order to make appear the burner menu, which will allow the user to move the burner assembly out of the boiler, as shown in figure 7.

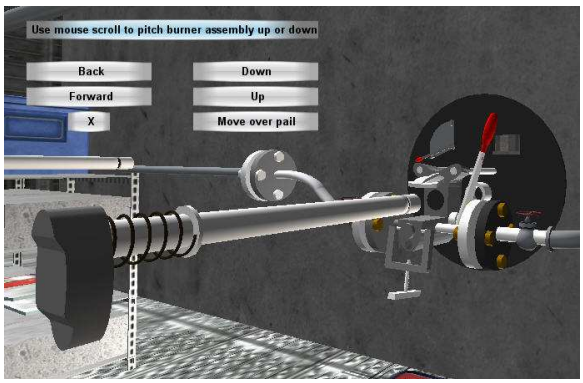



Figure 7 The burner can be moved using the burner menu. Here the burner has been moved out of the boiler, and is now ready to be placed in an appropriate container. Note the replacement burner in the background

Before the burner is moved it should be pitched up to prevent oil leaking on the deck, as shown in figure 8. Not doing so causes a warning message to appear. The burner is pitched up or down using the mouse scroll wheel.

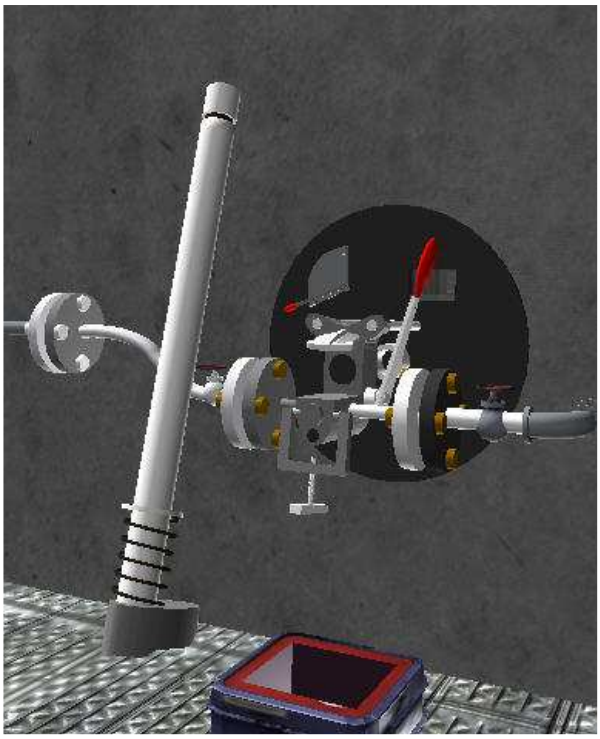


Figure 8 The burner assembly pitched up to prevent spillage of oil on the deck.

Once the burner has been pitched up, it can be moved over the storage container, pitched down, and then placed into the container, as shown in Figure 9.

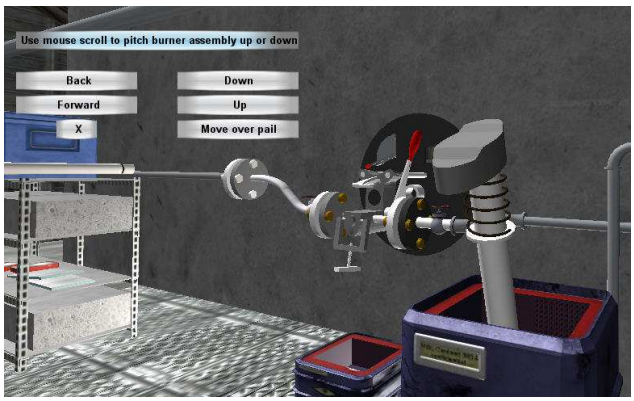



Figure 9 The burner assembly placed in its appropriate container

Finally, the new burner assembly can be placed into position and moved into the boiler. The steam, air and fuel valves then must be opened in the proper sequence to prevent a warning message from being displayed, and the flame is ignited automatically. Figure 10 shows the new burner assembly before moving.

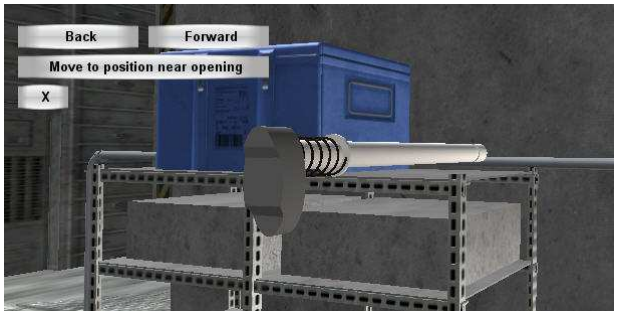



Figure 10 The replacement burner assembly before moving into the boiler.

## 4. CONCLUSIONS

We intend to submit the burner assembly simulation to the U.S. Coast Guard for approval to enable USMMA to use the simulation for STCW assessment. This will alleviate staffing problems caused by the time-consuming process of performing the assessment of this competency.

At the time of this writing the simulation has not been tested on students in order to determine the effectiveness of the simulation, but it appears that the burner assembly simulation can be a useful tool for the training and assessment of mariners. One anecdote has been offered by the programmer of the simulation, whose 10-year old daughter has learned from the simulation how to replace a burner. We expect to have some data on the effectiveness of the simulation by the time of the next IAMU conference.

The creation of a simulator of this type is not an overly onerous task, but it does require some time and dedication. Creating the artwork can be particularly time-consuming, especially for the inexperienced. Often artwork can be purchased on the internet which can greatly reduce the time and effort required. The burner artwork was created in about 100 hours, and the programming also done in about 100 hours.

The programming for this simulation was not very difficult. The Java language used by the Unity game engine is easy to work with, and the programming process has been made as simple as possible by the creators of Unity. Other more complex simulations such as bridge simulators or full engine room simulators would certainly be within the capabilities of Unity3D, but would be considerably more difficult to create.

Our final goal is to stimulate and join other IAMU members in creating a suite of simulators which can be used by all marine institutions free-of-charge.

## 5. ACKNOWLEDGMENTS

We acknowledge the support of Professor William Sembler, chairman of the department of marine engineering, as well as that of Captain George Edenfield, chairman of the deck department at USMMA. In addition we thank Ms. Alexis Ramos and Ms. Maria Hansen for their continuous and unwavering support.

# REFORMATION OF MARITIME ENGLISH INSTRUCTION IN CHINA UNDER MANILA AMENDMENTS

[1]REN LUZHEN, [2]YU JINREN

[1,2]*Jimei University, China*

**ABSTRACT**

The Manila Amendments have established stricter, more unified standards for global crew training, certificating and watch keeping. With respect to the seamen' English competency, the Manila Amendment puts forward new requirements, including the promotion of English communication ability, company's responsibility towards the allocation of the seamen' duty. Low ability to communicate with foreign seamen in English became a key restrict factor for Chinese crews walking to international labour market. Therefore it is significant to analyze the problems and look for solutions that could be taken to improve Chinese seafarers' marine English for communication. This paper abstracts some new standards from STCW78/10 Amendments, analyses the present situation of maritime English teaching in China and finds that measures, such as optimizing the allocation of marine English instructor, setting teaching content specifically, improving teaching methods, reforming the assessment mode, creating good English learning atmosphere, should be taken to improve English communication ability of Chinese crews.

**Keywords:** *the Manila Amendments, marine English instruction, communication, Chinese seamen.*

## 1. INTRODUCTION

In the highly globalized international shipping context, the STCW Convention has been regarded as one of the most important conventions adopted by International Maritime Organization (IMO). After the implementation of STCW78/95, with the economic globalization, ships trend to be huger, more-specialized and high-speed. This requires stricter marine environment protection. Meanwhile, deeper and broader application of new technology requires higher standard of maritime training and watch keeping. Furthermore, the serious pirates' attacks become strong challenges to the maritime security, this as well requires higher standard.

The IMO, on the basis of factors mentioned above, after more than four years' complete modification and deliberations, convened the Manila Conference to officially adopt the Manila Amendment of STCW78/95 (hereinafter referred as "Manila Amendment"), establishing stricter, more unified standards for global crew training, certificating and watchkeeping. This will inevitably play a more important role in protecting the safety of life at sea, maritime security and marine environment.

With respect to the seamen' English competency, the Manila Amendment puts forward new requirements, including the promotion of English communication ability, company's responsibility to allocation the seamen' duty and official start of the SMCP (Standard Marine Communication Phrase). As an important communicative tool, maritime English differs from Basic English by its professional specialty and un-replaceable feature. But certain investigation shows that low ability to communicate with foreign seamen in English become a key restrict factor for Chinese crews walking to international labour market.

This paper, by using qualitative research methods including analysis, comparison, statistic, etc., abstracts some new standards from STCW78/10 Amendments; as well analyses the present situation of maritime English teaching in China and finds that the allocation of teaching resource does not satisfy the need of English teaching, the content is not reasonable to certain extent.

## 2. NEW REQUIREMENTS OF MANILA AMENDMENT AS REGARDS SEAMEN'S ENGLISH COMPETENCY

With the rapid development of world shipping and promotion of internationalization of seamen, seamen's English communication ability, as well as their effective communication ability are crucial. The IMO poses some new requirements or standards in the Manila Amendment against the internal requirement to seamen's English competency under new situation.

### *2.1 Shipping Companies should ensure their seamen have good ability of oral communication*

In A-l/14 of the Manila Amendments, paragraph 7 says "at all times on board its ships there shall be effective oral communication in accordance with Chapter Ⅴ, regulation 14, paragraph 3 and 4 of the International Convention for the Safety of Life an Sea, 1974 (SOLAS), as amended". This new standard requires the shipping companies to modify their standard of seafarer training quality system and join in the assessment of seafarers' English communication ability. This directly concerns the quality of Chinese graduates majoring on navigation and their prospective of employment. According to this new standard, navigation graduates should have the ability of oral English

communication, which poses higher requirements on Chinese maritime English instruction.

*2.2 Seamen's Ability to Keep Effective Communication with VTS*

In Table A-II/1, "Navigation at the operational level", under column of competency to "maintain a safe navigational watch", a mandatory standard of "The use of reporting in accordance with the General Principles for Ship Reporting Systems and with VTS procedures" is added. Meanwhile, in Table A-II/2, "Navigation at the management level", under column of competency of "Plan a voyage and conduct navigation", it is newly required to ensure reporting in accordance with the general principles for Ship Reporting Systems and with VTS procedures. In the procedure of using VTS, the Manila Amendments delete the pre-used Standard Marine Navigational Vocabulary and officially and completely start the usage of Standard Marine Communication Phrase which is simpler, more effective, more normative and standard than the former; and is helpful for the VTS centre to the effective communication in terms of inquiring navigation situation, reminding vessels to comply with the route regulation and publication of weather warning. However , because of the different language used in various VTS, it is natural to use English as communicating language which requires higher ability of synthetic application of English and oral communication.

Besides, under the column of "Bridge Resource Management", the Manila Amendments added paragraph 2 of "effective communication" and accordingly set up the standard of competency assessment, i.e. "Communication is clearly and unambiguously given and received". This is the first time for the Manila Amendments to set the standard of "unambiguity" of effective communication which the main implication is the quality of such communication, and is of higher requirement than that of "understood" in previous STCW78/95.

*2.3 Emphasizing seamen's English communication ability of effective communication*

In Table A-VI/1-4, an item of "Contribute to effective communications on board ship" is added, which requires that seafarers should have not only the ability of regular working conversation but also the ability of team cooperation and routine communication. As to the specific standard of competency, it requires that seafarers could "understand the principles of, and barriers to, effective communication between individuals and teams within the ship"; "establish and maintain effective communications". The realization of this new requirement depends in large on English as a vector which means good oral English communicative strategy and pragmatic competency of seamen. This concerns two subjects of "Navigational English Listening and Speaking" and "Navigational Trans-cultural Communication". It requires as well revising the existing curriculum system of marine English, their teaching contents, the syllabus and assessment guidelines in time to meet the requirement of the Manila Amendments.

*2.4 Enhancing seamen's actual application of English while working on board*

Under the part of "Goals of an ECDIS training programme" in Manila Amendments, "The ECDIS trainee should be able to … state the potential errors of displayed data and the usual errors of interpretation, and explain why ECDIS should not be relied upon as the sole reliable aid to navigation". Meanwhile, in section A-VIII/1, it is required that "the schedules shall be established in a standardized format in the working language or languages of the ship and in English".

This new requirement shows that the seafarers should have the ability of effectively and synthetically applying English under working context. Therefore, in the course of marine English instruction and training students should be required to be able to apply English to resolve problems when working, by means of simulation, to promote their application ability to meet the new standard.

## 3. PROBLEMS OF EXISTING MARINE ENGLISH INSTRUCTION IN CHINA

*3.1 Un-satisfaction of allocation of teachers to the needs of professional English education*

In present Chinese marine English teaching, majority of the marine English education is undertaken by those teachers with little or without any maritime background, which sometimes leads to simple translation or interpretation of professional knowledge. Some of the teachers, at the same time, undertake the Basic English and marine English education. The heavy work results in that they do not have enough time and spirit to trace and research the development of professional knowledge, let alone to improve the way of teaching English for Specific Purpose (ESP).

It is originally required that two different teaching methods should be utilized respectively for Basic English and professional English. The rapid shift from one kind of teaching method to another is quite hard for teachers taking Basic English and professional English simultaneously. This definitely leads not only to inadequate demonstration of systematic language and cultural knowledge in Basic English teaching but also the shortage of cultivation of application ability of professional language in marine English teaching.

*3.2 Unreasonable setting of teaching content*

With the rapid development of shipping industry, navigational instruments and equipments, together with navigational technology and relevant conventions are continuously updating, whereas the present textbook of marine English in China seldom catches up with such changes as STCW, ISM, ECDIS, BRM and so on. Some of the contents of the textbook have no relation to the actual situation.

Another problem concerning this aspect is more attention being posed on reading while less on listening and speaking. As it is well known, seamen's professional character determines they should have the ability of English listening, speaking, reading and writing. As a working language, English should originally be applied to the routine communication. In order to ensure the navigational safety and the practice, seamen's English ability should firstly satisfy the communication. The present situation, however, is that more and more attention is put on the reading of marine English. Moreover, reciting the marine new words and expressions becomes the main task of marine English teaching for the purpose of passing the relevant competency exam.

### *3.3 Phenomenon of exam-oriented education in marine English teaching*

Now marine English in China is one of the subjects which are necessary to take exam for the competency certificate of seamen. Majority of maritime universities or colleges, therefore, put the passing rate of exam as the important referencing indicator to assess and judge the departments or teachers, by which makes the "passing rate" the common goal of teachers and students. So teachers spend much of their tim with all kinds of ways or modes, searching for the latest and most complete question bank, demonstrating and interpreting to the students; meanwhile students spend most of their time reciting the question bank and its answers. Although majority of students pass the competency exam, their English ability is still not truly upgraded so that could not be competent for their working on board after graduation.

## 4. SUGGESTIONS TO REFORM THE MARINE ENGLISH INSTRUCTION IN CHINA

### *4.1 Optimizing the allocation of marine English instructor*

Regarding the advantage and disadvantage of whether the course of marine English is delivered by maritime specialized teachers or by Basic English teachers, the authors' point of view is that maritime specialized teachers have abundant on-board experience; therefore they have more advantages on marine professional knowledge, whereas the Basic English teachers have their obvious strengths on pronunciation, grammar, new words and expressions etc. According to the "marine English database" established by Foreign Language College of Dalian Maritime University (DMU), only 3% of most frequently used marine English words are not included in the vocabulary of CET-4, showing that majority of marine English words is the maritime professional implication or abbreviation of Basic English words [Xiaoling, Z, 2001]. The recent revision of the competency examination outline focuses more on inspecting students' maritime professional knowledge in English. Thus the author suggests that the incorporation of maritime professional teachers and Basic English teachers as a team be taken into consideration as to the allocation of marine English teachers, picking those with comparatively higher English ability among maritime professional teachers and enhancing their English, choosing those with certain navigational knowledge among basic English teachers and training. By doing so, it facilitates the inter-complement and learning from each other in teaching. Meanwhile, Basic English teachers should retain enough time to learn or update their navigational knowledge by means of undertaking as less Basic English teaching task as possible.

### *4.2 Specifically setting the teaching content*

At present, the institutes engaging navigational specialization education in China generally are three-year collages or four-year universities, which normally provide 1-2 years marine English learning. According to Chinese Rules on Seamen's Competency Examination, Evaluation and Certification, regardless of undergraduate or collage education, students would not get the competency certificate of third officer or fourth engineer until the date of 12 months sailing practice after passing the competency examination, change for competency certificate of second officer or third engineer until 12 months duration as third officer or fourth engineer, and then take part in competency examination of chief officer or second engineer after serving on board for more than 12 months as second officer or third engineer. Normally at least 36 months (usually longer than this period in practice) is needed for a graduate to become a management level seafarer. Therefore, marine English instruction should first meet the competency requirements to crews at operational level. Against crews' position responsibility, principle of "listening and speaking first, following by reading, and supplement of writing" should be established. At the mean time when Manila Amendments' requirements to operational level crews are satisfied, in lessons for listening and speaking, teaching content is set by mainly referencing of SMCP and all kinds of working situation of operational level; in lessons of reading, part of the content of management level might be added. In the case of inadequate time for marine English learning, writing lessons might not be arranged for collage students or put it in selective course.

### *4.3 Improving teaching methods*

What marine English instruction faces is the shipping industry which is characterized with its extremely strong practice, and university students without any practice experience, thus there must be certain innovation of teaching method. Situational teaching, on-site teaching and simulation teaching are very effective teaching methods. For example, arrange different working scenarios like cargo handling and PSC inspection and let students perform various roles; apply method of on-site teaching and picture display method in the course of ship's structure and equipments; utilize simulator to simulate the scene of avoidance coordination in sailing and VTS reporting. In order to improve teaching effectiveness, the traditional teaching method should be broken, replaced by flexible and

different teaching methods. This requires deep research by undertaking teacher of marine English instruction, as well needs the strong support of the institutions.

*4.4 Reforming the assessment mode*

The assessment mode of present marine English instruction is basically the paper exam (summative exam) in the end of the course, which has been weakening by competency certificate examination. This assessment mode is obviously not appropriate especially for lessons of listening or speaking, which could hardly reflect the true ability of students. The formative assessment is a relatively scientific mode of assessment which focuses on supervising and assessing the learning process of students. The assessment of marine English instruction may be suggested being divided into three categories: assessment at ordinary time, periodic assessment and final exam. The weight of each category could be 20%, 30% and 50% respectively. In the end, take about three assessments in synthetic consideration to get the final achievement of the subject. This mode of assessment can monitor the whole process of students' study and can more objectively reflect students' extent of endeavour and real level in marine English.

*4.5 Creating good English learning atmosphere*

The accumulation of maritime knowledge does not rely only on the textbook, which is as well the case on marine English learning. Maritime universities or colleges need to create good English learning atmosphere in campus or routine life. For example, maritime teachers introduce marine terminologies or expressions in English when delivering professional lessons; each level of universities or colleges demonstrates all kinds of navigational issues with English etc. Rich variety of activities can form good language environment to push students to actively speak English, thinking by English way.

## 5. CONCLUSIONS

Lower English ability is all the time one of main obstacles restraining Chinese crews walking to the international market. With the enforcement of Manila Amendments, the requirement of seamen's English ability the shipping market requests is further upgraded. There exist some weaknesses or problems to Chinese marine English instruction which need to be innovated. In order to improve marine English teaching level, cultivate more qualified, good seafarers satisfying shipping market's demand, Chinese maritime universities or colleges should take active, innovative actions including but not limited to the following: optimizing the allocation of marine English instructor, setting teaching content specifically, improving teaching methods, reforming the assessment mode, creating good English learning atmosphere.

## 6. REFERENCES

[1] HUTCHINSON, T., WATERS, A., *English for Specific Purposes* [M], Cambridge University Press, 1987.
[2] WEIHUA, L., JUNZHONG B., *The Connection of College English and Marine English Education* [J], Navigational Education Research, 2007.
[3] XIAOLING, Z., *Reforming Assumption of Maritime English Education* [J], Navigational Education Research, 2001.
[4] ENHONG, L., *Interpretation of the Manila Amendments to STCE Convention* [J], World Shipping, 2011.

# MANUAL DRAFTING AND CAD TEACHING TECHNIQUES FOR THE REQUIREMENTS OF THE CURRENT STCW

RODGERS POLLARD JOHN

*California Maritime Academy, USA*

**ABSTRACT**

Current STCW requirements require manual and CAD skills in mechanical drafting, which presents a unique set of challenges for Marine Engineering Technology programs that seek to prepare their students for licensure. Limited by a compressed academic schedule, how can a large engineering technology program provide its students with comprehensive training for such a diverse set of hands-on skill in such an unfamiliar area? The MET department at the California Maritime Academy has developed a distinctive mechanical drafting program that provides comprehensive training in manual drafting and CAD skills, for STCW requirements, in just one semester. This program has successfully prepared up to 100 students a year for STCW licensing and for the robust challenges of the student's future Marine Engineering career. The purpose of this presentation is to outline the structure, methods, and pedagogical techniques implemented in this program.

**Keywords***: MET, 3D, CAD, SolidWorks, drafting course.*

## 1. INTRODUCTION

The teaching of a maritime academy cadet machine drafting using either manual drafting or CAD skills within one semester, in their freshman year, is a full challenge. The majority of incoming students do not have any previous drafting experience during their high school education. Cursive writing techniques are no longer taught in the high schools. Without this type of experience, without fine motor skill and hand-eye coordination required for manual drafting, the incoming maritime academy cadet is in for a difficult challenge. The teaching and exposing of CAD techniques to the students is also a large task. However, with the proper tools, techniques and approaches, the overall task can be accomplished in a way that is meaningful and appreciated by the student and the instructor. This paper discusses the outline of the course. It discusses the challenges, pitfalls, and costs of the course as well as the grading and assessing of the students work. The purpose of this paper is to give insight into these difficulties and provide teaching techniques that develop and improve the Cadet's manual drafting and CAD skills, both for the purpose of STCW requirements and for the Cadet's marine engineering career opportunities and challenges. The topics covered will include:

- Our unique project-based curriculum
- Materials and costs
- Text books
- Skills-based learning
  Manual drafting techniques
  Fine motor skills, line quality
  Lettering
  Software training
- Overcoming common difficulties
- Implementation of technology in the classroom
- Assessment and grading

## 2. PROJECT-BASED CURRICULUM

Because of the short timeframe of the course, the drawing projects need to progress to the drafting of identifiable, tangible objects, from the start of the course. Therefore, basing the course around an object or project that is realistic and not abstract is the key goal.

The main body of the course focuses on the drafting of three pieces of equipment. These are:

- A machinist clamp, using manual drafting techniques.
- Parts of an angle drive reduction gear unit, using CAD techniques.
- A piece of equipment or a tool, using scale, manual drafting. The class discusses and chooses the piece of equipment and it must be a piece of equipment or a tool that has a specific purpose, either on the training ship, T/S "GOLDEN BEAR" , on the California Maritime Academy campus or in the local community.

These three drawing exercises focus on teaching the basic techniques of manual drafting and of CAD, during the progress of completing the drawings. The Cadet thus learns basic manual drafting and CAD procedures as the Cadet draws the object and sees the results of producing a tangible piece of equipment, a tool or a machinery part.

### *1.2. The Machinist Clamp*

The machinist clamp is the first drawing the Cadet attempts. It represents a recognizable machine shop tool that can be drawn easily full scale on "A" size paper, i.e., 8-1/2" x 11" paper. The Cadet is given the dimensions of the clamp parts. The clamp drawings consist of threads, rounds and machined surfaces and angles.

See Figure No. 1. Orthographic or multi-view drawings are made of the clamp jaws and screws on two drawing sheets. This teaches centering of the drawing, line drawing technique, drawing of threads, use of full scale and measuring, use of a circle template, dimensioning and arrows, lettering and inking technique. See Figures No. 2 and 3.


Figure 1

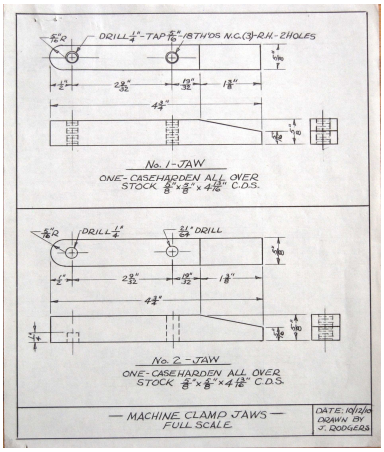



Figure 2

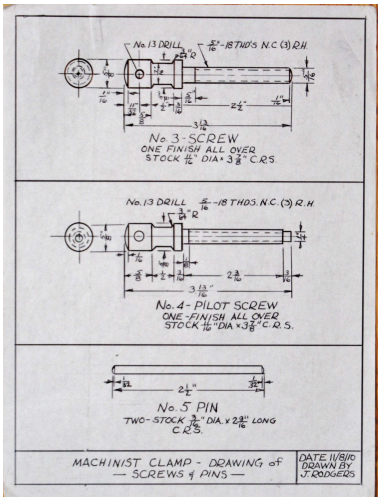



Figure 3

The third drawing sheet is of the assembled clamp. This teaches drawing of the assembled clamp to full scale, using all the given dimensions. It teaches the use of sectional cross-hatching. It teaches the use of item numbers and leader lines. See Figure 4.

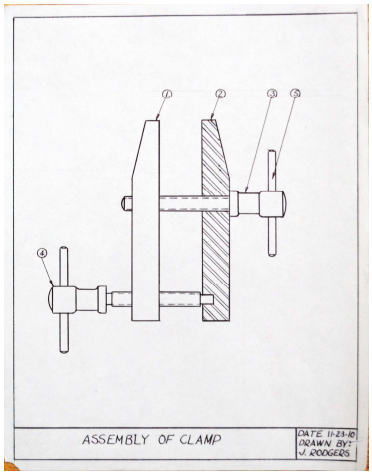



Figure 4

*2.2 Parts of Angle Drive Reduction Gear*

The CAD program SolidWorks is used to draw parts of an angle drive reduction gear unit. The instructor gives basic instruction on the drawing tools and features of SolidWorks. The class of Cadets is then divided into teams and each team is assigned one part of the reduction gear unit. Each team works as a group and, using the text book as a guide, produces both a drawing of the part and a written procedure of the keystrokes to complete the part. The teams then present their drawings and procedures as class presentations. In the presentations, the SolidWorks drawing tools and procedures are discussed by the Cadets. See Figure Nos. 5, 6 and 7.

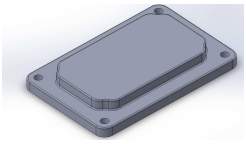


Figure 5

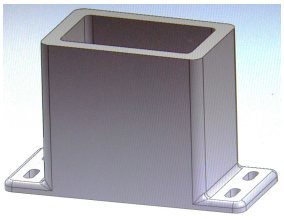


Figure 6

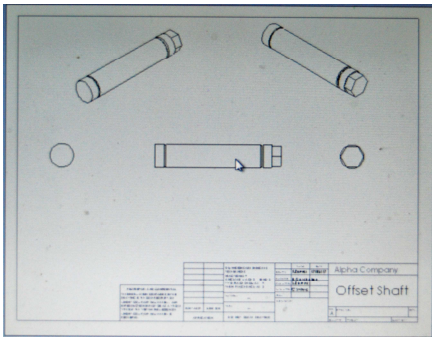



Figure 7

Because of the time constraints of the semester, the overall goal of using a 3D CAD program, such as SolidWorks, is not to complete the reduction gear unit.

The purpose is to give the Cadet confidence in learning and mastering an advanced CAD program.

*2.3 Scale Project Drawing*

The scale project drawing consists of drawing a piece of equipment that is to be used in the operation of the training ship T/S "Golden Bear". Or the item may be used on the California Maritime Academy campus or in the local community. The drawing is then used by the Advanced Welding or Machine Shop Class and the item is fabricated and installed for use. An example of a successful scale project is a "Training Valve Rack" that was designed for the Power Lab of the T/S "Golden Bear". See Figure No. 7 and 8.

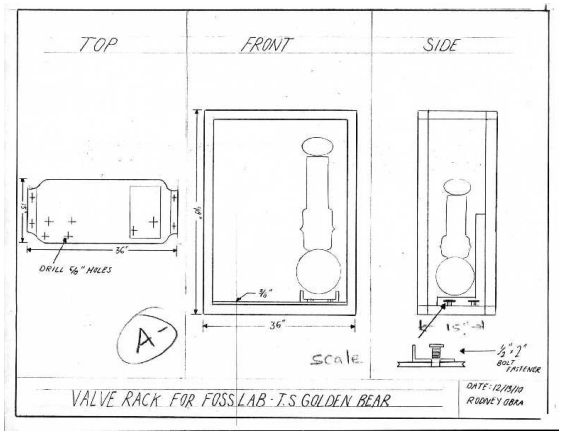



Figure 7

Figure 8

## 3. MATERIALS AND COSTS

Materials and costs required for teaching the manual drafting and CAD course are significant. Careful consideration of drafting tools, manual drafting techniques and also the choosing of a CAD program is critical to the overall success of the course.

*3.1 CAD Materials and Costs*

The major cost of conducting this course is having a computer classroom to conduct the CAD portion of the class. At the California Maritime Academy, four sections of the course are taught in the fall semester and each section has a total of approximately 20 to 25 Cadets. A classroom of 25 computer stations is used for the course. The next major cost of the course is securing a CAD program yearly subscription. The computer classroom computer stations will each require "stand-alone" programs. Educational subscriptions for stand-alone CAD programs may be purchased at large discounts. However, a yearly subscription cost of a 100 seat CAD program, the educational version, will be approximately $3,000 USD, minimum.

*3.2 Manual Drafting Materials and Costs*

The drafting tools for conducting the manual drafting portion of the class are:

- Compact Drawing Board, 11" x 12", with drawing mat surface
- Compact T-Square, 12" blade and 9" head
- 30/60 Triangle, 6"
- 45/90 Triangle, 8"
- Architect Scale, triangle type, 12"
- Circle Template, 1/16" to 1-1/2"
- Compass, small, type that allows a ball point pen to be used.
- Soft Eraser, white plastic type or rubber type
- No. 2 pencil
- Pencil sharpener
- Ball Point Pen
- Typing paper, 8-1/2" x 11"
- "White-Out" correction fluid

Typically, a suitable compact drawing board is not available from any supplier. See Figure No. 9.

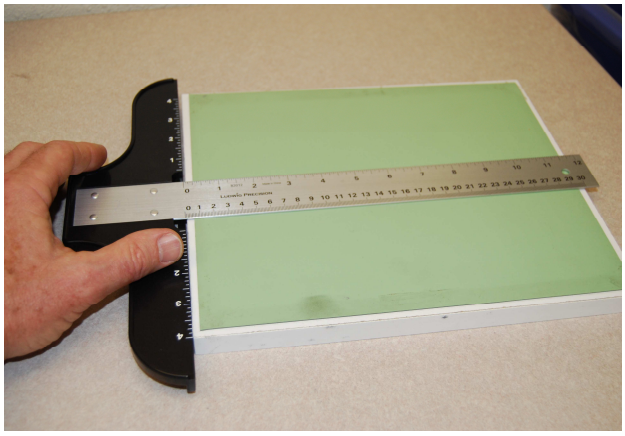


Figure 9

It is also beyond the Cadet's resources to fabricate such a board, as shown in Figure No. 9. Therefore, at the start of the course, the Cadet is loaned a compact drawing board and T-square, supplied by the Academy. This is done thru the Academy Library. Also, using a compact T-square and drawing board allows the Cadet to carry the T-square, the drawing board and all drafting tools in his or her backpack. Available 8-1/2 x 11 inch typing paper fits the compact board. The board may be carried easily to the engine room of the training ship for drawing machinery systems. The drawing board is made from a 12"x24" 'RubberMaid' Formica-covered shelf, bought at the local HomeDepot for $5.50. The shelf is then cut in two to make two boards. A drawing board surface "mat" is double stick taped to the drawing board.

The cost of the mat is approximately $3.50 USD per board. The cost of the T-square is $7.50 USD. The mat and T-squares are purchased from the Hearlihey Company, a division of the Pitsco Education Corporation. The remainder of the drafting tools are required to be purchased by the Cadet and may be easily purchased at the Academy Bookstore or a local art store.

## 4. TEXT BOOKS

The choice of text books for the course must be narrowed by choosing books that are reasonably priced for the benefit of the Cadets as well as being suitable for the course objectives. The two text books chosen have notably realistic drawings of equipment or tools and are notably void of abstract examples. The two text books that are required for the course are:

- Instructional Workbook for Drafting, 4th Edition, by Paul Wallach and Dan Hearlihy, Cost - $8.95 USD
- Beginner's Guide to SolidWorks 2013 – Level 1, by Alejandro Reyes, Cost - $34.00 USD

## 5. SKILLS-BASED LEARNING

Using realistic drawing examples, in lieu of abstract drawing examples, and having a project-based curriculum, keeps the course moving and keeps the attention of the Cadet. Using skills-based learning also helps focus the Cadet to constantly improve his drafting skills. It can be compared to teaching carpentry. If you have the student carpenter build a saw-horse or a birdhouse, they learn the skill required to handle the lumber, use each tool, measure, saw, hammer a nail, etc. The same approach is used in teaching the drafting course, and the focus is to ever improve the Cadet's skills.

### *5.1 Manual Drafting Technique, Line Quality, Lettering, Drafting Skill*

The manual drafting technique employed for the course is a unique and simple method. It uses a readily available No. 2 pencil and a common black ball point pen. This method was chosen due to the fact that drafting pencils and inking equipment is difficult to find and expensive. The use of traditional drafting pencils and inking equipment is time consuming. The method that is employed is easy to learn and fast to produce a drawing. It produces a drawing that is professional looking and clear to read. A drawing, using this method, produces an 8-1/2" x 11" drawing that can be copied, faxed, scanned, mailed or readily exchanged person to person.

The technique is simple. The drawing is first sketched out, very lightly, using a sharp, No. 2 pencil. Lines are drawn, dimensions are drawn, lettering is completed, all using the lightest pencil lines, with the lightest of touch, to complete the drawing. A ¼ inch width border is drawn around the drawing and a title block, ¾ inch, is drawn at the bottom of the drawing, all with light pencil lines. Drawing, in light pencil this way, allows the Cadet draftsperson to make and correct any errors. It allows the Cadet to draw and use guide lines and reference lines, and to layout and space lettering, all without worry or wasting time. Lastly, when the pencil drawing is correct and to the satisfaction of the Cadet, it is then "inked", using a ball point pen. The best pen to use is the least expensive, most common, and with a black ink. This is the type found in stores, such as a "Bic" pen. Having a drafting surface "mat" under the drawing sheet is important, as it helps the pen ball point "glide" and produces an even line quality. If the "mat" drawing surface is not installed on the board, then two sheets of blank paper, underlying the drawing, may be used with roughly the same benefit.

In inking the drawing, a constant pressure is applied when making the lines and the line is made with a continuous motion, with the pen held at a constant angle. The pen ball point is kept a slight distance away from the straight-edge, by holding the pen at a slight angle to the straight-edge. This keeps the ball point "rolling" and does not allow the ball point to catch or blot. The ball point pen is wiped of excess ink, before each line is made. The ball point should be "warmed up" before using, by making lines or "doodles" on a piece of scratch paper. Doing this prevents excessive ink blotting on the drawing and improves the drawing quality.

Making different line width is accomplished by changing the pen angle to the straight edge. Then a second or third pass is made over the line, as the width of the line requires. There are basically two line "weights" required. A "heavy" or wide line is used for object lines, border lines and title block lines. A "light" or narrower line is used for dimension lines and item leader lines. Lettering and dimension arrows are made, using the same pen, using a "heavy hand" pressure. Lettering and arrows, done properly, may be done with single strokes or passes of the ball point. Finally, when all inking is completed, the drawing is gone over with a white plastic or rubber eraser, removing all pencil lines, smudges and dirt marks. A clean, "inked" drawing emerges.

Inking errors may be corrected or drawing modifications may be made on the drawing by using "White-Out" correction fluid. Another method is to blank out the drawing portion not wanted, using a blank paper insert, taped to the drawing. The drawing and blank paper insert is then photo-copied. The photo-copy edition then becomes the drawing and the correction or modification is made to the photo-copy edition. The scale of the photo-copy edition is 99% accurate and well within drawing tolerances.

The use of this method of manual drafting requires practice by the Cadet to prefect his or her skill. It requires fine motor skill, hand eye coordination, and a level of focus. However done with proper training and done properly, it produces a clear and professional appearing drawing that the Cadet takes pride in and appreciates a new skill learned.

### *5.2 Software Training*

The teaching of a 3D CAD program, such as SolidWorks, within a short time period is a difficult event, unless done properly and with preparation.

However, the majority of Cadets come with an advantage. They have pre-disposition to computers and are natural computer operators and self-learners. They naturally take to the challenge of learning the CAD program. They take up the challenge of learning the CAD program and proceed to take instruction from the text book. They proceed to complete the drawing and do so with appreciation. Choosing an inexpensive, hard copy text book that is project and skills-based is key to their rapid learning.

Choosing which CAD program, SolidWorks, AutoCAD, Sketch-UP, Visio, etc., is based on the Instructor's preference and experience. The choice of an advanced CAD program, such as SolidWorks, for the CMA drafting course, was made based on the fact that by learning and mastering the SolidWorks program, it teaches the Cadet the confidence that allows the Cadet to master any CAD Program.

## 6. OVERCOMING COMMON DIFFICULTIES

Because manual drafting and lettering is most foreign to the majority of the Cadets, the most difficulty occurs in the manual drafting portion of the course. Difficulties in the CAD portion of the course are of less frequency. It is therefore important to make the manual drafting knowledge, a prerequisite to the CAD knowledge that the Cadet learns. Proper teaching techniques, grading, and the teaching pace of manual drafting knowledge is very important and must be done with care to make the Cadet confident and have pride in his or her drawing skill and work.

### *6.1 Manual Drafting - Lettering, line quality, arrows and proper dimensioning*

The block lettering required for manual drafting is difficult for most Cadets to initially learn. It is important to start the Cadet practicing block lettering from the very first day of the semester and for the Cadet to keep practicing until perfected. Every letter stroke is important and should be checked by the instructor. Any poor quality lettering strokes must be called out and the instructor must insist that the Cadet correct any incorrect lettering. Line quality and proper dimension arrows must be taught carefully from the start and must be checked point by point by the instructor from the start of the Cadet's learning process. Proper dimensioning and the drawing of arrows must be standardized using professional drafting standards, such as ASME/ANSI. Completing the Cadet drawing exercises in class, as much as possible, helps keep track of the Cadet's progress. The Cadet appreciates the Instructor's engagement in the learning process and the Cadet's homework load is lessened. Also having the Cadet do the exercise in class, allows the Instructor to correct the Cadet's drafting errors as they happen and not allow the errors to compound and collect in the Cadet's drawing.

### *6.2 CAD Training Difficulties*

CAD training difficulties consist mainly of finding a proper teaching technique and a proper CAD text book. Having adequate time to cover CAD techniques is also difficult due to the short timeframe. Having a hardcopy textbook allows the Cadet to read the text book beside the computer and directly key in the strokes in the SolidWorks program, on the computer. Some training programs are computer and subscription based, but these are too complex to facilitate and require two computer monitors, per Cadet. Starting the manual drafting portion of the course, immediately at the start of the semester, allows more adequate time to complete the CAD portion of the course, with adequate time. Basically a half and half proportioning of the manual drafting and CAD is ideal for the course, and should be strived for by the Instructor.

## 7. IMPLEMENTATION OF TECHNOLOGY IN THE CLASSROOM

The class size of the course necessitates the use of a screen projector and screen. PowerPoint presentations are used to teach drafting subjects, such as orthographic and isometric projection, threads and dimensioning.

A major teaching tool for teaching of lettering and the manual drafting techniques is the use of a document projector. The Instructor uses an EPSON Model ELPDC11 Document Projector. See Figure Nos. 10 and 11.

Figure 10

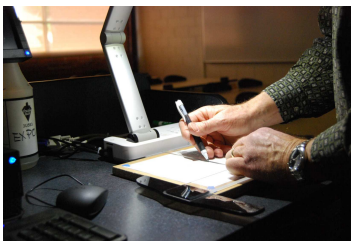


Figure 10

The use of the EPSON Document Projector allows the Cadet to watch, on the classroom screen, the individual drawing strokes of the Instructor, as the Instructor demonstrates the manual drafting technique of pencil sketching and inking. This allows the Instructor to quickly teach the proper techniques to all of the Cadets in the classroom and teach proper techniques from the start of the Semester. The Instructor keeps the document projector in his possession and brings it into the classroom. The document projector also allows the Instructor to show Cadets the text book pages, good examples of Student Cadet work, etc. Tools and equipment such as the machinist clamp can be measured under the projector and all the class can see, on the

classroom screen, the Instructor's measuring of the clamp.

## 8. ASSESSMENT AND GRADING

The grading of the Cadets performance in the course is broken down as follows:

- Weekly assignment, class exercises : 40%
- Quizzes: 15%
- Midterm Exam: 20%
- Final Project: 25%

The grading of the Cadet's individual manual drafting exercise is divided into ten categories, each category worth a total of 10 points for a total of 100 points. These categories are:

- Drawing details, centering, and proper views
- Accuracy, squareness, and scale
- Line quality and weight
- Dimensioning and Arrows
- Lettering quality, strokes, slanting of letters, size of lettering
- Notes and symbols
- Neatness and drafting skill
- Borders , Title Block, Title, Name, Date
- Following directions
- Inking

Grading the drawing exercises, with such a standard of grading, keeps the Cadet striving for satisfactory or better than satisfactory work

The quizzes and exams are multiple choice and fill-in-the-blank type questions. They may be supplemented by requiring the Cadet to complete a drawing exercise for the quiz or exam. The Cadets that are below satisfactory are warned at the mid-point of the semester and welcomed to seek individual tutoring either thru the Academy student tutoring programs or individual extra instruction from the Instructor.

## 9. CONCLUSIONS

The purpose of writing this paper was to give the reader insight into the awards and pitfalls of such a drafting course and to give the readers of this paper guidelines to setting up a drafting course for the purpose of STCW requirements. The students are starting the course as Freshmen Cadets. Their focus and maturity is not always to be counted upon. Having an efficient and quick-paced drafting course is key in relating to these new Cadets. The drafting course is given in the Fall semester, only. However teaching of the course is almost a year-round endeavour. The Instructor must strive to increase his or her skill level. This includes procuring and perfecting manual drafting techniques and drafting tools, as well as learning CAD programs and techniques. The pay-off to this "year-round" job is seeing a Cadet progress thru the drafting course and finish with a drafting and CAD skills "tool bag". A skills "tool bag" that will serve the Cadet very well in the future and becomes a sense of pride for the Cadet.

# PIRI REIS MARITIME UNIVERSITY PERSPECTIVE OF MET IN TURKEY

SAG OSMAN KAMİL

*Piri Reis Maritime University, Istanbul, Turkey*

**ABSTRACT**

The author intends, in this paper, to present the details of the innovations brought to MET in Turkey by Piri Reis Maritime University ranging from On Board Training to Crew Management Office system; from correct streamlining/recruitment of cadets to English as Language of Instruction; from proper utilisation of simulators to optimum interpretation of STCW Manila Amendmends in curriculum design; from internationalisation/globalisation as Black Sea Seafaring Officer 19.8% capacity to R&D in MET utilising the very first Green Campus of Turkey inaugurating in October 2013 at Tuzla, Istanbul.

**Keywords:** *Innovation, MET, Piri Reis Maritime University, Turkey, Black Sea Countries.*

## 1. INTRODUCTION

The 2010 BIMCO/ISF Update [1] presents various global supply/demand balance scenarios for the next decade. "COLD" scenario indicates a shortage of 2% in 2015, and a surplus of 2% in 2020 for officers. The "CENTRAL" or "BENCHMARK" scenario indicates a shortage of 5% in 2015 and 1% in 2020, whereas the "HOT" scenario denotes a shortage of 11% in 2015 and 9% in 2020 for officers. Thus, the 2010 Update highlights that the industry is likely to face a challenging future for crewing. Unless measures are taken to ensure a continued rapid growth in qualified seafarer numbers, especially for the officers, existing shortages are likely to intensify over the next decade. Also, it is most important to stress that the industry requires well qualified and high calibre seafarers capable of adapting to change and handling the wide range of tasks now required of them. Thus, any training programme provided must ensure quality is not compromised in the quest for increasing quantity.

The Black Sea Countries supply the 19.34% (120,658) of the seafaring officer capacity of the globe of total 192 seafaring countries (624,062) Turkey with 36,734(5.9%), Ukraine with 27,172 (4.4%), Russia with 25,000 (4.0%), Romania with 18,575 (3.0%), Bulgaria with 10,890 (1.7%), Georgia with 1378 (0.2%), and Moldova with 909 (0.15%) seafaring officers [1].

The total number of Active Turkish Seafaring Officers according to the Turkish Ministry of Transportation, Maritime Affairs and Communications during the period of 1993-2012 is quoted as 42,918, where as this number decreases to 38,765 for the period of 2002-2012 and to 30,593 for the period of 2006-2012 [2].

The total number of all MET Institutions in Turkey, namely Universities, Faculties, Departments, 2-year Polytechnics/Vocational Training Schools (Junior Colleges) and Vocational High Schools increased from 24 to 57 in the past few years (2010-2013), and the number of cadets recruited per year increased from 2,942 to 5,296, denoting an 80% increase [3].

Straightforward estimations simply denote that the 30,593 Active Turkish Seafaring Officers of the period 2006-2012 (when total annual cadet recruitment was 2,942) will increase to 42,830 during 2015; and to 55,068 during 2020 (with total annual cadet recruitment of 5,296). This is with the assumption that the annual intake of cadets to MET institutions will stay constant till the year 2020; and approximately 50%, 100% of the new annual intake will graduate by 2015, and 2020 respectively,all serving on board vessels [3].

Realising that the total 17,201 million DWT of the Turkish Merchant Fleet comprising 560 Turkish Flag and 665 Flag of Convenience Vessels over 1000 Gross Tons, ranking 15th among 192 countries [4] with an average age of 18.1 [4] will more or less (10% plus or minus) stay the same in the next decade, Turkey, with almost the same number of active seafaring officers as Philippines (57,688), Peoples Republic of China (51,511) and India (46,497), and a surplus number for the national market, will be among the few nationations dominating the international seafaring officer market of the Globe.

The Important Question here is: "Will this theoretical extrapolation on facts, figures and numbers reflect the practical situation in the Active Seafaring Officer Market of the years 2015 and 2020 as far as Turkish Seafaring Officers are concerned?"

It is important to grasp the existing General Structure of Turkish Education System and the Maritime Education and Training (MET) in Turkey before dealing with a healthy answer to the above question.

## 2. GENERAL STRUCTURE OF TURKISH EDUCATIONAL SYSTEM [5]

The basic structure of the Turkish National Education System is outlined in Basic Law on National Education (Law No 1739) as follows:

Pre-school education, which is optional, aims at contributing to the physical, mental and emotional development of the children, to help them acquire good habits and to prepare them for basic education. Pre-school education institutions include independent kinder gardens, nursery classes in primary schools and preparation classes. Basic Education provides children with basic knowledge and ensures their physical, mental,

and moral development in accordance with national objectives. It generally comprises the education of children in the 6-14 year age group. Eight years of basic education is compulsory for all Turkish citizens who have reached the age of six. This level of education is free of charge in public schools. There are also private schools with tuition fees under state control.

Secondary education encompasses two categories of education institutions, namely General High Schools, and Vocational/Technical High Schools where a minimum of four years of schooling is implemented after basic education. General High Schools are educational institutions that prepare students for institutions of higher learning. They implement a four year program over and above basic education and include students in the 15-18 year age group. Vocational and Technical High Schools provide special instruction with the aim of training qualified personel for industry.The duration of instruction in these schools is also four years.

Higher Education: the purpose of higher education is to train manpower within a system of contemporary educational and training principles to meet the needs of the country. It provides high level specialised education in various fields for students who have completed secondary education. The Higher Education Law ( Law No 2547) covers all higher education institutions and regulates their organisation and functions. Universities consisting of several units are established by the state and by Law as public corporations having autonomy in teaching and research. Furthermore, institutions of higher education, under the supervision and the control of the state, can also be established by private foundations as in the case of Piri Reis Maritime University, in accordance with procedures and principles set forth in the same Law provided that they are non-profit in nature.

The University is the main higher education institution. It possesses academic autonomy and a public legal personality. It is responsible for carrying out high level educational activities, scientific research and publications. It is made up of Faculties, Graduate Schools, Schools of Higher Education (colleges), conservatories, 2-year vocational training schools (junior colleges) and centers for applied work and research.

There is at present a total of 166 Universities in Turkey; 102 Government and 64 Foundation and Private Universities.

All institutions of Higher Education in Turkey have each year since 1974 accepted students in accordance with the results of the examinations organised by the Student Selection and Placement Center of Turkey.

A four test-battery is used, comprising a General Ability Test, a Mathematics and Natural Sciences Test, a Turkish Language, Literature and Social Sciences Test, and a Foreign Languages Test. In their Application Forms candidates normally rank a maximum of 30 Higher Education Programs in order of their personal preferences. The Test Scores are transformed into Standard Scores and four types of composite scores are calculated: Natural Sciences, Social Sciences, Natural and Social Sciences and Foreign Languages. Candidates are placed according to their composite scores, the list of their preferences and the number of places available in each higher education program.

## 3. MARITIME EDUCATION AND TRAINING IN TURKEY [6], [7]

Maritime Education and Training in Turkey is Degree/Nondegree, Monovalent, One Step at Extensions/Enrichments/Elevations Level. This is followed by 12 months Seatime (On Board Training), and CoC Exams implemented by the Ministry of Transportation, Maritime Affairs and Communications, the Administration in Turkey, Party to IMO.

The 4/5-Year MET Institutions granting University Undergraduate Degrees (University, Faculty, Department, College) lead to Unlimited Licenses in both Engine and Deck Departments. There are 24 such MET Institutions in Turkey at present, Istanbul Technical University – Maritime Faculty (A Government University) being the oldest and Piri Reis University being the sole Maritime University of Turkey, and a Foundation University sponsored by Turkish Chamber of Shipping.

Two Year Vocational Training Schools (Junior Colleges) granting HND Equivalencies lead to Limited Licenses in both Engine/Deck/Electro Technical Officer Departments. At present,there are 8 such institutions, and the number is likely to raise to 14 by the end of 2013.

Four Year Vocational Maritime High Schools granting Secondary High School Diplomas lead to Near Coastal Voyage/Limited Licenses in Deck/Engine/Electrical Officer Options. There are at present 62 Vocational High Schools in Turkey, 25 specialised in Maritime disciplines/options. Quality Standards System of MET in Turkey has been found to fully comply with the STCW Convention and the EU recognition of Turkish Maritime Education, Training and Certification System is consequently extended in accordance with the provisions of Directive 106/2008/EC.

## 4. PIRI REIS MARITIME UNIVERSITY OF ISTANBUL – TURKEY [8], [9], [10]

Piri Reis Maritime University was founded in 2008 by the support and sponsorship of the whole Turkish Maritime Sector comprising approximately 8,400 maritime-related Turkish Companies, namely Turkish Chamber of Shipping through Turkish Maritime Education Foundation, TUDEV.

Piri Reis Maritime University is named after the very famous Ottoman–Turkish Admiral and Cartographer who lived in the 16th Century, best known for his Map of the World and the Book of Navigation (Kitab-ı Bahriye), also enholding techniques of navigation and navigation-related information on

Astronomy. The Year 2013, the 500th Anniversary of the Map of Piri Reis is declared by UNESCO as the Piri Reis YEAR.

Piri Reis Maritime University (PRMU) is financed by 50% of Annual Budget of Turkish Chamber of Shipping and is situated on five different Campuses in

Tuzla, among which the sole internationally accredited Green Campus of Turkey inaugurating in October 2013 at the Marmara Sea Coast to further serve a number of newly founded Maritime related disciplines.

The language of instruction at Piri Reis Maritime University is 100% English, with Cadets wearing uniforms through a Regimental System. Attractive grants, loans and guaranteed job opportunities upon graduation are made available by shipowners for the cadets.

Existing undergraduate disciplines at PRMU are Nautical Engineering and Marine Engineering at Maritime Faculty; Naval Architecture and Small Craft Design at Faculty of Engineering and existing Postgraduate disciplines are Nautical/Marine Engineering and Naval Architecture/Small Craft Design (M.Eng/PhD.Levels) at Postgraduate School.

With the inauguration of the new Green Campus in October 2013, further maritime related Undergraduate/Postgraduate disciplines will commence like International Maritime Business Management and Trade, Maritime Economics and Finance in Maritime Administrative Sciences Faculty; Maritime Law, Maritime History, Maritime Environmental Engineering, Oceanography, Marine Biology, Fishing Technology in other related Faculties.

Two Year Vocational Training Schools/Junior Colleges granting HND, namely Deck, Engine, Naval Architecture, Port and Marina Management, Small Craft, Yacht Management, Insurance, Transportation, Computer Programming, Automation and Control, Logistics, Brokerage will also commence in 2013, and 2014, next two consequtive years.

The intended target of the total number of students by 2015 is 3,000 and 6,000 by 2020, with 300 Academicians.

The Vision of PRMU is the inauguration and development of Maritime University Education complying in full effect with the highest standards of the Globe.

The Mission of PRMU is to create synergy between vocational professional training and academic education. At present, an excellent platform is available in Turkey to initiate a very strong and sustainable cooperation between the Maritime Sector capabilities and the Academical milieu of the University yielding in an optimum synergy of theory and practice.

The Strategic plan of PRMU can be summarized as follows:

- International academic cooperation with the best Maritime Universities of the World, as well as leading respectability at maritime platforms like IMO and related NGO's.
- Emphasis on innovation and entrepreneurship in Maritime related disciplines.
- Academic cooperation with the Turkish Maritime Sector, as well as other National Maritime Institutions.
- Emphasis on International/National public relations and yielding in increasing the efficiency of PRMU in serving the MET Globe.
- Student, Academical, Administrative Staff satisfaction, thus yielding in recruiting top quality national/international students, academicians and administrative personnel.

## 5. A NEW, UNIQUE APPROACH TOWARDS INCREASING THE QUALITY AND EFFICIENCY OF MET IN TURKEY BY PRMU AND TURKISH CHAMBER OF SHIPPING

### *5.1. Recruıtment of correct cadets to Piri Reis Marıtıme Unıversıty*

It is observed that through annual Entrance Examination for Universities, government universities with MET institutions recruit students from standard high schools. Statistics denote that the big majority of these students upon graduation opt for shore based jobs rather than employment on board vessels, which yields in a continuous waste of human resouces and a shortage of sea personnel as officers.

On the other hand, graduates of Maritime Vocational High Schools, though they very much wish on board employment, can not make it successfully to the Maritime related universities, scoring comparatively lower grades as they spend more time on vocational courses compared with Maths, Physics, Chemistry of the Entrance exam during their four years at the High School. Also, coming comparatively from rather modest income families, they also cannot afford paying tuition fees to Foundation Universities, having to be engaged with other disciplines, which is again yielding in another extreme group of waste of human resources.

Thus, the Answer to the "Important Question" in the "Introduction part" of this presentation will be "A STRAIGHT FORWARD NO" with existing recruitment system.

However, PRMU is in the process of designing a brand new, special recruitment system, under the same higher education Law, to enable all Maritime Vocational High School graduates who have guaranteed working on board vessels upon graduation with a contract of the Crew Management Company of the University to enter to four or two year MET courses at PRMU with also the flexibility of transfer from junior college to faculty for successful cadets, enabling them to upgrade their limited licenses to unlimited CoC's. This unique process can only be achieved with Turkish Chamber of Shipping providing most attractive grants and loans to these students, as well as job guarantees upon graduation, and PRMU serving very special curriculum to the new entrants.

Thus, the ANSWER of the "Important Question" in the "Introduction part" of this presentation can now hopefully be "A MOST PROMISING YES" in the very near years to come with the innovative precautions taken by PRMU starting this year.

### *5.2. Traditional Turkish MET discipline*

Piri Reis Maritime University will provide a mandatory boarding, regimental MET system to the cadets wearing uniforms to simulate the discipline and

the psychology of the closed, indoors, sharing facilities atmosphere of seaborn vessels to get better efficiency from cadets upon graduation. At present, though cadets in most MET institutions wear uniforms, very few live the experience of the discipline of mandatory boarding regimental MET system, and upon joining a vessel, yielding in fast transfer to shore based jobs after facing the real life on board vessels, with unexpected, broken down psychology.

*5.3. On-board training system*

The 12 months compulsory On Board Training of STCW is carried out in periods of three months between First and Second Years; another three months between Second and Third years; and a final six months during the Spring term of the third year in majority on different Merchant Vessels of the Turkish Fleet. There are querries if especially the first two- three month trainings are feasible and productive for the cadet and the shipowner, and there are observations that the training provided for the cadet varies in quality from ship to ship, thus yielding in a non homogeneous approach for the whole party concerned. Also there is huge pressure on the Operational/Management Level Curriculum having to be dealt within 7 semesters instead of full 8 semesters due to the six months On Board Training of the 6th semester/third year.

Piri Reis Maritime University is in the process of proposing the extension of the On Board Training to the English Preparatory Class (extra year before the classical four years of University Undergraduate Curriculum) to the Administration to consider, which requires a change in the related Legislation and Directives. This approach is believed to increase the quality and the efficiency of MET in Turkey.

*5.4. On-board training vessel*

Turkish MET Institutions at present do not have On Board Training Vessels except M/V AKDENIZ of ITU Maritime Faculty, which is not operational due to shortages in the budget allocated by the Government. Both ITU Maritime Faculty and Piri Reis University are members of the Executive Committee of IMO Global On Board Training Center (GOBTC) doing their best to serve On Board Training, not only nationally, but also worldwide, with support from IMO. Piri Reis Maritime University and Turkish Chamber of Shipping very much believe that three to six months homogeneously implemented On Board Training on the Vessel of the University, prior to another six months on board training on a commercial vessel will yield in vast advantages for both the cadet and the shipowner.

Thus, Turkish Chamber of Shipping is in the process of allocating the Ferry passanger vessel M/V ANKARA to Piri Reis Maritime University later this year with the intention of serving IMO-GOBTC in Mediterranean not only to all Turkish Cadets, but also to the cadets from different nationalities with the cooperation of ICS and other Universities like ONMA/Ukraine, also with IMO support.

*5.5. Emphasıs on Englısh Language*

Piri Reis Maritime University gives extreme importance to MET in English Language. Thus, the language of instruction at PRMU is 100% English, where as in majority of other MET institutions, the curriculum is either entirely in Turkish, or partially in English. PRMU further believes that 100% instruction in English is not sufficient since the cadet speaks in native Turkish language outside the classroom. Thus, through EU/ERASMUS cadet exchange programs and dual MoU's signed with other MET Universities from the Region and the Globe; PRMU intends to have MIXED CADET ARRANGEMENT at University education so that cadets invited/recruited from different countries will have to practise communication with each other in English language, also outside the classroom, yielding in mastering the language much better in daily life. This also requires an amendment of MET Legislation and Directive in Turkey since at present all MET cadets are required to have Turkish Citizenship by law. This national bureaucratic obstacle can also be overcome through signing of "STCW I/10 Mutual Recognition of Certificates" between Turkey and other related Parties.

This will be a very good exercise for the MIXED CREW ARRANGEMENT on board vessels upon graduation.

*5.6. Distance/E - learning on board vessels*

At present, MET in Turkey is carried out classically in MET institutions. PRMU very much believes that MET can also be very efficiently carried out when the officer is serving on board the vessel without having to come back to shore-based MET to upgrade his License/CoC, thus yielding in avoiding unnecessary loss of manpower on board vessels. PRMU intends to commence the Distance Learning/E-Learning Department of the Maritime Faculty next Academical Year to serve officers on board vessels and make MET available to them without having to come back to shore to acquire it. This also needs an amendment of the related Turkish MET Legislation and the Directive by the Administration.

*5.7. MET Center of Excellence*

The facilities of simulation, laboratories, on board training vary in Turkey from one MET Institution to the other, though all satisfy the minimum STCW requirements. Some, like in ITU Maritime Faculty and the Green Campus of PRMU, have State of the Art

Facilities, where as some have more modest facilities. Thus, to improve the general quality and the efficiency of MET in Turkey, PRMU very much believes that Turkey needs a MET CENTER OF EXCELLENCE run by the Administration, where all MET institutions can make use of it throughout the year. A good example of this application is in Japan, namely On Board Training Institute of the Country, which all

MET institutions use efficiently and homogeneously throughout the year.

*5.8. Women in development of MET*

PRMU fully supports the IMO Motto of "Women in Development of MET" and gives utmost importance to recruiting as much women cadet as possible for MET. Observations denote that, in general, women are more hard working and studious compared with their male colleagues, and they will make very good Officers especially in Deck Department.

*5.9. Turkish Chamber of Shipping and better facilities on board vessels for future PRMU graduates*

Turkish Chamber of Shipping gives utmost importance to providing better living standards on board vessels for future PRMU graduates, to increase the quality and efficiency of the Officers graduating from PRMU, encouraging them to serve on board vessels longer periods than disappointingly experienced at present.

## 6. CONCLUSIONS

In this presentation the author concentrates on summarizing the strengths and weaknesses of the existing MET System implementation in Turkey by MET institutions, giving utmost emphasis to a number of international and national statistical values concerning the Turkish Officer in general. The presentation also highlights the new approach towards increasing the quality and the efficiency of MET in Turkey by Piri Reis Maritime University and Turkish Chamber of Shipping. The Author very much hopes that the issues raised by PRMU in this paper will yield positively in any training program provided to ensure quality is not comprimised in the quest for increasing quantity. Emphasizing the fact that The SEVEN Black Sea Countries supply 19.34% of the total seafaring officer capacity (624,062) of the Globe out of 192 seafaring countries [1], the author very much believes that cooperation between Black Sea Maritime Universities Association (BSUN) an NGO at Black Sea Economical Cooperation recently, mixed cadet arrangement further yielding in mixed crew arrangement will definitely contribute towards increasing the quality and the efficiency of the seafaring officer capacity of this very strategic region yielding in fruitful and tangible results for all parties concerned. A similar version of this paper is recently presented at "International Forum on Seafarers, Education, Training and Crewing", Odessa, Ukraine [11].

## 7. REFERENCES

[1] BIMCO/ISF, *The Worldwide Demand for and Supply of Seafarers Highlight*, Manpower 2010 Update, December 2010.
[2] TURKISH MINISTRY OF TRANSPORTATION, MARITIME AFFAIRS AND COMMUNICATIONS Website, www.denizcilik.gov.tr, March 2012.
[3] SAG, O.K., *The Impact of the Black Sea Maritime Cluster On The Global Shipping Industry*, 14th European Manning and Training Conference/Black Sea Crewing, Istanbul, Turkey, May 12, 2011.
[4] TURKISH CHAMBER OF SHIPPING, *Maritime Sector Report 2011*, Istanbul,Turkey, March 2012.
[5] SAG, O.K., *A unique Model of Approach to MET Piri Reis Maritime University-Istanbul/Turkey*, Maritime Education Summit – The Way Forward, Texas A&M University at Galveston and Texas Maritime Academy, Galveston TX, USA, March 13-15, 2011.
[6] SAG, O.K., *The Role of Republic of Turkey and Piri Reis Maritime University in Seafaring Officer Supply Capacity of the World*, Plymouth University, U.K, June 8-11, 2012.
[7] SAG, O.K., *Maritime Education and Training in Turkey and Piri Reis Maritime University*, Cambridge College, Dhaka, Bangladesh, December 17, 2012.
[8] SAG, O.K., Visit of Piri Reis Maritime University of Istanbul, Turkey to Shanghai Maritime University, Shanghai, Peoples Republic of China, February 10-16, 2012.
[9] SAG, O.K., *A new Maritime Foundation University in Turkey – Piri Reis University*, Hochschule Wismar, University of Applied Sciences-Technology, Business and Design-Maritime Simulation Center, Warnemünde, Wismar,Germany, July 03-05, 2011.
[10] SAG, O.K., *Brief Review of the World MET Cadets/Academicians Perspective on STW 2010 Amendments through First International Mermaid Congress of Piri Reis Maritime University of Turkey*, IMO 2010 STW Diplomatic Conference, Manila, Philippines, June 23, 2010.
[11] SAG, O.K., *A New Approach Towards Increasing The Quality and Efficiency of Maritime Education and Training in Turkey By Piri Reis Maritime University and Turkish Chamber of Shipping*, International Forum on Seafarers, Education, Training and Crewing, Odessa, Ukraine, April 24-25, 2013.

**PIRI REIS MARITIME UNIVERSITY NEW GREEN CAMPUS**








# THE IMPACT OF ECONOMIC CRISIS ON MARITIME TRANSPORT

SALTER IVOR

*Warsash Maritime Academy, Ukraine*

**ABSTRACT**

The economic crisis impacts on all the players in our industry, the ship owners, the charterers, the insurers, the regulators and the consumers that drive our business, they are all affected. An added factor in this particular crisis is that fuel costs are going up as well and this is not always the case. So, we can expect the ship owner to reign in various budgets within his/her organisation, such as training, maintenance, new buildings, they may look to put vessels on slow speed or even lay some of their tonnage up. The whole market responds to this crisis, the ship owner may look to scrap off some of their tonnage rather than lay them up and therefore the supply of tonnage to be scrapped goes up and so the price paid per light ton for the scrap steel will go down. If consumers demand fewer goods, then there is less demand for transport and freight rates will tend to tumble as owners try to cover some of their costs. Transport that is not being utilised is only a cost to its owners. In order to balance the demand for transport with supply, fewer ships will be utilised by charters and those that are will travel at economic speed to reduce the total cost of the fuel they burn.

It is my intention that this paper will cover all aspects of our industry, the insurers and the regulators, ship building and scraping, the seafarers and the trainers. The crisis will also have an effect on cargoes as it may increase the demand for Giffen goods. Therefore all aspects of our industry will be affected and this paper will illuminate this phase in the market.

**Keywords**: *Economic crisis, maritime transport, shipowner, maritime industry.*

## 1. INTRODUCTION

Economics is the study of how society decides what, how and for whom to produce (Begg 1984, p2). The branch of knowledge concerned with the production, consumption, and transfer of wealth within society. The efficiency of transport has really transformed the way the world's economy works so that goods manufactured on the other side of the world can compete with goods created at home. A local cobbler working in his village produces fine shoes at affordable price. Soon everyone in the village has a nice pair of shoes and the cobbler is wondering what he/she can do, when they here of a new road that is passing the village and linking it to a town. So the cobbler travels to the town where he/she sets up a shop and starts to sell shoes to the townsfolk. Soon the cobbler has lots of orders so he/she can take on more cobblers and make arrangements with the local cart owner to take his/her shoes to the shop in town. The town has a train station which links it to the city so the cobbler travels to the city to open a new shop. Each time the cobbler enters a new market as long as his/her shoes meet a demand in the market the more orders the cobbler gets. Now the cobbler needs to open a new plant and specialise the lines of production. The transport network around the plant not only takes the product to market but also brings in the materials needed for production from further afield. The cobbler could invest in wagons and carts or farms to produce the leather he needs to diversify his/her holdings. The city has a port and the cobbler travels to another country where he/she notices that there is a gap in the market for boots and so the economic activity expands. For the cobbler as long as the cost of production and the cost of transport to the market when combined are such that his/her goods can still compete in the market still find their niche in the market, then there will still be a demand for his/her shoes.

Before the industrial revolution transport was not so readily available, sailing ships although able to cover great distances, although pottery was shipped large distances. In Adam Smith's time, the author of "The Wealth of Nations" most production was manufactured within the consumer's home nation. In our time transport has enabled goods to be produced far away from the consumer. There is a balance here, if the cost of production; labour cost; manufacturing cost; the cost of raw materials and local transport cost is more than the cost of production plus the transport cost from further a field then the goods will continue to flow. The cost of labour has recently risen in some countries resulting in some production returning to the consumer's home country.

Oil is an important commodity, not only does is provide the fuel for the transport process but is often used in the process of manufacturing the commodity itself. Therefore increases in oil prices can have a double effect of producers. Anyone who was around in 1973 when OPEC increased the price of oil will understand the effects of the price rise and how inflexible was the demand for oil.

When considering the cost of transport we have to take into account the different modes of transport. The main types are by air; by sea; by rail or by road, we have to consider whether we wish to own the means of transport. Owning the means of transport may initially look attractive until we consider all that that may entail such as parking charges. When one analyses the fare structure numerous variables come into play; if one arranges transport a few days in advance that may reduce the cost, if one does not travel at peak time this may reduce the cost. Congestion pricing is a way of rationing

travel at peak times to those who are willing to pay for it or have no alternative. The more product you can transport at any one time will encourage economies of scale and therefore should reduce the cost of transport per unit i.e. one pair of shoes versus a shipping container full of shoes.

## 2. THE SHIPOWNERS

According to the Marine Information Centre website there is a fall in demand for transport and a report by Drewry shows that Very Large Crude carriers [VLCCs] continue to struggle. Drewry's Earnings index for dirty tankers plunged 62% to 14.2 during the month. This pulled the wider Tanker earnings index down by 52%. Katharina Stanzel of Intertanko reports that VLCCs operating on the spot Market have run up $5,5 billion in losses since 2009 (Ship and Bunker). By Easter 2013 there were as many as 91 VLCCs available in the Middle East Gulf looking for employment (Lloyds List).

The LNG and LPG industry is fairing far better due to the growing demand for gas in the emerging economies. This demand has lead owners to build new ships; evidence of this is there were 4 orders for Very Large Gas Carriers (VLGC) in 2011, but there were 11 orders in 2012. As the infrastructure at the port has improved, owners have gone for the larger vessels. The VLGC is approximately 84,000 cbm and costs $73.5 million.

In the container market the weak demand for transport is putting all the carriers under strain. In previous years this has led freight wars between the leading carriers. In order to avoid such competition, carriers are returning vessels they have leased to their owners. They remove the least efficient and more polluting vessels from the network. There are newly built Triple E vessels, these vessels have Economies of Scale, they are more Energy efficient and they pollute less, so the environment is improved. They are expected to consume 35% less fuel per container and create 50% less CO2.

In the cruise industry, larger and larger cruise ships continue to be built. Energy efficiency, being eco friendly and a clean ship are important factors in this industry. As fuel costs rise, that cost needs to be spread amongst a greater number of passengers to make it viable. Therefore, smaller cruise ships are struggling in this market. As evidence of that phenomenon, MSC Cruises has confirmed that they are retiring the Melody from service. She was built in 1995, but her capacity is just 1,000 passengers.

The dry bulk market suffered a decline in 2013, mainly in the capsize market, due to the steady supply of ships into this market, the disruption to coal shipments by weather, labour disputes and violation of environmental laws. Harsh drought conditions in the Midwest have reduced the expected harvest and that will affect the need for transport from the United States. However, the Indian and South American harvest may make up for this.

The reefer market has switched from reefer ships to reefer containers. Reefer vessels are being scrapped at a rate of 36 a year and the order book for this type of vessel is empty. Containerships will continue to carry these reefer containers, but there is no say whether they will be able to raise the pricing on these reefer slots.

The cost of fuel is $608.50/mt in Rotterdam and the price of oil has risen over the last 25 years. Using Brent crude as an example, crude from 1988 to 1998 stayed mostly between $10 and $20 a Barrel (bbl), but from 1998 to 2008 it went from $15/bbl to $95/bbl, peaked at $135/bbl in the middle of 2008, to drop again and then slowly recover to $110/bbl (Oilnergy). BP's chief economist, Jeremy Leggett, gives us 40 years at current usage (Makewealthhistory).

The oil industry will must be looking to its end game. Shipping companies must consider how their business might continue without oil, utilising a different form of fuel such as LNG, which is cleaner, has a longer life expectancy than oil, but brings with it some hazards that need to be managed. There are experiments with bacteria to produce ethanol, which could be used as a fuel; the human race will no doubt come up with an ingenious method of producing fuel.

## 3. GREAT RECESSION

The decline that began in December 2007 and accelerated in September 2008 has many names, the above being one of them. Liquidity in the markets was the trigger for this downturn. The recession affected the world's economy, gross domestic product of the state was weighed against the states sovereign debt and in some cases a crisis followed. Not only on a national scale, but also on an individual scale, banks had been lending to customers whose chance of defaulting on the loan was high. High individual debt levels made sense, while house prices rose but as soon as they began to fall people found they were living with negative equity and therefore the chance that they might default on their mortgage rose quickly. Total debt in many states is the highest ever recorded. Inter bank confidence fell, as banks began hoarding money to cover their loan losses. In fact, many banks had to be bailed out by the state. In these markets securing a loan for the purchase of a ship might seem impossible. However, looking at figures taken from the Ship Builders Association of Japan (SBAJ) March 2013 report on World Orders (Tabel 1), it would seem a great many orders where placed just before the markets went into recession, but many more continue to be built, which has lead to this great over supply we have at present.

Table 1. World Orders Report, March 2013

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| No. of Ships | 3,828 | 5,404 | 3,260 | 1,408 | 2,780 | 2,252 | 1,926 |
| Gross Tonnage | 99.6 m | 169.0 m | 88.0 m | 33.6 m | 82.4 m | 56.8 m | 38.4 m |
| World Completion | | | | | | | |
| No. of Ships | 2,447 | 2,782 | 3,242 | 3,554 | 3,748 | 3,670 | 3,655 |
| Gross Tonnage | 52.1 m | 57.3 m | 67.7 m | 77.1 m | 96.4 m | 101.8 m | 95.3 m |

## 4. SCRAP

Now called ship dumping, the scrap market in Asia has had a busy year in 2012; more than 1,000 ships were scrapped, India accounting for 527, followed by Bangladesh, Pakistan and China. The Basel and Hong Kong Convention were designed to eliminate the practice of beaching the ship and cutting it up or to limit the environmental damage this practice can cause. However, ships can be purchased on the high seas for their final run to the beach by the scrapping company. Prices are around $350 per lightship ton. The Exxon Valdez's hull apparently changed hands for $16 million. There is a contradiction here: China, where they have invested in some facilities, cannot compete with India, who has not. India is unlikely to invest in facilities, while regulators continue to look for ways to stop ships from being scrapped in the above countries. Many of the above countries look to the ship-breaking sector as vital for their economies as a supplier of steel for many industries, including construction and ship building (BBC).

Table 2. World scrap figures from the (SBAP) figures

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| Losses | 173 | 204 | 183 | 212 | 203 | 126 |
| Disposals | 708 | 616 | 803 | 1538 | 1389 | 1526 |
| Gross Tonnage (L+D) | 5.8 m | 5.0 m | 8.8 m | 26.3 m | 20.1 m | 25.8 m |

The IMO "International Shipping facts and Figures 2011" says the world fleet in 2010 for vessels greater than 100 gross tons (GT) is 103,392 ships of 958 million GT. In 2010, according to the figures above, 203 vessels were lost. So, in 2010 the risk of a loss was 1/509 ships, which seems a large figure, and if we added no more ships at the rate the gross tonnage is leaving the market, it would take 47 years to remove all the ships. A disparity between the figures might be explained by vessels in lay up. However, in the (SBAP) report from Clarkson, "Shipping Review and Outlook" data, it would appear that laying up vessels is a thing of the past, in 1982 about 20% of the tanker fleet and 15% of the bulk carrier fleet were laid up. This number decreased to less than 5% in 1987 and, since then, less than 5% of the world fleet have been laid up in any year, although there was a small peak in terms of all vessels laid up in 2011, but nothing like the 1980s. Laying up the vessel may be too expensive, previous experience with laying up vessels in the 1980s may have been negative.

## 5. GLOBALIZATION AND INTERNATIONAL TRADE

Goods move from one place to another when the cost of producing the good, plus the cost of transporting the good, plus a profit margin is equal to the cost you can sell the good in the other place. Small profits on thousands of items are the same as large profits on one item, allowing for the retailers for a profit margin. Barriers to trade were taxes or quotas on imported goods into a country. Some countries are accused by others of using non-traditional barriers to trade; this allows a one-way trade in goods, which can be profitable for the producer. The argument today is that we have an interdependent world economy that the streams of goods and materials enable us all to participate in the planet's wealth. A state cannot just be a consumer; otherwise its wealth will eventually pass to the producers of the goods it consumes. The establishment of this interdependent global trade system came with the provision of a cost effective transport system in the shape of shipping. However, should shipping become prohibitively expensive as the cost of fuel for its engines gets higher and higher? Will the nations and markets of the world return to a position where they have to be self-sufficient or will we return to an era of magnificent square riggers carrying the world's trade?

It is generally accepted that 90 per cent of the world's trade is carried by sea (IMO). At this moment in time I do not see a viable alternative that would enable world trade to continue should the fuel become too expensive to use. On 16th April 2013, the International Monetary Fund (IMF) announced that there was a gradual improvement of the global economy. The global economic growth is expected to reach 3.3 per cent in

2013. Bringing the public debt back to a prudent level poses the long term challenge the report says. Certain countries have borrowed vast sums of money and their ability to pay depends upon their Gross Domestic Product (GDP), a prudent level is less than 60% of GDP. At present, 10 large economies have a debt ratio above 90%, which is considered to be high: Japan - 245%; Greece – 179%; Italy - 131%; Portugal - 122%; Ireland - 122%; United States - 108%; Belgium - 100%; United Kingdom - 94%; France - 93% and Spain - 92%.

Food prices are expected to rise as an increase in bio fuel production will divert crops away from food uses (IMF). Demand for food is expected to increase and the stock to use ratio remains low, i.e. there is little reserve. Metal prices have generally declined due to less consumption and weak demand in China. The outlook for metal prices is dependant on consumption in China; if China's consumption falls, metal prices will reduce also. However, some metals, like Copper supply, continue to be difficult, hence the price has doubled in the last few years. The world's demand for oil grew by 1% with the decline in the developed countries more than offset by the increase in demand in the developing countries. The supply of oil grew in 2012 above demand, therefore some oil can be held in reserve. OPEC, concerned by the weak demand for oil and increasing supply, will be endeavouring to keep oil prices at $100 per barrel.

## 6. THE INDUSTRY

The cycle of business forces the weakest and most poorly managed ships and companies out of business when a down turn occurs, unless they are so big they cannot be allowed to fail, like the banks. The shipping industry has always consisted of four interrelated markets: the building market, the freight market, the sale and purchase market and the scrapping market. The demand and supply in one market will have a related effect on the other markets. When the supply of shipping is greater than the demand for shipping, we are in the position of overcapacity, which has the following effects on the four markets: the building market is underutilised, yards find it difficult to find customers, some customers may default, the cost of a new ship is very keen and it may even be built at low cost to keep the yard turning over.

The SBAJ put the cost of new buildings down between 10 to 15% and global orders down to 30% in 2013. In the freight market there is great competition for the goods that are being transported and therefore the cost of transport goes down. In the sale and purchase market, the purchase price of a ship is based on its value, but also on how much the vessel can earn. As the cost in the new building market is down the asset value in the sale and purchase market is also down. As the expected earnings in the freight market are down the amount that contributes to the value of the vessel is also down, according to SBAJ second hand prices fell by 27% in 2012. There is pressure on the owners to balance out the demand for shipping with the supply of shipping but as the demand for scrapping services rises the price offered to the owner per ton of lightship falls.

## 7. THE DECISION TO SCRAP

The owner has to decide whether to remove the ship from the market by scrapping the ship. This traditionally gave the owner a payment which would enable him to contribute to the costs of the other ships in the fleet. However, if the owner thinks the market is about to turn, he may hang on to the ship in order to exploit the market. The owner's decision then is not just based on the economics of the individual ship, but on what he expects the market to do in the future. The owner then is balancing the cost of keeping the ship operating against its possible future earnings; if its future earning potential is low and the cost of keeping it available is high, then the optimal decision is to scrap the vessel (Oil Tanker Phase Out). The owner needs to take that decision early in the market cycle, otherwise the value of the scrap will be declining. The age of the ship will have an influence on the decision the owner makes.

The new ship's costs will mainly be made up of the capital cost of the vessel but, as the ship gets older, the capital cost may be paid off at 10 or 15 years old and most of the costs will be the running costs, which go up as the vessel gets older. The SBAJ put 26% of the world fleet at older than 15 years. Once the vessel reaches 25 years old, this is her fifth special survey where much work may well be needed to keep her operational. The more the shipowner is offered to scrap his ship, the more likely he will be to do it. This is the demolition supply curve. So, the owner is balancing several factors: the future earning potential; the operating costs; the age of the ship; the present liquidity of the company; the future regulatory cost of the vessel and the scrap price available.

The scrap market has its own forces at work. The prices that the scrapper can get for the steel and other re-useable items are the basis on which he sets his price for the ships. If his revenue declines, then his offer for the ship will be less, which in turn will feed into the owner's decision on whether to scrap or hang on. The price the demolition company can offer will depend on the labour costs, waste disposal costs, regulatory costs, taxes and the cost of the capital it needs to pay the shipowner. The supply and demand curves reach an equilibrium which determines the market price for the set of circumstances in play at that time. Historically, that has meant that the shipowner received some payment for decommissioning his ship. However, it may be that in certain parts of the world the demolition costs will outweigh what can be earned by the scrapper of the vessel. In this scenario the owner will have to pay to scrap his vessel. In this scenario what is to stop owners from hanging onto their vessels as they can see no benefit in scrapping them and the market to be in a permanent position of oversupply?

Therefore regulatory pressure in the scrapping market may lead to effects in the other markets that have not been anticipated.

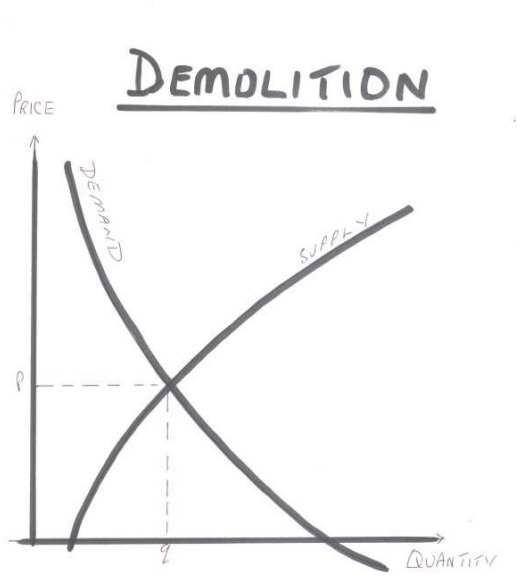



Figure 1 Demolition curves

Scrap yards will demand more vessels as the price per vessel decreases, whereas shipowners will release more vessels for scrap as the price per vessel increases. At some price and quantity, the supply and demand curves will be in balance. Today the cost of steel is low, 10% down on 2012. This feeds into the price on offer for the ship.

## 8. THE REGULATORS

Regulation has had a significant impact on the shipping industry. Although shipping is undoubtedly the most efficient transporter of goods in the global economy, regulators continue to reduce the environmental impact of ships rather than improve the conditions for the people who work on them. If 1 in every 600 airplanes were lost, the tourist industry might become a more domestic industry.

The criminalisation of seafarers has led to a position where well trained and experienced seafarers are not prepared to go to sea and face possible jail sentences for an accident or an incident beyond their control. The industry will allow the owner to escape justice, but seafarers who have tried their best face long civil and criminal prosecutions. Countries welcome the goods they want into port, but will often not let the seafarers who brought them ashore.

As of the 1st January 2013, chapter 4 of MARPOL VI, the new Energy Efficient Design came into place. It is important to reduce the Sulphur Oxide, Nitrogen Oxide and Particulate Matter ships engines produce. However, if the regulator is not astute, one section of the market can win an economic benefit over another by political means, which only distorts the market.

## 9. THE CHARTERERS

The Charterer represents the party who hires a ship or space on a ship for the purpose of transporting cargo from one place to another. The contract used to recall the exact bargain between the ship owner and the charter is called a charter party. The ship may be hired for a period of time or for a voyage, the whole ship may be hired or just some space upon it. The charterer wishes to pay as little as possible for the service, but he usually wants his goods to arrive at their destination. The freight rate or the charge for carrying the goods will vary according to several factors: the number of vessels available to carry the cargo, the quality and quantity of the product to be shipped, including any special requirements and dangers it may pose, the distance to be transported, the ports to be loaded and discharged and the bunkering cost.

If the cost of transport does not reflect the cost of providing the service, all those providing the service will eventually leave the market. However, if the charterer can sustain an oversupply of shipping in the market, then this should be reflected in lower freight rates.

## 10. THE INSURER

To be competitive, the insurer must offer insurance at a price that takes into consideration the risk, the amount that he is insuring, spread among his many customers, so that at the end of the year despite all the claims paid, he should still have a margin of profit.

The dilemma comes when one of his long term customers has an unusual loss. The insurer may be concerned that the ship has been lost due to an action of the owner, but does he investigate that fact and lose his long term customer who may look elsewhere for insurance in the future? The fraud of “scuttling” the vessel and then claiming on the insurance occurs mainly when the insured value is substantially greater than the second hand value. The hull and maybe the cargo insurer will investigate the claim, looking at the circumstances of the case and the key factors which will indicate whether further investigation is needed. An owner who is planning such a course of action will need to contact people, who for a price are willing to scuttle his vessel. If the whole crew or members of the crew have just been replaced this may be an indication. Also, if the vessel has sunk in an area where divers or other investigators cannot easily examine the wreck, such as if it is in deep water or where it cannot be found.

Usually the owner will be a small operator sailing under a flag of convenience with the ship registered in a tax haven. Crew who have served aboard a vessel which mysteriously sinks sometimes appear on another vessel in similar circumstances. In circumstances where the insurer is in doubt as to the validity of the claim, he should consider that refusal to pay the claim will no doubt mean he will have to defend that decision in a court of law against the ship owner with the costs that will entail.

## 11. TRAINING

When shipping companies are facing a recession and an oversupply of ships in the market, ships are no longer earning what was expected. Companies are looking to reduce expenditure in all areas, in order that they can weather the financial storm until the market

becomes favourable again. The training and development budget can be the first place to be cut or the last place to be cut depending upon the philosophy of the company.

## 12. THE BALANCE

If the market functions correctly, the supply of shipping should come into balance with the demand for shipping. The world fleet expanded from 2008 to 2012 by 36% compared to the expansion of world trade over the same period of only 9%. Therefore, the world fleet is oversupplied; scrapping did rise in 2012 but to only 3% of the world fleet. How can the market bring supply and demand back into balance?

It takes time to get a ship built and recessions can come without warning. You may also not be able to get out of a contract without prohibitive penalty clauses applying. At the moment, some fairly young ships, i.e. before their 15th birthday, are being scrapped. The prices on offer to scrap them are not good, as the cost of steel is low.

The new building yards are offering great deals. At present the new building cost is down between 10 and 15%. Some commentators say that government-supported yards are offering ships at less than the marginal cost to build the ship in order to keep the yard working. At present, there does seem to be a barrier to removing ships from the market. Oversupply of shipping in the market distorts the economics of the industry. The cost of transport is kept artificially low. The owners get a poor return on their investment.

The impact on the human element required to man the ships is that you need more people at a lower cost. Each ship has an environmental impact in its building, in its disposal and the fuel it uses during its life. Ensuring the balance between supply and demand is the most economic use of the industries and the world's resources.

## 13. REFERENCES

[1] Begg,D *et al* (1984) Economics 2nd edt. McGraw-Hill (UK).
[2] DREWRY MARITIME RESEARCH, www.micportal.com.
[3] SHIP AND BUNKER, http://ship&bunker.com.
[4] LLOYD'S LIST, http://lloydslist.com.
[5] OILNERGY, IPE Brent Crude Price, http://www.oilnergy.com.
[6] MAKE WEALTH HISTORY, http://makewealthhistory.org.
[7] SHIP BUILDERS ASSOCIATION OF JAPAN, http://www.sajn.or.jp/e/.
[8] BBC, Bangladesh ship breaking industry, www.bbc,co,uk.
[9] INTERNATIONAL MARITIME ORGANIZATION, *International Shipping Facts and Figures 2011 revised*, http://www.imo.org/KnowledgeCentre/ShipsAndShippingFactsAndFigures/Statisticalresources/Documents/December%202011%20update%20to%20July%202011%20version%20of%20International%20Shipping%20Facts%20and%20Figures.pdf.
[10] *Oil Tanker Phase Out and the Ship Scrapping Industry*, published June 2004, http://ec.europa.eu/transport/modes/maritime/studies/doc/2004_06_scrapping_study.pdf.
[11] INTERNATIONAL MONETARY FUND, http://www.imf.org/external/pubs/ft/survey/so/2013/POL041613B.htm
http://www.imf.org/external/pubs/ft/weo/2013/01/pdf/text.pdf.
[12] BOURKE, A.Z., *Recession Affects Training and Development program*, http://www.theinstitutes.org/MediaCenter/docs/articles/Recession_Affects_Training_and_Development_for_Web_10-09.pdf.

# CREW RESOURCE MANAGEMENT IN ERA OF TECHNOLOGY – ENHANCING MARITIME TRANSPORT SAFETY AND SEAWORTHINESS OF VESSELS

SANDELL IVAR PETER

*Satakunta University of Applied Sciences, Finland*

**ABSTRACT**

This article describes the research conducted by the writer concerning the possibilities in enhancing the safety of ships and seaworthiness through risk management and marine insurance connected to new possibilities developed by research results achieved by solutions developed for Bridge Resource Management and Crew Resource Management. The article describes the basic solution in new Nordic Marine Insurance Plan 2013 for encouraging the ship owners to develop safety practices which can be accepted by the insurers as safety regulations in insurance policies to affect the risk management and to create safety practices which in turn increase safety on vessels and create cost efficiency through decreased insurance premiums when risk management on a ship or whole fleet is taken care of by using these modern safety practices which are made possible through effective use of modern technology and use of research models adjusted to practices on vessels.

**Keywords:** *Transport safety, Risk management, Seaworthiness, Unseaworthiness, Marine insurance, Crew Resource Management, Ship owner' s liability, Bridge Resource Management.*

## 1. INTRODUCTION TO UNSEAWORTHINESS PROBLEMACY IN GENERAL

All vessels which leave port are made seaworthy as ascertained by the captain before the common perils for ship and cargo will be encountered. Seaworthiness of ships is a basic concept in Maritime law and in Law of Marine Insurance.

The concept of seaworthiness itself is related to a great deal of laws and provisions - given both by private and governmental organisations. The concept is also often used in universal language without specified meaning. In this article unseaworthiness is considered as a term and phenomenon related firstly to maritime transportation and ship owner´s liability and secondly to marine insurance.

The meaning of the seaworthiness concept is relevant when we consider liability issues between ship owners and cargo owners. As the law stands today in most jurisdictions – the vessel has to be seaworthy when the vessel leaves port. If the vessel later will be considered unseaworthy at the time of departure, the ship owner will usually be considered liable in relation to the cargo owners if there will be a causal link between the loss of cargo and the unseaworthiness of the vessel.

In the law of marine insurance, most maritime jurisdictions follow the same pattern using Seaworthiness/unseaworthiness evaluation as a basic rule to protect the insurer. The Nordic countries use safety regulations for the same purpose. Since the beginning of 2013 the unseaworthiness rule has been abolished from the clauses in all Nordic countries. This increases the use and meaning of safety regulations for the insurer, who is able to deny the insurance cover for ships when the owners are in breach of the safety regulations specified in insurance policies.

Seaworthiness/Unseaworthiness is still the core of the insurance conditions and insurance policies in other jurisdictions than in the Nordic jurisdictions. The regulation in Nordic countries can benefit the owners in several respects as the development of new safety practices through technology can more easily be directly connected to the safety culture of the ship or fleet and benefit the owners through risk evaluation when the premiums are adjusted to meet the real risk evaluation.

The concept of unseaworthiness is usually not defined in the provisions concerning the question. In all jurisdictions seaworthiness seems to be a relative term that must be evaluated according to the circumstances in question; the ship, trading area, time of the year, quality of the cargo etc.

The concept contains usually not only the physical condition of the vessel but also other aspects of the ship, like sufficient manning, skills and certification of the crew, defects in stowage, documentation etc.

Requirements are also different for vessels in port from vessels at sea. In some jurisdictions the concept is used without any qualification at all and in some jurisdictions unseaworthiness –provisions include more detailed guidelines as to what constitutes unseaworthiness.

## 2. MASTER'S LIABILITY FOR SAFETY AND SEAWORTHINESS OF VESSELS

### *2.1 Introduction*

In the world we are living now the primary responsibility of the master is to ensure compliance with various laws that apply to the vessel and crew - Was it national law or international law - both in the country of the vessels flag or the law of the country the vessel is visiting.

At first sight one could imagine that all masters should also have at least a master degree in international law before they accept this demanding post. But they do

not, and if some of them have, they will be hired by the London market - as we have seen to happen. The other important master´s responsibility is to ensure that company policies and procedures are followed.

Modern legislative trends are increasing the responsibilities placed not only on shore side administrators and managers but also shipboard personnel, especially the master. For example environmental laws carry with them not only civil penalties, but the potential for personal criminal liability as well.

The legislative atmosphere surrounding maritime transportation has been affected primarily by a few major accidents during the last decades. The laws affecting maritime activities are enacted largely as a response to catastrophes of one sort or another, or as a reaction to international pressures and trends. The last trends and pressures have especially and unfortunately been seen also as criminalisation of seafarers.

Masters should become familiar with the legal responsibilities of the position. Unlike in earlier days they have new problems like work-hour rules, reduced manning, automatisation, flow of personal documents, additionally required logs and recording documents number of which keeps increasing year by year etc. etc.

All this workload for the masters should be taken into consideration when the safety of ships is to be guaranteed. New technical procedures should be made to ensure the safe prosecution of the voyage and to help the masters in ensuring the safety on board.

When a master accepts the command of a vessel, he agrees to act honestly and to do the best of his ability to protect the interests of the company. He looks after the safety of the vessel, cargo, passengers, and crew at all times and he also has a legal and moral duty to protect the environment. The master acts as a direct representative of the company and sometimes also as a representative of the charterer and is responsible for all damage and accidents that happen on board. The master is responsible for all persons on board whether their presence is authorised or not. His work to ensure the safety should be made easier by technological means so that they make the safety procedures easier to be controlled by him.

### *2.2 Development of Seaworthiness requirement*

The concept of seaworthiness was born in 17th century England when insurers and charterer's needed a concept for evaluation of the conditions of the vessel they were going to insure or charter. Shipping registries and classification societies were needed for supervision of the requirements when the ships became larger and more technical entities.

Although seaworthiness was at first the concern of charterers and insurers, many other interests were soon involved and interested in seaworthiness of a ship. Authorities after all the others, which have been mentioned above, became last interested in the issue. Seaworthiness has been foremost an issue attached to shipping business before last decades when safety at sea has become increasingly important.

### *2.3 Technical seaworthiness of a vessel*

The requirement of technical seaworthiness means first and foremost vessels hull, machinery and all equipment connected to these and which are closely related to the use of a vessel. Modern vessels are practically loaded with technical instruments, which can be enumerated in under this requirement; steering gear, hatches, pipelines, fire fighting systems etc.

Although ship owners are also responsible for keeping the ship seaworthy, it is expressly stated that the master has a duty to ensure that all these technical seaworthiness requirements are fulfilled before the ship sets of on a voyage. The master accepts this responsibility by signing in ships log that the vessel has been made seaworthy before the voyage each time the ship leaves port.

### *2.4 Seaworthiness for a voyage*

The ship has to be manned and equipped for the intended voyage and the master is responsible for taking into account all possible needs for intended voyage plus possible changes of route ordered by ship owner or charterer. The ship has to carry along necessary charts and other navigational aids, medicine, bunkers, provision and documentation.

To compare the two requirements - technical seaworthiness and seaworthiness for a voyage – we could imagine a house with walls, roof and things that are fixed in the house to symbolize the technical seaworthiness of a vessel. Living in the house is not possible without all movable objects which make living in it possible for at least for a certain period of time which in turn symbolises equipping the ship for a certain voyage. The master is responsible for the cleanliness, sanitation, and good condition of the living quarters on the vessel. He also has to ensure that no unauthorized personnel are permitted aboard when the vessel leaves port.

### *2.5 Cargoworthiness*

The ship is expected to arrive at port of destination unharmed with its cargo. The ship has to be considered cargo worthy already before loading to make this possible. Cargo holds must be cleaned after previous cargo in a way that is expected by the new cargo. The master has to be aware of the required measures expected by the new cargo.

On the other hand the charterer will not be willing to pay for unnecessary delay caused by unnecessary cleaning or other measures which were not necessary for his cargo. All cargoes cannot be accepted at the same time and certain cargoes make the ship unseaworthy for transporting the others ( for example IMDG –cargo).

## 3. RESEARCH AND TECHNICAL SOLUTIONS TO ENHANCE THE SAFETY AND SEAWORTHINESS OF VESSELS

### *3.1 Introduction*

Seaworthiness must nowadays be evaluated in very different circumstances than traditionally. In the era of technology a seaworthy ship needs to be technically and electronically in order before leaving port and be equipped and manned in a way that it stays that way also during the voyage. Crew must be able to cope with the situations which might arise at the bridge.

The shipowner must have means to cope with the different requirements which are posed for the crew by the officials which control the seaworthiness of the ship and the skills and certificates /validity of the training of the crew.

The work at the bridge must also be arranged that way that the ship shall be manoeuvred in a way that stays seaworthy and the crew at the bridge doesn't lose concentration because of unnecessary occupancies or routines which make the crew lose concentration at the precise moment when the best endeavours would be needed.

Ship with wrong routines or unnecessary people at bridge can lead to a disaster which could be avoided by strict obedience of safety procedures in critical points of the voyage on a well-planned route. Different scientific models are analysed which can be used in this respect in order to guarantee a seaworthy vessel throughout the voyage.

Another aspect relating to technical possibilities for avoiding classical unseaworthiness problems are development and planning of electronical crew certificate management systems and spare part management systems which efficiently guarantee, if they are well used, that the requirement for safety can be met.

Satakunta University of Applied Sciences has for years encouraged the teachers and researchers into both theoretical studies and research connected with more practical examples to be performed with the students in relation to seaworthiness problems in relating to human behaviour and technical avoidance of such problems.

### *3.2 Cruise ship safety and cybernetic model for BRM*

Research concerning Cruise ship safety has been done for years but the last research project has been well timed as it was started before and finished after the Costa Concordia incident – and the core of the project was to analyse the safety from the ankle of the workload and activities on bridge. The greatest remarks during the study made by Master of Marine Technology student, Master Mariner *Risto Sipilä*, were made on the human behavior.

*Sipilä* pointed out that the natural features of human-being are not included to the training of the officers and seldom considered on board.

The implementation of new was found difficult. The attitude and working habits of the captains and the officers were strongly rooted and build, not only during the test use of the Cybernetic tool, an environment, where the alterations, possible improvements and the experimentation of them, or even independent thinking were rejected.

*Sipilä´*s research pointed out that the crucial role of the captain has huge effect on the projects like his study. As the captain is responsible of the safety on board and to implement the bridge team management to meet his criteria, he is usually the only person able to bring new ideas into force. This was acknowledged by the company as well.

Bridge operation related documents on safety management system state that the captain is responsible to plan and establish proper manning by creating watch plan and giving the required orders to instruct the officers accordingly. The responsibility is clearly noticeable but this kind of arrangement creates other difficulties. In the companies where the crew members shift between two or more vessels it is typical that the working methods shift with the persons. This hinders the formation of standards as the colleagues are constantly changing.

The captain as responsible person changes the whole bridge procedures according to his opinion. This creates every time difficulties to the colleagues who have to learn the new way of working in the middle of their contracts.

If the company doesn't create the procedures with the captains, who agree to implement the procedures on board, in the fleet there will be as many bridge management systems as there are captains. Implementing new systems and working procedures, especially when they deal with significant changes, must be introduced and brought into force from the higher level of management to enhance maritime safety - considers *Sipilä* in his research outcome.

*Sipilä* points out that this kind of implementation of working procedures would as well solve the confusions with the descriptions of required actions. When the company acknowledges the captain to be responsible to implement "proper manning on the bridge" they actually cover their own back and make the captain partly guilty of accidents.

This is a remarkable point in the cases when the captain is not fully capable to deal with the resources. After an accident the bridge management will be noted not to be in order, which shows that the captain hasn't fulfilled his duties. This leads to more complex difficulties. The totalitarian system, where the leaders command the underlings without interaction hasn't worked, and will not work on board either.

*Sipilä* highlights in his research that the safety standards of the work on the bridge during the navigation must be taken into account constantly; also when the idea of the double watch system is considered to be worth implementing, it is not appropriate to wait until it's completed. Beforehand, and when implementing big changes, the safety attitudes are the most remarkable factor to improve or hamper the standards.

The attitudes are impossible to transfer – they are everybody's own based on the qualities and knowledge of the person. These own opinions, and the actions based on them, will affect the ones of surrounding people and

influence their ideologies. The positive changes are about to increase and create culture, which uses the best possible methods to improve the safety standards: the human beings.

The research to be completed in SAMK is to find out the connections between liabilities of the owners in relation to seaworthiness of the vessels when the owners can be anticipated – or even shown – to accept the unsatisfactory procedures or safety culture on bridge. The relation of ISM code to new safety practices on maritime safety research shall also be under consideration in the near future.

In the future when seaworthiness will be evaluated constantly during the voyage also from the liability point of view - when the Rotterdam Rules will be effected by maritime nations - the question on causality and liability of the owners will be even more interesting.

*3.3. Resource management and communication in a shipping company – some considerations*

Resource management systems are often as many as shipping companies even though some standard systems have been developed. There are electronical systems which are tailored for companies on the basis of some basic solution and there are solutions that are tailored directly for a company on the basis of company´s own needs – and then there are companies which do not have any electronical systems in place at all.

The research which was made at the SAMK by Master of Maritime Management student, Master Mariner *Mona Zilliacus* during the last calendar year pointed out interesting considerations on the needs of such systems especially in relation to companies where demands for changing crews very often between different kinds of vessels.

The side effect of the research was to take into consideration the fact that there is a severe risk in such circumstances that the crew management misses the requirements if there is no proper system in place and the vessels sail with an unseaworthy manning as a consequence of a missing certificate and the crew does not have necessary knowledge on the demands of the vessel.

The outcome of the research was that there is a specific need for a workable and tailored program especially when the mobility between vessels is significant especially in situations with tug owners where only a part of the vessels are continuously manned.

Also this research has been promoting new research project concerning the relations of the procedures created by shipping companies in relation to the owner´s knowledge and liability for safety and seaworthiness of vessels in general.

Universities of Applied Sciences take care of the research which applies the results into practice.

In Master of Maritime Management program this basic idea is used in a way that these two are combined as research projects by Senior Lecturers or research fellows working on their Doctoral thesis and the students (Captains with bachelor degree + minimum of three years working experience at sea) working on their Masters thesis. They both benefit each others.

The findings that can be made on the basis of the analysis of the two recent Master theses will be more closely analysed in further work.
Especially Nordic Marine insurance

## 4. CONCLUSIONS

The continuous research project concerning seaworthiness of vessels and promoting safety at sea aspects to enhancing safety thorough insurance conditions has been conducted in SAMK for years. The idea of the Finnish educational system is twofold: the basic research should be made at the conditions (Nordic Marine Insurance Plan 2013) make it possible for the shipping companies to promote better safety cultures in shipping companies and to affect at the same time on the level of their own insurance premiums when the risks though technological solutions connected to ensurance of human behavior are created and put into place - and made safety regulations as detailed insurance conditions in the policy.

Universities and the The basic idea is simple to sell for the ship owners – The technical solutions and investments on workable models for BRM that promote safety, need investments when they are created and put into place, but the investments can be saved within a year or couple of years when the insurance premiums can be negotiated to take into consideration the new safety culture of the vessel or the whole fleet.

## 5. ACKNOWLEDGMENTS

In the end of this article I wish to thank all my Master of Maritime Management students who have graduated during the last four years and encouraged the others with their example and especially those who have been working with the thesis connected to the issues of Safety at sea, technological solutions and Seaworthiness.

The companionship between the student colleagues especially during the last 2 years has been remarkable and has also benefited the research significantly as the atmosphere among those conducting the research has been enthusiastic and supporting for both students and the teachers.

## 6. REFERENCES

[1] SIPILÄ, Risto, *The Cybernetic model of the bridge environment of a cruise vessel*, Master of Maritime Management thesis, Satakunta University of Applied Sciences, Rauma, 2012.

[2] ZILLIACUS, Mona, *Combining resource management and communications in a shipping company*, Master of Maritime Management thesis, Satakunta University of Applied Sciences, 2013.

[3] NORDIC MARINE INSURANCE PLAN 2013, www.nordicplan2013.no.

# INTELLIGENT TRANSPORT SYSTEMS – IMPROVING THE EFFECTIVENESS OF ECONOMY

[1]SAVELIEVA IRYNA, [2]KOSKINA YULIIA

*[1,2]Odessa National Maritime University, Ukraine*

**ABSTRACT**

The article is devoted to the intelligent transport systems, their nature and role in the Ukrainian economy development. The author identifies the problems and defines strategic goals of national ITS implementation.

**Keywords:** *Intelligent Transport Systems, economic efficiency*

## 1. INTRODUCTION

Globalization of the world economy, increasing the intensity and complexity of the traffic flows, new IT opportunities in monitoring and management of various economic and transport processes on different levels require intellectual support. Implementation of intelligent transport systems is one of the tools to increase the level of world economic development.

Intelligent Transportation Systems (ITS) - a complex set of informational, communicational systems and tools of automation in conjunction with transport infrastructure, vehicles and users, ensuring efficiency of the transportation process, improving its safety and quality. [1] In other words, ITS - the integration of information and communication technologies as applied to the key components of the transport processes: man - transport - transportation infrastructure.

ITS are innovative technologies. They are designed to provide efficient solutions to the number of complex problems in the field of transport. Among them are particularly important are the following:

- Reducing the risk and consequences of the natural and man-made disasters;

- Development of technology for development of intelligent monitoring and control systems;

- Creation of new transport systems and management technologies;

- Creation of energy-efficient systems of transportation, distribution and consumption of energy in the interaction of all modes of transport;

- Creation of innovative technologies and systems for processing, storage, transmission and protection of information;

- Creation of innovative software production systems and technologies, etc.

Immediate objectives of the ITS which monitor the transport processes, as well as involved in data mining and modeling, are as follows:

1. Automation of operational forecasting of the arrival time of transport units. In some cases, planning which is based on statistics and standards is quite difficult.

2. Transport management of land transport operators.

The task of analysis, modeling and cargo transportation management for the several operating land transport operators provides another example of the intelligent transport technologies capabilities utilization. It requires monitoring, accumulation and generalization of the results of the individual carriages by sections that were performed by different operators. Special graphical models (reflecting logistics, technology and economic charts) are formed that clearly represent generalized transportation performance with the required level of details. Modeled diagrams allow the analysis, modeling and planning of the carriages. With the aid of diagrams, it's possible to perform estimation of the expected delivery time, assets utilization and operational forecasting of the current traffic characteristics (expected levels of technological and economic KPIs, etc). In this case, it is also possible to apply ITS techniques and expert systems methods for automatic generation and adaptation of relevant mathematical and information resources of transport management systems.

3. Maintaining tasks of safety and accessibility of the data for all user groups.

4. Unification of decision support systems in the event of deviations from the reference system state under specified conditions.

Annual growth in international trade relations, development of the society and global economy demand quite high quality standards of the national transportation system service

Global transport complex has reached a new, innovative path of development. Therefore, in order to remain competitive in the transport market, national transport industry must focus on intense transportation system improvement[2]. It is possible presently with the development and implementation of intelligent transport systems, as confirmed by best available practices.

Relevance of innovative management methods implementation is also confirmed by its influence on the over the efficiency of the national economy as a whole. Efficiency is a complex concept, which is, among others, defined by the level of stability and dynamism, which, in turn, includes safety and quality [3]. In general, increasing the efficiency of the economy (all of its branches) depends on the level of each infrastructure element development, including the transport sector. Development of the latter is impossible without the ITS implementation. ITS are designed to ensure the safety, quality and dynamic development and, consequently, positively influence national economy as a whole.

Currently, Ukraine is carrying out fairly wide range of projects on ITS development and implementation, reflecting the interests of all transport process participants – transport companies and their customers. Thus following tasks require immediate attention:

- The development of transport infrastructure as a critical factor in the design and implementation of ITS;

- ITS operation prospects;

- International use of ITS;

- Development and use of legislative and regulatory support of global and domestic information technologies in transport;

- Create a national single integrated information and control system on transport;

- Improvement of electronic control and security systems;

- Development of the specific IT-logistics systems;

- Wider implementation of global navigation-transportation systems, and satellite technologies in the transport sector (GPS, GPRS, GLONASS, Galileo, etc.);

-Improving electronic systems and navigation equipment on vehicles, deployed at international sea, rail and road transport.

The main problems of ITS implementation in Ukraine:

1. The absence integrated intelligent management systems (IIMS), which is a barrier to long-term development of the transport industry. The modern development of transportation information management and communication systems of the country should be based on a common information and communication environment of the transport complex, which is impossible without the IMIS.

2. The development of intelligent transport systems of Ukraine is hampered by the absence of national legislation in this area.

3. Integration of the interests of all "customers" and "suppliers" as elements of ITS, is an important aspect of the ITS formation, especially as Ukraine intends to continue its integration into the global (at least - European), transport and communications and economic space.

The solution to the problem of supply of necessary quantity and quality of transport services is recognized as a catalyst for the development of the whole transport complex of the country. This is especially important within the maritime transport – an important system level of the foreign trade relations. Timely and regular deliveries of consignments to customers is extremely important to shipper while respecting the principle of "door to door" and compliance with the best available practices on optimization and the safety of the transportation. When the transportation routes are reasonably full, the solution to the above problem requires monitoring of the transport flows, vehicles, cargo, passengers, as well as formation of intelligent monitoring and control systems of transport, logistics and economic processes. Due to present absence of the integration in various modes of transport development in Ukraine, it is necessary to develop and adjust highly effective and innovative technologies. ITS are particularly relevant in the further development of the container transportation as a unified mean. Presently, containers can transport different types of cargo, ranging from general cargo, consumer products and up to coal, liquefied gas, oil, ore, etc. It’s development affects not only international, but also regional, inter-regional and local aspects of the present business practices [4].

Today, the government focuses its efforts to society-oriented economic development. Which means that availability and quality of transport services to the public shall comply with social standards. Thus, development of the appropriate state system to control transportation quality is necessary. In a line with this, development of urban and suburban passenger transport and passenger rolling stock, which would adhere to the modern standards, are required. Special attention shall be

focused on the development of high-speed and ultra-high-speed passenger transport. ITS shall become the basic tool for resolving these issues, as they integrate video surveillance and recording of public transport, electronic passenger identification and fare collection, etc.

Integration into the global transport and communications space and need for the realization of the national transit potential require the harmonization of technical and technological parameters of transport complex of Ukraine with appropriate international standards. In turn, it will ensure its competitiveness in the modern environment. Here, one of the major problems is the optimization of the major transport hubs (such as seaports, railway hubs, etc.) with the use of ITS.

In order to design, develop and deploy the ITS, it is necessary:

1) to assess the impact of ITS on the objectives and key performance indicators of the state program of development of the transport sector;

2) develop a program of pilot projects on ITS implementation at specific regions (separate transport hubs), where ITS should be considered as a set of technologies related to the use of the information on the state of traffic, elements, systems, and the economic parameters (their dynamics) that allow to implement operational monitoring, control and optimization (and timely correction).

Global transportation is influenced by major institutional and technological processes that have already radically changed and continue to change the face of the world transport. However, positive changes are accompanied by a number of negative consequences, the scope and significance of which give reason to consider these as a strategic challenge of national and global scale [5]. These include a high level of human waste, increasing consumption of non-renewable sources of energy and other resources, the negative impact of transport and its infrastructure on the environment, the ever-growing delays of goods and passengers in transit (as a result of the so-called "bottlenecks"), caused by actual lack of the capacity of the transport infrastructure, and even more so by inadequate traffic management.

For modern world ITS mean new fields in interaction of science, engineering, economics and business, considered as the most effective tool for solving transport problems and creation of the new industrial segments. The efforts of the government, public, international organizations, academicians, and business circles are aimed at finding solutions in such key areas as a significant increase in security at sea, rail, road, pipeline transportation, as well as productivity increase, growth of the capacity of internal and intermodal transport systems.

Taking into account that Ukraine country is dragging behind the intellectualization of the transport processes, proposals for the development of ITS in Ukraine shall first of all contain analysis of international experience on similar projects of ITS development and implementation. Starting from 1980-s most countries of Western Europe, the Asia-Pacific region (including China and India) and the U.S. deliberately and systematically promote own ITS as the basis of transport policy.

In accordance to the international practice, it is appropriate to consider ITS as an common transport ideology, the integration of the best IT and telecom achievements into all kinds of transport. Problem of ITS implementation is strategic in nature, as solution determines the overall competitiveness of each country on the world market. Also, due to large scale investments required, it can not be realized without the direct involvement of the state (i.e., without a government support program). The role of the state should be measured in the following four key areas:

- The formation of an institutional framework for national architecture, planning and coordination of economy development management;

- Creation of a legal framework, standardization and harmonization of requirements for technical solutions and software within security field;

- Support research and pilot projects on forming and implementation of the knowledge-based ITS-services with a high level of initial commercial risk and development of socially oriented ITS projects in the of low economic development;

- Development and implementation of ITS infrastructure components in the field of the public transport - drivers information system, adaptive traffic control systems, shipment information systems for shippers/cargo owners, ship operators and managers, owners, stevedoring companies, terminals, warehouses, weather conditions monitoring, driver behavior, road vehicles parameters monitoring, etc.

The theory and practice of innovations confirms that state involvement is crucial, since it determines the legal environment, creates a favorable innovative and investment climate, ensures compliance with established rules and regulations.

ITS marketing prospects are of interest to the scientific and business community. However, the current state of the market, particularly in Ukraine, has the following features:

- Fragmentation;

- Disconnection;

- Lack of national standards;

- Absence of the constant contacts with international ITS associations.

However, the solution of these problems, the formation and implementation of ITS in Ukraine will increase the efficiency of traffic management, reduce overhead costs for the transportation of goods and passengers, will accelerate the development of the national transport and communications, provide a favorable environment for the introduction of services on the basis of existing satellite navigation systems.

The expected socio-economic impact of the introduction of transport information management systems may estimated (similarly to the effect of the introduction of the same at the Western Europe, the U.S. and China) as 10% of GDP growth, the reduction of accidents by 30%, reduced fuel consumption by 20 % and increased employment by 5%, which in turn will increase the effectiveness of the Ukrainian economy as a whole and, consequently, the quality of life.

## 2. CONCLUSIONS

ITS is the common transport ideology of telematics integration achievements in all types of transport.

Problem of the introduction of ITS is strategic in nature, the solution generally the determining each country's competitiveness in the global market and due to the capital intensive and they can not be realized without the direct involvement of the government (i.e., without a government program and its support).

## 3. REFERENCES

[1] Intelligent transport systems. [Website]. URL: http://www.connect.ru/article.asp? id = 9558 (date accessed: 23.04.2012).

[2] The International Transport Forum has become the starting point of a new era of Russian transport // Transport of the Russian Federation. 2009. № 6 (25).

[3] Panamareva O.N. Essence of the concept of economic efficiency of the sea port // Sat. scientific. works. No. 12. Novorossiysk, 2007. Pp. 214-216.

[4] Intelligent transport systems as a tool to improve competitiveness of and profitability. [Website].URL:http://www.connect.ru/article.asp?id=9558 (date accessed: 23.04.2012).

[5] Intelligent transport systems: prospects for development. [Website]. URL: http://www.zdt-magazine.ru/publik/exibition/2009/05-09.htm (date accessed: 03. 03/05/2012).

# THE IMPORTANCE OF THE MULTINATIONAL CREW IN THE CADETS' PRACTICE

[1]STAN LIVIU CONSTANTIN, [2]MITU DANIELA ELENA

*[1,2]Constanta Maritime University, Romania*

**ABSTRACT**

For today moment, the shipping industry is a multinational one. All the activities in this industry are based on interaction and collaboration between people from different counties and cultures. In an international company, these details are common, due to company necessity in having offices placed in different countries according to the business interests. But these aspects become more complex when we refer to onboard ship activities. For this reason, it is necessary to observe and study the kind of compatibilities or non-compatibilities that exist among seamen from different countries in order to create a proper working environment onboard the ship.

The present paper intends to illustrate different elements encountered in the human resource management and their appliance in a multinational crew situation, to see how is to work inside of a multicultural crew as cadets or younger officer, through experiences of our university students during their onboard practice on different ships with different nationality crew members.

**Keywords:** *Cadets' practice, shipping industry, multinational company, multinational crew*

## 1. INTRODUCTION

Starting from the 90's, the concept of single nation crew had become less met on the world level. This situation was caused by the transfer of the ships from the public sector to the private one, especially in the eastern European countries and along with the ship flag changing under a more permissive one. These changes accelerated the implementation of the multinational crew onboard ships, the new owners wanted to put their own people in the ship's management positions covering the rest of the onboard positions with the possible cheapest hand work.

The new conditions do not represent a problem if the crew is prepared to face this change. Put in front of a new working environment, many seafarers had accommodation problems, difficulties in working relationships onboard and the biggest problem was generated by the use of a foreign language, mostly English, in the daily duties communication. Many of these first unpleasant conditions have been covered by the option of a most attractive payment, the salary onboard of these ships being higher than for the same position onboard of a national flag ship. It was necessary a long period to accommodate seafarers to the present situation, but it was usefully, because the crew was familiarized with the ships and for the beginning they represented the basement of the safety crew. In time, the contact with other nationalities crew members permitted the knowledge transfer and option to replace them.

Beside these problems of nationality, culture and language differences, another problem that can exist onboard is raised by age differences between crew members, in many cases younger persons have to coordinate and control older and more experienced crew members, situations generated by position and rank. These problems are bigger when we talk about a person on first experience onboard ship and particular in a multinational and multicultural crew.

Due to these facts, it was compulsory for the maritime training institutions to reflect and change the training concepts in order to facilitate the accommodation inside of a multinational crew, mainly onboard ships with a various cultures crew. One of the solutions proposed included the possibility to cover the requested onboard practice to foreign or multinational shipping companies.

Trying to find how cadets and younger officers have felt their first contact with the actual onboard environment, a multicultural one, a group of lecturers from our University realized a study about, using for this reason the experiences of our students during their onboard practice.

## 2. A MULTINATIONAL CREW – BETWEEN CONCEPT AND REALITY

The multinational crew appeared on the shipping market as result of different economical reasons. First of all is the necessity to reduce the costs with personnel, but also to keep the requested standards onboard.

In this way, owners changed their crew resource option to work force markets from Asia and Eastern Europe mainly. At beginning, they took position onboard as O/S or A/B in deck compartment and as motormen in engine department, after, the owners started to accept also deck and engine officers, even at managerial level, as Master, Chief Officer and Chief Engine.

The change from the single nation crew to multinational crew has not avoided by problems and difficulties, mostly due to different concepts applied by the owners onboard related to multiculturalism and working relationships. An ideal solution is to have seafarers from the same nationality in one department and if it is possible to assure the operational officers from the same nation. In order to satisfy owner's certitude that everything is alright onboard and his property is used in good condition, the ship management will be cover by owner's people, same nationality with the owner or very confident owner's persons. In present, many companies apply this concept, even better, the onboard ship, the operational is covered by one

nationality crew members and only the ship management is from other, in case of impossibility to be from the same nation.

In addition to different nationalities, multiculturalism can also involve different cultures for the different groups aboard, meaning that the different groups may have different ways of seeing things and different ideas about who is the most important aboard. They might, for example, be the people on the bridge rather than those in the engine room, or the young rather than the older people aboard.

Cultural differences represent the fundamental of communication and involve development of understanding skills amonmg different nationalities. These differences became visible when we were in contact with other nationality persons, a frequent fact onboard of multination crew ship. People see, interpret and evaluate the things around them in very different ways. What seem to be right in one culture can be, for many times, inappropriate for other culture.

Misunderstandings due to cultural differences appear when a person of a nominated culture wants to impose own point of view to another person, from a different culture and with different principles. Wrong interpretation is the main element arised when we want to induce to other person our own concepts.

Without a good knowledge of others cultural characteristics, it is preferable to adopt a diplomatic approach for different aspects which keep by a particular culture. To became consciences by the own culture dynamics is a difficult task. From our first life days, we are learned to see and to do some things at an unconscious level. Own experiences, personal values and cultural bases are leading us to do things in a designated way. There are moments when must to pass over our cultural borders to realize the impact of other culture on us. It is very usefully to have answers from different nationalities colleagues and also from different cultures, in order to help us in development the own style regarding to cultural treatment applied to other peoples.

Even cultural similarities can create misunderstandings sometimes. When consider than other persons have a similar culture with ours, we take the risk of wrong interpretation of our actions, with result in a negative reply from the others.

There are many references levels which can help to express the cultural differences perception, as:

- Primary level or parochial, when peoples do not know to do different things other than personal way. At this level the impact of cultural differences is ignored.
- Second level or ethnocentric, peoples accept others thinking way, beside of their own, but still considers own style as the most indicated one. At this level the cultural differences are seen as a source of problems and peoples have tendency to ignore or reduce the importance of these.
- Third level or synergistic, person conscience own thinking way and others thing ways and choose the best solution for the present situation. At this level, peoples realize that cultural differences can lead to problems, also to benefits and they are interests to use the cultural diversity for creation of new and alternative solutions.
- Last level or cultural participation, is the stage when persons from different cultures belong together to create a common thinking culture. At this level peoples talking one each other, creates new understandings, new rules to help in solving of a particular situation.

Increasing of the cultural knowledge means to observe the positive and negative aspects possible to appear inside of cultural differences. The cultural diversity can be a source of problems, especially in the fields where is necessary to collaborate and work together. The diversity increases the complexity and confusion level and make more difficult to reach a common sense.

In order to manage well the cultural differences is important in the first time to know and understand them, not to be afraid of.

So long, each of us is the product of his own culture is necessary to increase the self and collateral knowledge. For this objective there is not a book to treat the cultural differences, not exists written rules to be followed in suck kind of situations.

When peoples achieve the necessary cultural knowledge, they realize than:

- we are not the same;
- similarities and differences are both important;
- there are unlimited ways to reach the same goals of living together;
- best solution depend by the particularities, each situation is different and may request different solutions.

A correct approach of the cultural differences can be done through some concepts acceptance, like:

- accept that you don't know
- judge before
- be sure to be understood
- become familiar with ambiguity
- accept diversity.

These are few concepts regarding the correct deal with cultural differences. Not all of these can be applied onboard ships, but ones can provide good results, mainly when make references to an environment which request a very good collaboration and work relation.

In many cases, the cultural differences exist inside of the same nationality and are passed very hardly. When put together more than two nationalities persons, these differences become extremely difficult to be passed and in this situation it is necessary to know to manage them and to try to find a middle way if the best solution cannot be found.

Also, the cultural behaviour is different from person to person and the approach modalities must to be adequate to each person. It is very important to know from the beginning how to deal with these cultural differences, especially if you want to perform a longer carrier inside of a multinational working environment.

## 3. CONSTANTA MARITIME UNIVERSITY STUDENTS' ONBOARD PRACTICE

Until 2004 Constanta Maritime University students' practice has developed onboard of the scholarship

"Neptun", but due to a lot of engine and hull problems this activity has been suspended.

After the suspension of this activity, the solution found was to sent our students in international voyages with different shipping companies, local or international, for this action been contacted the local crewing agencies or owners offices. This was the first step, when over half of our students covered their requested onboard training on ships of different owners, most of them, international shipping companies with a great rename on the world shipping market, as NYK Ship Management, Japan, Peter Dohle from Germany, Maersk, Denmark, CMA-CGM from France and many others, in totally, 22 shipping companies being part of the partnership.

Taking account of the present regulations regarding onboard training period as cadet, 12 months for deck cadet and 6 months for engine cadets, our university took decision to help and facilitate students' onboard practice. In this way, in the present there are agreements signed between shipping companies, their local representatives, and our university, where there are stipulated the requested training objectives, onboard live and work condition and schedule for students and the level of theoretical knowledge necessary to be acquired by our students before to proceed to the onboard practice.

Adopting this solution, in time, the number of the shipping companies interested to take cadets has increased and the number of students trained has also increased. During the year of 2008 through this protocol a number of 555 students covered their onboard practice on ship owned or under management of collaborative shipping companies.

Inside of this protocol, the companies have possibility to offer scholarships to our students during their study years and other facilitations in order to create the own group of future company's officers. In the present, there are ship owners which select students, through tests and interviews, from the first study years and include them inside of the future companies' personnel development program, offering to our students' monthly scholarships, opportunity to cover the necessary onboard cadets' practice and to be sure on the end study, position inside company.

In the same direction, our University, as participant at European Erasmus Programme for the students' mobility, in partnership with European shipping companies, has gotten the possibility to other 182 students to cover their onboard practice, including an Erasmus scholarship as Erasmus students. After the first months of this project development, an increased number of students have became interested in this possibility, the advantage being represented by the cumulative amount between scholarship and cadet monthly payment.

For the future, we are interested to increase the number of partner shipping companies and also to extend the Erasmus programme in order to offer to more students the possibility to have the necessary cadets' period at the end of study years and to make possible participation to officer certification exams after their graduation.

## 4. STUDENTS' BEHAVIOUR INSIDE OF A MULTINATIONAL CREW

Starting from the present situation, when the world fleet is based on multinational and multicultural crews, and taking in consideration that our students make their onboard training on ships of international owners, a group of lecturers from our University had the initiative to realize a study about what are the students apprehensions and considerations regarding the first voyage or voyages onboard ships with multinational crews. This initiative has risen after a number of bad feedbacks from students, very disappointed by the first cadet voyage who intended to give up a maritime career after finishing their academic studies.

To do the study, the questionnaire and direct discussions techniques have adopted, involving in this action student from different faculties, in connection with maritime carrier, just arrived home from a cadet voyage.

The questionnaire was based on a set of questions about company where they made the voyage, crew structure by nationalities, social life and working activities onboard, type of relationships developed onboard with the others crew members, what nationalities and cultures they consider to be closer to own culture, if they have difficulties to socialize onboard, how long period consider necessary to achieve skills in order to understand other cultures and what are the opinions about the direction of their future maritime careers.

Analyzing questionnaire answers we were able to open a free discussion with students and to try to find the motivations for different answers. During discussions, the highest difficulty was to made students to speak freely about their experience during onboard stage or stages and to pass over the fact that they talked with a teacher.

The analysis of the answers allowed having a percentage view about students' opinions and the results showed that they are more compatible with the European countries' seafarers, have more possibilities to develop social and work relations with these ones and accept more easily orders and instructions from European officers and Masters. Part of them acknowledged that they interacted without problems with Asian seafarers also. Most difficult was to collaborate with superior officers or nominated onboard training officer when they are from an Asian culture. Some difficulties were noted in relations with the Eastern European officers, but these were produced due to different personal opinions, not professional.

A very important point found in almost all questionnaires studies was about difficulties in communication with other crew members, part because of poor English language knowledge, part because the English was talked with native language spelling influence and many words were difficult to be understood. Starting from the language problems, a part of the students avoided to socialize with some of the crew members and maintained a strictly professional relationship.

Period considered as minimum necessary to accommodate and start to interact with other nationalities crew members onboard has varied from one week to one month, more accessible on ships with a strong cadet training programme developed. Longer has considered being the accommodation period to daily duties and to the training schedule, some students taking the give up decision due to their forbearance about possibility to reach the conditions requested for duty onboard.

Many students had difficult to express an opinion or a point of view about cultural similarities or differences with other nationalities, they did not have enough knowledge about these matters, but talked about what they felt in relation with other nationality crew members considered as to be cultural correspondences or differences. They found many common aspects with persons from all over the world, especially about the free time spending or passions for sport activities and events, about musical preferences and in many cases these common activities represented the starting point in a future personal and friendly relationship. The differences were based, as expected, on religious problems or native social life characteristics, most of them in relation with Asian or African seafarers met onboard.

As a general opinion, the problems arisen from the nationality and cultural differences have considered possible to be passed if there is interest to develop a long and nice career in the maritime industry, especially onboard ships. An interest opinion has obtained from a part of the questioned students, who considered that problems and misunderstandings can appear every time and in every working environment. They acknowledged that the onboard environment is a particular one, with restrictions imposed by the space and activity characteristics, but the attraction for this job, a not easy one, but with many satisfactions, can lead to a personal approach more open to understanding and acceptance of the other nationality cultures and particularities.

On the other way, the students who expressed their option to give up to an onboard career, wants to perform in a relative activity field, where they have possibility to put in practice the knowledge acquired during the study years.

## 5. CONCLUSIONS

We have to accept the presence of a multicultural crew onboard ship. Also, the idea of correspondences and differences among cultures has to be the acceptance and in this direction to know to understand and manage the cultural relations. From the beginning, it is better to understand that differences are more visible than similarities and to try to pass over the first and to reach the seconds. When we talk about multiculturalism, it is important to realize as obviously the differences between concepts and reality and to learn to treat correctly each culture, as a unique entity, not to apply the same format to all contacted cultures.

The multicultural problems are harder to be managed at the first contact, especially by the younger maritime cadets and officers, persons who can be very affected by difficult relation with other nationality persons. A solution can be represented by the involvement of the training institutions in preparing of the younger cadets for a multicultural work environment. Before their first experience onboard ships, a special training about multicultural concepts and social activities in a multicultural crew can be welcome in order to offer the necessary knowledge about and how to deal with problems coming from cultural differences. For this reason, it is absolutely necessary to know what deficiencies have met the previous students onboard and to create a training programme based on these.

Our University lecturers study represents the starting point for more other studies on the same or additional subjects, offering an image about the actual students' position regarding the training activity onboard of a multinational ship. The present study shows that more than half of students who made their first voyage are not afraid by the idea to work in a multicultural environment, considering more interesting the opportunity to know and interact with other cultures. The students who considered as almost impossible to perform onboard of a multinational ship, took into consideration the capacity to work with persons from other cultures in a different activity field.

Maybe, our study will not reduce the number of students who wants to give up to a maritime career, but helps us to understand better what problems are met onboard and in this way to be able to offer solutions to be passed over.

## 6. REFERENCES

[1] ARSENIE, P., *Ship Management and Administration*, Nautica Publisher, 156-170, 2007.

[2] ANECHITOAIE, C., SURUGIU, F., *Maritime Organisations and Conventions*, Nautica Publisher, 71-75, 2008.

[3] HORCH, J., *An Analysis of Decision-Making Processes in Multicultural Maritime Scenarios*, Maritime Policy and Management, No. 31, 15-29, 2004.

[4] European Union – *DG VII, MARCOM Project: The Impact of Multicultural and Multilingual Crews on Maritime Communication*, Final Report, Volume 1, Transport RTD Program, 1999.

[5] International Maritime Organization, MSC 83/12/4, *Training and Watchkeeping – Need for 'Trainee' berths on board ships*, 30 July 2007.

[6] International Maritime Organization, STW 39/7/3, *Comprehensive Review of the STCW Convention and the STCW Code – Communication and leadership skills*, 31 October 2007.

# ONLINE LEARNING METHODS IN HIGHER EDUCATION

[1]STAN LIVIU CONSTANTIN, [2]MITU DANIELA ELENA
*1.*
*[1,2]Constanta Maritime University, Romania*

**ABSTRACT**

Last years, showed an increased interest on the concept of life long learning, especially in the European countries. Many activity fields, including maritime area involve this concept.

The best way of bringing school in the life of many people, often catch in the economical activities that do not give the opportunity to really participate into teaching process, is represented by the use of the online teaching techniques.

The present paper is showing on already applied online teaching system used by our university, designed to offer easy access to information for teachers and students, but also available for former students, now officers onboard ships, in order to be able to update latest information's about technical development in maritime field necessary in their duty activities.

The online teaching techniques are used for the develop of the concept "train the trainers" in our university for younger lecturers, to help them to integrate in the academic training system, through the project named "Seafarers' environmental, social and cultural implications of sharing life on board ship within multinational crews – SeaCultLife", dedicated to the development of the younger and experienced lecturers competencies related to the training domain requirement and also development and improvement of the skills in using of the newest teaching and training techniques.

**Keywords:** *Online teaching, knowledge's development, maritime field, life long learning, modern technology*

## 1. INTRODUCTION

The papers sent to the Paper Committee for publishing will be edited in DOC format. Editing board will convert the Word files in PDF format.

In the present, inside of the training system are used two concepts of teaching and training, in generally, the traditional concept, based on paper text and courses audition and the modern concept, using computerized technologies, as simulators, virtual reality and online courses. Both concepts are usefully, because not all types of information can be communicated using solely the traditional or the modern one.

There are knowledge, as fundamentals, which are better developed using the raditional concept, where the teacher expresses clearly the terms, definitions, formulas and interact with the students for a higher understanding.

On the other side, courses developed especially for specialization or for upgrading of the knowledge, after finishing of the academic training, can be more easily communicated through the modern technology, as online or distant learning. In this case it is considered that the receivers of information already have the fundamental knowledge and this new information come to complete it.

Also, the online teaching techniques are more accessible for persons involved in the social and economical life of civil society and do not have enough time to attend the classes.

The modern society need citizens more trained and specialized for its evolution and development. These requirements can be covered through a better opening of the scholar system, at all levels, to the civil society.

An important mission of the system, mainly of the academic level training system, is to ensure the necessary techniques and information volume for a more educated society, with a higher level of knowledge, in a continuous contact with the latest researches and technical development.

The completion of this mission can have benefits for the system itself, offering possibilities to bring inside persons with a higher level of knowledge, able to improve and continue the development of the present methodologies.

One of the activity field intensive interested in this learning opportunity, the online procedure, is the maritime field. Here, the characteristics of activity cannot allow the direct presence in the classes for improving of the existing knowledge and skills. In the last decades, the changes, especially technically, have been produced, making necessary a periodically improvement and update. The online teaching techniques represent the better solution for this case, the internet being accessible from the middle of the ocean now.

## 2. THE ONLINE LEARNING OPPORTUNITIES

In the present days, the computers and computerized programs are part of the life for many people. The computerized technologies became indispensable for many activity fields, computers being part of the production processes, or even the essence of the work.

Taking these aspects in consideration, to put the school in the virtual environment seems to be a good idea. In many cases, the interaction between person and computer is more benefic than an interaction person to person related to the process of information and knowledge transfer. The computerized information is taking as impersonal by the receiver and can be interpreted and adapted to the own perception. When the same information is expressed by a person, than can

become personalized, the sender putting belong the information, his own remarks or opinions.

Other important characteristic of the online learning is giving by the possibility to have access to the information all the time, according with the user schedule. This option is value for those persons who have a heavy life program, for who the regular teaching schedule is difficult to be kept. This is one of the possibility offers by the online learning technique with a great importance in the maritime activity, where the program is made under the local time, ship hours, mostly different by the school local time.

An advantage of the online learning is represented by the possibility of different computerized programs correlation inside of the same course. This lets the user to access the necessary technologies more easily from one place, not needing to change places for each in part. In this way, it is possible to develop the online courses for initial or specialized training which requests the use of the simulation technology or designing programs.

Our university experiences this option inside of a course for familiarization training for petroleum tanker ship operation. Inside of the online course, the students and already certified seafarers interested to attend to a job on a tanker ship, have the possibility to visualize simulated application regarding different operation necessary to be known on a tanker ship, previously, reading and learning the theoretical modules about these.

Using the online teaching techniques, the student or trainee has the possibility to access more courses on the same time, option to take all the information one time and cover the curricula in a shorter period than will be done during the regular classes.

The communication between trainers and trainees can be done through different ways, using the electronic correspondence or an open forum for general impressions and opinions. These communication procedures can help to the improvement of the present data and to generate the development of additional subjects with role of covering of missing date or useful information for the main course.

Taking into account the actual trend in technology and techniques development in the maritime field, this kind of informative issuing can realize a continue and constant flow of information to the interested people, involved in ship operation and maintenance.

## 3. THE LONG LIFE LEARNING CONCEPTS AND PRINCIPLES

Long life learning is a term that is widely used in a variety of contexts; however its meaning is often unclear. The term recognizes that learning is not confined to childhood or the classroom, but takes place throughout life and in a range of situations. During the last fifty years, constant scientific and technological innovation and change have had a profound effect on learning needs and styles. Learning can no longer be divided into a place and time to acquire knowledge, the school and a place and time to apply the knowledge acquired, the workplace.

Also, life long learning is used for combining formal, informal and non-formal education and training, with a reconsideration of professional recognition and quality assurance processes. It is the process of acquiring and expanding knowledge, skills and dispositions throughout the life to foster well-being.

Long life learning is viewed as all-purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence. Such learning contributes to promote both employability and active citizenship and combating social exclusion.

The philosophy of education system is now changing globally and rapidly towards a continuous learning process. The change in the education system opens up the opportunity of part-time higher education in vocational and non-vocational streams. Life long learning puts emphasis on the initiative, zeal and motivation of learners to educate himself/herself according to his/her space, need and time rather than on the educators. Its necessity arises out of quest for knowledge, recognition, needs to solve many of his/her problems and develop capability and competency to survive in society and market place. In a professional discipline, the need for long life learning is more to prepare own person for fast changing professional competencies.

Long life learning is, thus, a philosophy that makes one to learn throughout the life of an individual either formally or informally. The informal learning process takes place through various ways and means such as observation, experience, environment and the need of individuals. The formal learning process is through well defined, structured method of education. In this context, the continuing professional education plays a catalytic role augmenting the method of long life learning.

In October 2006 the European Commission published a Communication entitled "Adult learning: It is never too late to learn". This document suggests long life learning to be the core of the ambitious Lisbon 2010-process, in which the whole of the European Union should become a learning area. In December 2007, the European Parliament's Committee on Culture and Education published a "Report on Adult learning: It is never too late to learn", which recognized the Commission Communication and a number of related recommendations and resolutions, and which urged member states to establish a long life learning culture.

Corroborating the European Commission policy with the population ageing of European countries, the role of lifelong learning and the educational system position near this situation must be an important one.

Putting together the social and economical conditions, economical being prior, and the opportunities creates by the online teaching procedures the development possibilities of this lifelong learning concept increase considerable.

In an informative society, the use of the latest technology inside of the learning process, at any age, is the easiest and cheapest way of knowledge’s propagation.

## 4. THE FORMATION OF LECTURERS TO PROVIDE ONLINE TEACHING

The principal providers of the long life learning in this moment, all over the world, are the universities and associated graduate institutions. At this level, there are possibilities to create and develop material, as courses and practical applications, for graduates of the same or inferior level.

To provide the necessary knowledge for a specified activity domain is most important to have your own trained persons, as lecturers, as institution. Taking into account the differences between this kind of learning and the formal learning, it is obviously requested to institution to have persons in charge with necessary skills for this.

In this idea, the previous step in creation of the learning curricula is the process of train the trainers to be qualified for this activity.

Constanta Maritime University developed a project dedicated to formation of the lecturers, younger and experienced, in the new teaching technology, to acquire and improve the present skills and knowledge about the new forms of learning, including online learning techniques and providing of training for graduate persons.

The "Seafarers' environmental, social and cultural implications of sharing life on boardship within multinational crews – SeaCultLife" project is based on politics and strategies fated to support the European maritime academic system position into the worldwide context.

The project is developed according with the Lisbon European strategies with the scope to make from European Union a dynamic and competitive community with an economy based on knowledge, with much and better working places, increasing investment in education and research activities. For this purpose, the Commission in relation with the member states and universities put into practice concrete actions related to continuous professional formation in the educational field.

Starting from 2001, once the e-Europe plan has been launched, through e-Learning initiative, the communication and computerized technology became an important element of educational system.

All of these strategies opened new possibilities for universities and their staff, as increasing of quality in academic level, professional promotion to easement the economical grow and develop of society based on knowledge.

European Commission considers the maritime transport development as an important element in general economical growing. In this context, the maritime training system is the part which offer qualified work force on the European market.

Also International Maritime Organization put accent on the level of training in the maritime educational system. With the latest intentions of changing of the levels of training, in order to improve the STCW Convention, it appeared as necessary to be known the actual equipments and technologies met onboard ships. These requirements need people trained and familiarized with equipments, able to train the others.

The development of the maritime industry imposes the implementation of a framework for providing of advancing programs due to continue changing of this activity domain.

Beside general objective of the project, the specifically objectives are:

1. Increasing of lecturers competencies through promotion of knowledge and technologies in the academic maritime field.
2. Creation of a development, update and on-line management framework for initial and continue formative of the human resources.
3. Realizing of studies and analyze to define formative programs dedicated and an optimum correlation of these with maritime industry necessities.
4. Increasing of access and participation of lecturers to formative programs and to obtain a double qualification.
5. Encouraging of lecturers to maintain a high qualification level through participation at specialized courses.
6. Introduction of carrier advancing opportunities for younger lecturers.
7. Verifying of the process and teaching activities through initial and continue formative programs in scope of improvement of TIC using level.

All these objectives are based on the premise that continue learning is the main condition for restructuring and development of educational and formative systems, for assuring the decisive competencies during life and to realize the coherency among persons involved in the maritime academic system.

A high level of qualification has to be guaranteed by the training institutions through modular and flexible educational structures, completed with high standard personnel.

This project tries to involve maritime lecturers in international maritime transport framework, to put them in direct contact with the end users of their work, the companies from maritime industries and to know exactly their needs. The international maritime companies are the necessary source of information regarding worldwide requests for employ of the maritime personnel.

This information is used to know what are the actual requirements for the new enters in the maritime field, younger officers, also, to have acknowledge about the necessary skills and knowledge requested to the present acting persons. In the first case, the completion of the training for the maritime officers is done during the academic school years through the regular courses according with the international required curricula.

For the acting persons, with years of experience in the field, the training process is commonly based on courses and updated information that can be combined or added to the existent knowledge.

Most of these materials are provided online using our own web portal, access being free or using identification element, offered by the trainer lecturer.

During time, the users number of this portal has tripled, the biggest number being represented by the former students or seafarers interested.

## 5. CONCLUSIONS

In the present context of society, development is necessary to have people trained at the higher level and to maintain the training level from the begging to the ending of their activity. For this reason it is compulsory to develop or create systems able to provide adequate training and to offer possibilities to acquire new competencies and knowledge during life.

The use of the newest techniques as online and distant learning, combined with the traditional forms of training, or based on these, seems to represent the optimum solution for a better and high quality learning system inside of the life long learning concept.

The learning system requests trainers and lecturers capable to offer the necessary learning materials for the process. Constanta Maritime University started programs dedicated to the life long learning, based on a series of online courses and in parallel in order to improve its capacities for this learning method, training lecturers to be able to offer in the future the requested knowledge and information for the people involved in the maritime industry.

## 6. REFERENCES

[1] GHOSH, S.B., SEVUKAN, R., *Lifelong learning for LIS teacher and educators through open and distance learning: A case study of India*, World Library and Information Congress: 72nd IFLA General Conference and Council, Seoul, Korea, 2006.

[2] POWERS, K.D., POWERS, D.T., *Making sense of teaching methods in computing education. Frontiers in Education*, San Juan, Puerto Rico, 2000.

[3] RAICU, G., NITA, A., *Systems, methods and tools for knowledge management in virtual universities*, "E-Comm-Line 2008" Conference Proceeding, Bucharest, Romania, 2008.

[4] RAICU, G., CHIOTOROIU, L., *Object learning models in maritime e-learning*, Constanta Maritime University Annals, Constanta, Romania, Volume 8.

[5] RAICU, G., CHIOTOROIU, L., *WEB Enabled Simulation*, Constanta Maritime University Annals, Constanta, Romania, Volume 8.

[6] SALA, N., *The Internet and the "learning by doing" strategy in the educational processes: a case of study*, IEEE International Conference on Advanced Learning Technologies, 2001.

[7] STARR, D., *Virtual education: Current practices and future directions*, The Internet and Higher Education, Vol. 1, No. 2, 2000.

# SIMULATION TECHNOLOGY IN THE EDUCATIONAL PROCESS

[1]STAN LIVIU CONSTANTIN, [2]GROZAVU VIOREL DANIEL

[1,2]*Constanta Maritime University, Romania*

**ABSTRACT**

The development of the maritime transportation and its connected activities imposed the necessity of having more trained people involved in operation, able to act in very various situations based on a considerable volume of knowledge. To achieve these standards, the training process, especially for operation, safety and security activities, must be highly professional and in concordance with the international requirements in the field. This professional training involves the use of the latest developed techniques. The new technologies used today for the purpose of training in the maritime academic field are various, as simulators, dedicated computerized programs and all types of virtual learning. The paper reveals the simulator training process that Constanta Maritime University introduced in its education system, with good performances on the students' competencies and abilities. The focus is on the presentation of the course developed by the Electromechanical Faculty, through this process contributing to the skills development and also testing of the students, future marine officers. The paper, a case study on the simulator training process, is based on a rigorous and detailed presentation and analysis of the simulation and through the information presented offers an exhaustive and clear image of this new technology.

**Keywords:** *Simulation technology, simulator training process, education, computerized programs*

## 1. INTRODUCTION

The activities onboard ships are based on competences and skills. In order to have competent people, you must create them. This is the role of the maritime training system, to create competent persons for the maritime field.

Today, Constanta Maritime University (CMU) is the principal academic training institution in Romania. This position was acquired through a continuous effort to offer to the future deck and engine officers the best training and knowledge in the interest field. In this respect, changes were made, starting with re-evaluation of curricula, which was brought closer to the present requirements of the STCW Convention and shipping industry, succeeded by the improvements of teaching methods, usage of the high technology and newest simulators in this process, and last but not least, improvement and increase of the level of the trainers and teachers according to the latest technological development in this area of training. This was not an easy process, the beginning and first stages were complicated, partially due to the reduced knowledge on the new technologies and the best way to perform the best training in order to reach the proposed results. These difficulties were not finished once the familiarization started, they continued after this stage because the technological changes soon brought new products and also new procedures.

## 2. SIMULATION USAGE IN EDUCATION

Today, education is inseparable from the modern and new navigation technologies as teaching marine simulator, modelling, on-line teaching or web based applications. Introducing these new technologies in the educational process must ensure that these new training methods improve the technical knowledge of the student, an important guarantee for the professional skills of the future marine officer. Thus, the modern navigation educational technologies have had a higher demand in the last years and registered a large development and dispersion. The necessary changes in educational structure came without directives from leaders from academia, industry and government laboratories. There is a direct and natural result of the technological changes from our reality and also of the new requirements that have emerged in the educational and labor market.

Simulation represents a tool to generate "artificial experience" that would significantly improve professional judgment in the consultation process, especially with respect to human performance. The simulation exercises allow the learner to experiment with multiple approaches to solve a problem. Learners try different solutions in a safe environment and receive feedback.

The use of simulation in providing solutions to the problems of risk and crisis management and the optimal use of crew resources has a long history in maritime training. Many types of simulator: engine, bridge and cargo control room have tended to emphasize a physically realistic environment in which the exercises occur.

The scope and amount of simulator based training in crisis management needs to increase. Areas such as initial actions to spill oil and a distress incident need to be incorporated into simulation training programs. Simulation based training in the corporate emergency procedures also needs to be conducted to ensure that mariners are not reaching for the emergency manuals to find out what to do once an incident happens.

The development of the computer technology had a dramatic influence on simulators; also the new and developed needs of training from the education area stimulated the research in this field. The education system had to follow and implement the simulation

technology, the computerized knowledge being part of the educational processes, or even the essence of these, in some cases. As beginners, these simulation programs did not have a very expressive way for revealing the results and the procedures for obtaining results were difficult. During times these programs were improved and became indispensable for training courses processes. The next step in the technological development of the education training process was marked by the advanced computerized programs, most complex, with a more real presentation of processes and operations, the simulators.

In some parts of the world, simulators have been developed which have very high levels of physical fidelity, for example, multi-storey engine room mock-up and bridge simulators including features such as 360 degrees day/night views, pitch and roll, and full vibration and noise effects.

The simulators used in the maritime officers training is a compulsory request of the STCW Convention and Code in order to assure an increased safety of maritime activities.

## 3. ENGINE ROOM SIMULATOR AT CMU

Over the last years simulator training has proved to be an effective training method when training engineers, especially where an error of judgment can endanger life, environments and property. A dynamic real-time computerized simulator can, when it comes to certain situations, compress years of experience, into a few weeks and give competence to handle these situations and knowledge of the dynamic and interactive processes typical for a real engine room.

The simulators improve efficiency and give to the students, future engineers, the necessary experience and confidence in their job-situation.

Starting with 2002, CMU installed and put in operation three Kongsberg Norcontrol simulators: GMDSS and SAR simulator, Engine Room Simulator and Navigation simulator. CMU installed these simulators to organize practical training for its students and graduates, for ship and shore users, as well as for system service engineering training. Simulators, used for the practical training, proved to be the perfect solution to create appropriate conditions similar to the real situation on board ship - regarding operating ships, maritime equipments, practicing procedures established by the International Safety and Rescue Rules.

CMU has a KONGSBERG NORCONTROL ERS-MC 90-III Engine Room Simulator (ERS) that simulates a very large crude carrier with a MAN B&W slow speed turbo charged diesel engine as propulsion unit modelled with fixed and controllable propeller. The control room operator station and panels and bridge and steering panels are included. The ERS consists of:

- Kongsberg slot machine simulator - Simulation NORCONTROL MAN B & W Neptune 5L90MC - VLCC version V (the newest version, upgraded in July 2010) Class A Full;

Figure 1 Main switch board

Figure 2 Control room

- BigView based on four monitors (diagonal of 65") that allow for viewing and operation of all systems in the engine room department;

Figure 3 BigView

- Desktop simulation system consists of an instructor station and 8 workstations with the following available models:
  - MAN B&W 5L90MC - - VLCCL11-V;
  - Sulzer 12RTA84 - Container L11 ;
  - GE LM2500 30 - Gas Turbine ;
  - SP11 (Steam Propulsion) - LNG - Dual Fuel ;
  - Pielstick 10PC4 M22 - Ferry Boat.

The simulator is Full Mission Class A and is IMO, STCW and DNV certified.

Figure 4 Desktop simulation

## 4. SIMULATOR TRAINING PROCESS

Constanta Maritime University, through the Naval Electromechanical Faculty, uses the engine room simulator for research and training purposes. A complex course based on the simulator was defined that emphasizes the training process for our students. Such concept course is not easy and requires careful planning and management to be successful.

Forwards, the focus of the paper, a case study on the engine room simulator, is on the rigorous presentation of the Engine Team and Resource Management course developed by CMU.

The aim of the course is to familiarize the students with the operation of systems from engine room under varying conditions and to practice working procedures applicable to the board in terms of teamwork. This course is essentially a practical one and includes a series of exercises structured around the operation of a naval installation and built in collaboration with an engine simulator. The exercises are supervised by an instructor and a technician who, initially, allow the students to familiarize themselves with the tools and controls found in a commercial vessel's engine room. The student will have the ability to know the installations and auxiliary aggregates of an engine room under normal operating conditions and in such emergency. The exercises increase in difficulty throughout the course, the student is familiar with the procedures used for propulsion and auxiliary power facilities, with settings in normal operating conditions and monitoring tool during the watch.

Each exercise is preceded by a briefing session and followed by a discussion group - debriefing, where the actions and decisions taken by the student are examined.

During these exercises, each student assumes different roles in the engine watch keeping team and will be able to perform all operations during the watch keeping, covering all functions of an engineering hierarchy.

The aim of this course is to provide knowledge and skills required to operate, supervise and monitor the safety of the ship facilities in accordance with the provisions of Section A-III / 1, A-III / 2, A-VIII / 2 and B-VIII / 2 STCW95 the Code. The present course refers to many requested functions for a proper training of the students, who receive:

- Familiarization with the use of instrumentation and monitoring systems used in the engine department;
- Awareness of the need for better planning, use of checklists and programming times for specific procedures;
- Proper understanding of the supervisory procedures;
- Understanding the way in which the motor units are interdependent
- Gaining operational experience in identifying problems and solving them;
- Ability to make decisions;
- Organization of an engineering team;
- Knowledge of the individual role of each member in the context of teamwork;
- Performing specific tasks according to specific situations

The briefing and debriefing sessions and practical exercises on the simulator run under the guidance and supervision of two instructors and a technician certified by the company Kongsberg, the provider of the engine room simulator.

The course inside the education project based on the engine room simulator combines three different but interdependent content levels:

- Theory Modules
- Simulator Exercises
- Analyzing the results of the exercises

The course covers more than the requirements of the IMO-model courses. It starts with a "pre-test" to ensure that all participants are starting with at least a comparable level of knowledge.

1. Theory module (printed and Macromedia format). The theory is presented in a comprehensive way. Moreover, exercise and evaluation forms are shown from the beginning to the trainees. This module includes also Step by step demonstrator (simulator interactive demonstration, ViewletBuilder format) that represents all the steps the students or the trainees need to follow when a specific process is running on the simulator.

2. Simulator exercises (with e-Coach and evaluation editors), conducting practical exercises based on the engine room simulator KONGSBERG – NORCONTROL SIMULATION Neptune MAN B&W 5L90MC – VLCC. When creating simulator exercises, a certain procedure is followed. It has many steps, starting with the need for analysis for the exercise to be carried out. The exercises are very complex and various; the student works together with the instructor, the student works alone supervised by the instructor, the student works together with other 2 colleagues and forms a watch keeping team, developing the team work skills.

3. Analyzing the results of the exercises. Each exercise has an evaluation form consisting of various evaluation criteria. All these evaluations became evaluation actions inside the simulator. After the student/trainee runs a specific simulator exercise, a

database of the student's work is created and the instructors have the students exercise results.

The interactive mode of teaching this course, the proposed exercises and the situations created and the solutions offered of these particular situations make this course to be very attractive to students. The familiarization with the reality on board of a commercial vessel helps considerably in their future work of maritime officers, giving them confidence in their professional skills. Their real interest for attending this course leads us to continue this activity and improve the students' educational offers in the future.

The results obtained from the simulated application conducted us to conclude that this process is more appropriate for training than classical procedures based exclusively on the theoretical elements. The results and the performances obtained during this process are a proof of the improvement of the education system by these technologies and indicate the way to which the education has to be directed: more technological segments combined with the theoretical elements.

## 5. CONCLUSIONS

Simulation became a key method to achieve progress and performance in the educational area. This paper comes to enrich the information in this field, and could have extended echoes among trainers from education and beyond.

Based on the simulator training, the students can consolidate the theory information through practical exploration, they can try many times current operations they will perform on the ships in the future. Thus, their confidence is higher and the fear of failure is much lower.

The Engine Team and Resource Management Course was approved by the Romanian Naval Authority in 2008 and became mandatory for obtaining the competency certificate for maritime officer, operational level, in 2009. The course is addressed mainly to Constanta Maritime University students in the final year of study. As a result of the interest raised by the simulators, according to the statistics in recent years, the number of our students who passed a simulator training process increased, with good results in their next activity and also with good appreciation received from the shipping companies. Thus, around 50% of our students attended and passed the Engine Team and Resource Management Course during the year 2008-2009, a higher percentage of 90% during the year 2009-2010. From the beginning of this academic year, 2010-2011, 60% from our students from the last year attended this course and this percentage will surely reach the level of 90%, taking into account that this course becomes a compulsory one starting with January 2012, based on the STCW regulations. As a result of attending this course a higher pass rate in the examination for the competency certificate was noticed, but also a more accurate organization on board and an easy and quick resolution of the difficulties encountered there by our students; these results are based on the feedback received from the companies.

Level of skills developed or improved after such training increased in the last years, contributing to an easy access of the Romanian cadets and younger officers to the international maritime work force market. Today, our graduates are accepted as equal competitors along other nationality officers and respected for their knowledge and training level.

The encouraging results obtained by the students give the right to consider that the use of multimedia tools, computer program and web enabled simulation modules must be constantly improved and extended within the educational process. Also, the interactive methods prove to be efficient and have to be developed widely in the future. Distant learning combined with simulators will make a new and flexible training approach possible. Therefore, we can finally consider that e-Learning has a great and positive impact on the maritime education field and moreover learning combined with training will be by far the most effective way to increase skills and competence.

## 6. REFERENCES

[1] ANECHITOAIE, C., SURUGIU, F., *International maritime organizations and conventions*, Nautica Publisher, Constanta, 2008.

[2] ARSENIE P., HANZU-PAZARA R., RAICU G., GROSAN N., STAN, L., "*Teaching practice between old and new techniques*", Proceedings of the 13rd International Congress International Maritime Association of Mediterranean IMAM2009, Towards the Sustainable Technology and Transportation, Vol. I, Istanbul, Turkey, 2009.

[3] STAN L., "*Using Engine Room Simulators for marine engineers training"*, The 9th International Conference on Engine Room Simulators (ICERS 9), The International Maritime Lecturers Association in cooperation with The United States Merchant Marine Academy and The Global Maritime and Transportation School, Kings Point, New York, USA, 2009.

[4] STAN L., MEMET F., BUZBUCHI N., *"Engine Room Simulator, a new teaching method for maritime education"*, Proceedings of the 6th International Seminar on the Quality Management in Higher Education, Tulcea, 2010.

[5] IMO Model Course 2002, Engine Room Simulator, UK, Intype libra Ltd.

# HOW TO MAKE SENSE OF WHICH TRENDS TO ADOPT FOR MARITIME EDUCATION AND TRAINING

[1]SZWED S. PAUL, [2]KRISHNA SAMYRAGU

*[1,2]Massachusetts Maritime Academy, USA*

**ABSTRACT**

This paper will explore those opportunities and other trends in the broader educational environment and determine how well they translate into the MET context. It will describe the current state of the practice and challenges to adopting new modalities for learning. The authors and their colleagues are currently designing a new graduate program in global maritime business. Based upon results of the market survey and benchmark analysis, elements of customizable, asynchronous learning format have been incorporated into the program. This paper will describe how those elements were designed and how they were adapted for the MET context. The lessons learned will be invaluable to the MET community as well as the broader maritime community as we endeavor to more effectively enhance seafarer knowledge and competence.

**Keywords:** *MET, educational trends, distance/blended learning, individualized learning, social learning*

## 1. INTRODUCTION

By now, we've all heard that the world is flat. At least, that's the metaphor put forward by Thomas Friedman to describe the globalization pressures that have resulted in a levelled playing field and an opening of opportunities. Much of this globalization and flattening of the world has been attributed to the new technologies born out of the information revolution.

On the one hand, maritime education and training (MET) providers have exploited these technologies to enhance learning (locally). Constanta Maritime University provided a recent, excellent summary of these technologies and how they can be applied within the MET context [1]. On the other hand, there has been considerable effort to innovate MET via work emanating out of the SCTW [2].While each of these approaches are important to the innovation and enhancement of MET, the focus of this paper will be on the broader educational trends and some attempts to adapt them to the MET environment. For in the midst of the current information revolution, several questions come to mind:

- How does this notion of globalization effect maritime education and training (MET)?
- How will opportunities be opened to mariners?
- What are the best technologies and learning trends to apply in the maritime context?

While MET has long been global, multicultural, and technological in nature, it has not yet leveraged globalization full-scale. Opportunities remain in distance/blended learning, individualized learning, social learning, and natural learning.

This paper will explore the general trends in education and determine how well they translate into the MET context. It will examine several opportunities for enhancing learning in the maritime context and will identify opportunities for employing those trending educational modes, technologies, and pedagogies.

Finally, the paper will describe the ongoing efforts of the authors and their colleagues in designing a new graduate program in global maritime business. Based upon results of the market survey and benchmark analysis, elements of customizable, asynchronous learning format have been incorporated into the program. This paper will describe how those elements were designed and how they were adapted to the MET context. The lessons learned will be invaluable to the MET community as well as the broader maritime community as we endeavor to more effectively enhance seafarer knowledge and competence.

## 2. TRENDS IN EDUCATION

Often when we think about trends in education, we focus specifically and immediately upon the technologies that enable improvements in learning. Rather than starting with the technologies, this paper will look at the more general trends. In a year-end 2012 summary of trends in MET, *Maritime Professional* posted the following three important trends [3]:

- Social Learning – using social media, wikis, and other technologies to foster student-to-student learning
- Learning Process Maturation – in general, this involved using more mature processes to design, deliver, and assess learning
- e-Learning – using learning management systems (LMS) to focus on the learning process rather than merely as a repository of content

Another group out of New Zealand identified ten trends for 2013: openness, smart web, ubiquitous learning, personalization, data engagement, citizenship, virtual learning, thinking 3D, social learning, and user + control [4]. If one were to attempt to capture all of the trends observed or forecasted, this list would become excessive. So, in an attempt to narrow the scope and focus on only a few of the most relevant trends, this paper will focus on the following trends:

- Individualized Learning – also known as personalization
- Social Learning – as described above

- Distance or Blended Learning – which contains aspects of several from the list of ten above including openness, ubiquitous learning, and virtual learning.

This paper will now examine each of these trends and attempt to adapt them to the MET context. Later in the paper, the authors will describe how their institution is leveraging these trends in the development of a graduate program in global maritime business.

## 3. OPPORTUNITIES FOR MARITIME EDUCATION AND TRAINING (MET)

### *3.1 Trend no.1: Individualized Learning*

There is a growing awareness that the old *one-size-fits-all* paradigm to learning is no longer effective. With origins dating back to the 1960s and 1970s (and likely long before) [5], individualized learning is not new, but due to the information revolution and the on-demand culture that results, individualized learning is becoming increasingly mainstream.In individualized learning/instruction, the content, technology, pedagogy, and pace are all dictated in large part by the learner, or student. One of the primary reasons for introducing individualized learning was the fact that no two students learn in exactly the same way, and thus, would benefit from customized education to accommodate their learning styles and preferences. This holds true in the MET context whereby students come from widely varying backgrounds, experience levels and readiness. While individualized learning appears reasonable, it comes at a cost. How often does every student require a different approach to learning? Additionally, how much effort would be required to design, develop, and deploy an educational environment that could accommodate the range of potential learning preferences? Therefore, when considering how to implement this trend, particularly in the MET context, trade-off discussions and decisions must be had.

### *3.2 Trend no.2: Social Learning*

Social learning takes advantage of social media and other social channels to enhance the learning environment. Today, there is a common concept of social learning that emanates from the wide adoption of social media. However, the concept of social media, like that of individualized learning, dates back before the existence of social media. Originally, social learning was considered as the selection of social learning strategies by which students decided who they interacted with, who they decided to emulate, and who they decided to copy, often with foundations in population genetic and game theoretic models [6].

In this paper, we will adopt the more contemporary ideas of social learning as that which exploits the variety of the social networking services and social media tools available today. To distinguish it from the more general e-learning, social learning is defined by how content is produced and consumed – people share information with each other and determine the value of that information based upon their networks [7]. Often, in a professional setting, social learning can yield strong payoffs [8], however, in an educational setting where experience may be lacking, social learning must be used sparingly and with some consideration.

Thus, for the purposes of developing a graduate program in the MET context, social learning is used as a component of individualized learning, but not as a substitute for ensuring appropriate content is available and intentionally distributed. Social learning may be used as a means of enhancing the context of application once the concepts have been acquired.

### *3.3 Trend no.3: Distance/Blended Learning*

This trend appears to be the dominant trend in education. There is an explosion of distance and blended learning opportunities [9]. However, there is the presumption that online delivery modes using internet technologies are ubiquitous – which they are not. That said, there is undoubtedly a great opportunity in leveraging distance and blended learning.

Furthermore, this opportunity is enhanced for mariners and the MET context [10], [11], whereby schedules and commitments often are not conducive to more traditional formats of learning. A summary of international perspectives confirms this [12]. The primary basis for such an approach to learning is to increase access. Taken a step farther, an open curriculum (referred to earlier as openness), as evidenced in MOOC's (or massively open online courses), is available to all (with the ability to form connectivity).

Thus, a key consideration of determining the degree to how much a course will be presented online (100% for entirely "distance" learning, and a "blend" for that which uses less than 100% online and the balance in traditional in residence format). Additionally, it will be important to determine whether the online portion can be delivered synchronously or asynchronously. Each has advantages and challenges.

After providing a rapid overview of three trends in education, attention will now be turned to the adoption and application of those trends in the design and development of an actual MET program.

## 4. GRADUATE PROGRAM DESIGN

As a part of its 2012-2016 strategic plan, the Massachusetts Maritime Academy committed to exploring the potential for offering a graduate program in supply chain management[13]. In 2012, the International Maritime Business Department began investigating the potential for offering a new graduate program. A benchmarking analysis and a broad market survey were completed.

### *4.1 Benchmark Analysis*

The benchmarking analysis involved examining the market for similar products and services. Specifically, the following sets of schools were examined:

- U.S. MBA programs with specialization in supply chain management/logistics

- International (non-U.S.) maritime graduate programs
- U.S. maritime academies with maritime graduate programs

It was found that the market for specialized MBA programs in the U.S. was quite saturated and mature. There are literally hundreds of such programs in the U.S., including many from the top business schools. The following is a list of the top U.S. business schools that offer specialized supply chain management/logistics programs [14]:

1. Massachusetts Institute of Technology (Sloan)
2. Michigan State University (Broad)
3. Pennsylvania State University (Smeal)
4. Ohio State University (Fischer)
4. Stanford University
6. Arizona State University (Carey)
6. Carnegie Mellon University (Tepper)
8. University of Pennsylvania (Wharton)
9. Purdue University (Krannert)
10. University of Michigan (Ross)

In the 72,000 square mile (186,500 $km^2$) six-state region of New England alone, there are 231 degree-granting colleges and universities. Of those, 38% offer MBA programs and 10% offer specialized supply chain management programs.

Furthermore, the executive-formatted weekend MBA market within the greater-Boston metropolitan area (where Massachusetts Maritime Academy generally resides) is densely competitive and includes programslike the following [15]:

- Babson University – 21-month "fast track" MBA that meets 2.5 days every 7 weeks
- Massachusetts Institute of Technology – 18-month executive MBA that consists of 21 Friday-Saturday sessions every 4 weeks
- Boston University – 18-month MBA program that meets Friday-Saturday every other week

Additionally, an in-depth scoping analysis was conducted of several of the U.S. business schools just mentioned, as well as international (primarily European) and U.S. maritime graduate programs. Some of the international maritime programs that were examined included:

- Cardiff University Business School (U.K.)
- Cass Business School in London (U.K.)
- University of Antwerp's Institute for Maritime Management (Belgium)
- Erasmus University Centre for Maritime Economics and Logistics (Netherlands)
- University of Tasmania Maritime College (Australia).

Each of these programs was examined to determine entry requirements, program structure, fees, and curriculum. The intent of this scoping portion of the benchmarking analysis was to determine effective practices to generate ideas for the graduate program at Massachusetts Maritime Academy.

Finally, an in-depth analysis was conducted of the U.S. maritime academies with maritime graduate programs. This analysis was intended to determine market opportunities as well as identify current practices. The following schools were examined:

- California Maritime Academy – online M.S. in Marine Transportation and Engineering Management
- Maine Maritime Academy – M.S. in Global Logistics and Maritime Management
- SUNY Maritime College – M.S. in International Transportation Management
- Texas Maritime Academy at Texas A&M University in Galveston – Masters in Maritime Administration and Management
- U.S. Merchant Marine Academy – M.S. in Marine Engineering

Table 1 provides an overview of key dimensions of the U.S. maritime academy programs.

Table 1. Comparison of graduate programs at U.S. maritime academies

| Institution / Program | Established | Program Duration | Mode of Delivery | Cost ($US) | Features |
|---|---|---|---|---|---|
| California MSMTEM | 2011 | 2 years | Online | $27,000 | Many electives |
| Maine MSGLMM | 1985 | 1 year | Residence | $22,178 | No electives, reduced tuition for alumni |
| New York MSITM | 1968 | 2 years | Residence | $16,422 | Specialized certification |
| Texas MMAM | 2012 | 2 years | Residence | $15,050 | Policy and law tracks |

Information gathered from institutional websites in 2012.

Some of the most interesting effective practices observed through this analysis included:

- Blended delivery – to accommodate mariners' schedules at sea
- Reduced tuition for alumni
- Generalist (rather than specialist) program – to appeal to broadest possible audience
- Options for program duration (including "fast track") – rather than options for curriculum
- Broad maritime focus and network building

### *4.2 Market Survey*

The market survey was performed to determine the needs, interests, and preferences of potential students. The survey gathered information on the following variables of interest:

- Demographics – information about age, gender, education level, and amount and sector of professional experience
- Interest – level of interest in pursuing a graduate degree
- Motivation – reason for interest, if any, in pursuing a graduate degree
- Focus – preferred type of graduate program
- Topics – specific topics of interest
- Format – preferred structure of graduate program
- Mode – preferred mode of delivery

- Factors – identification of key factors involved in making decisions about which graduate program to attend

The survey was administered electronically to three separate groups of potential students (or customers):

1. Senior (fourth year) undergraduate international maritime business students
2. Graduates of the Massachusetts Maritime Academy
3. Students and faculty of non-U.S. maritime academies and maritime-affiliated schools

The first group was principally a convenience sample intended to test the survey instrument, but also as a key group of potential students interested in the graduate program. The survey was administered to 45 students and 20 responded (for a response rate of 44.4%). The respondents were predominantly male, of traditional college age, and with high interest in pursuing a graduate degree.

The second group represents a sample of primary potential students. It was administered to nearly 900 graduates of the Massachusetts Maritime Academy from all years and all majors. 304 graduates responded to the survey (32.3% response rate).The respondents were predominantly male, with average age over 40, with considerable maritime experience, and only 55% had interest in pursuing a graduate degree.

The third and final group represented a sample of secondary potential students. It is unknown as to how many people the survey was provided to, but 24 responded. The respondents were mostly male, mostly younger, and had considerable interest in pursuing a graduate program.

The following are some of the key findings of the market survey:

- 32% of MMA graduates, 66% of international students, and 55% of MMA undergraduate students have *high or very high interest* in global maritime leadership graduate degree program.
- Of those respondents interested in pursuing a graduate degree, most are seeking to *advance their career or obtain new knowledge*.
- 56.3% of MMA graduates, 72.3% of international, and 75% of MMA undergraduate students intend to *pursue a graduate degree in next five years.*
- About half of MMA graduates and undergraduate students prefer a program that *blends* business, maritime, and logistics. 58.8% of international students prefer a *global maritime business program*. See figure 1.

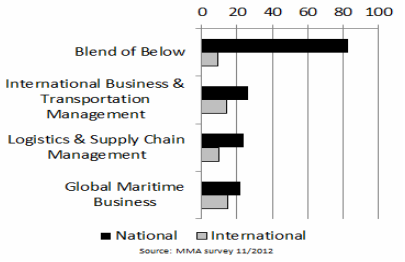



Figure 1 Preferred focus of program

- Risk management is the most sought after topic (43.5% of MMA graduates). Logistics was a top-selected topic in each of the three groups surveyed. Port & Terminal Management, Supply Chain Management, and Vessel Chartering & Brokerage were top-listed topics for at least two of the groups. See figure 2.

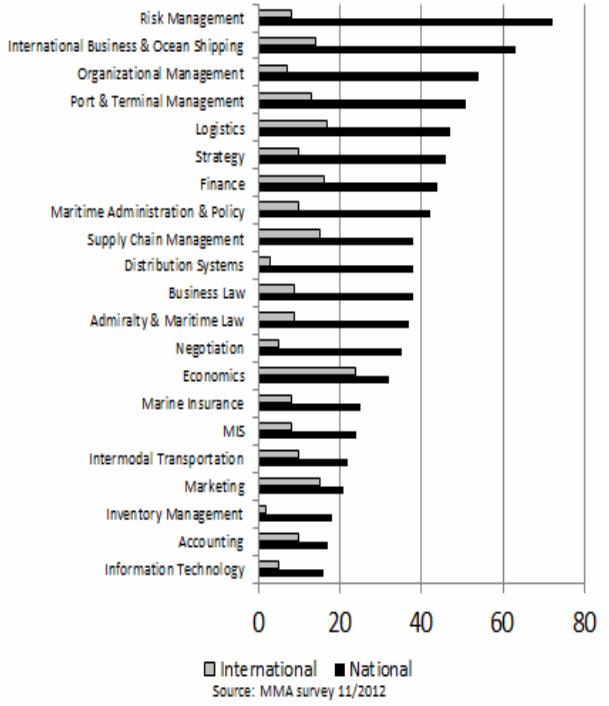



Figure 2 Preferred topics for program

- Most of the MMA graduates and MMA undergraduate students prefer a program that blends in residence and online sessions and runs 18-24 months. International students prefer a daytime program that runs 12 months. See figure 3.

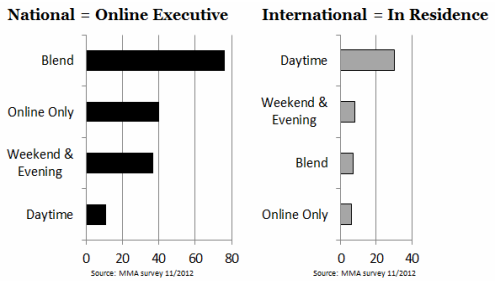



Figure 3 Preferred format/mode of program

- All groups indicated that "curriculum," "exposure to practitioners," and "cost" arethe most important factors for choosing a graduate school. "Ability to advance professional growth" and "mission of program" were also important factors for two of the groups.

### *4.3 Top-level Programmatic Design*

Based on the benchmarking analysis and the market survey, a preliminary program was developed. The program will *focus* on global maritime business (rather than supply chain management/logistics as originally envisioned).

This *focus* will bring in elements of international business and trade, marine transportation, logistics and supply chain management, and general business. The initial offering will be deployed using a blended *mode* of delivery (25% in residence and 75% online). This is consistent with trend of growth in the U.S. MBA market [16]. The initial introductory courses and the final capstone course will be intensive in-residence courses. All other courses will be online and may be completed asynchronously. Students will be able to complete this course in a two-year period. Eventually, it is envisioned that a 12-month "*fast-track*" residential option will also become available (once the blended program has been proven). Table 2 illustrates the proposed curriculum for the program.

Table 2. Global maritime business program curriculum

| Period | Course | Credits |
|---|---|---|
| Summer (August) | + Welcome Aboard: Introduction to Global Maritime Business<br>+ Shipping, Trade & Globalization<br>(2 weeks in residence) | 3.0<br>3.0 |
| Fall (Sept – Dec) | +Maritime Leadership & Strategy<br>+ Shipping Economics, Operations & Management I<br>+ Shipping Economics, Operations & Management II<br>(online) | 3.0<br>3.0<br>3.0 |
| Winter (Jan – Feb) | + Maritime Law, Policy & Regulation<br>+ Maritime Finance & Risk Management<br>(online) | 3.0<br>3.0 |
| Spring (March – June) | + Global Logistics & Supply Chain Management<br>+ Port Operations & Management<br>+ Business & Maritime Information Technology<br>(online) | 3.0<br>3.0<br>3.0 |
| Summer (June – August) | + Global Maritime Business Capstone<br>(online + 2 week in residence) | 6.0 |

The proposed curriculum (table 2) and the corresponding syllabi have been approved by the governance bodies within the Massachusetts Maritime Academy. Additionally, the Board of Trustees has approved the curriculum. Next, a proposal will be made to the Board of Higher Education for the Commonwealth (state) of Massachusetts.

### *4.4 Online Course Design*

Now that the top-level programmatic design (including individual course syllabi) has been approved, focus will turn toward the design of effective online courses. There are many design criteria that must be considered in the development of online and blended courses.

One of the keys to developing an effective and satisfying online course is to ensure an appropriate learning environment has been developed with adequate student engagement and interaction. Student interaction is particularly important at the graduate level [17]. Discussion is an important aspect of ensuring student interaction, particularly to help ensure connection to the program and other students [18],[19], [20].

## 5. CONCLUSIONS

In past decade or more, there has been a great expansion in options and opportunities when it comes to design and delivery of MET programs. This paper explored only a fraction of those trending options and considered them through the lens of the design and delivery of a graduate program.

While it would seem that implementing trends such as individualized learning, social learning, or distance/blended learning would appear to merely be an extension of traditional methods, there is much more to be considered. Not unlike the transition from sail to steam or manual to automation, new approaches and frameworks must be adopted. To be truely effective in our efforts at MET, we must once again become students of our trade and consume the vast literature and research on these topics. Together, through fora like this conference, we will become better educators and learn from others present and virtually present through their writings.

As we advance to the development stage of our blended graduate program in global maritime business, we endeavor to use what we've learned here as well as what we'll learn from colleagues facing similar challenges. In the end, we expect a world-class program will result because we have access to a world of high-quality programs and findings to draw from. Just as our students learning environment will be enriched by the trends, our program development will also be enhanced by our sharing efforts

## 6. REFERENCES

[1] RAICU, G., *Trend analysis in managing maritime e-learning technologies*, Constanta Maritime University's Annals XIII (18), 345-348, 2012, Retrieved at: ftp://ftp.repec.org/opt/ReDIF/RePEc/cmc/ annals/345-v18.pdf.

[2] ZIARATI, R., DEMIREL, C.E., ALBAYRAK, T., *Innovation in maritime education and training*, Keynote address, Proceedings of the 18th Conference of International Maritime Lecturers' Association, 8-19, 2010.Retrieved at: http://www.imla.co/sites/default/files/Proceedings IMLA18.pdf.

[3] GOLDBERG, M., *Maritime training technology round-up*, Maritime Professional, 17 December 2012. Retrieved at: http://www.maritimeprofessional.com/ Blogs/Maritime-Training-Issues/December-2012/2012-Maritime-Training-Technology-Wrapup.aspx.

[4] CORE Education, *Education's ten trends for 2013*, Retrieved at: http://www.core-ed.org/thought-leadership/ten-trends.

[5] DIAMOND, R.M., *Instructional development for individualized learning in higher education*, Englewood Cliffs, NJ: Ed. Tech. Pub., 1975.
[6] LALAND, K.N., *Social learning strategies*, Learning Behaviour, 32, 4–14, 2004.
[7] KIM, K.R., MOON, N.M., *Designing a social learning content management system based on learning objects*, Multimedia Tools and Applications, 64(2), 423-437, 2013.
[8] ALLEN, M., *Social Learning*, *T+D*, 65(8), 50, 2012.
[9] BEETHAM, H., SHARPE, R., *Rethinking pedagogy for a digital age: Designing and delivering e-learning*, London: Routledge, 2013.
[10] NG, A.K.Y., KOO,A.C., PALLIS, A.A., *Professionalization of the shipping industry via postgraduate education*, Ocean and Coastal Management, 54(5), 364–373, 2011.
[11] PALLIS, A.A., NG, A.Y., *Pursuing maritime education: an empirical study of students' profiles, motivations and expectations*, Maritime Policy and Management, 38(4), 369-393, 2011.
[12] MOORE, J.L., BENSON, A.D., *International Perspectives of Distance Learning in Higher Education*, In Tech, 2012.
[13] MASSACHUSETTS MARITIME ACADEMY, *Five-Year Strategic Plan (FY2012-2016)*, Massachusetts Maritime Academy, 2011. Retrieved at: http://www.maritime.edu/uploads/files/Strategic%20Plan%20FY%202012-2016%20w%20Special%20Mission.pdf.
[14] U.S. NEWS and WORLD REPORTS, *Best Colleges – Supply Chain Management/Logistics*, U.S. News & World Report LP, 2013. Retrieved at: http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-business-schools/logistics-rankings.
[15] BYRNE, J.A., *The Boston metro executive MBA programs*, Poets and Quants for Executives, 2011. Retrieved at: http://poetsandquantsforexecs.com/2012/01/19/the-best-boston-metro-emba-programs/.
[16] GRADUATE MANAGEMENT ADMISSIONS COUNCIL, *Application Trends Survey*, GMAC, 2012. Retrieved at: http://www.gmac.com/~/media/Files/gmac/Research/admissions-and-application-trends/2012-application-trends-survey-report.pdf.
[17] ARBAUGH, J.B., *Do undergraduates and MBAs differ online? Initial conclusions from the literature*, Journal of Leadership and Organizational Studies, 17(2), 129-142, 2010.
[18] GAO, F., *Designing a discussion environment to enhance connectivity and sustainability in asynchronous online discussion*, Journal of Educational Multimedia and Hypermedia, 20(1), 43-59, 2011.
[19] SULLIVAN, T.M., FREISHTAT, R., *Extending learning beyond the classroom: Graduate student experiences of online discussions in a hybrid course*, *Journal* of Continuing Higher Education, 61(1), 12-22, 2013.
[20] JIANXIA, D., JIANZHONG, X., *The quality of online discussion reported by graduate students*, Quarterly Review of Distance Education, 11(1), 13-24, 2010.
[21] BOLING, E.C.,HOUGH, M., KRINSKY, H., *Cutting the distance in distance education: Perspectives on what promotes positive, online learning experiences*, The Internet and Higher Education, 15(2): 118-126, 2012

# 'ENGAGEMENT BY DISTANCE' A DISTANCE DELIVERY METHOD MAXIMIZING STUDENT ENGAGEMENT

[1]TUCKER JOHN, [2]CROSS JOHN

*[1,2]Marine Institute, Memorial University of Newfoundland, Canada*

**ABSTRACT**

Distance delivery of courses is a concept that is well entrenched in history but has been driven by the technology of the era. The notes and books that were once sent by post have given way to the electronic and digital reality of communicating today. However with the switch to digital communications, new tools and techniques have arisen that empower us as educators to deliver courses as never before. This results in a teaching and learning experience that is closer to being in an actual classroom with an instructor than ever before.

Taking advantage of these new tools, the authors have been developing a distance teaching and learning methodology whereby learners are actively engaged and challenged in an online setting while learning course content. This is achieved by delivering content in a secure virtual learning environment using Flash or HTML5 videos that are interactive, periodically pausing during the delivery of information to ask questions as the instructor would in a classroom.

Assessments are performed as would be done in a classroom setting as well, but distributed to the students electronically and created using software that randomly varies the parameters in the questions such that each student receives a unique version of the assignment. In addition the assignments are marked instantaneously which also seems to increase engagement.

The authors have learned through experience that for many students, even during an asynchronous course, it is necessary to have some synchronous interaction with the course facilitator. We have developed a novel method for 'distance tutoring' which involves audio and visual interaction as well as the use of a whiteboard style application for the facilitator to draw diagrams and demonstrate calculations or other course content as appropriate.

To this point the focus of the paper is on devices employed in distance delivery, but there are two different methods the authors use to employ these devices and deliver effective courses by distance. These are the 'Bubble Method' and 'Master Method' and are described fully at this juncture.

The final piece to the puzzle is the method of evaluation in the form of tests and examinations. This paper will conclude by describing the network that is used by the Marine Institute as part of Memorial University of Newfoundland for delivering invigilated tests and examinations to students all over the world.

**Keywords:** *Student Engagement, Distance Delivery, etc.*

## 1. INTRODUCTION

Teaching is communicating. In its simplest form, the bare minimum for communication is that there is a sender, a receiver and a message. This bare minimum covers the delivery of information, but teaching requires more. As well as providing information there must be understanding that is instilled in the student. It is ensuring that this understanding has taken place that is critical to effective teaching. Ironically, it is this very element that distance education has not accomplished well. Since the use of the written word, information has been passed by distance. How we achieve this in the form of distance delivery and evaluation of course material is inherently tied to the tools for communicating that we have at our disposal and how we use them.

"Advances in technology have powered pragmatic shifts in education" (Frick, 1991). Through history it can be noted how the evolution of distance delivery of courses kept pace with the evolution of technologies employed in those deliveries.

In the early 1900's correspondence courses were quite common from post-secondary institutions. The acceptance of this delivery method for courses grew to the point where a National University Extension Association (NUEA) was created to deal with such issues as new pedagogical models and national level guidelines such as university policies regarding acceptance of credit from correspondence courses, credit transfers, and standard quality for correspondence educators.

Watkins (1991) cited that Vincent (1885) wrote:

> "the day is coming when the work done by correspondence will be greater in amount than that done in the classrooms of our academics and colleges; when the students who shall recite by correspondence will far outnumber those who make oral recitations."

The United States federal government granted radio broadcasting licenses to 202 colleges, universities and school boards in the period between the world wars (1918-1946) in support of evolving distance learning methods. In spite of this, by 1941 there was only one college level course offered by radio, and this course failed to attract any students (Atkins 1991).

After struggling to gain acceptance by academics, Educational television followed in the mid-20$^{th}$ century and was greeted with significantly greater success. The

perceived challenge to this point was in the dissemination or distribution of the knowledge. The authors believe that the actual obstacle to widespread acceptance and success of distance learning was in the lack of being able to receive information from the students and to truly engage them in the delivery and evaluation of the course material.

The definition of what is precisely meant by student engagement is one that is ongoing in academic circles. We know that it is something that we wish to occur as it results in a student investing his or herself into the material that is being delivered and the course exercises presented. It has been shown to overlap but not be synonymous with student motivation (Sharan et al. 1999).

The authors believe that student engagement, however it is defined, can be achieved by virtue of delivering the content to the learner, querying the student to ensure that the message has been received, and then rewarding the student for their successful learning of the content. The more active this type of exchange is, the better the student engagement.

The advent of the internet opened new possibilities by permitting course facilitators to not only deliver course content but to asynchronously communicate back and forth with learners in a much more timely fashion. The authors have developed a teaching strategy employing four key elements which are intended to maximize student engagement and success. These four elements include:

- Course Content
- Problem Solving
- Distance/E-Tutoring
- Course Management

The remainder of this paper describes the elements of this distance delivery method.

## 2. COURSE CONTENT

When many students are asked if they are interested in taking a course either by distance or face to face, most students assertively indicate that they greatly prefer to be in a classroom taking a course from the instructor. When I ask them why this is the case, they almost always say that they learn better when in a classroom.

When the authors first started the development of their online teaching methodology, we had experience teaching courses by distance and were familiar with the traditional challenges faced by both the learners enrolled in the course as well being the facilitator of such a course. With this in mind, it was intended to create an online delivery method that was asynchronous yet mimicking as closely as possible the course delivery experience achieved in a classroom setting.

Content was prepared and delivered using a digital video format. Essentially, a movie was created representing each lecture of the course. These were made accessible to the students using a virtual learning environment and had DVD style controls embedded in the 'Flash' video script which permitted students to start, pause, stop, rewind and fast forward the video as you would any movie.

Worksheets were also made available that were 'incomplete' sets of notes. Students were informed that they had the option of printing these for use while watching the video lectures to assist them in taking a complete set of notes while still requiring them to participate in note taking. Typically these notes have extended text and some complicated drawings on them and appropriate spaces for the student to make notes and create a complete set of course notes for themselves.

The envisioned concept was that students would have either paper for note taking or a set of worksheets with them at a desk while watching and listening to the video lecture on a computer or other appropriate device. The ability to pause and rewind the lecture facilitated course participation in the traditional sense and permitted the asynchronous element of the lecture to occur.

Reflecting on the correlation between video lectures and a typical in class delivery to a group of students, the authors were pleased that the students had the opportunity to read the written notes as they were presented in class, to hear the words spoken by the instructor and to take notes as they would in a traditional classroom. What was missing was the opportunity for the faculty member to periodically look at the students and gauge how they felt about receiving that material, and, should any doubts arise, ask such questions as "what does what I just said mean?" or "how do you do this?".

The answer was to change the video format and embed within it a series of 'engagement questions'. To this point the video lectures simply progressed chronologically. What the authors did was to every so often have the video stop and ask the student a question. With the use of Flash/HTML5, a question is orated by the faculty member to the student watching the video lecture and an answer field appears. The video remains paused until the student submits an answer. It is the choice of the instructor as to whether or not the video progresses based on the quality of the student response, but the sum total of the student responses is captured, assessed and recorded.

The authors do not create these questions such that they are of a level and scope as the questions the students might see in a take home assignment or test. The questions are typically relatively simple questions based on the content received immediately prior to the video question prompt.

As an example, an engagement question used in a video lecture from the course 'Transport Canada Applied Mechanics for Marine Engineers' which follows the introduction of the concept of a vector would be:

*Considering the vector diagram in Figure 1, add the parallel forces represented by vectors **A**, **B** and **C**.*

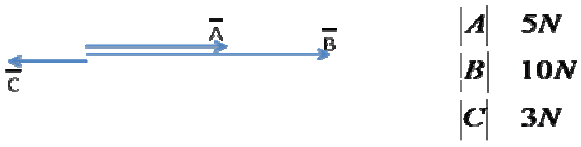



Figure 1 Vector Diagram for Sample Question

The question tests the concept yet is readily solved with minimal time.

By virtue of this in-line video quizzing, the faculty member is able to assess student participation in the actual lecture. Should the faculty member choose, they may award a participation grade to the student based on the results of these nested video quizzes.

## 3. PROBLEM SOLVING

Homework assignments, quizzes, tests and exams are a standard part of almost any in class delivery. Discussions do take place that require higher levels of consideration on the part of the students and when the material lends itself to written interpretation, papers may also be requested to be written.

The authors teach mechanical engineering courses at the Marine Institute which typically have an applied mathematics and fundamental knowledge basis. Take home assignments and in class tests and exams are commonplace in these courses and the instructors have created a database of questions for each of their courses using a software called MapleT.A. (Cross and Tucker, 2012).This software algorithmically generates assignments for students ensuring that each student receives a unique assignment to them which covers the material being taught in that section of the course. The ability to simply get the answer from a peer is no longer a viable option and now the student must work out problems on their own.

Additionally, feedback is instant. As soon as the student submits an assignment they are able to receive immediate feedback as to how they performed as well as a fully worked out solution customized to their version of the assignment. Once an assignment has been submitted and a final grade achieved, the quiz questions (where appropriate) are made available as randomly and algorithmically generated practice problems, giving the student access to a massive number of sample problems with fully worked out solutions for the student to use in preparing him or herself for tests or final examinations.

The engagement element is satisfied by virtue of the instant response when submitting answers to any of these questions as to how they did and the fully worked out solution. Engagement requires interaction and the more immediate, personalized and responsive the interaction, the greater the student stimulus and engagement. Young people today live in a society where instantaneous communication through social networking and instantaneous feedback through gaming are prevalent. They are conditioned to expect very short response times to queries, and as a consequence tend to lose interest when the response times are in the order of days rather than minutes.

Quick response times are typically not achieved by the traditional educational system and course evaluation methods. In this way this method of inserting problem solving practice problems and evaluations into either courses delivered by distance of face-to-face is an evolution that is in keeping with the evolution of young people today.

## 4. DISTANCE/E-TUTORING

The distance courses delivered by the authors are to a diverse group of students with a broad background spectrum. Based on the full history of the authors in delivering courses by distance, most of the students who enrol for these courses are highly motivated and wish to do well. A relatively small portion of this group are fully capable of doing well with minimal engagement or interaction by the faculty member but there are also a group who required more personal, one-on-one and synchronous engagement in the form of personal tutelage.

This was initially a bit of a stumbling block as it was counter to the concept of delivering courses by distance. Many of our students live and work a great distance away from the Marine Institute where the instructors maintain their offices. Some of them live in other countries or overseas. Also, based on the mathematical nature of this material, voice communications or typing was not adequate. Equation editors were useful, but slow and cumbersome to use.

Figure 2eInstructionInterwrite Tablet and Pen

The solution was to merge two technologies into a single tutoring solution. The authors obtained a device called an “eInstructionInterwrite Tablet and Pen”. This tablet, which is about the size of a mouse pad, works electronically with the pen to transfer what is written to the computer screen. It allows the instructor the ability to use the tablet and pen while working on a whiteboard online – instead of clicking on a computer’s mouse and

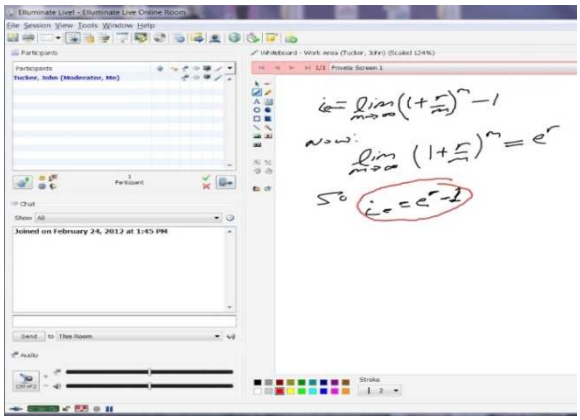


Figure 3Elluminate Live

struggling to draw or write mathematical symbols.

This device was married with a web conferencing software called "Elluminate Live" (Elive) (Figure 3). Elive is a software that uses voice over IP and teleconferencing, public and private chat, quizzing and polling, emoticons, and a webcam tool. It permits the faculty member to teleconference with their students synchronously, but for the authors purposes the most important function it performs is to enable the instructor to show the students an application that they are running on their computer.

When a student requests a synchronous tutoring session, the faculty member and the student agree on a mutually agreeable time and the student joins a video chat session (much like you can have with SKYPE) that is set up by the instructor. They can chat and speak to each other using the webcam. In addition, the faculty member shares a whiteboard application on their desktop which is viewed in real time by the student such as is shown in the diagram to the right.

The student and the faculty member chat in real time while the instructor can write 'on the board' as they would write on a notepad or chalk board in a face-to-face tutoring session. Additionally, you can have group sessions where the entire class is able to participate in such a session asking questions and having the instructor answer them.

In this way, the authors have introduced a true face-to-face feel and the associated level of engagement into a distance course delivery.

## 5. DELIVERY METHOD/PHILOSOPHY

There are two teaching methods (or philosophies) that the instructors have employed in delivering online courses.

Which method is employed depends on the program in which the course is delivered or the nature of the course as well as the learners.

### *5.1 The Bubble Method:*

The instructors entitle the first method of delivery the ‘Bubble Method’. This method has been used and found highly effective in the delivery of courses to students in a standard timeframe such as a semesterized program. The duration of the course may vary, but the key element is that the course itself has a specific start and end date. The course itself is scheduled completely within the time frame of the start and end date, and all students who participate in this course must adhere to these externally applied scheduling constraints.

In addition to the start and end date, additional scheduled events are set prior to the course start. These include:

- The release date and time of each video lecture;
- The start and due date and time for each course work assignment; and
- The scheduled date and time of each test and exam for the course.

This degree of scheduling is typical in the courses taught by the instructors, but the Bubble Method arose as a result of a series of uncontrolled circumstances.

The initial offering of a particular course by distance was assigned to the instructor a very short time before the course was scheduled to begin. During this first offering the instructor was busily preparing PowerPoint files, writing notes and recording files while teaching other courses as well as performing research duties. It was a struggle to just stay ahead of the students with respect to production of the lecture videos and release of these lectures in accordance with the posted schedule.

The outcome was asurprisingly innovative approach with hugely successful results. Originally, the lectures could only be made available as fast as they could be authored, resulting in students having to wait on the release of these videos and not being able to forge ahead with the course material. Additionally, the release dates for the assignments and their associated deadlines were set at the course start, resulting in the students being forced to work through the information at more or less the same time and as a group.

The progress of the vast majority of the course participants was generally within a week to ten days of the posted schedule with respect to viewing video lectures, submission of assignment questions and reviewing course discussion board postings. Intelligent questions and answers were posted in the discussion boards and everyone began collaborating on learning the same material. The discussion boards were alive with activity and no one was feeling intimidated by keen students who had worked ahead through the curriculum.

This concept of keeping the students in a “time bubble” as a method of teaching provided a greater sense of community and collaboration in the course than the instructors had seen in past offerings. This concept occurs naturally in classroom deliveries, but now the instructors are able to emulate this similar environment in distance deliveries. In short, student satisfaction was up, complaints were down.

### *5.2 The Mastery Method:*

The second method of delivery is one that was contrived with intent. The authors desired to create a system where content was released to the learners in a controlled fashion as the course participant demonstrated that pre-requisite knowledge had been learned. Additionally, it was intended that learners could completely operate on their own timings for the course (with the possible exception of a generous overall duration) thus being able to fulfil the requirements of the course in order but at their own pace.

The solution was to utilize the results of the engagement questions described in section 2 of this paper. The results of these nested video quizzes are utilized as a form of closed loop feedback to control the rate of content release to the learner. A flow chart of the logic employed in the mastery method of distance delivery is presented as Figure 3.

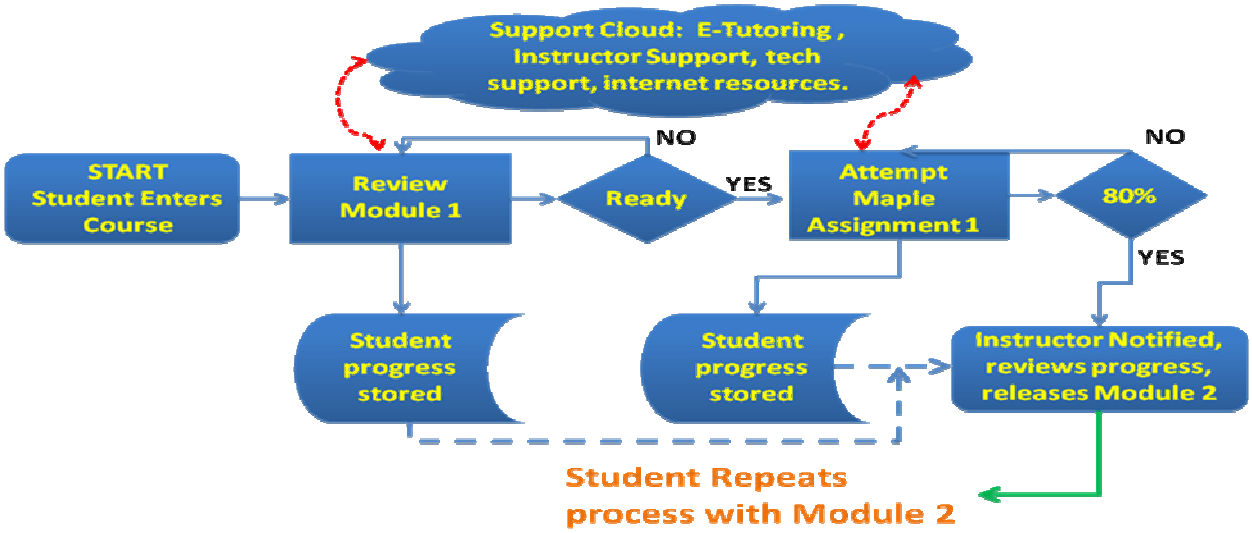



Figure 4 Flowchart of the mastery method of distance delivery

The above flowchart indicates the process whereby a learner in a mastery mode course would enter the module (be it at the start of the course or from a previous module) and gain access to the subsequent module. When a course participant first joins the course, the only content that is visible and accessible is the first module.

Upon gaining access to the video lecture (Module 1 in the flowchart of Figure 3), the student would review the module and answer the engagement questions nested in the video. Rules such as whether or not course participants are permitted to move back and forth in the lecture or re-answer questions can be customized to the course facilitators' preference.

Once the student has completed the module, the results from the nested quiz in module 1 are automatically input into the Learner Management System (LMS) grade system where a check is performed. If the grade is satisfactory, then a set of assignment questions are made available to the learner. The learner must then work through the question assignment and achieve a satisfactory grade(80% in the case of the flowchart of Figure 3) before they gain access to the next module of the course and are permitted to move on.

Through this entire process, support is available to the course participant in the form of E-Tutoring (described in Section 4), technical support as well as internet resources which are provided by the course facilitator and may also be searched by the course participant.

Student progress in the video lecture as well as the question assignment are automatically stored in the LMS using automatically, and the instructor receives email notifications indicating student progress through the various modules.

The net result of the application of this method is that learners have the opportunity to join the course at any point in time and work through the material in a sequential fashion at their own pace, proceeding only when they have demonstrated mastery of the subject.

## 6. INVIGILATED TESTING/EXAMINING

The Marine Institute of Memorial University of Newfoundland is governed by the rules established by the university senate and as are laid out in the MUN calendar. At this time MUN does not permit the administration of electronic tests or final examinations to students registered in MUN courses.

The technology to safely and securely administer a test or examination remotely is in a fledgling state, and the authors are working on methods to administer tests of this type to e-learners remotely.

The policy at this time is that tests and examinations are delivered in an invigilated fashion. To facilitate students taking courses by distance, Distance Education, Learning and Teaching Support (DELTS) of MUN have established a set of examination centres and a protocol for delivering tests and examinations to students participating in courses delivered by distance.

Agreements have been established with universities and colleges throughout Canada to be considered as examination centres for MUN. When a student registers in a program at MUN and signs up for a course, they also register a location as a residence for the course period. The participant is automatically registered to write or perform any invigilated evaluations at the nearest examination centre to their registered residence location.

A student scheduled to sit for an invigilated evaluation may request to have their evaluation administered at any examination centre up to two weeks prior to the scheduled evaluation.

Should the course participants residence be greater than 70 km from the nearest examination centre, then DELTS has a list of criteria for what constitutes an acceptable invigilator. It is the examinees' responsibility to identify an invigilator, and DELTS then negotiates a contract for a nominal fee for the examiner to administer the evaluation to the student at their remote location.

## 7. CONCLUSIONS

Engagement of course participants in a classroom setting and face-to-face is something that we as faculty have developed personal mechanisms to ensure. Regardless of the individual idiosyncrosies that any lecturer may employ, engagement of the learner occurs and is confirmed by virtue of communication, verbal or otherwise between the course facilitator and the participant.

The devices and methods that the authors employ in delivering courses by distance facilitate a distance delivery in which faculty can use their personal style and mechanisms to engage the learners as fully as possible.

This paper focuses on the devices used which include video lectures for the delivery of course content, algorithmic on-line quizzing softwarefor the delivery of assignment questions an possibly quizzes or examination, technology for E-tutoring which would typically be a synchronous interaction between the facilitator and the learner, and two different methods for employing these devices in an on-line delivery.

As to the actual interaction that occurs between course facilitator and participant or between the participants, how that happens and the nature of that event depends on too many variables to be explored in this paper.

Peter Drucker, a writer, management consultant and self-described social ecologist wrote (Druker 1992):

> "Teaching is the only major occupation of man for which we have not yet developed tools that make an average person capable of competence and performance. In teaching we rely on the "naturals," the ones who somehow know how to teach. "

The goal of the authors is to empower the naturals among us to teach by distance.

## 8. REFERENCES

[1] ATKINS, R., *Distance education: New technologies and opportunities for developing distance education in New South Wales,* New South Wales Education Department, 1991.

[2] DRUKER, P., *The Age of Discontinuity: Guidelines to our Changing Society*, New York: Harper and Row, p. 338,1992.

[3] FRICK, Theodore W., *Restructuring Education Through Technology*, Library of Congress Catalog Card Number 91-62121, ISBN 0-87367-326-3, Copyright (c) 1991 by the Phi Delta Kappa Educational Foundation, Bloomington, Indiana, 1991.

[4] SHARAN, S.,SHACHAR, H. and LEVINE, T., The *Innovative School: Organization and Instruction.* Praeger/Greenwood. p. 85, 1999.

[5] WATKINS, B. L.,*A quite radical idea: the invention and elaboration of collegiate correspondence study*. In B. L. Watkins & S. J. Wright (Eds.), The Foundations of American distance education: a century of collegiate correspondence study (pp. 1- 36). Debuque, Iowa: Kendall/Hunt, 1991.

# UTILIZATION OF RESOURCES ON TECHNO-NAUTICAL SERVICES BY DEVELOPING A DYNAMIC SIMULATION MODEL: AN APPLICATION ON THE PILOTAGE SERVICE IN ISTANBUL STRAITS

[1]UCAN EMRE, [2]NAS SELCUK

[1,2]*Dokuz Eylul University Maritime Faculty, Turkey*

**ABSTRACT**

In Turkey, techno-nautical services' principles are determined in Port Regulations prepared by Turkish Transportation, Maritime Affairs and Communication Ministry. But the principles are set mostly empirically or experience based. This study helps decision-makers and stakeholders for the correct utilization of resources on techno-nautical services by developing a dynamic simulation model. For this purpose, the pilotage service algorithm has been developed according to structured interviews with pilots, with statistical data of Traffic in Istanbul Straits and all rules and regulations in effect on the waterway. It is found out that by the designed algorithm, it is possible to make correct decision about the required human resource as pilots even in a complex system as in Istanbul Straits. And due to dynamic nature of algorithm with application of simulation software different scenarios can be evaluated easily.

**Keywords:** *Techno-nautical services, Marine Pilot, Algorithm.*

## 1. INTRODUCTION

Techno-Nautical services are key factors for safety of maritime transportation. Due to their expensive and critical nature such a complex resource must be optimally utilized in any situation. Optimum utilization of resources is always a challenge for decision makers and it is also a well-accepted fact that the authority normally makes its decision on utilization of resources empirically or when such a decision has to be given due to apparent faults in systems which is feed backed by stake holders.

But in this information age, nearly all complex systems can be formatted so that a scientific decision might be predicted before the circumstances require so. One way of accomplishing such a task is by creating a simulation model of said system [3]. A good algorithm must be written in order to create a reliable simulation model. To create a good algorithm all inputs to system must be evaluated and the problem should be well-specified. Also, an algorithm must be correct, efficient and if possible easy to implement [4].

## 2. OBJECTIVE

### *2.1 Objective, Cost or Safety*

This study is born by the authors' amazement when they have found that the utilization of techno-nautical resources, especially the use of pilots is conducted by empirical decisions.

It is clear that an algorithm might be designed to mirror the traffic in Straits and thus that algorithm might be used in a dynamic simulation model for optimization. Even then such optimizations are mainly based on the cost of the operations [1]. However, in this study the major aim of the application was the safety of traffic in Istanbul Straits. To this end, the fatigue element of the maritime pilots is taken into consideration [2]. But because the study is based on fatigue of the pilots it shall be the most cost efficient way for the relevant organizations nonetheless.

### *2.2 Importance of Istanbul Straits*

Istanbul Straits is a well-known and highly busy waterway which connects Black Sea and Marmara Sea and leads to the Aegean and farther into Oceans. It is 17 nm long Straits and one of the most dangerous waterways to pass through, as a ship needs to alter her course at least 12 times with the sharpest turn of $45^0$-$80^0$ at Yenikoy, while always struggling with ever changing surface currents which may go up to 6 knots because of the geographical shape and environmental conditions of the Istanbul Straits [5].

The safety of Istanbul Straits is a great concern for Turkey as this waterway directly divides the country's biggest city in half, but also all Black Sea countries care for it because it is the only open waterway for them to trade by seaway and The Straits has great geostrategic importance. Due to its utter importance, regulations governing the Istanbul Straits always become an international issue. After the Ottoman Empire declines in power in World War I, three consecutive international treaties signed about the Straits all over ruling the previous one, Treaty of Sevres (1920), Lausanne (1923) and Convention of Montreux(1936). Even today Istanbul Straits is governed by regulations in line with the Montreux Convention.

### *2.3 Importance of Pilotage Service in Istanbul Straits*

Under Section I, Merchant Vessels, Article 2 of Convention, it is stated that in time of peace, merchant ships shall enjoy complete freedom of transit and navigation with any kind of cargo, without any formalities. Pilotage and towage remain optional. This article is in the convention for the safe and free passage through The Straits by merchant ships. But after years passed and Istanbul Straits traffic ever become more

populated by transit vessels and inland traffic gets busier and busier due to the most populated city of Turkey enveloping the Straits, this article might be re-evaluated again for safety reasons. Statistically, 93% of ships involved in accidents in Istanbul Straits between 1982 and 2003 were without pilots [6]. And normally nearly all accidents in Istanbul Straits resulted in delays in transit traffic due to closed Straits while rescue operations taking place. One of the most infamous accidents of such kind was the Independenta Tanker collision (1979) in the Istanbul Straits resulting in loss of life, disastrous environmental impact and delay in transit.

### *2.4 Pilots in Istanbul Straits*

Pilots in Istanbul Straits are employed by the Republic of Turkey, Ministry of Transport, Maritime Affairs and Communications, Directorate General of Coastal Safety (KEGM). Pilots are employed according to "Competence, training certification and working procedures regulations" [7] published by the mentioned Ministry.

In this regulation in Article 5, Turkish Straits' Pilots are differentiated from harbour pilots and also classified as junior and senior pilots based on experience.

Requirements to be a Turkish Straits' Pilot are:

- Being a Turkish Citizen
- Being legally clear to be a civil servant
- Being a master mariner with at least 1 year of experience and a university graduate
- Being healthy according to seamen standards
- Being a fluent speaker
- Having successfully completed the basic pilot training

Once all these conditions are met, the pilot becomes an apprentice pilot and shall be under the supervision of a senior pilot who records his achievements in an apprentice book to be presented to harbour master at the end of its training. For the Straits pilots this training means apprentice pilot should attend to Straits passage manoeuvres of at least 160 vessels above the 5000 GRT for more than 4 months period if possible evenly distributed from both directions of passage. This training also includes some attendance to tugs and VTS operations.

After that, if training is found satisfactory, the apprentice pilot should take a written and oral exam prepared by authority. If all goes well, the apprentice pilot is granted a junior pilot certificate for 4 years duration and he is limited to handle ships below 20000 GRT [7].

As can be seen from above regulations, Istanbul Straits Pilots are highly trained individuals with great experience. But also due to this factor, utilization of this resource is extremely important as it is not possible to employ any mariner as a pilot in a whim.

### *2.5 Fatigue and Marine Pilots*

It is a well known fact that fatigue interferes with concentration of marine pilots. Especially sleep deprivation is found a major factor of fatigue. Though most pilots claim that fatigue is not a major concern in their job due to fatigue management procedures, it is also apparent that due to commercial pressure of the business and maybe, due to lack of sufficient number of pilots, pilots might find themselves in fatigue condition more than they want to admit. Even though there are control procedures to prevent this kind of situations again commercial pressure might be too hard to avoid [8].

## 3. METHODOLOGY

### *3.1 Designing an Algorithm*

To design an algorithm the question must be well known. This study's question is "If ship traffic is predicted correctly, how many pilots will be sufficient for safe transit in Istanbul Straits in any given time according to pilots' rest periods?"

Then inputs must be known. Here inputs might be summarized as below:

- Ships' arriving rate to Istanbul Straits
- Probability of a ship to request pilot service
- Any regulations forcing ships to behave in a particular way
- Istanbul Straits traffic regime at the moment
- Pilot stations
- Pilot rest hours
- Pilot on duty times
- Duration of a passage through Straits

Then the output of this algorithm must be evaluated. The output will be the resting times of the pilots in this study. But lots of other statistical data can be analysed like waiting time of ships for pilots, average passage times, if use of pilot shortens the waiting time for passage etc. Anyway, such data is out of the scope of the study. The algorithm designed here can be used in any simulation software and optimizations can be calculated accordingly. Due to the changing nature of inputs of the Istanbul Straits, created simulation model will be also a discrete and dynamic simulation.

In this paper a pseudocode is created as an algorithm so it will be easy to understand and it may be replicated with success with any number of programming languages [9].

Also the algorithm is optimized to calculate the resting periods of pilots according to Number of pilots on duty. Even though other factors can change rest periods of the pilots, according to interviews with stakeholders, other methods will be hard to implement and unpractical.

### *3.2. Gathering Data*

The data for the algorithm was gathered from various resources. For example, the arrival spread of the ships to Istanbul Straits is gathered from KEGM's statistical data of 2010 and 2011. Samples are used to analyse the arrival spread of the ships from North to South and vice versa. Even though a regular spread could not be achieved according to chi square tests, the least square error is achieved by using exponential

spread, this analyse is computed by Rockwell, Arena Input Analyser V10. Low chi square test results means might be interpreted that there are far too many variables affecting the first contact report times of ships to be accepted as exponential spread. But as shown in figure 1 spread closely resembles an exponential curve and exponential spreads commonly used for arrival intervals. Thus in this study exponential spread is used for arrival times of the ships.

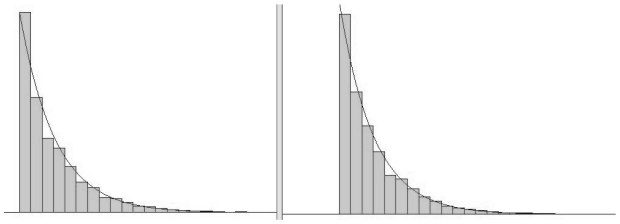


Figure 1 Visual familiarity between ships arrival times from N to S and S to N and exponential spread.

According to these analyses from 100690 sample data, for arrival intervals from North to South exponential spread of 20.7 and for South to North exponential spread of 20.5 is computed. Type of ships also calculated from this data. But before that it should be considered what types of ships need to be evaluated for a scheduling algorithm.

There are studies about the scheduling problem of the Istanbul Straits [9]. It should be noted that Turkish Coastal Safety General Directorate classifies vessels in different groups to schedule the transit passage of vessels. These types can be described as follows:

MPR : Passenger, Yachts, Live stock carrier
NAV : Military
Ships other than Tankers without IMDG Cargo
G 12 : Ships less than 150 meters
G 3 : Ships between 150 – 200 meters
G 4 : Ships between 200 – 250 meters
G 5 : Ships longer than 250 meters
Tankers and other ships carrying IMDG Cargo
T 12 : Ships less than 150 meters
T 3 : Ships between 150 – 200 meters
T 2, 5 : Ships longer than 200 meters
Towed Ships
Ships larger than 300 meters

According to KEGM's application procedures [11], MPR and NAV have priority over other vessels. G5, T4, T5, Towed vessels, Ships larger than 300 meters can only pass Straits in day light conditions. Tankers and IMDG cargo carrying vessels have lower priority as safety conditions are re-examined for passage. So a tentative scheduling can be determined as follows:

MPR=NAV>G12>G3>G4>G5>T12>T3>T2,5>Towed (1)

Of course, day time and night time passage will shift according to the requirements of only day light passage vessels and scheduling must be reorganized accordingly. It must be remembered that vessels longer than 300 meters require special permission to transit the Straits.

In following table statistical data about the Istanbul Straits for years 2010 and 2011 have been analyzed to find out the frequency of these types of vessels for the creation of model. So it is noted that some types of vessels transit the Straits extremely rare and modelling of such vessels will not contribute to the model in the scope of analyzing pilot fatigue, because such vessels actually stop the Straits traffic causing a long rest period for other pilots not onboard the vessel. For example vessels over 300 meters long are in these category and G5 vessels are extremely rare.

Table 1. Frequency of Vessel Types Transiting Istanbul Straits in 2010 - 2011

| | **South to North** | | **North to South** | |
|---|---|---|---|---|
| | **All** | **Freq.** | **All** | **Freq.** |
| **MPR** | 585 | 1,16 | 591 | 1,18 |
| **NAV** | 96 | 0,19 | 104 | 0,21 |
| **G12** | 32886 | 65,38 | 32728 | 65,07 |
| **G3** | 5874 | 11,68 | 5966 | 11,86 |
| **G4** | 554 | 1,10 | 588 | 1,17 |
| **G5** | 6 | 0,01 | 6 | 0,01 |
| **T12** | 5163 | 10,27 | 5345 | 10,63 |
| **T3** | 4463 | 8,87 | 4417 | 8,78 |
| **T4-5** | 670 | 1,33 | 648 | 1,29 |
| **TOTAL** | 50297 | 100 | 50393 | 100 |

Source: KEGM Statistical Data

After the scheduling algorithm, another important part of the model is the Straits pilot working conditions. To gather this data, structured interviews have been completed by Istanbul Straits pilots.

The most important findings of these interviews can be summarized as follows:

- There are two pilot stations in Istanbul Straits. One is located at South and other is at North entrance of Straits.
- Each shift of pilot consists of 23 pilots
- Pilots arrive for their 48 hours shift at south pilot station. They rest for 96 hours after each shift and start their shift "well rested" according to their perception.
- Straits traffic is one way due to safety precautions of KEGM and Turkish government.
- Due to one way traffic, there is a transportation problem between south and north pilot stations.
- This problem is generally solved by a dedicated service boat for pilot transfer and generally 8 pilots transferred with each service (this number may greatly vary, but 8 people is average)
- Pilot transfer generally completed between 45 minutes to 1 hour.
- There are other possible ways for transporting pilots when need is immediate or need requires a few of pilots, but they are uncommon and not

- convenient and usually takes more time due to land traffic congestion. (Mini-bus, taxi etc.)
- General scheduling frequency is 6 vessels in an hour, 7 when Straits is congested. (According to KEGM statistical data approximately 1 vessel per 8 minutes.)
- One way traffic changes direction in roughly 12 hours periods but also subject to lots of other considerations as available pilots, ship number in queue, weather or other conditions.
- It takes approximately 15 minutes for a pilot to board a vessel from pilot station and nearly 15 minutes disembark from a ship and arrive to pilot station.

There are some special points analysed from above declarations. It is clear that 2 models must be simulated as one from south to north and other from north to south. But there is only 1 resource available and that is Istanbul Straits. Real limitation of Straits is the distance between navigating ships, though in practice a time limit is used as rule of thumb. Due to pilot boarding and disembarkation times, 30 minutes must be added to transit times of vessels to calculate real working hours. A transportation system must be modelled and 1 hour should be taken as transit time and must be counted as working hour.

And final transit times are important as it actually shows that pilot is on-board the vessel and working.

Vessel passage times are subject to great change due to lots of external factors and analyse of KEGM data points out there is not an optimum spread for passing times. Thus average time for ship type is taken as transit times of vessels.

As it can be seen from the table below, average transit from South to North takes considerable more time (apprx.26%) than the passage from North to South. The main reason of this phenomenon is the surface currents affecting the Istanbul Straits under normal conditions.

Table 3. Average transit times for Vessels Transiting Istanbul Straits in 2010-2011.

| In Hours | South to North | North to South |
|---|---|---|
| **MPR** | 1.657 | 1.555 |
| **NAV** | 1.736 | 1.6 |
| **G12** | 2.029 | 1.583 |
| **G3** | 1.634 | 1.414 |
| **G4** | 1.542 | 1.381 |
| **G5** | 2 | 2.002 |
| **T12** | 1.8 | 1.447 |
| **T3** | 1.517 | 1.376 |
| **T4-5** | 1.491 | 1.411 |
| **TOTAL** | 1.89 | 1.53 |

Another consideration about the model is frequency of pilot service usage for the vessel transiting the Straits. Again KEGM data is analysed for this purpose. It shows that nearly half of the vessels passing through the Istanbul Straits use pilots. And there is a slight more pilot usage when vessels transiting from South to North.

Even though frequency is not much to consider, probably same phenomenon of surface currents is also in affect in this selection of pilotage service.

Table 3. Frequency of Pilot Service Usage for Vessels Transiting Istanbul Straits in 2010-2011

| | **South** | **To** | **North** | **North** | **To** | **South** |
|---|---|---|---|---|---|---|
| | **TTL** | **W/P** | **FREQ** | **TTL** | **W/P** | **FREQ** |
| **MPR** | 585 | 512 | 87.52 | 591 | 518 | 87.65 |
| **NAV** | 96 | 24 | 25 | 104 | 29 | 27.88 |
| **G12** | 32886 | 13134 | 39.94 | 32728 | 11731 | 35.84 |
| **G3** | 5874 | 4638 | 78.96 | 5966 | 4767 | 79.90 |
| **G4** | 554 | 554 | 100 | 588 | 588 | 100 |
| **G5** | 6 | 6 | 100 | 6 | 6 | 100 |
| **T12** | 5163 | 2906 | 56.29 | 5345 | 2652 | 49.62 |
| **T3** | 4463 | 4351 | 97.49 | 4417 | 4326 | 97.94 |
| **T4-5** | 670 | 670 | 100 | 648 | 648 | 100 |
| **TOTAL** | 50297 | 26795 | 53.27 | 50393 | 25265 | 50.14 |

Source: KEGM Statistical Data

## 4. ALGORITHM

There are different parts of this model. Firstly, some parts must be created to check the time in simulation software. Such an algorithm in pseudocode can be written as follows:

### *4.1. Time Creation*

Even though different simulation software might have an internal clock, due to discrete event simulation specifications it is safer to create a time logic to specify important times.

First part is the checking of day light. 12 hour day light is taken as average for the purpose of this simulation.

1. Create 1 entity at experiment start (Experiment time 1000)
2. Assign entity that sun is up.
3. Delay entity for 480 minutes (8 hours).
4. Assign entity that sun is down. (Experiment time 1800)
5. Delay entity for 720 minutes (12 hours).
6. Assign entity that sun is up. (Experiment time 0600)
7. Delay entity for 240 minutes (4 hours)
8. Loop entity to line 3.

Another time logic must be created to check the availability of Straits for north to south or south to north traffic. This is a rough guide to see which side of passage must be open for the Istanbul Straits in any given time in experiment. This logic will be evaluated with other considerations too.

1. Create 1 entity at experiment start (Experiment time 1000)

2. Assign entity that Straits is open from South to North
3. Delay entity for 720 minutes (12 hours).
4. Assign entity that Straits is open from North to South. (Experiment time 2200)
5. Delay entity for 720 minutes (12 hours).
6. Loop entity to line 2.

Also different time logic must be created for pilot transfer times, as it will be unnecessary to send pilots to a pilot station when the traffic shifts its directions before the pilots arrive.

1. Create 1 entity at experiment start (Experiment time 1000)
2. Assign entity that transfer is allowed from North station to South station.
3. Delay entity for 660 minutes (11 hours).
4. Assign entity that transfer is not allowed.(Too late for transfer)
5. Delay entity for 60 minutes (1 hour).
6. Assign entity that transfer is allowed from South station to North station.
7. Delay entity for 660 minutes (11 hours).
8. Assign entity that transfer is not allowed.(Too late for transfer)
9. Loop entity to line 2.

*4.2. Queues Creation*

There are 4 queues in this model: 2 for pilot station and pilots and 2 for arriving ships from two sides of the Straits.

For pilots:

1. Create number of pilots required in experiment start.
2. Assign each entity a name to distinguish them in model.
3. Mark each pilot's time now in experiment.
4. Send each pilot to first queue.
5. Name the queue Pilot Station South
6. Queue ranking First In - First Out.
1. Create a Queue for North Pilot Station.
2. Queue ranking First In - First Out.

Other 2 queues have more sophisticated models and will be explained in Istanbul Straits Models.

*4.3. Istanbul Straits Model*

1. Create ships according to exponential spread.
2. Assign created ships type
3. Branch ships according to their type
4. Assign ships a priority for the Entrance Queue according to their type
5. Assign a random pilot request to ships based on their type and KEGM data
6. For ships types that requires day light to pass through Straits check if sun is up, if sun is up give them highest priority for Straits. If sun is down delay them 60 minutes and send them to line 4
7. Check if ship is requesting pilot and update priority over ships without pilot.
8. Put ships in a queue (Istanbul Straits South Entrance)
9. Queue ranking rule is lowest priority first
10. Seize entities from queue if Straits is open for transit for correct direction. If not, do not accept ships to Straits.
11. If Straits is open, seize the highest priority ship from queue first in - first out between two same priorities.
12. If ship has requested, pilot check availability of pilot in pilot station, if there is no pilot delay ship for 10 minutes and send back to queue.
13. Use Straits as a resource
14. Release resource after 10 minutes for pilot requested ships and 8 minutes for other ships.
15. Check if ship requested pilot
16. Take a pilot from South Pilot station
17. Mark time for specific pilot. Subtract time from the pilots' arrival time to pilot station queue.
18. Record time as Rest period, record pilot name, record experiment time.(This data will be analysed to see pilot resting times)
19. Delay pilot in ship according to average time from KEGM statistics.
20. Drop off pilot from ship
21. Mark dropped off pilot's time now in experiment
22. Send pilot to next station
23. Dispose of ship that finished its transit of Straits.

Create same model for other direction of Istanbul Straits passage. Here most important part is marking times of each pilot before entering the pilot station queue and after exiting from the pilot station queue.

## 5. CONCLUSIONS

If above pseudocode is created in any discrete simulation software and resting period data is analysed this created dynamic simulation model can be used to safely assess the required number of pilots in Istanbul Straits according to their recommended rest periods.

In this algorithm, cost of pilots and ship delays due to shortage of pilots are not evaluated. But such additions can easily be modified to algorithm.

Also, the model can easily be altered for more or less arriving ships, different number of pilots, more frequent pilot requests, for faster pilot transfers, etc.

In this paper KEGM data is analysed to give numerical examples and clearly demonstrate what the required data is to design an algorithm for Istanbul Straits pilotage service.

Though with these key elements any such water way can be modelled easily and analysed clearly.

## 6. ACKNOWLEDGMENTS

We would like to acknowledge the Republic of Turkey Ministry of Transport, Maritime Affairs and Communication, Directorate General of Coastal Safety (KEGM) for their support with statistical data for Turkish Straits.

## 7. REFERENCES

[1] CLAESSENS, E.M., *Optimization procedures in maritime fleet management*, Maritime Policy and Management, *14(1*), 27-48, 1987.

[2] FU, M.C., *Optimization via simulation: A review*, Annals of Operations Research, 53(1), 199-247, 1994.

[3] SKIENA, S.S., *The Algorithm Design Manual*, Springer-Verlag, New York, 1998.

[4] T.C. Denizcilik Müsteşarlığı, (2000), Türk Boğazları Seyir Güvenliği. İstanbul: T.C. Başbakanlık Denizcilik Müsteşarlığı Yayınları.

[5] ECE, J.N., *Istanbul Bogazindaki Deniz Kazalari*, 2006. http://www.denizhaber.com/index.php?sayfa=yazar&id=11&yazi_id=100095, (11.4.2013).

[6] RESMI GAZETE (26360), *Kilavuz Kaptanlarin Yeterlilikleri, Egitimleri, Belgelendirilmeleri ve Calisma Usulleri Hakkinda Yonetmelik*, 2006.

[7] DARBRA, R.M., CRAWFORD, J.F.E., HALEY, C.W., MORRISON, R.J., *Safety culture and hazard risk perception of Australian and New Zealand maritime pilots*, Marine Policy, 31(6), 736-745, 2007.

[8] HOROWITZ, E., SAHNI, S., RAJASEKARAN, S., *Computer Algorithms in Pseudocode: The Human Dimension*, 1997.

[9] ULUSCU, O.S., OZBAS, B., ALTIOK, T., OR, I., YILMAZ, T., *Transit vessel scheduling in the Straits of Istanbul*, The Journal of Navigation, 62, 59-77, 2009.

[10] T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı (2012), Türk Boğazları Deniz Trafik Düzeni Tüzüğü Uygulama Talimatı, https://www.google.com.tr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CD8QFjAC&url=https%3A%2F%2Fatlantis.denizcilik.gov.tr%2Fmevzuat%2Fdosyam%2FTBDTDTUT.doc&ei=LfChUefID6Wn4gSr9YHQDA&usg=AFQjCNHMYBRXkXWbj7CHxGzqaFgFqQ6lBQ&sig2=V0iCdGq0IqkgtbkYm408Fw&bvm=bv.47008514,d.bGE&cad=rja , (26.05.2013).

# WAYS TO IMPLEMENT THE STCW MANILA AMENDMENTS FOR TRAINING IN LEADERSHIP AND TEAMWORK

[1]UNGUREANU-CHIREA CARMEN,[2]CONSTANTINESCU ELIODOR

[1,2]*Constanta Maritime University, Romania*

**ABSTRACT**

*Team working* is not identified within the revisions to STCW as a specific competence: rather it is referred to in terms of '*necessary team member(s)…*' and '*…consideration of team experiences.*' However, the impact of positive and negative behaviors on teamwork was clearly identified, and thus we believe it to be an essential behavioral marker. It is these specific training issues – sometimes referred to as *human factors training, non-technical training* – that we will address in this paper. With the introduction of new training concepts and training terms, such as *leadership & teamwork* we shall try in this paper to define and explain what is meant by those terms. Keeping advanced theory and knowledge simple we shall try to describe the training objectives and avoid making trainees, and possibly also trainers, afraid of the new subjects.

**Keywords:** *leadership, teamwork, competence, skills, training*

## 1. INTRODUCTION

All personnel are affected in some capacity by the STCW Manila Amendmentsso a detailed review of the IMO Conventions is required. The Convention is a legal document and is written for precision, not everyday clarity. Do not base your operational changes on hearsay because there will be many scams associated with these changes.

Major components of the STCW conventions were modified during the last revision in June of 2010. These amendments will bring the training requirements up to date for modern operational situations and technologies. Some of the changes from the Manila Amendments are:

- "Revised requirements on hours of work and rest and new requirements for the prevention of drug and alcohol abuse, as well as updated standards relating to medical fitness standards for seafarers"
- "New requirements relating to training in modern technology such as electronic charts and information systems"
- *"New requirements for marine environment awareness training and training in leadership and teamwork"*
- "Updating of competence requirements for personnel serving on board all types of tankers, including new requirements for personnel serving on liquefied gas tankers"
- "New requirements for security training, as well as provisions to ensure that seafarers are properly trained to cope if their ship comes under attack by pirates"
- "New training guidance for personnel serving on board ships operating in polar waters"
- "New training guidance for personnel operating Dynamic Positioning Systems"

The update marked in italic is especially important to this paper. Qualified personnel are important in every industry, but in the maritime sector you are to a greater extent dependent on the competence of the persons serving on board. In a historical aspect the level of competence has been handled by the seafarers themselves or on a regional or national basis, which has meant that the level of training and competence of the seafarers could vary greatly.

Each competence is connected with a degree of requisite knowledge, understanding and proficiency. These denominations correlate well with those used in the taxonomy for educational objectives (Anderson, Krathwohl, Airasian, and Cruikshank, 2001). Some competencies are easy to assess, whereas others call for extensive planning.

Education is an ever developing process. This paper will prove that the training in leadership and teamwork education at Constanta Maritime University is in accordance with the latest international requirements, and what is more important, that the efforts of incorporate new topics will prove fruitful in terms of learning outcome for the students.

## 2. TAXONOMY OF EDUCATIONAL OBJECTIVES

There is a well spread and well accepted taxonomy of educational objectives created in the 1950's by the educational psychologist Benjamin Bloom. The taxonomy, usually referred to as Bloom's taxonomy, categorizes *skills and objectives for students.* Educational objectives are divided into three major domains: the cognitive, the psychomotor and affective domain. When it comes to educational objectives within the mariner's area, the cognitive area is the most relevant. The cognitive area constitutes, among other things, skill objectives of knowledge, comprehension and application. These objectives correlate very closely to those of the STCW Code: *knowledge*, *understanding* and *proficiency* (Anderson, Krathwohl, Airasian, and Cruikshank, 2001).

- *Knowledge*

When it comes to cognitive levels, knowledge is considered to be the lowest. In this sense knowledge only requires that the student can recall previously learned material like facts, basic concepts and terminology. For *Leadership and Teamwork* course module this can be knowledge of the standard representational symbols used by different cultures. Test of such knowledge can easily be achieved through written exams.

- *Understanding*

The level of understanding or comprehension requires a deeper understanding of facts and ideas, which can be shown by interpretation and description. For *Leadership and Teamwork* course module, a trainee might be shown a picture for situation awareness and be asked to describe how the cultural differences operate: Group-Individual, Power Distance, Uncertainty Avoidance, Feminine-Masculine, and Short-Long term. Testing of comprehension can also be achieved in written format but would require more elaborate answers than just short ones.

- *Proficiency*

Proficiency is the highest of the skill objectives in the STCW Code. To demonstrate proficiency you have to apply acquired knowledge. To do this for example for *Leadership and Teamwork* course module a student can be asked to describe the importance of "closed loop communication" and how you achieve a good communication climate. The best way to assess application of acquired knowledge would be to demonstrate proficiency through practical examination.

### *2.1 Higher Education Institutions' Development*

Any organization, public or private, and certainly also faculties and Universities depend on the knowledge, skills, expertise and motivation of its human resources. Development needs of teachers in these areas should therefore be amongst an organization's major and long-term goals. These developmental goals can be achieved by:

- providing teachers with training opportunities to achieve maximum effectiveness;
- ensuring that employees develop their skills and capabilities to be able to work efficiently and rapidly respond to changes within their organisations;
- improving performance of their present duties;
- ensuring that the best use is made of the natural abilities and individual skills of all employees for the benefit of the organisation and their career.

Development and training is a continuous and systematic process. The process of training should necessarily be directed to give every teacher a sense of professionalism, excellence, motivation and customer satisfaction.

### *2.2. Quality shipping needs Life Long Learning*

One approach to conceptualising lifelong learning claims it is concerned with promoting skills and competences necessary for developing general capabilities and specific performance in work situations. Skills and competences developed through programs of lifelong learning are vital for workers performance in their tackling of precise job responsibilities and how well they can adapt their general and particular knowledge and competences to new tasks. On this analysis a more highly educated and skilled workforce will contribute to a more advanced and competitive economy.

The economic justification for Lifelong Learning depends upon two prior assumptions: that 'lifelong education' is instrumental for a further goal; that the goal of lifelong learning is economics-related. This approach has now been re-assessed: it presents a limited account of the need for 'lifelong learning'. Another approach claims lifelong learning is good in and for itself. Its aim is to enable those engaging in it not arrive anywhere but 'to travel with a different view' (Peters 1965). This way people travel with wider, richer and more elevated perspectives. Indeed we may argue that human beings have a duty to themselves to seek that kind of improvement: see Kant: It is a duty of man to himself to cultivate his natural powers (of the spirit, of the mind and of the body) as means to all kinds of possible ends. Man owes it to himself (an intelligence) not to let his natural predispositions and capacities (which his reason can use someday) remain unused, and not to leave them, as it were, to rust (1964 cited in Bailey 1988: 123).

People can have their view of the world and capacity for rational choice continually expanded and transformed by the educational experiences and cognitive achievements offered by lifelong learning. This notion has been taken seriously by community groups, who have articulated and promoted other versions, styles and patterns of lifelong learning. In addition to the provision of lifelong opportunities available through traditional institutions and agencies, there is a trend for offering opportunities for lifelong learning by the creation and expansion of a range of community initiatives.

Lifelong learning offers people the opportunity to bring up to date their knowledge of activities which they previously had either laid aside or always wanted to try but were unable; to try out activities and pursuits that they previously had imagined were outside their time or competence; or to work at extending their intellectual horizons by seeking to understand and master some of the recent cognitive advances, that have transformed their worlds.

## 3. NON-TECHNICAL SKILLS. LEADERSHIP AND TEAMWORK

During everyday operation onboard a ship, technical and non-technical skills are integrated into each other and both skills need to perform tasks as safely and efficiently as possible. But there are important differences between them. The technical skills are related to a specific department, function or rank while non-technical skills are applicable to all. Most technical training has to be carried out with groups kept apart, divided into, for example, deck and engine. The non-

technical training may be carried out with no separation of people at all.

The assessment of technical and non-technical training also differs. Technical training can most often be assessed by means of a test. The assessment of non-technical training requires different methods. Students can learn about leadership and teamwork theory. Trainees may even demonstrate specific behavioral objectives of the training in a simulator in connection with the course. The challenge is to make safe and sound leadership and teamwork principles become part of a permanent behavior onboard after training. The trainees must understand the importance of the training. To succeed, trainers need encouragement and support for the desired behavior from the companies they work for. If the willingness to apply the theories would be related to the *attitudes of people*, the company support would be related to the *culture of the company*. The attitudes of people and the culture of the company are two importantissues for the training to be effective and show intended results.

That is why at Constanta Maritime University the training programs are organized in such a way that the non-technical training according to the new STCW requirements is carried out as a separate training course (such as the Communication, Leadership and Teamwork coursemodule) without mixing it with the technical issues. The major benefit is that all disciplines and ranks are able to come together in the same training class, receiving the same course contents, terminology and training objectives. As we previously mentioned, assessment of trainees in connection with the course is difficult and will not provide long-term evidence that the training has been effective. Trainers should stress thatthe initial training is just an introduction for the "real training" that starts onboard.

### *3.1. Constanta Maritime University and the STCW non-technical requirements*

The purpose of this paper is to illustrate what course modules of Constanta Maritime University are needed to meet the STCW Manila amendments' non-technical training requirements, such as Resource Management, Leadership and Teamwork.

The STCW sections that contain requirements related to non-technical skills are:

- Reg. A-II/I for Bridge Resource Management
- Reg. A-III/I for Engine-room Resource Management
- Reg. A-II/2 and A-III/2 for Use Leadership and Managerial Skills
- Reg. A-II/I, A-III/I and A-III/6 for Application of Leadership and Team Working Skills.

The course modules that are delivered at Constanta Maritime University are sufficient to cover the STCW requirements. However, we cannot see it possible to deliver complete training in leadership and teamwork without discussing the basic issues related to attitudes and culture. We think that a requirement for a training certificate will therefore be to cover the "*Communication Skills*" and "*Cultural Awareness*".

## 4. STCW MANILA AMENDMENTS COMMUNICATION SKILLS

When the STCW Conventions were amended in 2010 the foundation was laid for significant industry wide improvements for workers. Amendments to STCW cause a lot of controversy since they sweep across all business segments and directly impact every worker.

Globally, maritime workers are at risk because of the flexible labour laws of shipping in the developing world. Even the great industrial powers have exploitation of their workers since ship board work is out of sight and out of mind.

The Manila Amendments to STCW 2010 include many new training and certification guidelines. One of the minor directives aims *to improve interpersonal communications skills for all crew and ground personnel.*

One of the biggest benefits will come from improved radio communications. The transition from analogue electronics to digital has caused many problems because digital microphones commonly limit volume levels. This leads to an in and out transmission in noisy environments like a windy deck or in an open boat underway. Analogue transmissions would simply distort so you heard something but it was unintelligible. Digital radios in the same situation sound like the microphone is being keyed during the transmission.

Annunciation and radio traffic etiquette can also use some improvement to improve safety. Some radio traffic is very cryptic when operators have been calling the same security zone for ten years and their annunciation is sloppy and nearly impossible for visiting vessels to understand.

The universal adoption of English as the operating language of choice for mariners worldwide is going to make the transition to the new standards more difficult. Many maritime schools worldwide offer excellent foreign language training. It will be a difficult task to retrain generations of mariners no matter what their native language.

### *4.1. Communications Directives in STCW*

The idea of sailors consulting a guide to etiquette is funny to you then you are not alone. This point of focus has the potential to be one of the richest sources of maritime humour in recent times. There are many serious consequences when communication is vague or indecipherable. In many accident reports communication is cited as one of the main contributors in serious incidents. Everyone involved knows the dangers of work at sea so it is reasonable to expect a crew to show some respect towards the possibly deadly situation.

Some of the serious consequences take place over a longer span of time. Ongoing, consistently poor communication will whittle away at crew morale since it is difficult to do a job that is poorly defined. The same is true of crew members who cannot express concerns or improvements to a situation. These are mostly face to face interactions we are talking about but it also includes written communications. These directives will impact everyone on crew from the Master, who must now refine

communications in the mountain of paperwork, to the deckhand who is now expected to have training to resolve differences in fair and equitable manner. There are some more realistic and productive parts of STCW Communications. The mentoring of crew by officers is likely to really tighten up working relationships and improve the workplace overall. This is closely tied to potions of the STCW Manila Amendments that require significantly more training and frequent re-certification.

## 5. CONCLUSIONS

Combining the STCW requirements related to leadership and teamwork in a syllabus is most suitable for a stand-alone course. While strongly supporting the introduction of non-technical skills in the STCW as such, there are still things that could be improved. We believe that it is a draw back to have the non-technical contents split up in different tables keeping departments and ranks apart. The different labels *Bridge Resource Management* and *Engine-Room Management* to the same content add to the confusion. During our meetings with our students that had been on board vessel for training, we often hear about the feeling of „us and them"- between ranks, between departments, and between ship and shore. To improve safety and open up to efficient communication.

and teamwork, such barriers must be brought down. We do not agree to non-technical training where target groups are kept apart. At Constanta Maritime University we develop the same course for all target groups with the purpose of establishing a shared view on how things should be done.

## 6. REFERENCES

[1] IMO, *The Manila amendments to the STCW Convention and Code*, International Maritime Organization, 2010.

[2] IMO, *International Convention on Standards of Training, Certification and Watch keeping for Seafarers*, International Maritime Organization, London, 2011.

[3] FLIN, R., O'CONNOR, P., CRICHTON, M., *Safety at the Sharp End: A Guide to Non-Technical Skills*, Ashgate, Aldershot, 2008.

[4] ANDERSON, L.W., KRATHWOHL, D.R., AIRASIAN, P.W., and CRUIKSHANK, K.A.,*A Taxonomy for Learning, Teaching and Assessing -a revision of Bloom's taxonomy for educational objectives* New York: Longman, 2001.

[5] REAY, D., *Evaluating Training*, London: Kogan Page, 1994.

[6] BAILEY, K., *The conceptualization of validity: Current perspectives*, Social Science Research, 17, 1988.

# REDUCE FUEL OIL CONSUMPTION BY MODIFICATION OF PROPELLER

VAN TUAN NGUYEN

*Vietnam Maritime University, Vietnam*

**ABSTRACT**

After a certain time of operation, the conflict between Main engine, Propeller and Hull of ships has occurred, which causes decreasing of engine output and increasing the fuel consumption. In order to solve this problem, researches have been conducted in Japan. The best solution to reduce fuel consumption of the aged ships proved to be modification of propeller. The modification of propeller of ship can be made in several ways: Diameter cut, Twisted blade and Edge cut or Modification of edge.

According to current situation of Vietnam, Maritime Research Institute (MRI) – Vietnam Maritime University (VIMARU) found that Edge cut method would be the most applicable method. This Edge cut method was applied to the merchant ship Glory Star (16.800 MT) in Ho Chi Minh City (Vietnam) from October 24th to December 24th 2012. As a result, calculating method of the edge cutting amount of propeller's blades upon the actual conflict situation of Main engine, Propeller, Hull and the experiment have been studied, developed and obtained.

**Keywords:** *Main engine, propeller, hull, output, fuel rack index, fuel consumption, confliction, blade, edge, pitch.*

## 1. RELATION SHIP OF MAIN ENGINE - PROPELLER - HULL

### *1.1 Design point*

Design problems for a ship begin from defining the most basic features, which consists of water occupied volume (equivalent to the cargoes loaded) and its speed. Based on its foundation, a designer starts to draw the curve of hull, calculate resistant, choose engine, propeller and operating modes.

M.E is chosen to assure the suitability between its effective output and thrusted power of propeller, overcoming the resistance and keep the speed of ship. Turning speed of M.E has to be compatible with turning speed of propeller at which the thrusted output reaches largest.

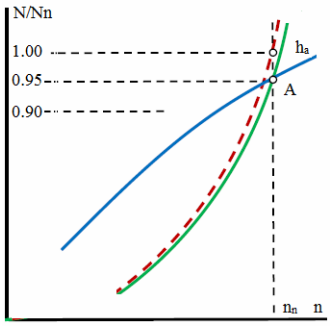



Figure 1 Combined point between Main Engine - Propeller in designing

On the power curve particularity N-n, a design point A will normally satisfy following conditions [1]:

- Full loaded ship sailing in normal marine condition;
- At the norm revolution speed $n_n$ Output of M.E reaches at $N = 0.95N_n$
- Speed of the ship will reach the designed value and some other features.

At the design point A, operating mode of M.E (diesel engine) is correlatively at the revolution $n_n$ and fuel rack index (see figure 1).

During the actual operating period, there are many factors affected which make the operating point between Diesel engine and Propeller be not the point A. Combination as initial design does not keep stable and becomes 'confliction'.

### *1.2 The loss of M.E's output*

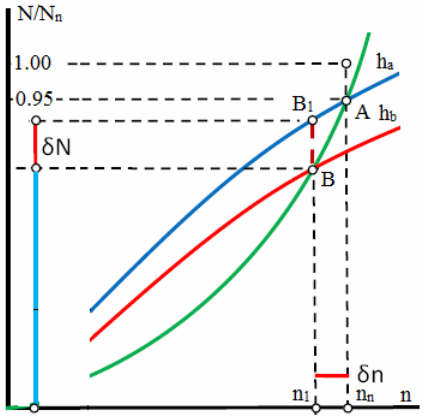



Figure 2 The loss of M.E output

Since the technical condition of M.E is decreased, the operating output will be lowered, which means that at the normal operating condition, while keeping the fuel rack index, the engine's output will be decreased. On the graph of figure 2, while keeping the fuel rack index $h_a$ (point A) unchanged, since the output decreased, it makes the turning speed of Propeller be decreased from $n_n$ to $n_1$ (point B). This fact is described in figure 2: at point B, the output of M.E provided to the propeller $N_b$ correlatively at the revolution speed $n_1$. However, at the turning speed $n_1$ the actual fuel rack index of M.E is not $h_b$ but $h_a$ (point $B_1$). So, the amount of loss of output is $\delta N$ (see figure 2). The amount of fuel correlatively with the difference between $h_a$ and $h_b$ (at turning speed $n_1$) may be understood as the loss of fuel consumption

increased [4].

Instead of operating, correlative to the fuel rack index, engine may generate the output lower due to the inner leakage of Fuel Injection pump and quality of Fuel valve (Nozzle). Therefore, before performing an experiment of evaluating the decrease of output, the quality of Fuel Injection pump and Nozzle should be maintained in advance).

*1.3 Heavy Propeller – Hull*

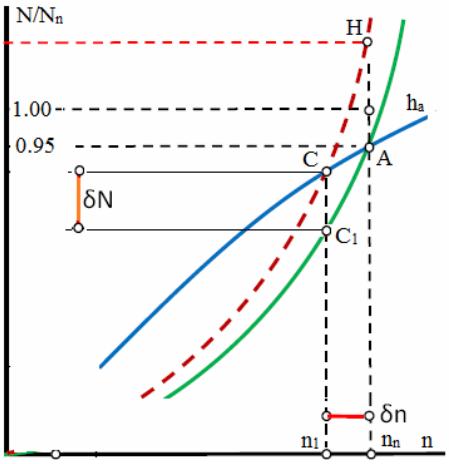



Figure 3 Operating main engine in heavy load or torque rich condition

The state of confliction may happen due to the bad weather condition, the resistance of Hull of the ship increases or Propeller becomes heavier. In these conditions, if M.E is kept operating at the fuel rack index $h_a$, its turning speed cannot reach the value $n_n$ but can only reach the value $n_2$ (see figure 3). Comparing to the standard of Propeller's particularity (state of sea trial), the output of engine becomes larger in addition of δN (turning speed decreased around δn).

Operating main engine in this condition is very critical, if the operating revolution is increased, the output and especially the rotating torque will be increased very much (point H, figure 3). In some cases the crankshafts were broken, the gears of gearbox were damaged and the fuel consumption was increased rather much.

## 2. MARINE DIESEL ENGINE OPERATION IN VIETNAM

Diesel engines installed on marine ships consist of two types: Propeller driven by Main Engine and Generating Engine driven by Auxiliary Engines. M.E is designed to drive directly or indirectly the Propeller (Fixed Propeller Pitch - F.P.P or Controllable Propeller Pitch - C.P.P). On Vietnam's ships, about 95% M.Es drive the fix Propellers directly. From the beginning of 2000, the medium speed engines driving the Propellers via Gearboxes have been installed on significant numbers of medium and small newly built ships [3].

The basic feature of M.E is that it operates according to curve of the Propeller, where the output used on Propeller is rated by power of three with the turning speed: $N = C.n^x$ (x = 3) and using heavy fuel oils (HFO). The most important parameters used to evaluate the operating condition of M.E are the turning speed and the fuel rack index (load indicator).

Most Diesel engines installed on ships in service for more than 5 years are all operated in both decreased and incurred the confliction to Propeller-Hull technical conditions [3].

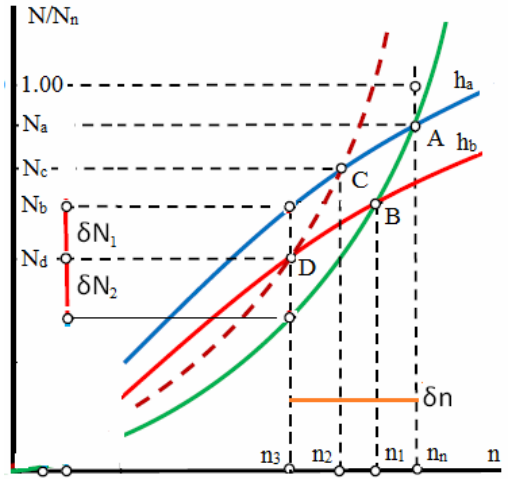



Figure 4 M.E is under output loss and confliction

The impacts concurrently by two factors as described above in figure 4 will move the operating co-operated point to point D (output $N_d$ and turning speed $n_3$). Moreover, the effect of the fuel consumption is significantly reduced.

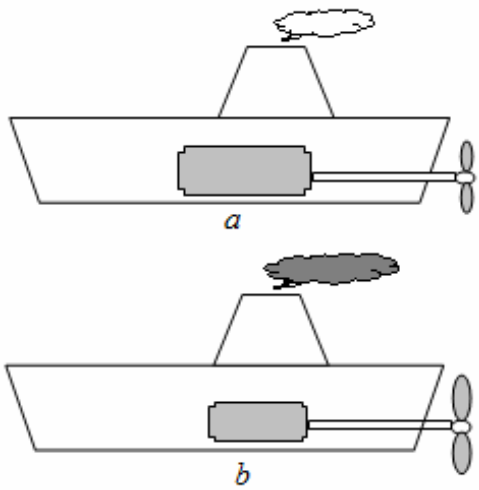



Figure 5 The relation between M.E - Propeller - Hull: a - at design and b - while operating

Phenomena relating to the heavy load (or torque rich) on M.E originated by Propeller - Hull is called the confliction between M.E - Propeller - Hull. If compare this to the initial design, M.E seems to be smaller while the propeller and hull seem to be larger and larger (see figure 5). To protect the engine, the operator often reduces the fuel control handle, therefore the revolution speed and output is decreased.

According to technical reports of some Vietnam shipowners, from 2007, there is rather much confliction happening right after launching or after operating in very short time [3].

## 3. RESEARCH ON CONFLICTION OF M.E - PROPELLER - HULL

### *3.1 Research in Japan*

Researches which targeted to resist the phenomena of confliction between diesel engine-propeller-hull by Kawasaki Heavy Industries Maker, Kobelco Marine Eng., Kamome propeller Co. Ltd., [5] consist of:

- Diameter cut: this method is aimed at avoiding the torque rich by reducing the Propeller diameter. Due to cut off large amount of blade, it alters the Propeller moment of inertia so widely that it may affect on the Main Engine torsional vibration and it may decrease the Propeller efficiency largely.
- Twisted blade: twisting the blade at each blade root to reduce pitch, by using special equipment upon heat up at the workshop, had also been taken. This method has disadvantage of possible residual stress caused by heat given to the material and complicated work to take off Propeller for measurement of blade pitch after the correction.
- Edge cut: with the point aimed at the alternation of Propeller performance caused by the variable shapes on the trailing edge, it has been developed to reduce the Propeller absorbing torque as said the 'Edge cut' or 'Modification of edge'. In this case, it is required to carry out the complicated calculation for the hydrodynamic estimation on the alternation of Propeller performance. Nowadays, such complicated calculation is undertaken by computer within short time and the edge cut method has been undertaken widely.

All results of researches are approved by quality from Class offices such as Nippon Kaiji Kyokai, American Bureau of Shipping, Lloyd's Register, Germanischer Lloyd [5].

### *3.2 Research in MRI – VIMARU*

From year 2003, in the program developed in co-operation with Japan (JICA), the officers of Vietnam Maritime University (VIMARU) have approached all the results studied by Japan and got the first step of research relating to the actual matters when operating ships in Vietnam.

Researches of Marine Research Institute (MRI) of VIMARU concentrate on the following targets [3]:

- Overcome the confliction among M.E - Propeller - Hull;
- Minimize the loss of output of M.E by technical conditions;

MRI builds up steps to target on inspecting and defining the amount of loss of M.E output and degree of heavy load toward the Propeller - Hull. The standard data referred in 'sea trial' document is used to compare and evaluate to the actual data. Moreover, the data used to evaluate and calculate is chosen to not have used the complicated measuring equipments. For example: to determine the amount of fuel oil injected in a cylinder in one cycle or fuel rack index instead of measuring the effective output of M.E.

Based on the data measured and calculated above, MRI builds up the below projects:

- Cutting and grinding the edge of propeller's blades based on the confliction degree;
- Repairing the M.E to restore the output;

## 4. THE RESULT EXPERIMENTED SIGNIFICANTLY

In August 2012, shipowner K. Marine suggested to MRI research team to build up the plan to resolve the matter of loss output of M.E and confliction M.E - Propeller - Hull for the M/T Glory Star.

All the major works related to the science project consist of:

- Approaching, handling documents and checking the actual condition of M.E of M/T Glory Star;
- Calculating the amount of loss of M.E output;
- Calculating the degree of confliction M.E - Propeller - Hull;
- Measuring all parameters of actual Propeller;
- Calculating the dimension needed cutting at edges and grinding blades of Propeller;
- Build up the repair project to restore the M.E output.

The contract was done at Hochiminh city (Vietnam) from October 24th to December 24th, 2012 with all related data as below:

### *4.1 Degree of confliction & amount of loss of M.E output*

In fact, operating at turning speed from 470 to 472 rpm, M.E of M/T Glory Star has to be operated under the overload of output ranging from 12% to 15%, include:

- Degree of confliction M.E - Propeller - Hull in range from 7 - 9%
- Amount of loss of M.E output in range from 6 - 7%

### *4.2 The Propeller of G.S ship*

The Propeller of M/T Glory Star (figure 7) is made by the drawing P-1030-G22 with specifications below:

- Diameter: 4,382 mm;
- Pitch ratio: 0.691;
- Number of blade: 5;
- Material: BRONZE GRASS 4;
- Total weight: 7,327 kg;
- Average pitch: 3,026 mm;

However, after inspecting actual specification of Propeller of M/T Glory Star at SG S.M factory on October 27th, 2012, some differences were found as below:

- The actual weight is more than 8,000 kg if compared to design 7,327 kg
- The actual average pitch blade measured is 3,080 compared to design 3,026

*4.3 Modification on propeller*

All blades of propeller described in figure 6, with the data relating to the degree of modification defined as follows (see figure 6):

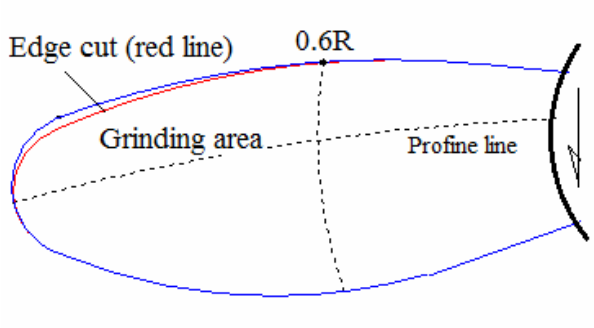



Figure 6 Deploy cutting the edge of propeller's blades

*4.3.1 Cutting edge of blade:*

- Blade is cut at the area of escape edge (red line), start from 0.6R;
- The cut area got the maximum depth from 47 to 55 mm;

*4.3.2 Grinding the blade:*

- The area grinded defines at face side, limited by the profile line and cutting edge;
- Deploy grinding from deepest toward cut edge to line profile;

*4.4 Running test*

After complete repairing, ship G.S was running test in ballast condition from Sai Gon to Dung Quat and in status of 13.000T from Dung Quat to Sai Gon. Measuring to define all parameters, the below results were found:

- The fuel rack index of H.P Pump reduced 4 - 5 (before: 37 - 39; after : 33 - 34);
- Fuel consumption per day reduced 2.0 - 2.5 MT (before: 17.09 - 17.69 MT; after: 14.37 - 15.16 MT);
- Speed of the ship changed slightly; other features of this ship are normal.

## 5. CONCLUSIONS

MRI was on its first steps to complete as below:

- Built up the method to calculate the amount of edge cut (cutting, grinding) of propeller's blades depending on the degree of confliction M.E - Propeller - Hull.
- The results of qualitative (before) and quantitative (present) is quite suitable with the experiment.
- Modification of propeller's blades for old ships could improve the operating mode of M.E; reduce the fuel consumption but not decrease or slightly decrease the speed of ships.

## 6. REFERENCES

[1] *Bibliography (final adjustment)*, Honda Shipbuilding Co.ltd, Japan, 13/5/1997, (M2 content 1-2-2: shafting and propeller).
[2] *"Japan diesel engine testing data"*, IHI, TUMM, MITSUI.
[3] VAN TUAN, N., *Marine Diesel engine operation in Vietnam*, Vietnam Maritime University, 2006.
[4] JAPAN MARINE RESEARCH ORGANIZATION, *General report of seagoing vessel research in Japan*, (1997 - 1998), Tokyo, Japan, 1998, http://nippon zaidan.info/seikabutsu/1998/00307/contents/... (006.trm; mokuji.htm).
[5] *"Japan marine journals"*, Kawasaki Heavy Industries, Kobelco Marine Eng., Kamome propeller Co., Ltd. Yokohama.


Figure 7 M/T Glory Star 16,800 T (K. Marine)

# SIMULATIONS PERFORMED TO REFLOAT A GROUNDED SHIP

VARSAMI ANASTASIA ELENA

*Constanta Maritime University, Romania*

**ABSTRACT**

Over the years, there has been an increased concern in the shipping industry about general risk issues. The consequence of this trend is that whenever a catastrophic accident occurs amongst the ships belonging to the worldwide fleet - and receives media coverage - there is an immediate political and public demand for actions to prevent the same type of catastrophe in the future. Many of the past improvements in safety of marine structure have been triggered by disasters but there is a change in this trend. In line of these aspects, it is clear that rational procedures for evaluating the consequences of accidental loads are highly desirable, not to say necessary.

In this paper I am researching the conditions to refloat a grounded ship by using only the means available onboard.

**Keywords:** *shipping industry, ship, simulation, grounded, refloat.*

## 1. INTRODUCTION

During maritime transport it happens many times for ships to go aground. There are various causes for this, combining usually human error with unfavourable meteorological conditions. In most cases, crews try and usually succeed to refloat the ship by her own means. The procedure is a relatively simple one consisting of moving weights from bow to stern if possible and putting the main engine astern in different rudder angles.

Our research emphasizes the fact that the operations for refloating a grounded ship are time-critical and environmental conditions may improve or worsen with time, but the condition of a grounded ship steadily deteriorates. The first manoeuvre taken into consideration by our research to be applied is represented by the attempt of refloating the ship by using the means present onboard (ship's own means of propulsions and different angles of the rudder).

These are the fastest manoeuvres available onboard and in the same time, they are the cheapest ones. The longer the ship remains in a grounded position, the higher are the possibilities for the ship to suffer severe damages and a pollution event to occur. In this paper, I am trying to analyse the possibility of refloating a ship by using her own means of propulsion, namely her main engine, in combination with rudder's different angles. For this purpose, I have performed several simulations using TransasNavi Trainer 5000 Simulator and CAE ANSYS12.1.

The simulation performed on TransasNavi Trainer 5000 Simulator presents a combination of refloating methods: using the main engine in different levels and directions of speed with rudder's different angles in order to reduce the bow draft and thus the pressure exerted by the ship on the sea bottom.

The simulation performed on CAE ANSYS12.1 presents the study of the effect that manoeuvres have when refloating a ship by her own means on the ship's structure, specifically in order to emphasise the limit functioning regimes which may be approached by the ship's crew without endangering the ship's structural integrity.

## 2. SIMULATIONS ON TRANSAS NAVI TRAINER 5000

During the simulation session, using Transas Navi Trainer 5000 simulator, we've tried to analyse the possibility of refloating a ship by using her own means of propulsion, namely her main engine.

The ship, with her main characteristics and dimensions, is presented below, a LNG (Liquefied Natural Gas), Figure 1, fully loaded and she runs aground on an argillaceous bottom, where the water depth is decreasing significantly.

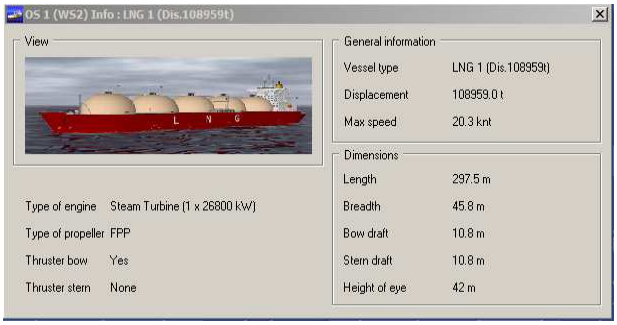



Figure 1 Main characteristics and dimensions of the ship used for simulations

The detailed actions taken to refloat the grounded ship only by using her main engine are presented in the paragraphs below.

During the simulations, I have selected a series of pre-set parameters, like:

- bow/stern drafts
- transversal/longitudinal speeds
- vertical and longitudinal forces
- rolling moment, pitching moment, lateral moment

Their variation for different situations of refloating attempts was followed as in figure 2.

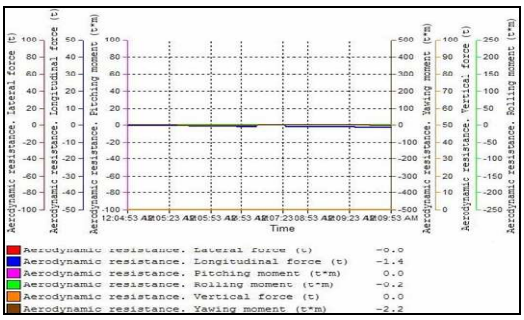



Figure 2 Values of parameters selected for the analysis

During the simulation, it is presented the ship's movement towards the area where the grounding event is going to take place. The water depth decreases gradually, and initially, in deep water, the ship maintains its course but suddenly, due to a decreasing depth and shallow water influence, the ship's course has a deflection towards one of the boards, in this case towards portside.

The bottom of the sea chosen for the grounding event is an argillaceous one and it implicates one of the worst situations for a ship to ground on, because it is very hard for the ship to recover its floatability and to reinstate its floating status due to argil's density and the fact that it is very adherent. During the simulation sessions it will be noticed that, in spite of all efforts, the ship does not manage to refloat itself by using her own means of propulsion and manoeuvring. During the simulation sessions the engine was used up to 'full ahead' and 'full astern' and the rudder was sequentially used from 'hard to port' to 'hard to starboard'.

A series of parameters regarding elements of aerodynamic resistance have been selected. Initially, the influence of surface wind was not taken into consideration and so, the values of the parameters seem to be influenced only by the lateral force and longitudinal forces created due to the existence of shallow waters that push the ship away from its course.

Taking into consideration modification of wind force value, for the beginning Beaufort force 4 – 5 and then Beaufort force 6 (Fig. 3), it can be noticed a significant modification of parameters' values chosen for the study inside this simulation. It can be noticed a significant growth of lateral force moment and rolling moment, values that have a certain influence over ship's grounding; besides grounding speed, lateral pushing force (on the horizontal) and rolling pushing force (on the vertical) are also applied.

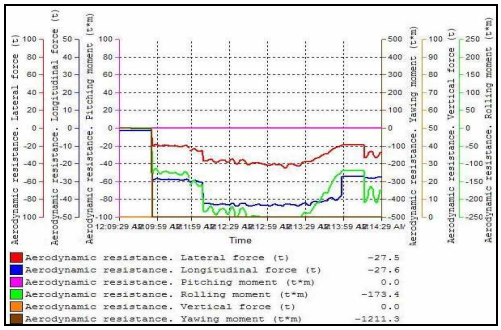



Figure 3 Modification of parameters' values selected depending on wind force (6 Beaufort)

During the simulation, it can be noticed that the parameters' values reach the value of almost zero, and the only one that still affects the ship is the lateral force moment, all the other parameters have small values in comparison with the maximum negative and positive values they can reach.

Further on, it can be observed the variation of lateral force moment for the grounded ship from minus to plus, practically the ship rotates around a gyration point (we will be able to notice this in the second and third simulation).

During the simulation there is an attempt to refloat the ship by using the main engine on 'full astern' (figure 4).

It can be noticed the vector of the ship's direction oriented backwards and the estimation of future positions of the ship, meaning ship's orientation.

Also, it can be noticed the ship's intention to move to portside, practically speaking there is a lateral deflection of the stern but the bow maintains itself approximately on the same direction, and this indicates that the ship yaws, pivots around a point situated from the centre of the ship to the bow. It is a classic situation when the ship grounds with the bow, with more than half of its total length, and the stern remains in water deep enough so that the ship can use its engine and rudder in order to refloat herself.

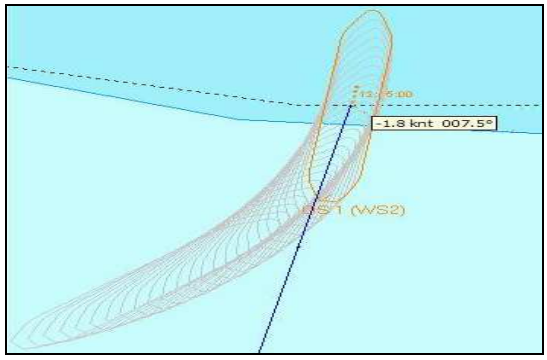



Figure 4 The attempt to refloat the ship with the engine on 'full astern'

During the attempt of refloating the ship, it can be observed a rather small variation of values of lateral force moment, from negative to positive values, which indicates modification of ship's bow orientation (horizontal movements portside-starboard side) and modification of values of pitching moment from -40 to zero (vertical movement on longitudinal axis) which indicates bow's and stern's movement up and down around an axis situated in the new ship's centre of gravity, a centre that appeared as a consequence of grounding.

Further on, the simulation presents the attempts to refloat the ship in that particular case when environment's external conditions (wind, wave and current) do not influence the grounded ship.

The ship is grounded approximately 50-55% towards the bow area, and the stern remains in water deep enough so that the ship can use the main engine, the rudder and the propeller.

In figure 5 it can be observed the speed's vector oriented backwards. The engine is 'astern' and the rudder is amidships. The ship has a rotation movement around the gyration point and also it can be noticed that the stern tends to move backwards and to portside.

When inversing the sail on opposite tack, from 'full astern' to 'full ahead', it can be noticed a rather small movement of forwarding, ahead and astern without managing to shove off from the argillaceous soil.

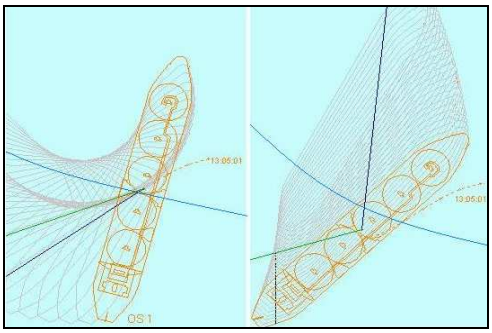


Figure 5 The attempt to refloat the ship with engine ahead – astern

Values of selected parameters remain at a minimum value, the only value that has significant variations is the vertical force of hydrodynamic resistance, a force that reaches the maximum value for a period of time and then decreases, afterwards increasing again, maintaining its' high value.

There is a ship's intention to move towards portside, on its' total length and afterwards it can be noticed that the ship's bow has the tendency to move towards portside, which means that the stern moves towards starboard side.

Taking into consideration the two combined movements of the ship in which the ship's stern moves to portside and the one in which the ship's stern tends to move to starboard side, it can be concluded that the ship gyrates, moves on a circular arc around the pivot point.

The attempts to refloat the ship by using the engine ahead-astern were not successful, although the ship's rotation movement (on the circular arc with a radius starting from the pivot point) creates a freeing area in the argillaceous soil and thus the ship should get out from the grounding zone when the engine is being used 'astern'.

Further on, there is an attempt to shove off the ship by increasing the main engine's maximum revolutions when using it 'astern' to values higher than the maximum permissible ones but the ship continues its gyration movement to starboard side (the bow) and portside (the stern), Figure 6. In the figure it can be observed the movement vector oriented backwards.

When using the engine 'ahead', the main engine cannot be used with maximum revolutions because there is a high risk for the ship to enter even deeper in the argillaceous soil. We can observe the ship's intentions to align almost parallel with the fathom line that indicates the area's minimum depth and the effect caused by the rudder's position (to portside and to starboard side) is not a positive effect.

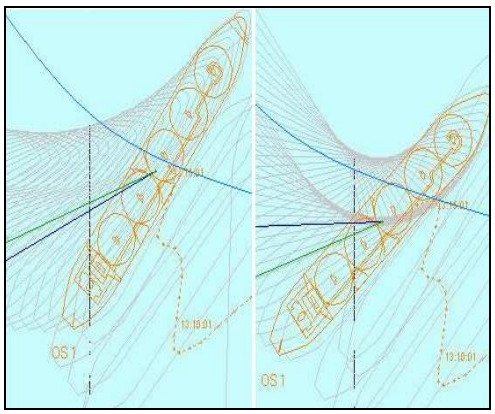


Figure 6 Increasing the main engine's revolutions in the attempt to shove off the ship

The new parameters chosen for the study have very high variations of their values (figure 7), especially the parameters chosen for hydrodynamic resistance, rolling moment (marked with a green line) and lateral force moment (marked with a blue line), reaching extreme values, from negative to positive.

It must be mentioned that in real cases, when the ship is grounded with part of the bow on the bottom and the stern is free to move and thus floating and the propeller is totally submerged (in our case the bow is grounded for about 90 – 100 metres of the ship's total length), when the main engine is used 'astern' at a high level of revolutions per minute, the stern rises and this makes the bow 'go deeper' into argillaceous soil, and this does not help in any way in our particular case.

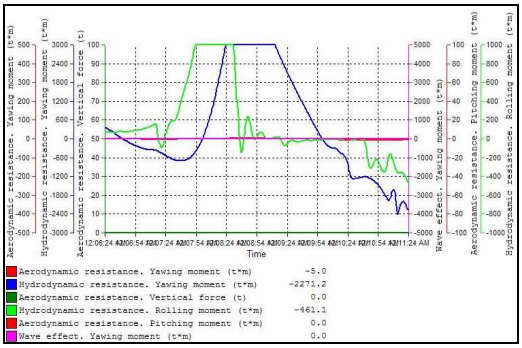



Figure 7 Variation of the new chosen parameters

The method used to refloat the ship, namely using her own means of propulsion and rudder's angles did not manage to free the ship.

## 3. SIMULATIONS ON CAE ANSYS12.1

In order to determine the structural response of the hull's construction elements, first a study may be developed in order to create the refloating process conditions, using the hull's model on which pressures and structural loads generated by the respective situation are applied.

The model adopted for performing this study is that of an oil tanker with the following characteristics:

- Maximum length 333 m
- Length between perpendiculars 320 m
- Maximum width 60 m
- Displacement 364018.9 metric tons
- Draught when fully loaded 22,522 m
- Height of the free board when fully loaded 4,65 m

Figure 8 VLCC Ship, chosen for developing the geometrical model (www.aukevisser.nl)

The execution of the hull had as a basis the ship's body plan (www.simman2008.dk), modelling first the plating and bridge parts after which a rigidity element were added.

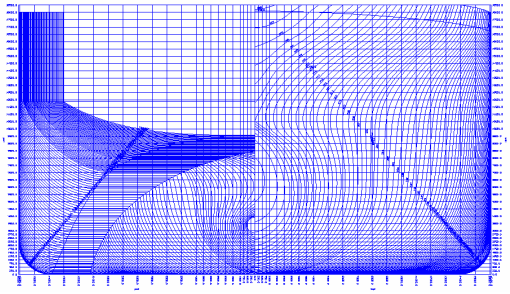


Figure 9 The basic body plan for the mathematical model

In order to simplify the modelling process, limited first of all by the available calculus power, from the 231 couplers, 40 theoretical couplers were used, and rigidity elements of the structure were also simplified. The model was executed with the CAD SolidWorks 2010 software.

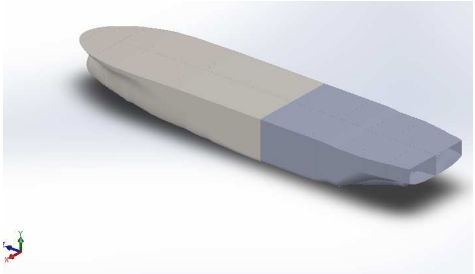


Figure 10 The three dimensional model

It was considered that the plating parts have a width between 10 and 13 mm, made of steel type AISI 1080, normalized at 900°C, and cooled under air.

In order to establish the loads to be applied on the model, this is subjected first to a study CFD performed through CAD / CAE Ansys 12.1 – CFX.

In order to get as high an accuracy as possible, the model on a 1:1 scale was used, applying a refinement of the digitized structure from the limit layer area (Van 1998). The model used for this study is the one developed for the structural analysis.

The simulation parameters were established, considering that during the refloating procedures the ship has not the maximum draught, setting therefore a 7 m draught both at the bow and stern. Also, for the functioning conditions of the propelling installation when going astern, a maximum speed of 5 knots was considered, corresponding to the speed of 2.6 m/s.

The calculus field is limited to 50 m from the stern area and four times the maximum length, on the Oz axis, respectively four times the maximum width and height of the model on Ox and Oy axes.

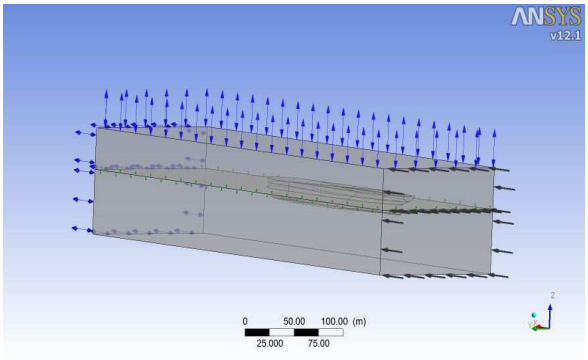



Figure 11 Determination of the calculus domain

Following the digitization process, 393208 knots and 1478147 elements resulted for the whole digitization structure. Further on I have analysed variations of the values of forces as well as pressures and speed at the flow around the immerse hull.

Following the study of the results, the conclusion is that in order to analyse the structure it should be kept in view a towing force of 219.86 kN, corresponding to an approximate load of 12% of the nominal power of the main engine when making headway. This resultant force when going astern in the case of the free body ship, calm water case, is the force which needs to be added to the friction force resulted from the contact between the bottom bow – ground (light grounding), in order to determine the total towing force at the maximum speed of 5 knots, corresponding to an intermediary transitory stage of the displacement operations when refloating the ship (in the initial phase t=0 of the refloating operations the ship's speed is zero).

It is well known the fact that in order to re-establish the manoeuvring capacity of the ship if she goes aground, there are two possible alternatives:

1. Refloating the ship by using the propulsion system onboard;
2. Refloating the ship by using tug boats – push boats.

In the first situation, when trying to refloat the ship by her own means, the purpose of such a structural analysis is to determine the ship's hull response to arising pressures and to establish the convenient

maximum regarding the hull's pressures and the pushing/towing force of the main engine. The purpose is for this determination to be expressed also as a percentage of the available power of the main engine.

In order to reach such a goal, a structural static analysis is considered to be appropriate, considering the fact that registered peaks do not vary according to the simulation time. 3D-FEM (Ansys) model is developed for the supplementary pressures' analysis in the VLCC tanker's structure, in the initial grounding phase (displacement from the grounding location, zero speed of the ship) with the ship's own propulsion, in the case without water hole (light grounding), for the case of loading when damaged (7 m draught).

Due to structural complexity and the available calculus power, the model presented in figure 13 was simplified, on one hand establishing a symmetry plan, defined by the ship's longitudinal plan, and on the other hand, the model includes the main platting for the ship's hull, with a very simplified idealization of the frame elements, without pressures from her own weight and hydrostatic push, considering as a reference the case of equilibrium ship – fluid – ground in the light grounding stage. Practically the extreme case is considered when in the initial phase of displacement, the friction force is very high (modelled through constraint), including 7 values in the study for the longitudinal towing force (generated by the ship's own propulsion system) starting with 100% of the pushing force and continuing with 95%, 90%, 85%, 80%, 60% and 40% of the pushing force.

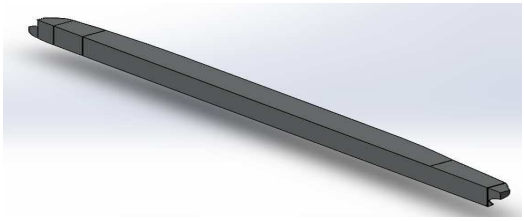


Figure 12 The geometrical model after applying the symmetry plan

The geometrical model was introduced in the sequence software CAD / CAE Ansys Workbench 12.1, resulting in a digitized structure with a maximum length of the element of 0.7 m, minimum length of $1.0002 \times 10^{-5}$ m, successive elements' size having a transition rate of 0.272. The number of knots of the digitized structure is 228328, and the number of elements is 678594.

In the next stage, the defining manner of constraints and loading models was established. In figure 13 their definition manner is presented.

As previously mentioned, the model will be considered as constrained in the contact area with the ground, on the surface of 32 $m^2$ (figure 13), and afterwards it will be applied at the pushing bearing level with a force uniformly distributed on its surface on Oz direction.

For all considered situations, the maximum values for the Equivalent Tensions Von Misses are established in the limited interval by the couplers 4-5.

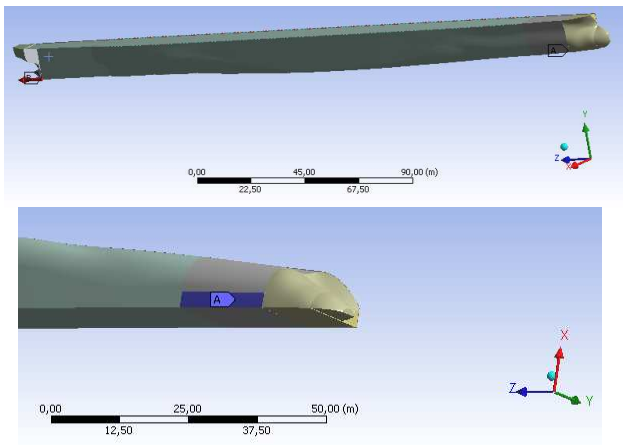
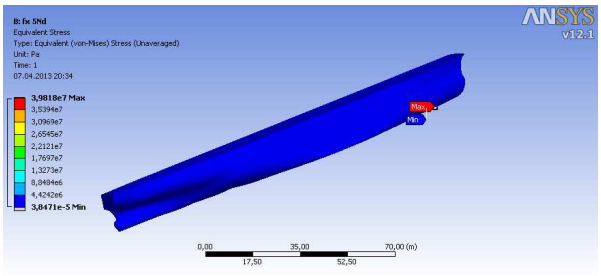
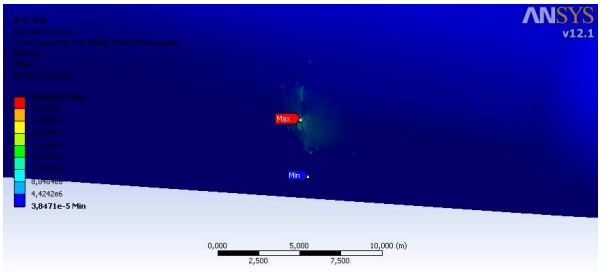



Figure 13 Edge conditions and FEM structural model loadings
A – constraint in the contact area with the bottom
B – towing force

In figure 14, local variations of the Von Misses tensions are presented for the analyzed model.




a) von Misses tensions for the maximum loading case



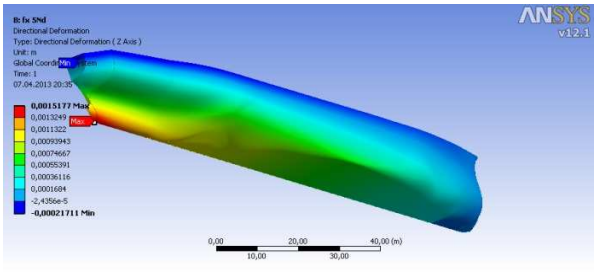

b) detail of the maximum and minimum values for Von Misses tensions in the joining area of the platting for the maximum loading case

Figure 14 Variation of equivalent tensions von Misses for the seven loading cases

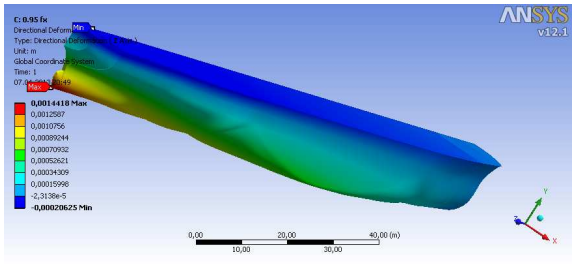
It is noticed the fact that in the joining area of plates right near the constraint area, tension enhancers are registered generating peaks of the determined values.

Analyzing the maximum values of tensions equivalent and comparing them with the established value for the limit flow of the material used ($55 \times 10^7$ $N/m^2$), it is noticed the fact that for neither of the analyzed cases does it exist the danger of reaching some characteristic values for the plastic deformation field.

Further on, the study of specific deformations proceeds on the development direction of the towing force in order to determine the areas in which they reach maximum values.




a) movement on Oz axis for maximum towing force




b) movement on Oz axis for 95% of the maximum towing force

Figure 15 Movements on Oz axis for the seven simulated situations

As expected, the maximum deformation area along the Oz axis is the joining area between rigidity elements at the stern and the pushing bearing. This leads to an interest for facts related to elastic deformations developed on the pushing bearing level.

Considering the registered values for the observed dimensions, it can be noticed that the structure's answer during a possible refloating manoeuvre is favourable, without the existence in normal conditions of the suspicion of touching the rupture limits for the plates' material and rigidity elements.

At the same level, relatively high values of movements being observed, which in the maximum towing forces area reach peaks of over 10 mm, in order to overcharge the joints of the structural elements, the avoidance of applying forces with amplitudes higher than 175.88 kN may be considered.

For this value of the towing force, considering the existent main engine onboard the ship taken as a model (MAN B&W 7S80ME-C) and considering the next estimated values of capacity of the component elements of the propulsion system: propulsion capacity: 50%; axes line capacity: 98%; mechanic capacity of the main engine: 80%, it results in the next values for established powers on the level of every element in the propulsion system:

- towing power: 1356.03 kW;
- propeller power: 2643.34 kW;
- indicated power of the main engine: 2996.68 kW.

Knowing the effective power of the main engine, 31570 kW [www.man.com] respectively, and reporting to the determined power for the studied situation, it results in a charging of the main engine of 9.5% of its nominal power.

## 4. CONCLUSIONS

My research emphasizes the fact that the actions taken for refloating a grounded ship are time-critical and environmental conditions may improve or worsen with time, but the condition of a grounded ship steadily deteriorates. The manoeuvre presented by our research is represented by the attempt of refloating the ship by using the means present onboard (ship's own means of propulsions and rudder's angles). The longer the ship remains in a grounded position, the higher are the possibilities for a ship to suffer severe damages and a pollution event to occur.

The method used to refloat the ship, namely using her own means of propulsion and rudder's angles did not manage to free the ship. Future research will take into consideration to perform ballast/de-ballast operations, move the cargo from the forward tanks to another ship and eventually to ask for external help. All these further actions imply extra costs that must be supported by the owner and they are almost every time the last options taken into consideration.

Another interesting conclusion is that in the case of pressures higher than 80% of the maximum determined force for going astern, pressures on the structural elements' joints are high enough to necessitate further consideration from masters. It is clear that there are situations in which masters have to use the maximum capacity of the propulsion system in order to refloat the ship, but it is recommended in such situations to thoroughly inspect the structural elements' joints situated in the pushing bearing area afterwards, which is actually the most elicited area.

## 5. REFERENCES

[1] BARSAN, E., MUNTEAN, C., *Combined Complex Maritime Simulation Scenarios for Reducing Maritime Accidents Caused by Human Error*, Proceedings of the WSEAS 3rd International Conference on Maritime and Naval Science and Engineering, Constanta, Romania, 2010.

[2] BARSAN, E., HANZU, R., IORDANOAIA, F., BATRINCA, G., ARSENIE, P., *Utilizarea simulatoarelor navale în procesul de instruire*, Nautica Publishing House, Constanta, 2010.

[3] NOVAC, I., CHIOTOROIU, L., *Teoria navei. Rezistenta la înaintare a navelor*, Ex Ponto Publishing House, ISBN 973-644-7, Constanta, 2004.

[4] VARSAMI, A., POPESCU, C., DUMITRACHE, C., HANZU, R., CHIRCOR, M., ACOMI, N., *The Influence of Grounding Events on Maritime Industry*, Annals of DAAAM for 2011 and Proceedings of the 22nd International DAAAM Symposium, volume 22, no. 1, Viena, Austria, 2011.

[5] VARSAMI, A., CHIRCOR, M., *Stranded Ships and their salvage*, Constanta Maritime University Annals, year XII, vol. 15, Constanta, 2011.

[6] www.aukevisser.nl

# THE CONCEPT AND CALCULUS OF 'REFLOATING A SHIP' APPLIED TO GROUNDED SHIPS

[1]VARSAMI ANASTASIA, [2]BELEV BLAGOVEST, [3]HANZU-PAZARA RADU

*[1,3] Constanta Maritime University, Romania, [2]N.Y. Vaptsarov Naval Academy, Bulgaria*

**ABSTRACT**

Grounding has been representing an important topic in the maritime industry because it is almost always connected to a catastrophic pollution of the marine environment. It is really important for the shipping industry to manage to obtain such a ship's construction with respect to the grounding events but this problem has been only partially solved. Another important matter is represented by the refloating methods that should be applied on these ships that are grounded in order to minimize the effects of the pollution that could arise from this operation. There is a need for a basic understanding of the geometry, stability and strength of intact ships before trying to refloat a damaged, grounded or sunken ship. Understanding these, the refloating operation can be evaluated in accordance with the ship's properties that vary during the grounding event.

**Keywords:** *ship, grounding, refloat, pollution, marine.*

## 1. INTRODUCTION

It is really vital to have a well thought-out and organized refloating plan in order to apply a certain refloating operation.

In order to have such a refloating plan it is necessary to investigate properly the ship's site and gather the appropriate information.

To develop a workable refloating plan, the position and condition of the ship must be evaluated, understand the complexities of the given situation and conceptualize the work and methods necessary to accomplish the aims of the operation.

Planning must proceed from broadly based tactics covering entire operations to detailed plans for specific ships or other portions of an operation.

In all cases, the plan must serve the purpose of the operation; then balance the work to be done with the resources available and the schedule required.

Ships' groundings can have devastating effects on the marine environment.

Cleaning up after a major grounding event could lead to enormous amounts of money and even then there is no certainty that the cleaning process has the best results or even the wanted results.

The society needed such events to truly admit that there is an increased need for safer ships and also for new requirements in ships' construction so that this kind of unfortunate events would not be met again in the future in the maritime business.

It is not a good thing that these requirements are triggered only when there is an appropriate media attention given to these events.

This kind of requirements should first of all come from the shipbuilders and afterwards from the ship-owners but due to the high costs involved that arise from these safety measurements it can be easily understood that it is not in their interest to raise the expenses in the process of building a ship.

Also, when talking about refloating a grounded ship, it is first of all necessary to fully understand the event that lead the ship into that position so that the best method for refloating is applied. It is an important demand to establish the appropriate method of refloating so that the risk of pollution is reduced to minimum.

## 2. GROUNDING ISSUES

A grounded ship is subject to very different forces and conditions than when in normal service. Part of a grounded ship's weight is supported by the surrounding water, part by the ground.

The portion of the ship's weight supported by the ground is *ground reaction* (*Φ*), or *tons aground*; it is equal to the lost buoyancy. The ground reaction distribution is uneven and unpredictable. There are four major effects of ground reaction:

- The loss of buoyancy alters hydrostatic characteristics and hull girder loading.
- The upward force of ground reaction at the keel causes a virtual rise in the centre of gravity.
- Extremely high local loading with damage or penetration of the hull can occur, particularly on rocky bottoms.
- Ground reaction holds the ship stationary; she cannot respond to or fall away from disturbing forces, such as waves, as she does when afloat.

The conditions of a grounding event are seldom fully defined in the beginning and often are not completely defined during the refloating operation.

The grounding condition and the environment are the principal sources of forces on a grounded ship.

Ship's refloating is time-critical because environmental conditions may improve or worsen with time, but the condition of a grounded ship steadily deteriorates.

The way the ship lies on the ground and her position relative to the seafloor and coastline influence the casualty in two ways:

- The way the ship lies on, and is supported by, the ground is a principal indicator of the effort required to free her.

- Distribution of the ship's weight between residual buoyancy and ground reaction affects stability and strength.

The ship's position relative to the shore and underwater features can either intensify or mitigate environmental effects. Specific considerations are:

- Magnitude and distribution of ground reaction.
- Changes in list and trim caused by the stranding.
- The area of the ship in contact with the bottom.
- Depth of water under and around the ship.

An overall view on groundings categorizes the accidents in two major groups:

- Grounding on soft sea beds, so-called Light Groundings. The damage to the hull in terms of crushing at the point of ground contact is limited but the hull girder may fail in a global mode due to shear force and bending moment exceeding the hull girder capacity.
- Grounding on hard bottoms, so-called Hard Groundings. The primary concern here is the local crushing and tearing of the ship bottom due to a cutting rock.

The force required to move a casualty over its strand is the sum of the forces required to:

- Overcome friction between the ship and seafloor.
- Move loose seafloor material that may be pushed ahead of the ship.
- Break or crush obstructions or impalements, such as rock outcroppings, coral heads, etc.
- Overcome suction on soft bottoms.
- Friction is a function of ground reaction as modified by other factors, such as the coefficient of friction of the bottom, the area of the hull in contact with the bottom, and the casualty's list and trim. Freeing force is reduced by decreasing the effects of these factors, as well as by decreasing ground reaction.

## 3. CALCULUS FOR A GROUNDED SHIP

A ship is considered to be grounded if there is contact between the keel and the bottom of the sea.

Grounding affects the initial equilibrium adding to the weight and pressure a third force, $\Phi$, called grounding reaction, as a result of elementary reactions in contact points.

We have $P_0$ and $\eta_0$ the weight and pressure before grounding. After grounding, the ship is subjected in her new position of equilibrium to forces $P=P_0$ (unchanged weight), $\eta$ (new pressure) and $\Phi$ grounding reaction. Reaction $\Phi$ is therefore necessarily vertical having a value:

$$\Phi = P - \varpi W \qquad (1)$$

Reading the draught of the grounded ship defines the keel, resulting W and $\Phi$, P so that the position of **G** is calculated starting from a standard situation considering the real situation of the cargo and perishable cargoes at grounding. The vertical of $\Phi$ is established through the annulment condition of the resulting moment. The application point E on this vertical is usually deducted with an excellent approximation of the position of the contact area.

We can compare grounding with removing a weight $\Phi$ in E. E having a very low position and $\Phi$ being relatively high, it results in an important reduction of the stability which we can appreciate by diminishing the module P (r – a) which becomes $P\left(r-a\right)-\Phi e$, where $e$ is the vertical distance separating E from the differential meta-centre reported at transversal canting, or easier at floatability.

A grounded ship is seldom in danger of listing, given that groundings frequently cause ruptures on the ship's hull and invasions leading to water holes which negatively influence stability. Meanwhile the contact area resulted could be sandy blocking the ship's hull and preventing the ship from listing.

If several particular classical situations are accepted (grounding in the centre of sternpost) the issue arising when the ship is grounded is obviously that of refloating the ship.

If grounding is an easy one, meaning that the grounding reaction is weak, the ship may be refloated by her own means, putting the engine full astern for example, or by using tugs.

In some cases, the tides' help could be waited for and then refloating comes naturally: if grounded in shallow waters, the ship could refloat at high tide.

On the contrary, groundings at high tide are more dangerous as the grounding reaction increases once the sea level decreases leading to a higher risk of listing.

In serious situations, efforts should be made for vertical refloating which could be done in different ways: relieving weight by unloading weights (the simplest method), auxiliary floatation means, lifting machineries (lifting craft, crane), etc.

The method for calculating these efforts (values and target points) depends on the nature of grounding.

We shall limit our exemplification to the case of the ship grounded in point E of the keel (figure 1) considering the adding or elimination of some weights. Using some simplified results, we shall only get an approximation, but this would be usually enough for defining a way of action even if the weights loaded and unloaded from the ship are really small when compared to P.

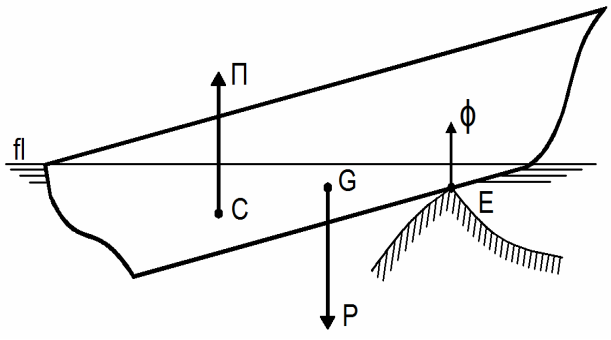



Figure 1 A ship grounded in point E

*3.1 Example of a calculus of refloating efforts*

Let it be $t_E$ the draught of the grounded ship in section E; $t_E$ is a datum of the problem representing the riprap or rock filling immersion at contact. If the free ship had in this section an inferior draught compared to $t_E$, grounding in E wouldn't have happened. We should consider the efforts which, applied on the ship before grounding, would have led to a draught equal to $t_E$ (limit condition). Applying these efforts on the grounded ship should refloat point E, and consequently liberate the ship astern if trimming is positive and headways if it's negative.

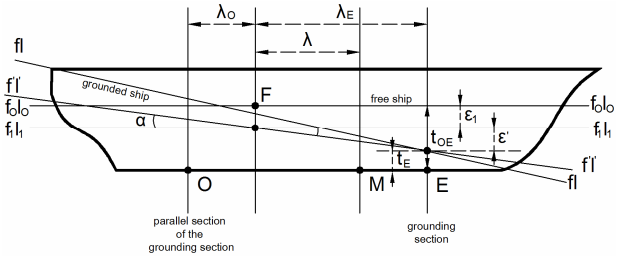



Figure 2 Forces acting on a grounded ship

The vertical of M is applied on the free ship before grounding (floatation $f_0l_0$) an effort $\Phi$ directed upwards and the value of $\Phi$ is determined in such way that the variation of the section's draught E should be: $\Delta t=t_{OE}-t_E$. We can write $\Phi$' being considered to be positive upwards and $\lambda$ positive in front of F:

- applying $\Phi$' in section F:

$$f_0l_0 \rightarrow f_1l_1, \quad with \quad \varepsilon_1 = \frac{\Phi'}{\varpi\Sigma} \tag{2}$$

- transfer of $\Phi$' from section F in section M:

$$f_1l_1 \rightarrow f'l' \quad , cu \ \ tg\alpha = \frac{\Phi'\lambda}{P(R-a)} = \frac{\varepsilon'}{\lambda_E}$$

$$resulting \quad \Delta t = \varepsilon_1 + \varepsilon' = \frac{\Phi'}{\varpi\Sigma} + \frac{\Phi'\lambda\lambda_E}{P(R-a)} \tag{3}$$

$$and \qquad \Delta t = \frac{\Phi'}{\varpi\Sigma}\left[1 + \frac{\varpi\Sigma}{P(R-a)}\lambda\lambda_E\right] = \frac{\Phi'}{\varpi\Sigma}(1-\frac{\lambda}{\lambda_0})$$

O being the conjugated point of E in the equilibrium position $f_0l_0$.

The refloating effort on the vertical of point E ($\lambda = \lambda_E$) is of course equal to the grounding reaction, $\Phi$:

$$\Phi = \varpi S\Delta t \frac{\lambda_0}{\lambda_0 - \lambda_E} = P - \varpi W \tag{4}$$

Resulting in the expression of $\Phi$':

$$\Phi' = \Phi \frac{\lambda_0 - \lambda_E}{\lambda_0 - \lambda} \tag{5}$$

The refloating effort on the vertical of the floatation centre is:

$$\Phi'_F = \varpi S\Delta t \tag{6}$$

And we can also write:

$$\Phi' = \Phi'_F \frac{\lambda_0}{\lambda_0 - \lambda} \tag{7}$$

$\Phi$' is infinite for $\lambda = \lambda_0$. Any effort applied on the vertical of **O** cannot lead to a variation of the draught in E (definition of the conjugated points).

The curve $\Phi'(\lambda)$ is in the shape represented by figure 3.

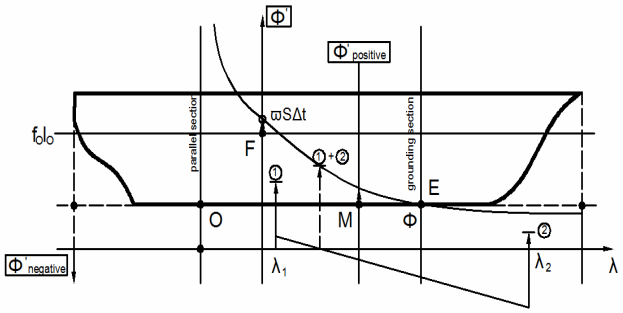



Figure 3 The curve $\Phi'(\lambda)$

It represents particularly the value of the refloating effort which must be applied right forward (minimum effort).

It also allows the definition of efforts' combinations, such as:

( effort 1 in $\lambda_1$ (floatation gears)
(
(+ effort 2 in $\lambda_2$ (lifting craft)
(
(= refloating effort 1 + 2 sufficient.

Corresponding characteristics at $f_0l_0$ are not known in advance but, as previously mentioned, they are accessible through calculus starting from well known standard situations. After grounding, the usual actions are relieving the ship by unloading all possible weights, especially in high areas (improving stability) as well as the starting situation $f_0l_0$ which is already an attenuating situation.

The action of the tide is simply introduced in the calculi above through the variation of $t_E$ meaning $\Delta t$**,** resulting in several curves $\Phi'$ (low tide, high tide, medium level sea). The refloating operation is of course performed at high tide as the efforts are minimal then.

*3.2 Stability calculi*

We shouldn't omit a close pursue of the evolution of transversal stability from the grounding moment calculating the consequences of every operation.

Considering only one module of the initial stability and the calculus approached by the initial formulas are generally not enough; therefore we shall be led towards establishing some stability diagrams complete for a certain number of intermediary situations. If there are any keels near the right ones, the calculi are simple, but it rarely happens so when it comes to grounding.

In any case, the next resultants should always be present (applicable of course to weights or important forces):

- weights on board (forces working downwards) above the floating line
- weights unloaded (forces working upwards) above the floating line
- mobile weights, especially topsides

All three of them represent danger to the grounded ship.

## 4. CONCLUSIONS

During maritime transport it happens many times for ships to run aground. There are various causes for this, combining usually human error with unfavourable meteorological conditions.

In most cases, crews try and usually succeed to refloat the ship by her own means. The procedure is a relatively simple one consisting in moving weights from bow to stern if possible and putting the main engine astern in different rudder angles, but there are several cases when the ship severely runs aground and there is an urgent need for a calculus type in order to help the crew and the rescue team establish the most efficient method for refloating.

This paper presented an alternative for this particular calculus.

The need for immediate refloating is time critical because there is always a risk for the grounding event to determine a catastrophe for the marine environment.

## 5. REFERENCES

[1] BARSAN, E., MUNTEAN, C., *Combined Complex Maritime Simulation Scenarios for Reducing Maritime Accidents Caused by Human Error*, Proceedings of the WSEAS 3rd International Conference on Maritime and Naval Science and Engineering, Constanta, Romania, 2010.

[2] BARSAN, E., HANZU, R., IORDANOAIA, F., BATRINCA, G., ARSENIE, P., *Utilizarea simulatoarelor navale în procesul de instruire*, Nautica Publishing House, Constanta, 2010.

[3] CAHILL, R.A., *Strandings and their causes*, Fairplay Publications, ISBN 0905045602, London, 1985.

[4] NOVAC, I., CHIOTOROIU, L., *Teoria navei. Rezistența la înaintare a navelor*, Ex Ponto Publishing House, ISBN 973-644-7, Constanta, 2004.

[5] PEDERSEN, P.T., *Collision and Grounding Mechanics*, pages 125-158, Danish Society of Naval Architecture, Copenhagen, May 1995.

[6] VARSAMI, A., POPESCU, C., DUMITRACHE, C., HANZU, R., CHIRCOR, M., ACOMI, N., *The Influence of Grounding Events on Maritime Industry*, Annals of DAAAM for 2011 and Proceedings of the 22nd International DAAAM Symposium, volume 22, no. 1, Vienna, Austria, 2011.

[7] VARSAMI, A., CHIRCOR, M., *Stranded Ships and their salvage*, Constanta Maritime University Annals, year XII, vol. 15, Constanta, 2011.

# ISSUES RELATED TO SAFETY ONBOARD PASSENGER SHIPS

[1]VARSAMI ANASTASIA ELENA, [2]POPESCU CORINA,
[3]HANZU-PAZARA RADU IOAN, [4]DUMITRACHE RAMONA

[1,2,3,4]*Constanta Maritime University, Romania*

**ABSTRACT**

Passenger vessels are the ones that possess the highest risk for the loss of life from all merchant ships sailing every day all over the world. Masters of large passenger vessels have a great responsibility and deserve to be provided with a ship that is 'fit for purpose', one that is able to carry passengers and crew from the point of departure to the destination safely and without damage to the marine environment, and that also includes a well-trained crew from the safety matter point of view.

In this paper, we are trying to develop the subject of crew training and to show that it has an important role in saving passengers' lives and other crew members' lives. We shall also try to draw the attention towards the fact that if something really bad happens to a passenger ship, there are going to be problems in rescuing people on board and here we refer mainly to the passengers because they are the ones completely out of loop in these cases.

**Keywords:** *passenger ship, safety, crew, training, rescue*

## 1. INTRODUCTION

The increase in size of large passenger vessels has resulted in a considerable concern being expressed with respect to their watertight integrity and fire fighting protection. In addition, concern has been expressed with respect to the adequacy of life-saving appliances, and the quality and quantity of crews and their training and experience in operating these vessels and dealing with emergency situations, including evacuation.

The structural change in the employment of crews on passenger vessels, largely from agencies, raises serious questions over the ability to fight fire and ensure an orderly evacuation of passengers. While a core crew in both deck and engine, including the officers, are trained to a high level, the bulk of the catering department receive minimalist training, which in our opinion is not enough for a proper reaction in case of an emergency on board.

## 2. SAFETY ON BOARD PASSENGER SHIPS

Recent development of passenger ships has lead to larger and larger vessels with an increasing capacity for carrying people. Modern cruise liners have the capacity of carrying several thousand people on board and even though accidents involving such large passenger ships are rare, if a serious accident should occur, its consequences could be disastrous.

The safety of large passenger ships is thus an increasingly important issue. Some previous catastrophes involving a large number of fatalities on passenger ships are the collision of the Admiral Nakhimov in 1986 (425 fatalities), the capsizing of the Herald of Free Enterprise in 1987 (193 fatalities), the collision and subsequent fire and sinking of the Dona Paz in 1987 (4386 fatalities), the fire on the Scandinavia Star in 1990 (158 fatalities), the foundering of the Estonia in 1994 (852 fatalities) and the fire and subsequent sinking of the Dashun in 1999 (282 fatalities). These are just some examples of major accidents involving passenger ships, and although all the accidents are characterized by a set of very particular circumstances that lead to the catastrophe, they serve as good examples of the grave consequences that might result from passenger ship accidents.

Safety on board passenger ships is an issue that has been discussed over and over again and it is going to be dealt with even more as these ships have a tendency of becoming larger and larger every day.

Inspections on board these particular ships focus on structural fire safety, proper functioning of all safety systems and equipment including fire fighting systems, lifesaving equipment and other safety systems such as the lifeboats, life rafts and lifejackets in addition to crew training and competence. Additionally, special attention is given to fire and abandon ship drills conducted by the ships' crew, and requires satisfactory operational tests of key equipment such as steering systems, fire pumps and bilge pumps.

All passenger ships have life boats, life rafts and life preservers for every person on board with additional capacity in accordance with international regulation. Safety of Life At Sea Convention (SOLAS) requires that lifeboats be capable of being loaded, launched and manoeuvred away from the ship within 30 minutes of the Master's signal to abandon ship.

Even if all the passengers and seafarers are evacuated from the ship and accommodated in life boats and life rafts, there is still a need to ensure that search and rescue facilities and other vessels that come to their aid are able to assist them. It is therefore suggested that there is a need to establish a maximum number of persons who can be carried on a ship at any time, including passengers and crew, and that the maximum number should depend on operational area and the available search and rescue facilities.

For some time it has been understood that life boats should not be placed more than 14 metres above the water. Most cruise ships delivered in the last few years have been designed in that way. The problems associated

with high sided vessels are well known and were graphically demonstrated during the ESTONIA disaster in 1994.

MS *Estonia* was a cruise ferry built in 1979/80 in Germany. The ship sank in 1994 in the Baltic Sea in one of the worst maritime disasters of the 20th century. It is the deadliest shipwreck disaster to have occurred in the Baltic Sea in peacetime, costing 852 lives. She was carrying 989 people: 803 passengers and 186 crew. Most of the passengers were Scandinavian, while most of the crew members were Estonian. The ship was fully loaded, and was listing slightly to port because of poor cargo distribution.

The casualties had an immense impact on the world concept of ferry safety and led to changes in safety regulations and life raft design much as the *Titanic* disaster did in 1912. However "If you are out to sea, the best lifeboat is the ship itself." New designs, the "citadel concept", once again influenced by *Estonia*, aim to ensure damaged ships have sufficient buoyancy to remain afloat though cost will determine if any are built. SOLAS 90 which came into effect in 2010 specifies existing passenger ships stability requirements and those in North West Europe must also be able to survive 50 centimetres (20 in) of water on the car deck.

Therefore, experience has cast doubt on the adequacy of existing life saving appliances. The current equipment, especially life boats and life rafts, has proved to be inadequate when confronted with high sea states and attention should be given to investigating how modern technology and new designs could improve the survivability of those forced to abandon ship in all sea states.

## 3. PREVENTING DISASTERS

The key issues associated with large passenger vessels are: collisions and grounding; fire protection; stability and watertight integrity; life-saving appliances, including abandonment and crew training.

In order to analyse the possibility to prevent any collision or grounding situation that may occur we should first admit that in spite of being a significant hazard, construction of these vessels affords better protection than most other ship types. However, this raises significant issues concerning the quality and training and the adequacy of manning, both on the bridge and in the engine room. One solution in this case would be a campaign for adequate manning of bridge and engine room, including at least two officers on duty both on the bridge and in the engine room at all times while the vessel is at sea. And the key aspect here is “at least”.

Such vessels are in essence small towns and as such need sufficient operational crew not only to meet routine operational requirements, but also to be able to meet the demands associated with intensive operations. This requires adequate manning levels, not only to prevent fatigue, but also to deal with routine and non-routine operation of the vessel, by responding to emergency situations.

When it comes to stability and watertight integrity, the extrapolation of the rules of construction with respect to large passenger vessels has raised significant questions over their safety. In particular, on vessels which have been constructed with a shallow draft in order to improve port access and increased number of decks to provide leisure facilities including swimming pools, so reducing the GM. The effects need to be addressed, particularly in adverse weather conditions and when a vessel is turning. The existing standards of the stability and watertight integrity should be maintained and where necessary increased.

In order to provide a proper fire protection the parties involved should take into account the fact that the increased size of compartments, including shopping malls and atriums, increases the potential for the spread of fire. While effective automated systems may reduce the risk of spreading the fire, there is a need for consideration of compartmental size and the adequacy of current fire-fighting arrangements. Research into existing fire protection systems and adequacy of current protection measures should also be encouraged.

Further on, Life-Saving Appliances and Abandonment should be taken into consideration. Lifeboats have increased in size and mass evacuation systems have been developed to meet the increasing number of passengers carried. While regulatory requirements have been met, the adequacy of such systems has increasingly been questioned.

While occasional reference has been made to innovative systems, i.e. escape modules, the lifeboat and life raft have remained unchanged as the main means of evacuation and survival. In this case, research into innovative systems for abandonment adequacy of existing evacuation systems and the compatibility of life-saving appliances and equipment is important as well.

Last but not least, crew training (the human element) plays a very important part from our point of view if not the most important for providing safety onboard passenger ships. And the best solution in this cases it to seek additional training requirement for all personnel on large passenger vessels.

In order to exemplify such preventing measures we should take a look into the latest most discussed by the media and controversial case of Costa Concordia passenger ship which sank on 13 January 2012, in calm seas and overcast weather, under command of Captain Francesco Schettino. *Costa Concordia* struck a rock in the Tyrrhenian Sea just off the eastern shore of Isola del Giglio, off the western coast of Italy about 100 km (62 mi) northwest of Rome. This tore a 50 m (160 ft) gash on the port (left) side of her hull, which almost immediately flooded parts of the engine room and caused loss of power to her propulsion and electrical systems.

At its ninety-first session, the Maritime Safety Committee noted with appreciation the progress reports on the ongoing investigation into the loss of the **Costa Concordia** presented by the Government of Italy (MSC 91/7/5 and MSC 91/7/7). The Committee also considered document MSC 91/WP.12 (Secretary-General) which addressed the most urgent management and operational issues upon which the Secretary-General considered the Organization already had enough information to take action.

The following recommendations have been made, notwithstanding that issues related to the human element are at the root of the loss of the Costa Concordia. Nevertheless, following the investigation, Italy considers it appropriate to bring to the notice of the international maritime community its views regarding the growing size of passenger cruise ships and its believe that investigation of issues relating to: mitigating the human contribution factor with education, training and technology; improving day by day the standards of construction, through modern technology; and the need for the maritime community to make the maximum contribution to the related study and consequent technical research should be a priority.

## 4. CREW TRAINING

The human element (crew members) aspects are essential to the safety of passenger vessels. Therefore, on board these particular vessels there should be an adequate number of suitably qualified and medically fit seafarers who are familiar with their duties and the layout of the particular vessel, who share a common working language (Maritime English) and are adequately rested and not impaired by fatigue. The seafarers should also be able to communicate with the passengers and be able to assist them in emergency situations. The seafarers also should be familiar with the company's safety management policy.

Although used in a slightly different context, a phrase from some British propaganda during World War II neatly sums up the dangers of ineffective communications: 'Careless talk costs lives'. That may be over-dramatic in most cases where communications between seafarers or between ship and shore go awry but it does illustrate the importance of effective communications and the real dangers if they go badly wrong. Communication difficulties often occur in these areas due in part to cultural differences but also due to language 'barriers'. Some examples illustrate these problems.

Such an example is the case of the Scandinavian Star passenger ship fire. A small fire in some bedding spread throughout the ship and 158 people lost their lives. Escape routes were filled with smoke and those unfamiliar with the ship needed the assistance of crew and signage to find their way. The signs were not in a language familiar to those who were passengers on board so proved an ineffective means of providing safety instructions. The officers and many of the crew did not share a common language and the language of the crew was not the same as most of the passengers. Although the fire was not related to poor communications between officers and crew, the poor safety organization on board coupled with the inability of the officers to communicate with all of the crew and the inability of the crew to communicate with the passengers exacerbated the loss of life.

The ship was not under-manned and the officers possessed the necessary qualification and certificates but authorities found that the navigation officers should have had better training in safety matters. They also found that there was a language problem in that many of the Portuguese had little or no knowledge of English. However the most serious criticism made of the crew is that they never acted as an organised unit and that no real attempt was made to fight the fire. Furthermore it was found that the alarm was only sounded for a short period of time.

The current trend within the industry is for new cruise ships to be larger and to carry an increasing number of passengers, with a larger ship's compliment to cater for their needs. The 1995 SOLAS Conference suggested that the recommendatory time for the evacuation of a Ro-Ro passenger vessel should be within 60 minutes from the abandon-ship signal being given (Conference Resolution No. 4). It is suggested that 30 minutes is more realistic but that means that the crew should be well trained in order to achieve this because they also have to help the passengers who barely know the way around the ship, not to mention the evacuation exits. Also, the crew has to be well trained as far as lowering the life saving equipment is concerned and launching them into the sea.

We, as authors, believe that one of the main problems on board this kind of ships is represented by the crew's training regarding their own and the passengers' safety. In case of an emergency there are only few crew members who will still have a proper training and fast enough reaction and who will try and succeed to assist the passengers.

On board these ships the only well trained crew is represented by the one belonging to the Deck Department. All the others have to learn from somebody belonging to this department (mainly the Safety Officer). He is the one who should properly train the auxiliary crew. This training is mainly done during the first week of the new crew's embarkation. Among this crew there are a lot of people who do not speak or understand English so it is impossible for them to fully understand their responsibilities during an emergency situation as it has been assigned by their Muster List Number. The main thing that they have to understand is that they are responsible not only for their lives but also for the passengers' lives.

Tragic passenger ships disasters in the past have shown the need for improved safety-standards in the cruising industry. Because of the huge numbers of passengers carried on ships at the same time and the unforgivable environment they mostly sail in, small accidents can quickly result in big casualty numbers. An effective crew training and evacuation-procedure should therefore be mandatory.

IMO says that the safety of passenger ships would be improved by increasing surveys and inspections and urges Administrations to conduct or arrange for the conduct of unscheduled inspections of passenger ships in addition to renewal and periodical surveys. It recommends that these inspections should, in particular, address aspects of an operational nature such as familiarization of crew members with their effectiveness in regard to safety procedures, emergency procedures, maintenance, safe manning, working practices, passenger safety, and so on.

In addition, SOLAS amended to require a working language to be established on passenger ships to ensure

effective crew performance in safety matters. Each crew member must be able to understand and, where appropriate, give orders in that language (it is easy to understand that this language should be English). A proper English language used on board passenger ships can also reduce the barriers of good communication between crew members and passengers in case of an emergency, but this is going to happen only if we assume that all the passengers can understand English.

As it is well known, most of the maritime accidents happen due to human errors, these occur especially because of a bad communication as a result of not using the standard maritime English that should be well known by all the crew members of a ship.

Also, IMO states that large passenger ships should be crewed, equipped and have arrangements to ensure the safety of persons on board for survival in the area of operation, taking into account climatic conditions and the availability of SAR functions; large passenger ships should be crewed and equipped to ensure the health safety, medical care and security of persons on board until more specialized assistance is available.

Therefore, on board a passenger ship there should be an emergency plan easy to understand by the crew members who do not have a maritime training and experience and this plan should be easy to explain by the person who does the training. Moreover, the drills should be well conducted and an individual training should also be performed for those who cannot demonstrate proper knowledge of their way around the ship.

The main problem is that the passengers know nothing about a ship and that they have to be guided during an emergency situation by a crew member, so this is why the crew should also be trained to deal with people in such cases. It is well known from previous cases that usually the crew members go into panic too and they completely forget the fact that they also have a responsibility towards the passengers. During an emergency situation on board a large passenger ship, it is very likely that the crew members would try to save their own lives and completely forget about the passengers that they have to take care of.

It is very important that the Safety Officer makes the crew aware about the importance of the drills and trainings. Also, another important matter is that trainings done on board represent the main maritime training that the auxiliary crew has. This is not quite right as far as safety is concerned because in this case the crew members will not have proper maritime safety training and they will not know how to react in case of an emergency. Even if, at the end of the training done by the Safety Officer, in order to pass the exam the crew members have to take a test, this is not a real proof of their training.

If something bad happens to a passenger ship in the middle of the ocean, and an Abandon Ship signal is going to be given, there is also a matter of who is going to rescue almost 3000 people or even more. So, the entire rescue operation lies in the hands of the crew members but with only one condition: first they should have real maritime safety training and last but not least a crowd and crisis management training.

One of the current problems within the cruise ship industry is the high turnover of seafarers. It is not uncommon for the average turnover rate to be between 25% and 35% per year and this has considerable implications for the implementation of the International Safety Management Code (ISM Code) and therefore the safety of the passenger vessel. Special consideration should therefore be given to measures which will make the industry more attractive and thereby reduce such unacceptably high turnover rates. One such measure would undoubtedly be to professionalize many of the positions and functions through the adoption of formal qualifications and certification requirements.

## 5. CONCLUSIONS

Because passenger ships are larger every year, everybody from the maritime cruise business admits the fact that rescuing people in proper time from a passenger ship that sinks in the middle of the ocean is a problem that has no solution. There is not enough rescuing equipment to react in sufficient time in order to save all the people on board, so the crew members are the ones that have to take care of the passengers until the rescue teams arrive. In order to do that, the crew has to have knowledge about safety on board their ship: emergency exits, lowering life boats and life rafts, position of main Muster Stations and alternative Muster Stations in case the main ones cannot be used, Survival Techniques, Crowd and Crisis Management and so on.

All these can be known only if the crew members pass the exams for Seaman's Book in their native country or they get the training on board their ship. Either way, they have to know what to do in case of an emergency. Otherwise, if a passenger ship is in trouble, we, as authors believe that there will be a lot of casualties, a scenario that can be avoided if the crew members are well and properly trained.

## 7. REFERENCES

[1] ALLAN, T., *The 1995 SOLAS Diplomatic Conference. Life Saving Appliances, Evacuation and Escape Requirements, RINA International Conference on Escape, Evacuation and Rescue-Design for the Future,* RINA, London, 1996.

[2] International Maritime Organisation (IMO), *International Convention for the Safety Of Life At Sea (SOLAS),* Consolidated edition, 1997.

[3] International Maritime Organisation (IMO), *MSC Circular n. MSC/Circ. 909, Interim Guidelines for a Simplified Evacuation Analysis On Ro-Ro Passenger Ships*, 1999.

[4] Maritime Safety Committee, 92nd Session, Passenger Ship Safety, *Preliminary Recommendations arising from the Costa Concordia marine casualty investigation,* 18 March 2013.

[5] POPESCU, C., VARSAMI, A., *Maritime English – A Necessity for Nowadays Apprentices*, Proceedings WSEAS 3rd International Conference on Maritime and Naval Science and Engineering, Constanta, Romania, 2010.

# IT TECHNOLOGIES IN SHIPBUILDING

[1]VASYLISHYNA YULIA, [2]NIKITIN W. PAVEL

*[1,2]Kyiv State Maritime Academy, Ukraine*

**ABSTRACT**

Shipbuilding and industrial marine industry has a long and proud history that encompasses everything from the world's finest 19th-century sailing schooners to modern world class icebreakers. In between are a diverse group of vessels that have been designed and built in this country to serve our unique, expansive coastline and its network of coastal marine communities.

**Keywords:** *Design Aids, 3D Modeling, Interference Checking, CAPAC® Systems, Chloropac® Systems.*

## 1. INTRODUCTION

The 16th International Conference on Computer Applications in Shipbuilding (ICCAS) will review operational experience from existing computer applications in the design and building of ships and offshore structures and will cover a full range of topics including; CAD, CAM, integrated systems, knowledge management, simulation and virtual reality applications.

It will also examine the advances in Information Technology which have contributed to increased productivity in both shipbuilding and maritime operations; including increasing co-operative working between shipyards, marine equipment and system manufacturers, engineering partners and shipping companies.

These conferences attract a large international audience and provide an excellent forum for both those developing and using computer applications in shipbuilding.

The global maritime industry faces many challenges as it seeks to recover from the financial crisis which has affected all sectors of the industry, whilst at the same time, responding to the continuing demands of operators, regulators and society for greater efficiency, safety and the protection of the environment. This response will require innovative thinking from all sectors of the maritime industry, and particularly those involved in ship design and construction.

## 2. SHIPBUILDING TECHNOLOGY

In today's shipbuilding industry, the need for technology that supports concurrent engineering, design, and life cycle management is critical. From the initial design stage of the project through the ship construction stage, IT provides shipbuilding technology designed to reduce costs and increase shipyard productivity. Facets of our shipbuilding technology solutions to assist with shipbuilding plans include:

1. Ship Design and Assembly
2. Materials Planning and Procurement
3. Information Management

The ship design and construction process benefits from Intergraph shipbuilding technology. Through automating routine tasks and allowing pre-configuration of equipment characteristics, shipbuilding companies benefit from reduced labor costs and quicker time-to-design schedules. Shipbuilding plans can leverage automated drawing generation functionality, providing shipbuilding companies with accurate and up-to-date documentation while also reducing the cost of design.

To maximize efficiency throughout the procurement process, a comprehensive materials management solution is required. By providing workflow management functionality to support a shipyard of any size, IT shipbuilding technology supports all stages of the shipbuilding process, from concept to procurement.

In today's shipbuilding industry, shipbuilding companies need a fresh approach to information management in order to efficiently execute their shipbuilding plans. By facilitating optimization throughout the design, production and life cycle management stages, IT shipbuilding technology provides the information management tools needed to make the shipyard more competitive.

IT delivers innovative shipbuilding technology designed to support shipbuilding companies in the ways they need it most. For shipbuilding companies whose shipbuilding plans are specific to military vessels, or those who design for cruise or cargo ships, ship design and construction are transformed with Intergraph's solutions.

## 3. MULTI-DISCIPLINE 3D MARINE, OFFSHORE & SHIPBUILDING MODELING & DESIGN

Smart Marine 3D, IT’s latest 3D marine, offshore, and shipbuilding design solution, dramatically increases design, modeling, and deliverable production productivity across all key disciplines involved in the design of today’s complex structures while increasing overall design quality, data integrity, and productivity. Using industry-standard database technologies, Smart Marine 3D is a true, data-centric offshore modeling environment. Smart Marine 3D also includes fabrication requirements for pipes and plate and profile nesting applications. Smart Marine 3D includes a series of integrated tasks addressing key design activities, including:

**Project Setup and Reference Data Tasks** – Definition and management of multi-disciplinary component catalogs and specifications;

**Design Aids** – Intelligent grids combined with 3D space management tools;

**3D Modeling** – Plates, profiles, piping, equipment, outfitting structure, civil/ foundation, electrical cable tray, HVAC ducting, multi-disciplinary hangers and supports, disciplines such as hole management, and planning for managing data in blocks or modules;

**Interference Checking** – Constant, interactive interference checking and project-level interference checking integral for improvements in quality and productivity;

Smart Marine 3D enables designs to be checked for clashes and corrected prior to fabrication and assembly. Cost, time, and schedules can be reduced and quality increased. This instills a high degree of confidence that "as-designed" equals "as-built."

When seawater or freshwater are used as part of an engineering process - in petrochemical works, electric power generating or desalination plants, offshore oil & gas production and in ships or other applications using water - biological fouling can be an issue. Siemens Water Technologies can help prevent biofouling and marine corrosion in these applications by providing cost-effective, energy efficient and flexible treatment systems that require virtually no operator attention.

## 4. CAPAC® SYSTEMS

For over 50 years the CAPAC® system has been installed to provide automatic, permanent protection that prevents electrolysis and galvanic corrosion from attacking the submerged surfaces of a broad range of sea-going vessels and fixed or mobile offshore structures. Capac® systems combine our in-house, state-of-the-art anode and electrode technologies with excellent engineering, design, manufacturing and quality control to produce superior, reliable solutions.

There are more than 3,000 Capac® systems installed around the world.

## 5. SEACURE™ BALLAST WATER TREATMENT

To help meet new ballast water treatment standards, Siemens Water Technologies has developed the SeaCURE™ ballast water treatment system. The system uses a combination of physical separation and a proprietary, on-demand treatment with biocides, produced in-situ from seawater, without the addition of chemicals. The system is based on a proven 30+ year record and over 2,500 shipboard installations of Siemens' well-known Chloropac® biofouling control system.

Loose components in customized SeaCURE™ ballast water treatment system shown in actual engine room.

## 6. CONCLUSIONS

Intergraph provides solutions for every size of shipyard and any type of shipbuilding plans. From vessels requiring specialized ship structural design, to shipbuilding plans that require additional offshore engineering services, Intergraph has the shipbuilding technology, the experience, and the track record to help shipbuilding companies gain and maintain a leading edge.

Ship piping design, and particularly floating production, storage, and offloading vessel piping, requires rugged installations that can withstand the hull/platform movement associated with wave loads. These analyses involve the consideration of volumes of data that may be overwhelming due to ever-changing boundary conditions. Intergraph analysis solutions provide integrated tools that provide opportunities to improve change management and the iterative information flow that takes place in analyzing and designing these maritime vessels.

One of the core components of a sound marine, offshore, and shipbuilding design and operating environment is knowledge and information. A significant challenge is how to capture this specific information, build on it through the design, procurement, and construction phases, and hand this over to owners and operators. Once the essential data is put into the owner's or operator's hands, how should this data best be used? This data is the backbone for marine, offshore, and shipbuilding facility decisions in all phases. As the project develops, the data required grows, changes, and transforms into a valuable asset that can be put to use.

Marine, offshore, and shipbuilding designers, owners, and operators need engineering data management software with enhanced decision support capabilities to facilitate global design, production, and life cycle optimization of the offshore facility. From concept and design through maintenance, operations, and decommissioning, Intergraph enables electronic management of all of the marine, offshore, and shipbuilding facilities' engineering information. By integrating information on the physical asset, processes, and regulatory and safety imperatives, Intergraph's engineering data management tools can set the basis for the pursuit of operational excellence performance.

## 7. REFERENCES

[1] BERTRAM, V. (1994) „Investitionsbeurteilung von Software“ 28. Fortbildungskurs, IfS, Hamburg van der Bles, G.; Dirkse, C. (2000) *Integrated Shipbuilding by Concurrent Engineering 1st International Euro Conference on Computer and Information Technology in the Marine Industries (COMPIT)*, Potsdam.

[2] BUHR, W., KEIL, H., KRUGER, S., *Rechnereinsatz im Projekt* Proc. STG, Springer, 1998, 353-363.

[3] HAMMER, M., CHAMPY, J. (1996) „Die tragende Rolle der Informationstechnik“, in *Business Reengeneering - Die Radikalkur fur das Unternehmen*, CAMPUS, 112-133.

[4] http://www.intergraph.com

[5] http://www.ic.gc.ca

[6] http://www.rina.org.uk

[7] http://www.wikipedia.org.

# TEACHING INTERCULTURAL COMMUNICATION SKILLS OR HOW TO BECOME A CROSS- CULTURALLY INTELLIGENT SEAFARER

VISAN RALUCA IOANA

*Constanta Maritime University, Romania*

**ABSTRACT**

When Romanian seafarers meet seafarers from other cultures, they generally perceive them as very similar to themselves, very dissimilar, or something in between. Thus, there is a continuum from the very similar to the totally foreign. Where Romanian seafarers mentally place foreign seafarers on the continuum affects their communication with the foreign seafarers – even their willingness to communicate. Cross-cultural communication on board tends to be more successful in terms of interaction and outcomes when seafarers are culturally close and less successful when they are culturally distant from each other. Cultural distance between seafarers is a major determinant of stress and leads to failure to communicate and build relationships on board. An important indicator of cultural distance is variations in pronunciation and usage of Maritime English. Therefore, the ability to interact effectively with culturally diverse seafarers is not a skill possessed by all; yet it is becoming more and more important in today's global maritime world. This skill is labeled cultural intelligence (CQ) and has caught the attention of maritime educators and researchers alike. It is an important step towards cross-cultural competence. Developing cultural intelligence and acquiring intercultural skills can help maritime Romanian students develop a successful career on board. Learning how to instruct maritime students in the art of cross-cultural communication is a necessary prerequisite of effective maritime lecturers. More importantly, maritime lecturers must take the lead and develop strategies that assure their students will learn not only navigation and marine technology, but also intercultural communication skills. Thus, maritime lecturers must be master communicators who can influence young minds in positive ways and help improve education based on intercultural communication skills.

**Keywords:** *intercultural management skills, cross-cultural intelligence, maritime English, culturally diverse seafarers*

## 1. INTRODUCTION

Effective communication skills, as well as intercultural management skills are necessary prerequisites for modern seafarers operating in a multicultural environment. That is why, one of the main challenges facing the current maritime sector lies in the cultural and linguistic diversity and in how to develop its strengths and eliminate its weaknesses.

The international shipping companies are calling for objectives whose purpose is not only to ensure safety, increase security and protect the marine environment, but also to promote unity amongst seafarers and respect diversity on board merchant ships. Since most of the world's merchant fleet is operated by multilingual crews, the demand to explore and encourage intercultural competence in seafarers has also become the present concern of several MET institutions.

Thus, in the present paper we purport the idea that seafarers high in cultural intelligence CQ will be more adept at developing and maintaining onboard cross-cultural relationships. Understanding his/her own culture, learning about another culture, and then determining the differences provides the seafarer with knowledge that is a first step to becoming culturally intelligent. Focusing also on a survey-based research questionnaire conducted within Constanta Maritime University, the paper also aims to emphasize and analyze why it is important that our seafarers grow into onboard intercultural managers. Shipping is a global industry and with this globalization comes social change. The seafarer is now swept along with myriad changes in the industry and while he is sometimes encouraged to enhance skills and to increase his flexibility in terms of work roles, he is more often than not left alone to come to terms with his limitations because of nationality on a multinational ship. The need for clear verbal communications between parties in the merchant marine environment is multi-faceted as the ship is the working environment, learning environment and social environment for its crew.

## 2. ON SEAFARERS' CROSS-CULTURAL INTELLIGENCE

With the increasing tendency of globalization, it is getting more important to provide maritime students a university education with intercultural aspects and onboard experiences. In order to achieve this objective, education provided by MET institutions should be able to give students a background on intercultural communication and how to compete the challenges that will be faced in the intercultural maritime environment.

The global seafarer of today and tomorrow must exhibit the flexibility to adapt behaviors for each new cultural situation faced through knowledge and mindfulness. Increasing one's skills in these components of culture intelligence will make the seafarer more effective in the global maritime environment.

Cultural intelligence is an aggregate, multidimensional construct, consisting of a cognitive, metacognitive, behavioral and motivational component. Metacognition, cognition and motivation are mental capabilities that reside within the mind, while overt actions are behavioral capabilities (Ang et al., 2007).

The four dimensions are qualitatively different facets of the overall capability to function and manage effectively in culturally diverse settings (Earley, 2002; Earley and Ang, 2003).

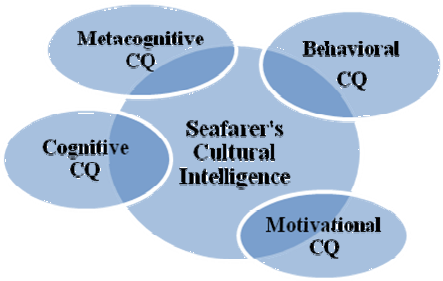



Figure 1 Cultural intelligence components

The dimensions may or may not correlate with each other; for example, a seafarer may be knowledgeable of a culture, but may lack the ability to act upon this knowledge. Thus, cognitive CQ, metacognitive CQ, behavioral CQ and motivational CQ are different capabilities that together form overall CQ.

*2.1 Cognitive CQ increases the effectiveness with which seafarers adapt in intercultural maritime settings*

Seafarers high in cognitive cultural intelligence have developed a thorough understanding of the norms, practices and conventions common to different cultures through their education and personal experiences (Earley and Ang, 2003). They understand political and economic systems, institutions and cultural values and have advanced cognitive categorization schemes through which they can recognize similarities and differences across cultures.

*2.2 Metacognitive CQ increases the effectiveness with which seafarers adapt in intercultural maritime settings*

Metacognitive CQ includes the mental processes seafarers use to acquire and understand cultural knowledge, including knowledge of and control over individual thought processes relating to culture. Seamen high in metacognitive CQ have advanced information acquisition skills and are consciously aware of others cultural preferences before and during interactions. They question cultural assumptions and adjust their mental models during and after interactions. They not only understand the processes through which they can enhance their cultural understanding, but also the means through which this understanding should be applied during interactions.

*2.3 Behavioral CQ increases the effectiveness with which seafarers adapt in intercultural maritime settings*

Behavioral CQ reflects the capability to exhibit appropriate verbal and non-verbal actions when interacting with people from different cultures (Earley and Ang, 2003). Seafarers high in behavioral CQ are effective when adapting to the culture of their mates based on their broad range of communication capabilities, such as exhibiting culturally appropriate words, tone, gestures and facial expressions. These capabilities provide the means through which cognitive and metacognitive knowledge of culture can be applied.

*2.4 Motivational CQ increases the effectiveness with which seafarers adapt in intercultural maritime settings*

Motivational CQ refers to the level of attention and energy a seafarer directs toward learning about and functioning in situations characterized by cultural differences (Earley and Ang, 2003). We shall position motivational CQ as a moderating influence capable of differentially affecting the impact cognitive CQ, metacognitive CQ and behavioral CQ have on adaptation effectiveness. The benefits realized through these capabilities will be either maximized or marginalized based upon the extent to which the seaman is motivated to act upon them. Motivational CQ is therefore the dominant factor influencing the effectiveness with which seafarers adapt in intercultural maritime settings.

*2.5 The Profiles of Culturally Intelligent Seafarers*

We consider that most seafarers fit at least one of the set of six cultural intelligence profiles brought forward by Earley and Mosakowski (2004). These profiles can provide a broad analysis of an individual's cultural intelligence level and are represented as follows:

- The Provincial: can be quite effective when working with people of similar background, but runs into trouble in a broader field.
- The Analyst: methodically decodes a foreign culture's rules and expectations by resorting to a variety of elaborate learning strategies.
- The Natural: relies entirely on his intuition and first impressions rather than on a systematic learning style. May falter in ambiguous multicultural situations.
- The Ambassador: upon coming in contact with a seafarer from another culture he doesn't know much about, he convincingly communicates the humility to know what he doesn't know.
- The Mimic: has high degree of control over his actions and behavior; great deal of insight into significance of cultural cues picked up; facilitates communication and builds trust.
- The Chameleon: possesses high levels of all four CQ components and is a very uncommon seafarer type; may even be mistaken for a native; possesses insider skills and outsider perspectives.

Having all these aspects in view, cultural intelligence in globalized maritime setting is an important skill set for seafarers enabling diverse shipping companies to achieve their goals by being more responsive to the global marketplace.

## 3. INTERCULTURAL COMMUNICATION ON BOARD

The logic behind sending Constudents for onboard experience is providing them with a short term international experience during which they can develop

required skills that will probably guide them in today's global maritime setting. We shall argue that these onboard experiences provide students with required knowledge, behaviors and skills for better intercultural communicative competence. The idea has to be pointed out that the onboard study experience leads to intercultural competence and as a result produces global maritime graduates.

Intercultural communication shapes the way seafarers contend with change, deliver messages across borders and cultures and revisit the fundamental properties of time and space (Monge, 1998). Effective functioning in an international maritime setting depends on the ability of seamen to adapt to the complexity of other cultures. Seafarers need to learn how to effectively understand, accept and respond to cultural differences.

Effective intercultural communication skill is "the ability of an individual or a group to achieve understanding through verbal or non-verbal exchange and interaction between cultures" (Ricard, 1993: 7). To achieve the desired intercultural communication competence, seamen have to possess a well-defined set of skills, including valuing, observing, listening, speaking and gesturing (Ricard, 1993). These critical skills differ depending on the cultural background and personal characteristics of the people involved in communication.

Communication researchers have many times attempted to describe intercultural communication competence and its underlying dimensions. Ruben (1976) identified seven dimensions of intercultural communication competence: the capacity to be flexible, the capacity to be nonjudgmental, the capacity to tolerate ambiguity, the capacity to communicate respect, the capacity to personalize one's knowledge and perceptions, the capacity to display empathy and the capacity for turn taking. There are three major factors of intercultural communication competence:

- the ability to deal with psychological stress,
- the ability to communicate effectively, and
- the ability to establish interpersonal relationships.

Intercultural communicative competence on board represents a seafarer's set of complex abilities required to perform effectively and appropriately when interacting with other seafarers who are linguistically and culturally different. Seafarers' communication competency is a prerequisite for understanding the role that communication plays in the global maritime market.

At IMEC22 Cole and Trenkner (2010) brought forth the idea of "raising the maritime English bar" by referring to Manila Amendments (STCW) and improving standards in Maritime English. This means that all seafarers must attempt to promote "good communication through sound promotion of intercultural skills" (Noble, Vangehuchten and Van Parys, 2011: 146). Those on board must communicate between ship and shore when in coastal waters, between ships in areas of congestion or where avoiding action is required, or even during search and rescue activities. During periods of pilotage, English is frequently used as a common language and both Pilot and crew must be able to communicate effectively to ensure safety.

Communication on an intra-ship level takes place on a daily basis between crewmembers during operation of the vessel – when giving and carrying out orders under "normal" or "emergency" situations – and when the multilingual crew must interact to maintain "social harmony" in an off duty context and in their everyday "teamwork" to ensure effective day to day operation.

## 4. DEVELOPMENT OF THE "INTERCULTURAL COMMUNICATION ON BOARD" COURSE

Questions concerning how navigators should be effective in their discourse with their mates outside their boundaries lead to the development of the *intercultural communication on board* course. We strongly believe that this course will help our students function outside the script to understand the values and beliefs behind behaviour and ultimately, to make them realize how other different people think.

Constanta Maritime University is open to several students' placement programmes such as Erasmus and Leonardo da Vinci that help our future maritime officers to find the "magic pill" for crossing cultures on their own. Several placement report questionnaires have been conducted and analyzed at Constanta Maritime University (Chirea-Ungureanu and Visan, 2011) and the results indicate that sometimes to opt for a multicultural crew is to favour the well known "technique of control, divide and rule". In this respect, the ability to communicate in an isolated and independent environment is crucial. Apart from the several placement report questionnaires developed in our institution, we have considered of utmost importance to come up with other important key questions (see subsection 4.1. below) related to intercultural communicative competence on board, questions that are especially connected to the introduction within the maritime curricula of the course on intercultural communication on board (Visan and Georgescu, 2012).

### *4.1. A survey-based questionnaire*

The general question addressed in this study is concerned with the perception of students of Constanta Maritime University regarding the introduction of the "Intercultural Communication on Board Ship" course. This study attempts to answer the following research question: Can a course on multicultural issues increase the seafarers' competence?

The study was conducted at the English language Department in Constanta Maritime University, Romania. The participants in the study were one hundred students who had performed their on board training in multicultural crews. First, we explained to the students the intended goal. After explaining to them the tasks they would be required to perform, we assured them that confidentiality would be maintained. Each student was then given a questionnaire consisting of ten questions. The time allotted to answers was one hour.

The questions included in the questionnaire were the following: (1) What nationality did you have to work with at sea?; (2) Have you come across any

communication barriers?; (3) Can these communication barriers be put down to the linguistic aspect of maritime English in particular? (Can you give examples?); (4) Apart from language barriers, have you faced any other difficulties due to cultural diversity?; (5) Did you feel in your shoes working in a multicultural environment? If not, what sort of problems did you meet with?; (6) Do seafarers need to know the culture of others while working in a multicultural environment?; (7) Do you think that there should be a course on communication skills and cultural awareness within Constanta Maritime University? Why?/Why not?; (8) Do you think a course on Intercultural Communication will be useful to improve the safety and the working environment on board? Why?/Why not?; (9) Should this course be taken by ratings as well?; (10) What relevant topics should be included in the Intercultural Communication course? The outcome of the present survey is presented below.

*4.1.1. Dissemination results*

This section will deal with the participants' responses to the questionnaire (see 4.1.). From the responses to the first question we made up a list of nationalities that Romanian seafarers had to interact with.

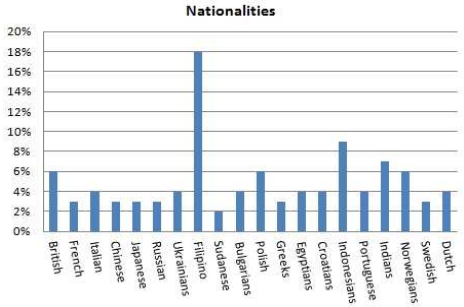



Figure 2 Nationalities Romanian seafarers interact with

Therefore, as shown in Fig. 1, the proportion of the nationalities was the following: British (6%), French (3%), Italians (4%), Chinese (3%), Japanese (3%), Russian (3%), Ukrainians (4%), Filipino (18%), Sudanese (2%), Bulgarians (4%), Polish (6%), Greeks (3%), Egyptians (4%), Croatians (4%), Indonesians (9%), Portuguese (4%), Indians (7%), Norwegians (6%), Swedish (3%), Dutch (4%), etc.

Answers to question number two reveal that 90% of the respondents did come across communication barriers. The next item pictures the most common linguistic barriers on board ships (see Fig. 3).

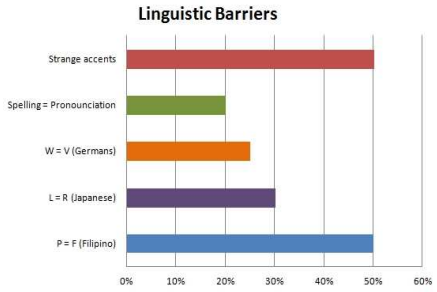



Figure 3 Linguistic barriers on board ships

Thus, 50% of the respondents acknowledged linguistic barriers arising from: strange accents, improper use of multi-word lexical units, lack of a basic knowledge of English. For example, 20% reported that when speaking English, Italian seafarers have a tendency to pronounce words and terms as they are spelled, so that ballast is /bʌlʌst/, guide is /ɡwid/. So do Romanians. This is also true for loanwords borrowed from English as water, which is pronounced /vatɛr/ instead of /□wɔːtə/.

On the other hand, 25% claimed that Germans pronounce English words beginning with a /w/ as /v/. This explains the mispronunciation of the English term winch as /vintʃ/. According to 30% of the participants, Japanese tend to confuse /l/ and /r/ both in perception and production. This is because Japanese language does not make such a distinction (Takagi, 2010: 199). Therefore, it is difficult for Japanese seafarers to identify the following minimally-paired words without context: pilot – pirate; ladder – rudder (id. ibid.). In a similar manner, terms and words such as rocket, rough, rate agreement would be perceived as lock it!, laugh and late agreement.

Another example is the substitution of [p] for [f] by the Filipino when pronouncing English words or terms containing /f/: fore which they pronounce /pore/, aft /apt/, funnel /punnel/, fender / pender/, fly-/ply/, fork as in fork lift would become /pork lift/ and funk hole /punk hole/. The given percent by the testees was 50%.

With regard to the improper usage of multi-word lexical units, a study by Visan and Georgescu (2011) suggests that collocational competence is an essential prerequisite for the overall mastery of Maritime English, perhaps one of the highest levels of linguistic proficiency that future maritime officers can attain. Answers to the fourth question show that cultural diversity can lead to a skewed perception of customs (Fig. 4).

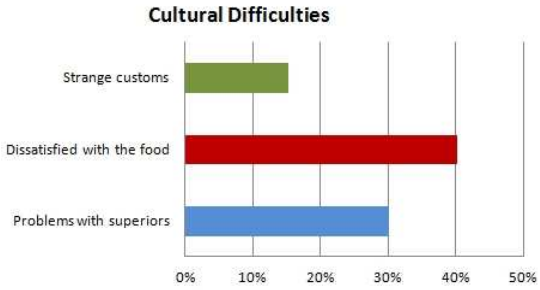



Figure 4 Cultural Difficulties

Strange customs have been noticed by fifteen percent (15%) of the respondents. For instance, the Sudanese males take foreigners by the hand when they feel like communicating something important, which is unusual in Romania. It is said that the most important person on board is the cook. But what happens when he makes sweet meals or very spicy ones? Crew members of different nationalities will feel very miserable; that is why, 40% of the testees were dissatisfied with the food. The attitude of the master and chief engineer was thought to be bossy and arrogant by 30%.

Although Romanians are sociable and tolerant people 54% of them met with problems.

Responses to question number six reveal that 85% agreed that knowledge about other cultures is vital for their future work on board. As for question number eight, 10% believe that the course will not be useful in improving the safety on board, on the ground that the safety regulations are strict and compulsory and everybody must comply with them. Answers to question number nine show that 15% do not think that the course will improve in any way the relationships between ratings. Finally, a large number of students contributed to the contents of the project course (see Fig. 5).

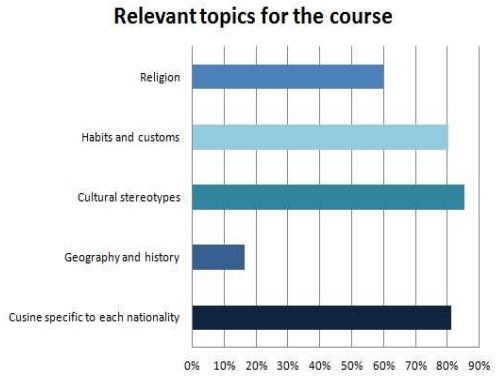



Figure 5 Relevant topics for the course

Thus, 60% suggested topics related to religion, while 80% favoured habits and customs, 85% requested lectures on cultural stereotypes; 16% are interested in geography and history; 81% considered that cuisine specific to each nationality should be included in the course.

Culturally responsive teaching in the maritime field sets the following tasks prior to the compilation of the course: (a) involving maritime undergraduates who have onboard training in the construction of knowledge: questionnaires; having students work in teams of mixed ability; providing authentic dialogues; raising students' awareness of the responsibility for their own learning; (b) validation of information on board ship: Presentation of scenarios in front of a multicultural crew; case studies; getting a positive response from the target nationality in each scenario in regard to the authenticity of material; a final indoor review and revision in the light of the information received on board.

## 5. CONCLUSIONS

Developing cultural intelligence takes time and experience to truly become confident that one can respond authentically in words and actions to different cultural situations. Understanding the nature of cultural intelligence, diagnosing one's cultural intelligence level and proactively developing a higher level of cultural intelligence can position a seafarer to succeed in a globalized maritime environment and support a shipping company's overall business goals. The importance of the course on "Intercultural Communication On Board" reveals its vitality as part of merchant marine students' curricular content.

A seafarer must be trained to demonstrate his ability to communicate effectively and to exchange information accurately. With a view to this, the maritime lecturers have to find the best way to describe how intercultural communication should be taught. The compilation of such a course is meant not only to educate students, but also strengthen their ability to study and comprehend the foreigners' heritage background.

## 6. REFERENCES

[1] ANG, S., DYNE, L.V., KOH, C., NG, K.Y., TEMPLER, K.J., Tay, C., CHANDRASEKAR, N.A., *"Cultural Intelligence: Its Measurement and Effects on Cultural Judgment and Decision Making, Cultural Adaptation and Task Performance"*, Management and Organization Review, Vol. 3, No. 3**,** pp. 335-371, 2007.

[2] CHIREA-UNGUREANU, C., VISAN, I.R., *Teaching Communication Skills as a Prerequisite of the Course on "Intercultural Communication on Board Ships"*, Proceedings of the International Conference IMLA 19, pp 101-107, 2011.

[3] EARLEY, P.C., *Redefining Interactions across-Cultures and Organizations: Moving Forward with Cultural Intelligence*, in STAW, B.M., KRAMER, R.M. (Eds.) Research in Organizational Behavior, San Francisco, CA, JAI Press, 2002.

[4] EARLEY, P.C., ANG, S., *Cultural Intelligence: An Analysis of Individual Interactions across Cultures*, Stanford University Press, Palo Alto, CA, 2003.

[5] EARLEY, P., MOSAKOWSKI, E., *Cultural Intelligence*, Harvard Business Review, 82(10), pp. 139-146, 2004.

[6] MONGE, P.R, *Communication theory for a globalizing world*, in TRENT, J.S. (Ed.), Communication: Views from the helm for the 21st century, Needham Heights, MA: Allyn and Bacon, pp. 3-7, 1998.

[7] NOBLE, A., VANGEHUCHTEN, L., VAN PARYS, W., *Intercultural Competence and Effective Communication at Sea: An Invitation to Celebrate Diversity on Board*, Proceedings of IMEC 23 - The International Maritime English Conference, Nautica, pp 131-149, 2011.

[8] RICARD, V.B., *Developing intercultural communication skills*, Malabar, FL: Krieger Publishing Company, 1993.

[9] RUBEN, B., *Human communication and cross-cultural effectiveness*, International and Intercultural Communication Journal IV, pp 95-105, 1976.

[10] TAKAGI, N., *Phonetic Characteristics of Japanese Mariners English*, The 22nd International Maritime English Conference IMEC 22 Proceedings, pp 196-201, 2010.

[11] TRENKNER, P., COLE, C., *Rasing the Maritime Bar: The STCW Manila Amendments and Their Impact on Maritime English*, The 22nd International Maritime English Conference IMEC 22 Proceedings, pp 3-16, 2010.

[12] VISAN, I.R, GEORGESCU, M., *Collocationl Competence in Marititme English for Better Communication on Board*, Proceedings of IMEC 23 The International Maritime English Conference, Nautica, pp 230-242, 2011.

[13] VISAN, I.R., GEORGESCU, M., *Steering among a Sea of Multicultural Islands*, in Recent Researches in Engineering Mechanics, Urban and Naval Transportation and Tourism - Proceedings of the 5th WSEAS International Conference on Maritime and Naval Science and Engineering, WSEAS Press, pp 167-171, 2012.

# ENHANCING SHIP NAVIGATION SAFETY BY IMPROVING STEERING SYSTEM RELIABILITY

[1]ZAKHARCHENKO VADYM, [2]SHEVCHENKO VALERY

*[1,2]Odessa National Maritime Academy, Ukraine*

**ABSTRACT**

Recent years ships navigation was intensively increased. Thus enhancing safety in maritime transport becomes a more difficult task which requires improvement of navigator skills from one side and technical means reliability from the other side. With technical point of view safe navigation depends on ship controllability which is provided by reliable steering system operation.

In some cases steering gear control systems give only common alarm without showing the exact source of failure. This problem can be solved by providing steering gear control system by fault detection and fault isolation algorithms.

This paper proposes fault detection and fault isolation algorithms for such faults in the steering gear system as: rudder stuck due to hydraulic lock when two pumps in operation; backlash in rudder position feedback circuit.

**Keywords:** *Steering gear, fault-tolerant control, control algorithm, reconfiguration, compensation.*

## 1. INTRODUCTION

A number of ships navigation accidents are known due to faults in steering gears [1]. One of the first steps on steering system reliability improvement was made by the 1981 Amendments to International Convention SOLAS-74 which requires that the main steering gear is arranged so that after a single failure in its piping system or in one of the power units the defect can be isolated so that steering capability can be maintained or speedily regained. In modern steering systems this requirement is fulfilled by making redundant each power and control component of the system [1]. In spite of redundancy in steering system fault finding and isolation process is manual and still takes a lot of time thus increasing risks of ships navigation safety and even becoming a reason of incidents and accidents.

## 2. RESEARCH ACTUALITY

Steering system reliability and efficiency problems were considered in papers [2; 3]. According to [2] steering system reliability enhancing problem could be solved by implementing fault detection and fault isolation algorithms into steering gear control system.

Such algorithms could be used either for automatic fault isolation by control system or for operator advice in decision-making system. For the achievement of this goal it is reasonable to use an emerging area in automatic ship control – Fault-tolerant control (FTC) [4], where several disciplines and techniques are combined to obtain a unique functionality. In paper [5] FTC was applied for ship course changing/keeping system.

FTC provides a mechanism to monitor behaviour of components and function blocks and to take appropriate remedial action in order to keep the manoeuvre capability of the ship and prevent the loss of the control performance. The strict requirements for navigation safety, the complexity of ships function tasks define the actuality of applying FTC methods as for whole ships control systems or particular steering gear control system.

## 3. FINDINGS OF THE RESEARCH

Two typical faults in hydraulic steering gear [1] are considered in this paper: backlash in rudder position feedback circuit; rudder stuck due to hydraulic lock when two pumps in operation.

For research authors used mathematical model of hydraulic steering gear given in [6]:

$$y(s) = \frac{B \cdot Q_s}{\left(I \cdot s^2 + B \cdot A \cdot s\right)} \cdot \left(\frac{1}{\tau \cdot s + 1}\right) \cdot \cdot X(s) - \frac{1}{I \cdot s^2 + B \cdot A \cdot s} \cdot \left(\sum M_{ext}(s)\right) \quad (1)$$

where $B = \frac{A \cdot \rho/2 \cdot Q_s}{\left(2 \cdot \pi \cdot r \cdot U \cdot C_d\right)}$,

$Q_s$ – hydraulic oil volumetric flow rate through the pump; $A$ – piston's area; $\rho$ – hydraulic oil density; $C_d$ – discharge coefficient, equal to $\pi/(\pi+2)$ for turbulent flow; $r$ – piston radius; $I$ – moment of inertia; $U$ – oil volume elasticity value; $x \in [-1,1]$ – rated position of valve; $y$ – piston velocity; $\Sigma M_{ext}$ – external resistance moment. Hydraulic steering gear block diagram is presented in figure 1. This steering gear is a "follow up" system with PD controller, where command rudder angle $\delta_c$ is generated by steering wheel or autopilot.

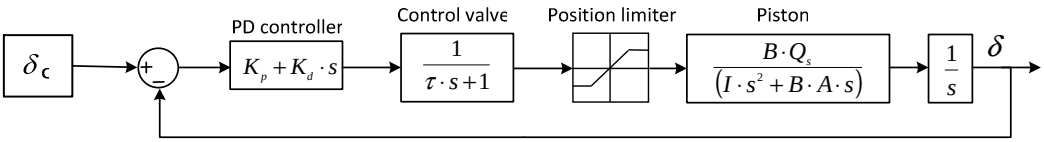



Figure 1 Hydraulic steering gear block diagram

The first fault can be modelled by including the backlash block in the feedback circuit of the hydraulic steering gear block diagram (fig.3).

The steering gear control process was modelled with different command angles and proper for practice backlashes (1-3˚) due to equipment wear.

The following model numeric values were used for modelling [6]: $B{\cdot}Q_s$=37564.44; $I$=25; $B{\cdot}A$=6629.02; $\tau$=0.4.

Modeling results are presented in figure 2.

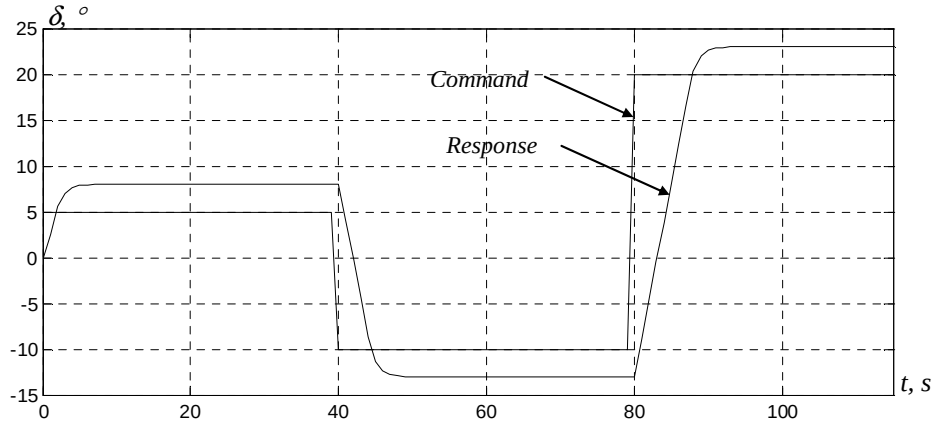



Figure 2 Steering gear response with backlash in feedback

As shown in figure 2, in case of 3˚ feedback backlash, rudder response will exceed command signal by the same value. According to FTC methods such problem can be solved either by system reconfiguration or fault compensation. Authors use second method and for this goal upgrade system presented in figure 1 adding reference model and compensator (fig. 3).

It is expected that reference model (fig. 3) precisely describes steering gear response. In this case difference signal $d$ between model output $\delta^*$ and steering system output $\delta$ could be used for compensation of backlash influence. For compensation authors consider the signal, described by formula:

$$c(t) = c(t-1) + k \cdot d(t) \qquad (2)$$

where $c$ – compensating signal; $k$ – gain; $d$ – difference signal between model output and steering system output.

Modeling results of steering system with compensator are presented in figure 4. As seen from the diagrams (fig. 4), application of such FTC method like compensation in steering gear control system can reduce rudder position control error from 3˚ to 0,5˚ in case of backlash in rudder position feedback circuit.

Taking into account that modern control systems are based on microprocessors, FTC methods can be implemented in control system software.

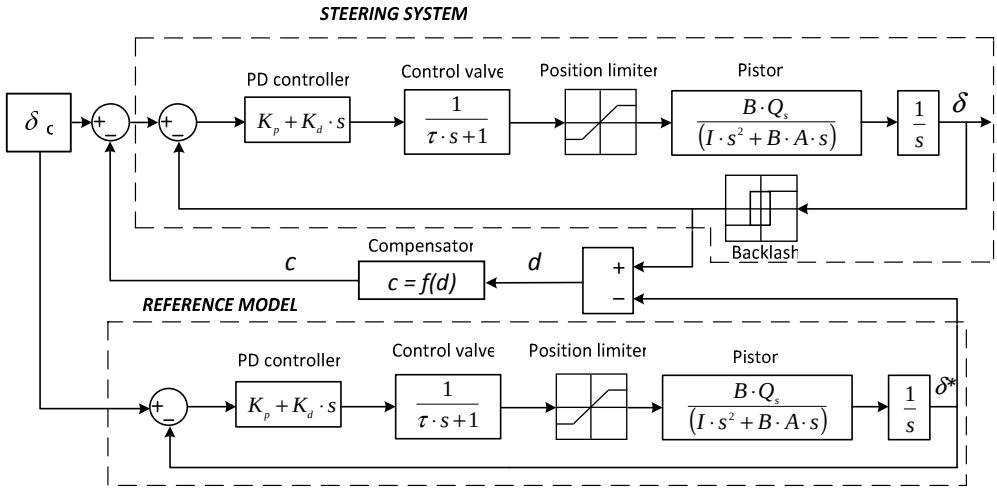



Figure 3 Block diagram of steering gear control system with compensator

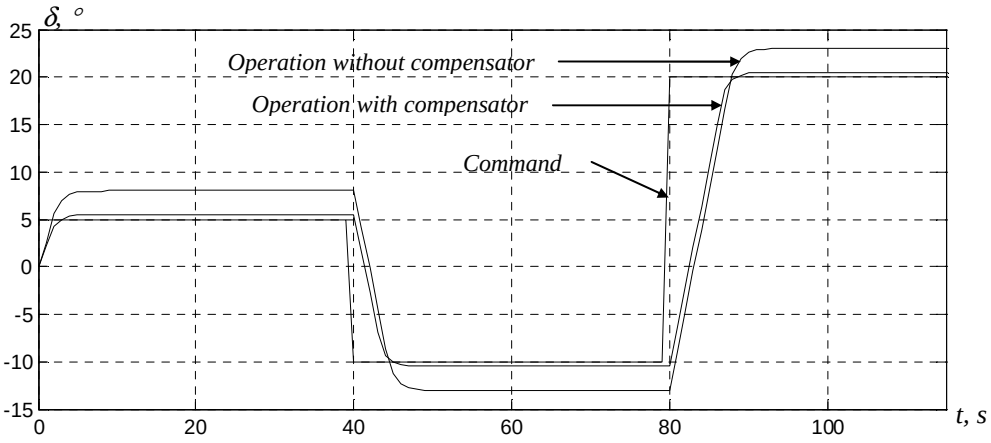



Figure 4 Steering gear response with/without compensator

Thus backlash compensation can be expressed by next algorithm:

$$Start.INPUT(\delta_c, \delta, \delta^*).(\delta = \delta^*) \overset{1}{\uparrow} \omega \overset{3}{\uparrow}$$

$$\overset{1}{\downarrow}(\delta > \delta^*) \overset{3}{\uparrow} CVP = RCVP \overset{2}{\uparrow} OUTPUT.$$

$$(\delta_c = \delta_c(t-1) - k(\delta - \delta^*)) \overset{3}{\uparrow}$$

$$\overset{2}{\downarrow} OUTPUT.MCVF.DOP \overset{3}{\downarrow} End$$

where $\delta$ – rudder position; $\delta_c$ – rudder command; $\delta^*$ – reference model rudder position; *CVP* – control valve position; *RCVP* – reference model control valve position; *MCVF* – message: control valve failure; *DOP* – decision of operator request.

As mentioned above, such fault as rudder stuck due to hydraulic lock when two pumps in operation is dangerous and can lead to loss of ship controllability.

Such fault can be modeled by inputting to steering gear model of maximum amplitude rudder command signal (-35˚) as presented in figure 5.

As seen in diagram "Failure without reconfiguration" in figure 6 rudder stuck in hard to port (-30˚) position at the moment of 90 sec.

One of the possible solutions of this problem according to good practice [1] can be alternate switching off/on steering gear pumps till the rudder will start move to command position.

Nowadays operators do this procedure themselves, which takes time and can lead to accident.

Taking this into account the reconfiguration algorithm for steering gear control system creation will be preferable.

For this purpose authors add to steering gear control system reconfiguration unit, which inputs are: $\varepsilon(t)$ – difference between steering gear command and response signal; steering gears conditions (on/off) as illustrated in reconfiguration unit in figure 5.

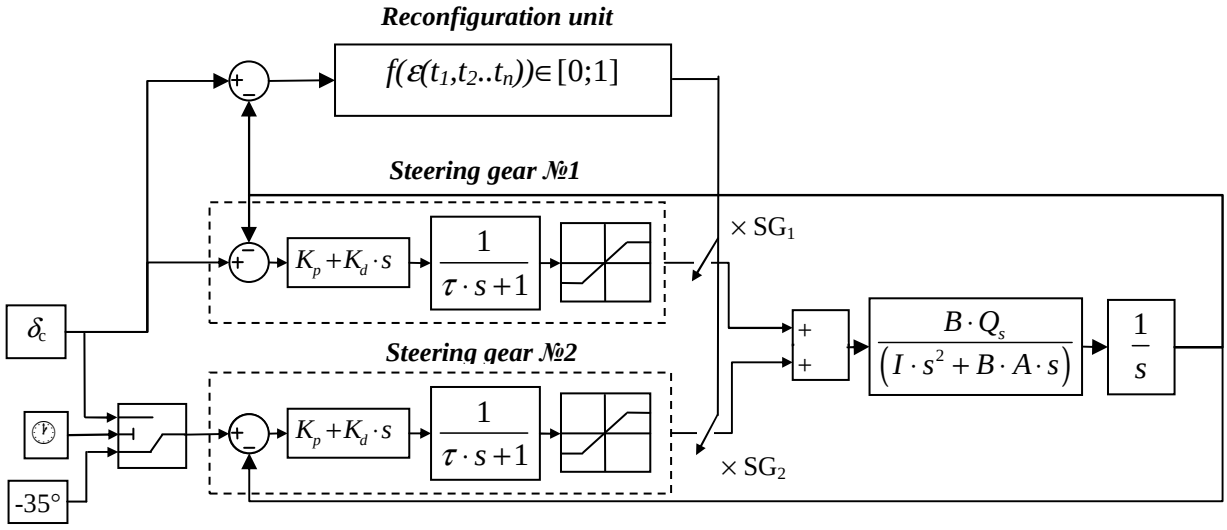



Figure 5 Block diagram of steering gear control system with reconfiguration unit

Authors propose following algorithm for reconfiguration unit:

$$Start.INPUT(\delta_c, \delta, \varepsilon(t) = \delta_c - \delta, SG_1,$$

$$SG_2).\varepsilon(t) = \varepsilon(t - T_1) \neq 0 \,\&\, \varepsilon(t) > \varepsilon(t - T_2) \overset{1}{\uparrow}$$

$$\omega \overset{4}{\uparrow} \overset{1}{\downarrow} SG_1(t-1) = 0 \,\&\, \varepsilon(t) < \varepsilon(t - T_2) \overset{2}{\uparrow} \omega \overset{4}{\uparrow}$$

$$\overset{2}{\downarrow} SG_1(t-1) = 0 \,\&\, \varepsilon(t) = 0 \overset{5}{\uparrow} \overset{3}{\downarrow} SG_1(t-1) = 0;$$

$$SG_2(t-1) = 1 \overset{4}{\uparrow} \omega \overset{5}{\uparrow} \overset{4}{\downarrow} OUTPUT.$$

$$MSG_1(t) = 0; MSG_2(t) = 1. PR.WAIT.$$

$$\varepsilon(t) < \varepsilon(t - T_1) \overset{5}{\uparrow} \omega \overset{10}{\uparrow} \overset{5}{\downarrow} \varepsilon(t) = \varepsilon(t - T_1) \neq 0 \,\&$$

$$\& \,|\, \varepsilon(t) \,|>|\, \varepsilon(t - T_1) \,| \overset{6}{\uparrow} \omega \overset{9}{\uparrow} \overset{6}{\downarrow} SG_2(t-1) = 0 \,\&$$

$$\& \,\varepsilon(t) < \varepsilon(t - T_2) \overset{7}{\uparrow} \omega \overset{9}{\uparrow} \overset{7}{\downarrow} SG_2(t-1) = 0 \,\&$$

$$\varepsilon(t) = 0 \overset{8}{\uparrow} \omega \overset{9}{\uparrow} \overset{8}{\downarrow} WR : DOP; MEM \overset{9}{\downarrow}$$

$$OUTPUT.MSG_1(t) = 1; MSG_2(t) = 2.$$

$$PR.WAIT.\varepsilon(t) < \varepsilon(t - T_1) \overset{8}{\uparrow} \overset{10}{\downarrow} End$$

where $SG_{1,2}$ – steering gears condition Boolean functions (on/off – 1/0); $T_{1,2}$ – fault evaluation time constants ($T_1$=3 sec, $T_2$=6 sec, with discretization step $\Delta t$=1 sec).

The modeling results of the system reconfiguration when rudder stuck are presented by "Failure of SG №1", "Failure of SG №2" diagrams in figure 6.

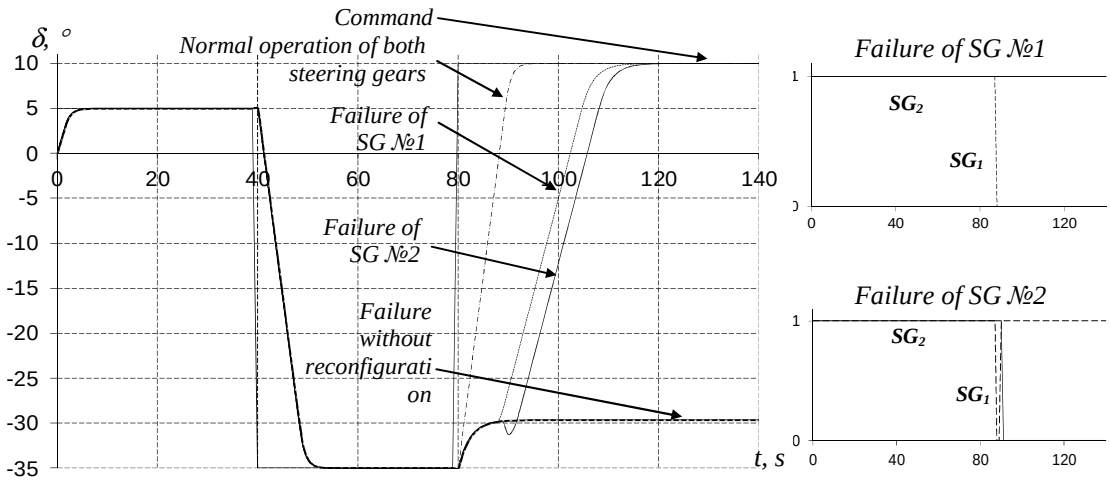



Figure 6 Steering gear response diagrams with/without reconfiguration

As seen from the diagrams (fig. 6) reconfiguration can be quickly isolated using the proposed above algorithm.

The proposed algorithm can be implemented in software form in steering gear control system.

## 4. CONCLUSIONS

The steering system compositions were found to be tolerant for such faults as: rudder stuck due to hydraulic lock when two pumps in operation; backlash in rudder position feedback circuit. Reconfiguration and compensation algorithms were developed using FTC methods.

Simulation results in MATLAB have shown that FTC methods are effective applicable to the steering systems and are desirable to use in future researches for improving steering system reliability.

## 5. REFERENCES

[1] KHARIN, V.M., *Ships Hydraulic Steering Gears*, Odessa National Maritime Academy, 2005, 280 p.

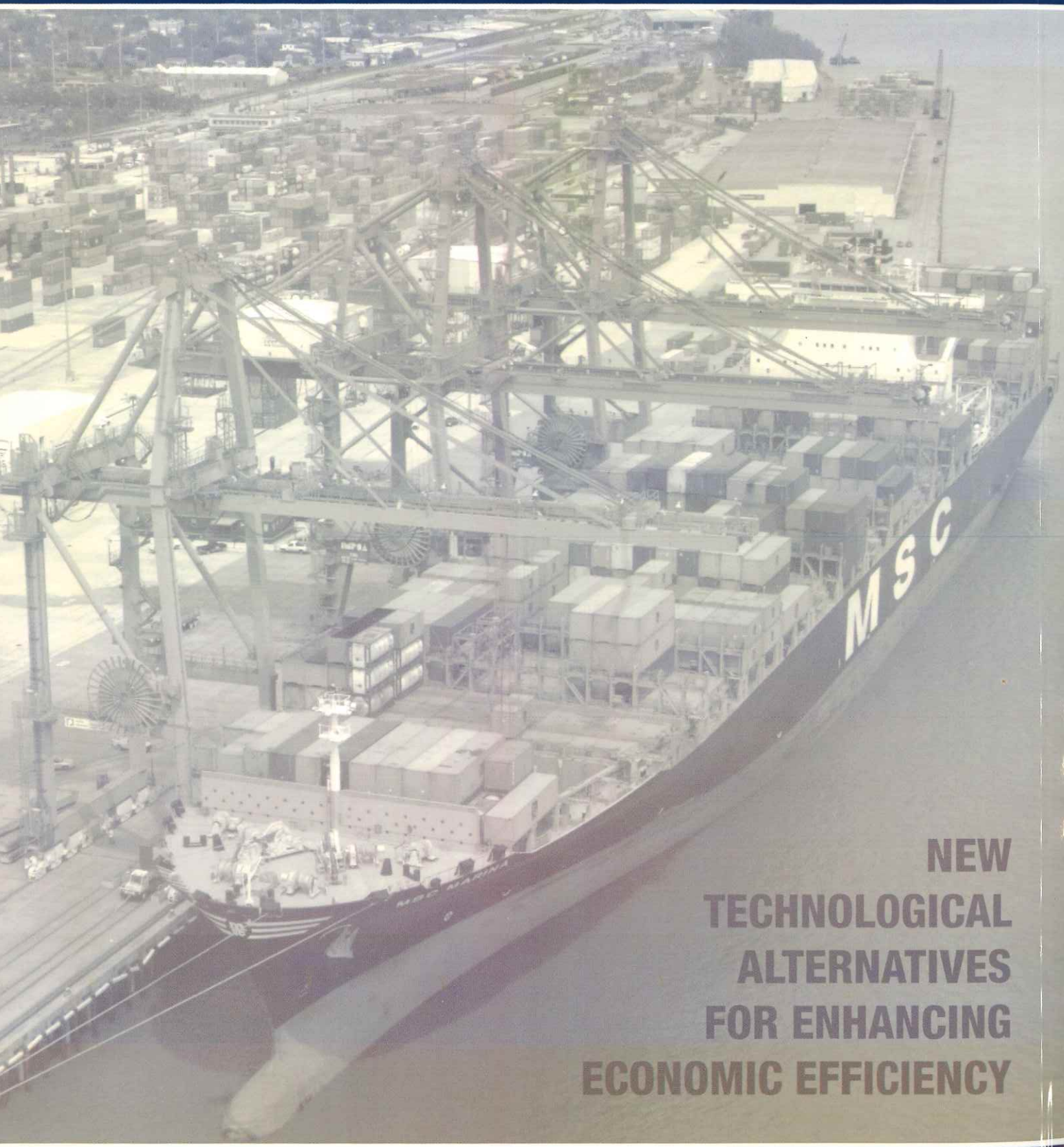
[2] PIPCHENKO, A.D., SHEVCHENKO, V.A., *Analysis of Automated Ship Tracking*, Odessa National Maritime Academy, Navigation, 19, 2010 p. 149-155

[3] ZAKHARCHENKO, V.N., LUKOVTSEV, V.S., SHEVCHENKO, V.A., *Performance Enhancing of Ship Course Control System*, Odessa National Maritime Academy, Navigation, 16, 2009

[4] BLANKE, M., STAROSWIECKI, M., WU, N.E., *Concepts and Methods in Fault-tolerant Control*. Invited tutorial lecture at American Control Conference, Washington, USA, 22-24 June 2001. 15 p.

[5] OMERDIC, E., ROBERTS, G.N., VUKIC, Z., *Reconfigurable Control System for Ship Course-changing/keeping*, 15th IFAC World Congress, Barcelona, Spain, July 21-26, 2002.

[6] XIROS N. I., TSOURAPAS V. P., MOURTZOUCHOS K. K. *A hydraulic steering gear simulator for analysis and control*, Proceeding of WSEAS conference. Athens, Greece, 2004. – pp. 276 – 287.




# NEW TECHNOLOGICAL ALTERNATIVES FOR ENHANCING ECONOMIC EFFICIENCY

ISBN: 978-973-692-354-8